

CATALOG

Part I

June 1973 - December 1976

SOC-1 to SOC-146

SOC-1

OPTIMIZATION OF DESIGN TOLERANCES USING NONLINEAR PROGRAMMING

J.W. Bandler

June 1973,            No. of Pages: 16

Revised:

Key Words:            Engineering design, nonlinear programming, convex programming, optimization theorems, approximation of functions

Abstract: A possible mathematical formulation of the practical problem of computer-aided design of, for example, electrical circuits and systems and engineering designs in general, subject to tolerances on the  $k$  independent parameters is proposed. An automated scheme is suggested starting from arbitrary initial acceptable or unacceptable designs and culminating in designs which under reasonable restrictions are acceptable in the worst case sense. It is proved, in particular, that if the region of points in the parameter space for which designs are both feasible and acceptable satisfies a certain condition (less restrictive than convexity) then no more than 2 points, the vertices of the tolerance region, need to be considered during optimization.

Description:            Reprint.  
Presented at the Sixth Annual Princeton Conference on Information Sciences and Systems (Princeton, N.J., March 1972). Published in J. Optimization Theory and Applications, vol. 14, July 1974, pp. 99-114.

Related Work:            SOC-18, SOC-24, SOC-29, SOC-37, SOC-49, SOC-62, SOC-65, SOC-87, SOC-93, SOC-105, SOC-110, SOC-111, SOC-113, SOC-118, SOC-119, SOC-120, SOC-124, SOC-132, SOC-142, SOC-155, SOC-167, SOC-173.

Price:                 \$ 5.00.

SOC-2

NONLINEAR PROGRAMMING USING MINIMAX TECHNIQUES

J.W. Bandler and C. Charalambous

June 1973,            No. of Pages: 13

Revised:

Key Words:            Nonlinear programming, minimax approximation, least-square methods, function minimization, penalty function methods

Abstract:    A minimax approach to nonlinear programming is presented. The original nonlinear programming problem is formulated as an unconstrained minimax problem. Under reasonable restrictions it is shown that a point satisfying the necessary conditions for a minimax optimum also satisfies the Kuhn-Tucker necessary conditions for the original problem. A least  $p$ th type of objective function for minimization with extremely large values of  $p$  is proposed to solve the problem. Several numerical examples compare the present approach with the well-known SUMT method of Fiacco and McCormick. In both cases a recent minimization algorithm by Fletcher is used.

Description:    Reprint.  
Presented at Fifth Hawaii International Conference on System Sciences (Honolulu, Hawaii, Jan. 1972).  
Published in J. Optimization Theory and Applications, vol. 13, June 1974, pp. 607-619.

Related Work:    SOC-12, SOC-13, SOC-15, SOC-29, SOC-71, SOC-78, SOC-80, SOC-84, SOC-93, SOC-108, SOC-113, SOC-151, SOC-155.

Price:            \$ 5.00.

SOC-3

NONLINEAR MINIMAX OPTIMIZATION AS A SEQUENCE OF LEAST PTH OPTIMIZATION  
WITH FINITE VALUES OF P

C. Charalambous and J.W. Bandler

June 1973,           No. of pages: 15

Revised:            March 1974

Key Words:         Minimax optimization, least pth optimization,  
                    optimization theorems, approximation of functions,  
                    convergence

Abstract: Following developments in nonlinear least pth optimization by the authors it is possible to derive two new methods of nonlinear minimax optimization. Unlike the Polya algorithm in which a sequence of least pth optimizations as  $p$  is taken our methods do not require the value of  $p$  to tend to infinity. Instead we construct a sequence of least pth optimization problems with a finite value of  $p$ . It is shown that this sequence will converge to a minimax solution. Two interesting minimax problems were constructed which illustrate some of the theoretical ideas. Further numerical evidence is presented on the modelling of a fourth-order system by a second-order model with values of  $p$  varying between 2 and 10000.

Description:        Reprint.  
                    Published in Int. J. Systems Science, vol. 7, 1976, pp.  
                    377-391.

Related Work:      SOC-13, SOC-29, SOC-70, SOC-80, SOC-84, SOC-93,  
                    SOC-108, SOC-113, SOC-151, SOC-155.

Price:             \$ 5.00.

SOC-4

Superceded by SOC-29.

SOC-5

AN ADAPTIVE APPROACH TO OPTIMAL LINEAR FILTERING AND PREDICTION

N.K. Sinha

June 1973,            No. of Pages: 13

Revised:

Key Words:            Adaptive filtering, Kalman filter

Abstract:    An adaptive approach to Kalman filtering is presented which does not require the exact knowledge of the noise covariance matrices. The steady-state Kalman gains are obtained by using a recursive algorithm based on stochastic approximation which satisfies the Innovations Theorem.

Description:    Proc. Int. Conference on Systems and Control (Coimbatore, India, Aug. 1973), pp. B2.1-B2.10.

Related Work:    SOC-86, SOC-95, SOC-121.

Price:            \$ 5.00.

SOC-6

ON-LINE IDENTIFICATION OF CONTINUOUS SYSTEMS FROM SAMPLED DATA

N.K. Sinha

June 1973,            No. of Pages: 8

Revised:

Key Words:            Discrete-time models, on-line identification

Abstract:    The application of a digital computer for on-line identification of the parameters of a linear system from the samples of observed input and output data is considered. A discrete-time model is first obtained using a recursive algorithm such that the values of the parameters may be updated at the end of each sampling interval. From this model a continuous-time model is then derived. The method has been applied to the identification of the parameters of a realistic model of a nuclear reactor.

Description:    Proc. 3rd IFAC Symp. on Identification and System Parameter Estimation (The Hague, June 1973), pp. 385-392.

Related Work:    SOC-14, SOC-41, SOC-67, SOC-79.

Price:            \$ 2.00.

SOC-7

SYSTEM IDENTIFICATION USING STOCHASTIC APPROXIMATION

N.K. Sinha

June 1973,            No. of Pages: 4

Revised:

Key Words:            Identification, stochastic approximation

Abstract: This paper discusses the application of stochastic approximation to the identification of linear systems. The parameters of a discrete-time model are first determined in a recursive manner from the samples of the observed input and output data contaminated with noise using a new algorithm for stochastic approximation proposed recently. From this model, the parameters of the corresponding continuous-time system are then estimated. Simulation results are presented indicating that the proposed scheme for identification converges much faster than the existing methods based on stochastic approximation, provided that the signal-to-noise power ratio is not less than one.

Description:           Proc. 3rd IFAC Symp. on Identification and System Parameter Estimation (The Hague, June 1973), pp. 755-758.

Related Work:        SOC-40, SOC-170.

Price:                \$ 2.00.



SOC-8

ADAPTIVE CONTROL WITH INCOMPLETE IDENTIFICATION

N.K. Sinha

June 1973,            No. of pages: 6

Revised:

Key Words:            Adaptive control

Abstract: Adaptive control of system with incomplete knowledge of the plant is feasible using a vector cost function which is measured continually. The problem of adaptation simplifies to the iterative determination of the parameters of the controller. The characteristics of the system are defined in terms of matrix arrays, all of which need not be known a priori, but are learned in a learning and adapting loop. Using an efficient gradient method, the norm of the vector cost function is minimized in an iterative manner. Several examples show the general procedure for applying the method.

Description:           Proc. 3rd IFAC Symp. on Sensitivity, Adaptivity and Optimality (Ischia, Italy, June 1973), PP. 343-348.

Related Work:        SOC-39.

Price:                \$ 2.00.

SOC-9

REDUCTION OF THE SENSITIVITY OF OPTIMAL CONTROL SYSTEMS BY USING TWO DEGREES OF FREEDOM

N.K. Sinha

June 1973,            No. of Pages: 4

Revised:

Key Words:            Sensitivity reduction, optimal control

Abstract:    This paper considers the implementation of optimal control using two degrees of freedom, i.e., a combination of the open- and closed-loop configurations. It has been shown that with this arrangement, one can minimize the integral state sensitivity, while at the same time, either the performance sensitivity, or the terminal-state sensitivity may be reduced to zero. In practice, some compromise must be accepted between the reductions in the various sensitivities. An example of a linear system with an integral quadratic cost function is used to illustrate the procedure.

Description:    Proc. 3rd IFAC Symp. on Sensitivity, Adaptivity and Optimality (Ischia, Italy, June 1973), pp. 267-270.

Related Work:

Price:                \$ 2.00.

SOC-10

AN ITERATIVE APPROACH TO THE FINITE-ELEMENT METHOD IN FIELD PROBLEMS

W. Kinsner and E. Della Torre

June 1973,            No. of Pages: 56

Revised:

Key words:            Finite-element methods, Laplace, Poisson, and Helmholtz  
                         equations,    iterative    solutions,    convergence  
                         acceleration

Abstract:    This paper presents an iterative approach to the  
finite-element method. Several finite-element formulations are derived  
for the Laplace, Poisson and Helmholtz equations. These formulations  
expedite the iterative solutions.

Description:    A fuller version of a paper published in IEEE Trans.  
Microwave Theory and Techniques, vol. MTT-22, March  
1974, pp. 221-228.

Related Work:    SOC-43, SOC-59, SOC-93, SOC-141.

Price:            \$ 5.00.

SOC-11

COMPUTER-AIDED SYSTEM MODELLING AND DESIGN

J.W. Bandler and T.V. Srinivasan

June 1973,           No. of Pages: 21

Revised:

Key Words:           Minimax methods, least pth methods, minimax optimality,  
                          system modelling

Abstract: This paper reviews some recent algorithms for minimax and near-minimax approximation and the application of these algorithms to optimum system modelling and electrical network design. The philosophy of system modelling is discussed in length, including various techniques involved in implementing the models. Automated modelling and design of high-order systems is shown to be feasible, and the present state of the art in minimax circuit design is considered in detail.

Description:       Proc. Int. Conference on Systems and Control (Coimbatore,  
                          India, Aug. 1973).

Related Work:      SOC-12, SOC-22, SOC-93, SOC-113.

Price:               \$ 5.00.

SOC-12

NEW DIRECTIONS IN NONLINEAR PROGRAMMING FOR CIRCUIT DESIGN

J.W. Bandler

June 1973,            No. of Pages: 10

Revised:

Key Words:            Unconstrained minimization, nonlinear programming,  
least pth optimization, engineering design, penalty  
methods

Abstract: This paper surveys some recent and important results in non-linear programming useful in the efficient optimal design of circuits. Huang's general algorithm for unconstrained minimization is reviewed. It is also shown how constrained minimax problems can be solved exactly as unconstrained minimax problems, and then approximately solved using unconstrained gradient methods.

Description:           Proc. Sixteenth Midwest Symposium on Circuit Theory  
(Waterloo, Canada, April 1973), pp. VI.3.1-VI.3.10.

Related Work:        SOC-2, SOC-11, SOC-15, SOC-17, SOC-19, SOC-20, SOC-22,  
SOC-42, SOC-70, SOC-71, SOC-93, SOC-113, SOC-120.

Price:                \$ 2.00.

SOC-13

NEW ALGORITHMS FOR NETWORK OPTIMIZATION

C. Charalambous and J.W. Bandler

June 1973, No. of Pages: 20

Revised:

Key Words: Minimax design, electrical circuit optimization, least pth methods

Abstract: Two new algorithms suitable for computer-aided optimization of networks are presented. They are both based on the nonlinear least pth approximation approach which has been successfully applied by the authors to microwave network design problems requiring minimax or near minimax solutions. A basic difference here is that, instead of requiring very large values of p, any finite value of p greater than one can be used to produce extremely accurate minimax solutions. The paper discusses a six variable transformer example where values of p equal to 2, 4, 6, 10, 100, 1,000, and 10,000 have all been used separately to obtain substantially the same solution. Both the adjoint network method for gradient evaluation and the Fletcher method are employed for greater efficiency. Comparisons with the razor search and grazor search methods are made. Some far-reaching observations concerning minimax design are also made.

Description: Presented at the IEEE International Microwave Symposium (Boulder, Colo., June 1973). Published in IEEE Trans. Microwave Theory and Techniques, vol. MTT-21, Dec. 1973, pp. 815-818.

Related Work: SOC-2, SOC-3, SOC-29, SOC-70, SOC-80, SOC-88, SOC-93, SOC-113.

Price: \$ 5.00.

SOC-14

COMPARISON OF SOME ON-LINE SYSTEM IDENTIFICATION METHODS FOR A SIMULATED  
FIRST ORDER PROCESS

N.K. Sinha and A. Sen

September 1973, No. of Pages: 7

Revised: August 1978

Key Words: Discrete-time models, on-line identification

Abstract: Various methods are discussed for the on-line identification of complex physical systems from the samples of input and output data. An example of a first-order discrete-time system, with many different values of the output noise level, is used for comparing the effectiveness of the methods under realistic situations.

Description: Published in Automatic Control Theory and Applications, vol. 2, May 1974, pp. 37-43.

Related Work: SOC-6, SOC-67.

Price: \$ 3.00.

SOC-15

NONLINEAR PROGRAMMING PACKAGE FOR CONSTRAINED OPTIMIZATION VERSION  
FLNLP1

J.W. Bandler and W.Y. Chu

August 1973,      No. of Pages: 30

Revised:

Key Words:      Constrained minimization, nonlinear programming,  
minimax optimization, gradient minimization methods,  
interactive design

Abstract:      The program developed solves nonlinear programming problems  
using a minimax approach with the efficient gradient method by Fletcher.  
It is available for batch-processing as well as on the time-sharing  
system INTERCOM of McMaster's CDC 6400.

Description:      Contains Fortran listing, user's manual.  
Source deck available for \$30.00.

Related Work:      SOC-2, SOC-12, SOC-71, SOC-78, SOC-93, SOC-113.

Price:            \$15.00.



SOC-16

STANDARDIZED TIME FOR COMPUTER PROGRAMS

W. Kinsner

August 1973,      No. of Pages: 15

Revised:

Key Words:      Algorithm efficiency, assessment criteria, timing programs

Abstract: A simple means of comparing the effectiveness of computer programs executed on different machines has been presented. Various criteria for an assessment of the program effectiveness have been discussed. A standard timing program and a test program have been run on different computers. The results confirm the existence of a common basis to adjust execution times from one computer to another.

Description:      Presented at the Symposium on Computers, Electronics and Control (Calgary, Canada, May 1974).  
Contains Fortran listing, user's manual.  
Source deck available for \$15.00.

Related Work:      SOC-43, SOC-59, SOC-74, SOC-93.

Price:              \$ 5.00.

SOC-17

FUNCTION OPTIMIZATION PACKAGE VERSION FLOPT1

J.W. Bandler and W.Y. Chu

August 1973,      No. of Pages: 30

Revised:

Key Words:            Unconstrained minimization, gradient minimization  
                         methods, penalty function methods, interactive design

Abstract: The program developed solves unconstrained optimization problems by the Fletcher method. It is adaptable to solving constrained problems by using sequential unconstrained minimization techniques. The program is available for batch processing as well as on the time-sharing system INTERCOM of McMaster's CDC 6400.

Description:           Contains Fortran listing, user's manual.  
                         Source deck available for \$30.00.

Related Work:        SOC-12, SOC-42, SOC-84, SOC-93, SOC-108, SOC-113,  
                         SOC-151.

Price:                \$15.00.

SOC-18

THE TOLERANCE PROBLEM IN OPTIMAL DESIGN

J.W. Bandler

September 1973, No. of pages: 6

Revised:

Key Words:           Engineering design, tolerance assignment problems,  
                          electrical circuit sensitivities, design centering

Abstract: This paper reviews recent results in the tolerance assignment problem. A mathematical statement of the problem is made and difficulties in solving it are pointed out. The approach is taken that component tolerance assignment is an integral part of computer-aided circuit and system design. It is shown that both the optimal nominal parameter values and tolerances should be determined simultaneously using optimization methods for the best results. A bibliography of recent or relevant work in the area of circuit design subject to tolerances is appended.

Description:       Proc. European Microwave Conference (Brussels, Belgium,  
                          Sept. 1973), Paper A.13.1.(I).

Related Work:     As for SOC-1.

Price:            \$ 2.00.

SOC-19

A SPECIAL PROGRAM FOR LEAST  $p$ TH APPROXIMATION INCLUDING INTERPOLATION

J.R. Popovic and J.W. Bandler

October 1973, No. of Pages: 32

Revised:

Key Words: Function approximation, approximation in modelling and design, minimax approximation, gradient minimization methods

Abstract: Minimization of a least  $p$ th objective function of  $k$  variables using gradient methods. Interpolation brings the discrete problem closer to the continuous minimax approximation problem.

Description: Contains Fortran listing, user's manual.  
Source deck available for \$50.00.

Related Work: This report should be read in conjunction with "General programmes for least  $p$ th and near minimax approximation", Int. J. Systems Science, vol. 5, 1974, pp. 907-932. SOC-12, SOC-93, SOC-113, SOC-155.

Price: \$15.00.

SOC-20

A GENERAL PROGRAM FOR DISCRETE LEAST PTH APPROXIMATION

J.R. Popovic and J.W. Bandler

October 1973, No. of pages: 38

Revised:

Key Words: Function approximation, approximation in modelling and design, minimax approximation, gradient minimization methods

Abstract: To minimize an objective function of k variables defined as the generalized discrete least pth objective using gradient methods.

Description: Contains Fortran listing, user's manual.  
Source deck available for \$50.00.

Related Work: This report should be read in conjunction with "General programmes for least pth and near minimax approximation", Int. J. Systems Science, vol. 5, 1974, pp. 907-932. SOC-12, SOC-93, SOC-113, SOC-155.

Price: \$15.00.

SOC-21

OPTIMIZATION OF TURBO-ALTERNATOR TRANSIENT RESPONSE USING STATE FEEDBACK  
DECOUPLING

P.J. Nolan, N.K. Sinha and R.T.H. Alden

October 1973, No. of Pages: 19

Revised:

Key Words: Decoupling, turbo-alternator response optimization

Abstract: The application of state feedback decoupling is proposed for the minimization of transients following small changes in real and reactive power levels in a turbo-alternator connected to an infinite bus through a transmission line. For an example, a ninth-order linearized system model is decoupled into two third-order single-input single-output systems. The poles of these systems are optimally placed to satisfy a variety of design specifications. From the computational point of view, this approach is far more attractive than that using state-variable or output feedback without decoupling. It also provides better insight into the problem.

Description: Published in Int. J. Control, vol. 19, June 1974, pp. 1177-1186.

Related Work: SOC-45, SOC-48.

Price: \$ 5.00.

SOC-22

MINIMAX SYSTEM MODELLING AND DESIGN

T.V. Srinivasan

July 1973,            No. of Pages: 175

Revised:

Key Words:            Minimax design, system modelling, automated design,  
                         approximation algorithms, steepest descent

Abstract: Computer-aided system modelling and design for minimax objectives have been considered in detail. A new algorithm for minimax approximation, called the grazor search method, has been proposed and successfully used on a number of network design problems to test the reliability and efficiency of the method. A critical comparison of the method with existing algorithms has shown the grazor search algorithm to be reliable in most of the problems considered. Practical ideas have been presented to deal with constrained minimax optimization problems and to investigate a solution for minimax optimality. Two user-oriented computer programs incorporating these ideas have been included as part of the thesis. Lower-order modelling of a high-order system has been considered for minimax objectives, and the suggested ideas make it feasible to design automated models for a variety of transient and steady-state constraint specifications.

Description:            Ph.D. Thesis.  
                         Contains Fortran listings and user's manual for the  
                         grazor search method and for checking minimax  
                         optimality. Source decks available for \$100.00.

Related Work:            SOC-11, SOC-12, SOC-68, SOC-155.

Price:                    \$30.00.

SOC-23

STATISTICAL IDENTIFICATION OF THE DYNAMIC BEHAVIOUR OF A DUAL INPUT HEAT EXCHANGER NETWORK

J.D. Wright and D.W. Bacon

October 1973, No. of Pages: 50

Revised:

Key Words: Statistical identification, modelling

Abstract: Statistical modelling procedures proposed by Box and Jenkins are used to develop models for the transfer function and noise behaviour of a dual input pilot scale heat exchanger network. Data were collected under operating conditions closely resembling full scale industrial operation first with uncorrelated inputs and then with correlated inputs. Two modelling strategies, a superposition approach and a transformed input approach, are employed to analyze the data. Computational advantages of the transformed input procedure for correlated input situations is demonstrated and the effectiveness of both strategies in detecting nonstationarity in the system noise is also illustrated.

Description: Presented at the Fourth Joint Chemical Engineering Conference (Vancouver, Canada, Sept. 1973).

Related Work:

Price: \$ 5.00.



SOC-24

AUTOMATED NETWORK DESIGN WITH OPTIMAL TOLERANCES

J.W. Bandler and P.C. Liu

October 1973, No. of pages: 15

Revised:

Key Words:

Abstract: A new approach to network design to obtain optimal parameter values simultaneously with an optimal set of component tolerances is proposed. An automated scheme could start from an arbitrary initial acceptable or unacceptable design and under appropriate restrictions stop at an acceptable design which is optimum in the worst case sense for the obtained tolerances.

Description: Presented at the IEEE International Symposium on Circuit Theory (Toronto, Canada, Apr. 1973). Published in IEEE Trans. Circuits and Systems, vol. CAS-21, Mar. 1974, pp. 219-222.

Related Work: As for SOC-1.

Price: \$ 2.00.

SOC-25

TIME DOMAIN APPROXIMATION USING DIGITAL METHODS

N.K. Sinha, A. Sen and R.H.Y. To

October 1973, No. of Pages: 19

Revised:

Key Words: Digital methods, time-domain approximation

Abstract: Two digital methods are proposed for the solution of the time-domain approximation problem. The first method, based on a recursive algorithm for the matrix pseudoinverse, determines the pulse transfer function of a discrete-time system of a prescribed order providing the best fit in the least squares sense at the sample points. The continuous-time system transfer function is then derived by using a simple transformation provided that the sampling frequency exceeds the Nyquist rate. The method is direct and computationally efficient. The second method is based on using an efficient gradient search algorithm providing the best fit in the least pth sense at the sample points. A number of examples illustrate the methods.

Description: Published in Int. J. Systems Science, vol. 5, April 1974, pp. 373-382.

Related Work: SOC-92.

Price: \$ 5.00.

SOC-26

ON THE OPTIMIZATION OF DISTRIBUTED PARAMETER SYSTEMS WITH BOUNDARY CONTROL: A COUNTER EXAMPLE FOR THE MAXIMUM PRINCIPLE

F. Gruyaert and C.M. Crowe

November 1973, No. of Pages: 29

Revised: July 1974

Key Words: Distributed parameter systems, boundary control, maximum principle

Abstract: A counterexample is given to the strong maximum principle for boundary control of a class of distributed parameter systems. The particular system deals with chemical reactors suffering catalyst decay and is in the class whose members are described by sets of first order partial differential equations of the hyperbolic type. It is shown that an optimal control exists and that over any finite time interval in which the control is unconstrained, the exit conversion from the reactor remains constant. It is further shown that for certain values of the parameters, the optimal control policy violates the necessary conditions of the strong maximum principle for boundary control of distributed parameter systems.

Description:

Related Work:

Price: \$ 5.00.

SOC-27

MARTINGALES AND THEIR APPLICATION TO OPTIMAL STATE ESTIMATION

T. Prasad and N.K. Sinha

December 1973, No. of Pages: 23

Revised:

Key Words: Martingales, optimal filtering

Abstract: The main properties of martingales are discussed from an engineering point of view, this is followed by applications of the theory to optimal linear as well as nonlinear estimation problems.

Description: Published in Int. J. Systems Science, vol. 5, Nov. 1974, pp. 1039-1054.

Related Work:

Price: \$ 5.00.

SOC-28

LIQUID ANALOGS OF ELECTRICAL MACHINES

R.T.H. Alden

December 1973, No. of Pages: 6

Revised:

Key Words: Experimental technique, field analysis, electrical machines

Abstract: General modeling criteria are presented for constructing liquid metal analogs for conducting paths in electrical machines. The use of mercury is specifically discussed as a convenient analog for solid copper and aluminum secondaries, and molten metal in electric furnaces. The construction of probes to measure flux and current density is presented, as are applications of the technique to bus bars, linear induction motors, and channel furnaces.

Description: Presented at the IEEE Winter Power Meeting (New York, Jan. 1974). Published in IEEE Trans. Power Apparatus and Systems, vol. PAS-94, Jan. 1975, pp. 123-127.

Related Work:

Price: \$ 2.00.

SOC-29

DISOPT - A GENERAL PROGRAM FOR CONTINUOUS AND DISCRETE NONLINEAR PROGRAMMING PROBLEMS

J.H.K. Chen

March 1974,           No. of Pages: 80

Revised:             June 1975

Key Words:           Engineering design, optimization programs, discrete optimization, tolerance assignment

Abstract: An integrated computer program in FORTRAN IV for continuous or discrete, constrained or unconstrained general optimization problems is presented. The program, called DISOPT, is applicable to a wide variety of design problems such as continuous and discrete tolerance assignments, digital filter design, circuit design, system modelling and approximation problems. Many recent techniques and algorithms for nonlinear programming have been incorporated. The user may optionally choose the combination of techniques and algorithms best suited to his problems.

Description:         M. Eng. Thesis.  
                      Contains Fortran listing, user's manual.  
                      Source deck available for \$100.00.

Related Work:        SOC-1, SOC-2, SOC-3, SOC-4, SOC-13, SOC-18, SOC-24,  
                      SOC-36, SOC-49, SOC-62, SOC-65, SOC-71, SOC-80, SOC-87,  
                      SOC-113, SOC-155, SOC-174. Supercedes SOC-4.

Price:               \$30.00.

SOC-30

Superceded by SOC-82.

SOC-31

ANALYTICAL INTEGRATION OF  $\log(a + \sqrt{x^2 + b^2})$

W. Kinsner

April 1974,          No. of Pages: 6

Revised:

Key Words:          Analytical integration

Abstract: Closed form expressions for the integral  $\int \log(a + \sqrt{x^2 + b^2}) dx$ , where either  $|a| < |b|$  or  $|a| > |b|$ , are derived. This integral often appears in field problems. Its numerical integration may be difficult and expensive.

Description:

Related Work:      SOC-141.

Price:              \$ 2.00.



SOC-32

MINIMAL REALIZATION OF TRANSFER FUNCTION MATRICES

N.K. Sinha and P. Rozsa

April 1974,            No. of Pages: 4

Revised:

Key Words:            Irreducible realization, multivariable systems

Abstract:    A computationally efficient algorithm is presented for a minimal realization of a linear time-invariant multivariable system from a given rational transfer function matrix. It is based on the systematic transformation of the Hankel matrix of the system to the Hermite normal form using outer products.

Description:    Proc. Milwaukee Symp. on Automatic Control (Milwaukee, Wis., March 1974), pp. 345-348.

Related Work:    SOC-57, SOC-61, SOC-89, SOC-121, SOC-165.

Price:                \$ 2.00.

SOC-33

MODELLING A PERMANENT-MAGNET STEPPING MOTOR FOR CONTROL APPLICATIONS

N.K. Sinha, A.R. Elliott and R.C.S. Wong

April 1974,            No. of Pages: 6

Revised:

Key Words:            Stepping motors, realistic models

Abstract:    A new mathematical model for a permanent-magnet stepping motor is proposed which includes the effect of the saliency of the poles. Comparisons show that this model is more accurate than the existing models and hence, more suitable for many applications involving computer control.

Description:    Proc. Milwaukee Symp. on Automatic Control (Milwaukee, Wis., March 1974), pp. 353-358.

Related Work:

Price:            \$ 2.00.

SOC-34

ON-LINE IDENTIFICATION OF A DUAL-INPUT HEAT-EXCHANGER SYSTEM

A. Sen, N.K. Sinha and J.D. Wright

April 1974,            No. of Pages: 6

Revised:

Key Words:            On-line identification, comparison of methods

Abstract: Several methods of on-line system identification are applied to the identification of a two-stage heat exchanger from the actual input-output data obtained during a test run. The results are then compared with the model obtained earlier using a highly-regarded off-line method, the time-series analysis of Box and Jenkins.

Description:           Proc. Milwaukee Symp. on Automatic Control (Milwaukee, Wis., March 1974), pp. 340-344.

Related Work:        SOC-85.

Price:                \$ 2.00.

SOC-35

COMPUTER CONTROL OF TURBO-ALTERNATORS USING OPTIMAL LOW-ORDER MODELS

P.J. Nolan, N.K. Sinha and R.T.H. Alden

April 1974,           No. of Pages: 6

Revised:

Key Words:           Low-order models, turbo-alternators

Abstract:       A suitable low-order model for complex modern turbo-alternator systems can be used effectively for computer control of such systems. This paper considers such low-order models for determining the sub-optimal control laws for a system including exciter and prime-mover controls and a full version of Parks' equations based on data from a 500 MW thermal unit of Ontario Hydro. Comparison with the optimal controller based on the original high-order model shows that the sub-optimal controller is almost indistinguishable from the actual optimum.

Description:       Proc. Eighth Annual Princeton Conference on Information Sciences and Systems (Princeton, N.J., March 1974), pp. 570-575.

Related Work:       SOC-48.

Price:             \$ 2.00.

SOC-36

DESIGN OF RECURSIVE DIGITAL FILTERS WITH OPTIMIZED WORD LENGTH COEFFICIENTS

J.W. Bandler, B.L. Bardakjian and J.H.K. Chen

April 1974, No. of Pages: 6

Revised: March 1975

Key Words: Digital filters, discrete optimization, branch and bound methods, gradient minimization methods

Abstract: The problem of designing recursive digital filters with optimum word length coefficients to meet arbitrary, prescribed magnitude characteristics in the frequency domain is numerically investigated. The continuous nonlinear programming problem is formulated as an unconstrained minimax problem, and Dakin's branch and bound technique is used in conjunction with Fletcher's unconstrained minimization program to discretize the continuous solution. The objective function to be minimized is directly concerned with the word lengths of the coefficients, which are also introduced as variables.

Description: Reprint.  
Presented at the Eighth Annual Princeton Conference on Information Sciences and Systems (Princeton, N.J., March 1974). Published in Computer Aided Design, vol. 7, July 1975, pp. 151-156.

Related Work: SOC-29, SOC-93, SOC-113.

Price: \$ 2.00.

SOC-37

SOME IMPLICATIONS OF BIQUADRATIC FUNCTIONS IN THE TOLERANCE PROBLEM

J.W. Bandler and P.C. Liu

April 1974,           No. of Pages: 22

Revised:

Key Words:           Tolerance analysis, electrical circuit design,  
                  worst-case design, network sensitivities

Abstract:    The usual assumptions for the tolerance problem in the frequency domain are that the worst cases occur at boundary points of a tolerance region, and that the acceptable region is simply connected. These assumptions are investigated and conditions for validity are given for the class of networks which have bilinear dependence on the parameter of interest.

Description:   Presented at the IEEE International Symposium on Circuits and Systems (San Francisco, Calif., April 1974). Published in IEEE Trans. Circuits and Systems, vol. CAS-22, May 1975, pp. 385-390.

Related Work:   SOC-1, SOC-18, SOC-24, SOC-49, SOC-62, SOC-87, SOC-93,  
                  SOC-113.

Price:           \$ 5.00.

SOC-38

MODELLING AN EDUCATIONAL SYSTEM

N.K. Sinha and C.D. diCenzo

April 1974,            No. of Pages: 5

Revised:

Key Words:            Stochastic approximation, educational systems

Abstract:    A stochastic approximation method is presented for determining the parameters of a stochastic model for an educational system. As an example, the parameters of such a model are derived for the student population in the faculty of Engineering of McMaster University.

Description:    Proc. Fifth Annual Pittsburgh Conference on Modeling and Simulation (Pittsburgh, Pa., April 1974), pp. 437-441.

Related Work:

Price:            \$ 2.00.

SOC-39

ADAPTIVE CONTROL USING STOCHASTIC APPROXIMATION

N.K. Sinha and T. Prasad

April 1974,           No. of Pages: 6

Revised:

Key Words:           Stochastic approximation, adaptive control

Abstract: Adaptive control of systems with uncertainty can be implemented without complete identification of the plant if the cost function is measured continuously and the parameters of the controller are adjusted, using an efficient gradient method, to obtain optimum performance. As, in practice, only noisy measurements of the cost function are available, one has to use stochastic gradient methods. In this paper some efficient stochastic approximation algorithms are proposed for adaptive control.

Description:       Proc. Milwaukee Symp. on Automatic Computation and Control (Milwaukee, Wis., April 1975), pp. 365-370.

Related Work:       SOC-8, SOC-94, SOC-170.

Price:               \$ 2.00.



SOC-40

ON-LINE SYSTEM IDENTIFICATION USING STOCHASTIC APPROXIMATION

A. Sen and N.K. Sinha

April 1974,            No. of Pages: 4

Revised:

Key Words:            Stochastic approximation, discrete-time models

Abstract: A two-stage recursive stochastic approximation algorithm is presented for estimating the parameters of a discrete-time system from noisy input-output observations. The first stage of the algorithm filters the observations which are then used in the second stage to obtain unbiased estimates. The algorithm is suitable for on-line identification of the parameters of a physical system under the realistic condition of imperfect measurements. Examples of simulation indicate that this two-stage algorithm provides good estimates even for high noise-to-signal ratios.

Description:           Proc. Eighth Annual Princeton Conference on Information Sciences and Systems (Princeton, N.J., March 1974), pp. 295-298.

Related Work:        SOC-7.

Price:                \$ 2.00.

SOC-41

A GENERALIZED PSEUDOINVERSE ALGORITHM FOR UNBIASED PARAMETER ESTIMATION

A. Sen and N.K. Sinha

May 1974,            No. of Pages: 7

Revised:

Key Words:            Unbiased estimation, on-line identification

Abstract:    Unbiased estimates of the parameters of a discrete-time system from noisy measurements of input-output data can be obtained by using a generalized pseudo-inverse algorithm. Because of its recursive nature, the algorithm can be used for on-line identification. Results of simulation are presented comparing this algorithm with earlier methods.

Description:    Proc. Int. Symp. on Computers, Electronics and Control (Calgary, Canada, May 1974).

Related Work:    SOC-6, SOC-67.

Price:            \$ 2.00.

SOC-42

EFFICIENT, INTERACTIVE SEMI-AUTOMATED OPTIMIZATION OF MODELS AND DESIGNS

J.W. Bandler, W.Y. Chu and J.R. Popovic

May 1974,            No. of Pages: 8

Revised:

Key Words:            Engineering design, interactive design, least pth optimization, extrapolation, gradient minimization methods, electrical filter design, microwave filters

Abstract: The work described in this paper is directed towards a compromise between fully automated design and modelling, which, it is felt, is still some way off, and fully interactive design, which, in contrast, is probably unnecessarily inefficient in the use of machines. At the heart of the software are efficient gradient methods of minimizing unconstrained nonlinear functions of many variables, such as the Fletcher method. In an effort to satisfy design specifications and constraints we use least pth approximation techniques devised by Bandler and Charalambous. A number of interactive optimization programs are discussed, in particular, one that optimizes certain cascaded two-port electrical circuits in the frequency domain, and ones that minimize nonlinear functions of many variables, constrained and unconstrained. The aim of the paper is to discuss the present state of the authors' program and to indicate future directions to be explored. To this end, results of the incorporation of extrapolation into the program as well as the forcing of symmetry are presented.

Description:           Proc. Int. Symp. on Computers, Electronics and Control (Calgary, Canada, May 1974).

Related Work:        SOC-12, SOC-17, SOC-69, SOC-71, SOC-84, SOC-93, SOC-113, SOC-151.

Price:                \$ 2.00.

SOC-43

CONVERGENCE ACCELERATION IN THE NUMERICAL SOLUTION OF FIELD PROBLEMS

W. Kinsner

June 1974,            No. of Pages: 324

Revised:

Key Words:            PDE, numerical solutions of PDE's, convergence acceleration, finite difference methods, finite element methods, field problems

Abstract: The purpose of this thesis is to present a unified treatment of numerical solutions to the elliptic partial differential equations, particularly the Laplace, Poisson, and Helmholtz equations, in homogeneous and inhomogeneous isotropic media in electrostatic, magnetostatic, and electromagnetic field problems, with particular attention given to iterative solutions. Another objective is to design a family of methods for accelerating the convergence of these solutions. The concept of the convergence acceleration is generalized to deterministic and stochastic vector sequences. Several hybrid methods, combining the finite difference and finite element approaches, are proposed. The methods have been tested either by test examples or by practical solutions to field problems.

Description:            Ph.D. Thesis.

Related Work:            SOC-10, SOC-16, SOC-47, SOC-59, SOC-73, SOC-93, SOC-96, SOC-141, SOC-150.

Price:                    \$30.00.

SOC-44

SENSITIVITIES OF LARGE INTERCONNECTED POWER SYSTEMS

P.J. Nolan, N.K. Sinha and R.T.H. Alden

June 1974,            No. of Pages: 25

Revised:

Key Words:            Power systems, large-scale systems, sensitivities

Abstract: The eigenvalue sensitivities of a large interconnected system of synchronous machines are obtained using the P, Q, R, matrix technique. Full advantage is taken of the sparseness of these matrices and the fact that they can be easily differentiated with respect to the parameters. The sensitivities of a 14th order model of a regulated synchronous machine connected to an infinite bus and of a two-machine system represented by a 24th order model are presented as specific illustrations.

Description:           Proc. IFAC Symp. Large Scale Systems Theory (Udine, Italy, June 1976), pp. 51-58.

Related Work:         SOC-129.

Price:                 \$ 5.00.

SOC-45

DECOUPLING AND POLE PLACEMENT IN LINEAR MULTIVARIABLE SYSTEMS: A DIRECT ALGEBRAIC APPROACH

P. Rozsa and N.K. Sinha

June 1974,           No. of Pages: 43

Revised:            June 1975

Key Words:         Decoupling, pole placement, linear multivariable systems

Abstract: Starting with the controllable canonical form representation of a linear multivariable system, necessary and sufficient conditions are established for decoupling a linear multivariable system and placing its poles at arbitrary locations by using linear state variable feedback and a constant nonsingular transformation of the input. Since these conditions are based only on the matrix C of the triple A, B, C in the canonical representation, they are very easy to apply. An efficient algorithm for decoupling and pole placement, is then presented.

Description:        Shorter version in Proc. Midwest Symp. on Circuits and Systems (Montreal, Aug. 1975).

Related Work:      SOC-21, SOC-48, SOC-61, SOC-169.

Price:             \$ 5.00.

SOC-46

MODELLING AND OPTIMIZATION OF MAGNETIC BUBBLE GENERATORS

W. Kinsner and E. Della Torre

June 1974,            No. of Pages: 33

Revised:

Key Words:            Magnetic bubbles, domain cutting, domain walls, bubble devices

Abstract: Stable magnetic domains of various shapes exist in uniaxial magnetic materials under uniform bias field conditions. An inhomogeneous applied field causes an instability in a strip or bubble domain. This deformation of domains can be used for the controlled generation of bubble domains which are used in bubble devices. This paper presents an analysis of the problem, formation of a physical model, constructing a mathematical model, and finally optimization ideas and techniques used to obtain optimum device geometries and ratings. This analysis have been limited to variational techniques. The objective function is related to the demagnetizing field, bias field, field inhomogeneity, effective wall field, and coercive force. Residual and discretization errors have been analysed and extrapolation techniques have been used to minimize errors. The analysis and predictions have been verified experimentally.

Description:            An extension of a paper "Modelling and optimization of magnetic bubble devices", (SOC-60) presented at the International Computers, Electronics and Control Symposium (Calgary, Canada, May 1974).

Related Work:        SOC-58, SOC-60, SOC-74, SOC-93, SOC-141.

Price:                \$ 5.00.

SOC-47

AN EFFICIENT SCANNING TECHNIQUE

W. Kinsner and E. Della Torre

June 1974,           No. of Pages: 15

Revised:

Key Words:           Scanning techniques, raster scan, contour scan, partial  
                      differential equations, pattern recognition

Abstract: Scanning an array refers to selecting all the elements of the array in a particular order. We shall consider two scanning techniques: a raster scan and a new contour scan. The raster scan selects the elements of a row from left to right and rows sequentially from top to bottom. The contour scanning technique consists in selecting the elements of an array so that they are adjacent to or lie on a given boundary, and the subsequent elements are adjacent to the previously selected points. Use of the contour scanning technique, rather than the raster scan, accelerates the speed of propagation by finite-difference methods or other iterative methods. This technique is useful in other applications such as pattern recognition, though, the implementation discussed here refers to iterative solutions of elliptic boundary value problems.

Description:         Contains Fortran listing, user's manual.  
                      Source deck available for \$30.00.

Related Work:        SOC-43, SOC-93, SOC-96, SOC-150.

Price:               \$15.00.



SOC-48

DECOUPLING OF A POWER SYSTEM USING LOW ORDER MODELS

P.J. Nolan, N.K. Sinha and R.T.H. Alden

July 1974,            No. of Pages: 15

Revised:

Key Words:            Decoupling, power systems, state feedback

Abstract: The application of state feedback decoupling has been previously proposed for the optimization of the dynamic response of a turbo-alternator connected to an infinite bus through a transmission line. The practical difficulties involved in the implementation are greatly reduced if an accurate low order model can be used to represent the high order system model.

Two methods of reduction are considered in this study, namely, a dominant eigenvalue approach and an approach based on matching model and system responses. It is shown that for the typical 12th order system considered, the latter approach yields the most suitable model and is more conceptually straight forward in this application.

Description:           Proc. Int. Conference on Electrical Machines (London, Sept. 1974), pp. F5-1 - F5-10.

Related Work:        SOC-21, SOC-35, SOC-45.

Price:                \$ 2.00.

SOC-49

WORST CASE NETWORK TOLERANCE OPTIMIZATION

J.W. Bandler, P.C. Liu and J.H.K. Chen

July 1974,            No. of Pages: 43

Revised:            January 1975

Key Words:        Tolerance analysis, electrical circuit design,  
                      worst-case design, optimization

Abstract: The theory and its implementation in a new user-oriented computer program package is described for solving continuous or discrete worst-case tolerance assignment problems simultaneously with the selection of the most favourable nominal design. Basically, the tolerance problem is to ensure that a design subject to specified tolerances will meet performance or other specifications. Our approach which is believed to be new to the microwave design area, can solve a variety of tolerance and related problems. Dakin's tree search, a new quasi-Newton minimization method and least pth approximation are used. The program itself is organized such that future additions and deletions of performance specifications and constraints, replacement of cost functions and optimization methods are readily realized. Options and default values are used to enhance flexibility. The full Fortran listing of the program and documentation will be made available.

Description:        Published in IEEE Trans. Microwave Theory and  
                      Techniques, vol. MTT-23, Aug. 1975, pp. 630-641.

Related Work:      As for SOC-1.

Price:              \$ 5.00.

SOC-50

THE FORMULATION AND REDUCTION OF A STATE SPACE MODEL FOR THE DYNAMIC BEHAVIOUR OF A NON-ADIABATIC PACKED BED CATALYTIC REACTOR

A. Jutan, J-P. Tremblay, J.F. MacGregor and J.D. Wright

August 1974, No. of Pages: 29

Revised:

Key Words: State space modelling, partial differential equations

Abstract: A state space representation of the transient behaviour of an actual fixed bed catalytic non-adiabatic tubular reactor, to be used for control purposes, is obtained using a combination of finite difference and orthogonal collocation methods on the partial differential equations describing the system. The dimensionality of the resulting high order state space model is reduced using an aggregation matrix containing quadrature weights. The steady-state and dynamic behaviour of the model is checked by simulation.

Description: Presented at the 98th National Meeting of the AIChE (Salt Lake City, Aug. 1974).

Related Work: SOC-152, SOC-153, SOC-154, SOC-157.

Price: \$ 5.00.

SOC-51

OPTIMAL TUNING OF DIGITAL CONTROLLERS OF ARBITRARY FORM USING DYNAMIC-STOCHASTIC MODELS

J.F. MacGregor, J.D. Wright and H.M. Hong

August 1974, No. of Pages: 18

Revised:

Key Words: Digital controllers, tuning, dynamic-stochastic models

Abstract: A method is presented for tuning digital controllers by modelling the disturbances in the process by an autoregressive-integrated-moving-average type of stochastic model and the process dynamics by a discrete transfer function. The criterion of optimality is minimum variance at the output possibly subject to a constraint on the variance of the manipulated variable. This procedure is intended to cover the situation where one is limited to a specified form of controller such as PID controllers. The method is applied and compared with other methods on two actual processes: a steam-jacketed continuous stirred tank reactor, and a system of heat exchangers in series.

Description:

Related Work:

Price: \$ 2.00.

SOC-52

BUBBLE MEMORY USING PARALLEL-BAR CIRCUITS

E. Della Torre and W. Kinsner

September 1974, No. of Pages: 10

Revised:

Key Words:           Magnetic bubbles, bubble serial memories, parallel-bar (PB) circuit, alternating field access bubble circuits, memory organization

Abstract: Various bubble domain devices have been proposed for large compact memories. A new parallel-bar (PB) bubble propagating circuit has many advantages over those conventional rotating transverse field propagating circuits. The operation of the PB circuit is insensitive to fields in the direction of bubble propagation. This property has been used to design a major-minor loop memory. Various transfer gates, corners, and bubble recirculators have been suggested. The power requirement may be reduced by 50% as compared to the rotating field memories.

Description:       This patent application was filed at the McMaster University Committee for the Management of Research and Consulting Contracts and Patents April 12, 1973; in the Canadian Patents and Development Ltd. May 25, 1973; and as a US Patent Application No. 467,237 May 6, 1974.

Related Work:       SOC-56, SOC-74, SOC-83.

Price:               \$15.00.

SOC-53

MAGNETOSTRICTIVE-PIEZOELECTRIC BUBBLE DETECTOR

W. Kinsner and E. Della Torre

September 1974, No. of Pages: 6

Revised:

Key Words:           Magnetic bubbles, bubble sensing

Abstract: A new magnetic bubble sensing device based on a combined magnetostrictive-piezoelectric phenomenon has been proposed. The sensor acts as an electro-mechanical transformer. The output signal from the sensor has a high signal-to-noise ratio due to the absence of an activating electric current in the device.

Description:       This patent application was filed at the McMaster University Committee for the Management of Research and Consulting Contracts and Patents on May 3, 1973; in the Canadian Patents and Development Ltd. on May 30, 1973; and as a US Patent Application No. 425,696 on December 17, 1973.

Related Work:       SOC-55, SOC-64, SOC-74, SOC-77, SOC-81.

Price:               \$15.00.

SOC-54

MAGNETIC BUBBLE DOMAIN LIGHT MODULATOR

E. Della Torre and W. Kinsner

September 1974, No. of Pages: 14

Revised:

Key Words:           Magnetic bubbles, signal processing, coherent-optical  
                          signal processing, light modulators

Abstract: A light modulator based on magnetic bubbles spatially distributed in thin film bubble materials has been proposed. The spatial distribution of bubbles can represent any one- or two-dimensional function. A bubble-supporting platelet with such a representation can serve as medium whose transparency is proportional either to density modulation or to aperture area modulation. The bubble modulator can be used in a coherent-optical signal processing system. The modulator offers unique features not available in other light modulating devices.

Description:       This patent application was filed at the McMaster University Committee for the Management of Research and Consulting Contracts and Patents on April 16, 1974; in the Canadian Patents and Development Ltd. on May 30, 1974.

Related Work:      SOC-74.

Price:             \$15.00.

SOC-55

SONIC MAGNETIC-BUBBLE-DOMAIN SENSING DEVICE

W. Kinsner and E. Della Torre

September 1974, No. of Pages: 6

Revised:

Key Words:           Magnetic bubbles, bubble sensing

Abstract: A new magnetic bubble sensor based on the interaction between ultrasonic waves and a magnetostrictive material magnetized by a bubble has been proposed. The sensor can detect both propagating and stationary bubbles. Estimated output signals are of the order of tens of millivolts. The signal-to-noise ratio of the detector is high since there is no activating current in the sensor.

Description:        This patent application was filed at the McMaster University Committee for the Management of Research and Consulting Contracts and Patents on May 27, 1974; in the Canadian Patents and Development Ltd. on May 30, 1974.

Related Work:       SOC-53, SOC-64, SOC-74, SOC-81.

Price:               \$15.00.



SOC-56

CHANNEL BAR BUBBLE DOMAIN PROPAGATING CIRCUIT

E. Della Torre and W. Kinsner

September 1974, No. of Pages: 18

Revised:

Key Words:           Magnetic bubbles, bubble propagation, alternating field  
                          access devices

Abstract: A new bubble propagating circuit has been proposed. The circuit propagates bubbles by means of combined forces due to the properties of a modulated channel in a bubble supporting material and a field produced by soft-magnetic-material bars which are magnetized by an alternating transverse magnetic field. Propagating characteristics are superior to other propagating circuits due to the high stability of bubbles in the channel. Various types of the circuit, corners, and transfer gates have been suggested. The circuits have been used in a major-minor loop bubble memory.

Description:       This patent application was filed at the McMaster  
                          University Committee for the Management of Research and  
                          Consulting Contracts and Patents on Septemeber 3, 1974.

Related Work:       SOC-52, SOC-64, SOC-74, SOC-83.

Price:               \$15.00.

SOC-57

MINIMAL REALIZATION OF A TRANSFER FUNCTION MATRIX IN CANONICAL FORMS

P. Rozsa and N.K. Sinha

September 1974, No. of Pages: 20

Revised:

Key Words: Canonical forms, irreducible realization

Abstract: An algorithm is presented for obtaining a minimal-order realization of a linear time-invariant multivariable system from a given rational transfer function matrix. The procedure yields the dynamical equations directly in a canonical form, while still requiring less amount of computation than the existing methods.

Description: Published in Int. J. Control, vol. 21, 1975, pp. 273-284.

Related Work: SOC-32, SOC-61, SOC-89, SOC-165.

Price: \$ 2.00.

SOC-58

BUBBLE CUTTING CIRCUITS

W. Kinsner, E. Della Torre and R. Hutton

September 1974, No. of Pages: 19

Revised:

Key Words:           Magnetic bubbles, bubble generation, bubble circuit  
                          optimization

Abstract: An inhomogeneous applied field can cause an instability in a strip domain that can be used for the controlled generation of bubble domains. These instabilities have been studied experimentally and obtained between wall shape calculations and experimental data. Predictions of cutting current as a function of strip width deviate, however, for widths larger than  $\sqrt{5.5}h$  due to the limitations of the model and the experimental conditions.

Description:       Published in IEEE Trans. Magnetics, vol. MAG-10, Dec.  
                          1974, pp. 1071-1079.

Related Work:     SOC-46, SOC-60, SOC-74.

Price:             \$ 5.00.

SOC-59

A SUCCESSIVE EXTRAPOLATED RELAXATION (SER) METHOD FOR SOLVING PARTIAL DIFFERENCE EQUATIONS

E. Della Torre and W. Kinsner

September 1974, No. of Pages: 13

Revised:

Key Words: PDE, extrapolation, convergence, Aitken's  $\mathcal{S}^2$  process

Abstract: An algorithm is described for solving partial difference equations by a successive extrapolated relaxation (SER). The algorithm is based on the modified Aitken's  $\mathcal{S}^2$  process when applied to vector sequences. Various factors concerning the stability and convergence of solutions are discussed. Given illustrative examples indicate that this method is more efficient than the background sequence generating method.

Description: Presented at the Symposium on Computers, Electronics and Control (Calgary, Canada, May 1974).

Related Work: SOC-10, SOC-16, SOC-43, SOC-93.

Price: \$ 2.00.

SOC-60

MODELLING AND OPTIMIZATION OF MAGNETIC BUBBLE DEVICES

W. Kinsner and E. Della Torre

September 1974, No. of Pages: 16

Revised:

Key Words:           Magnetic bubbles, bubble generation

Abstract: Stable magnetic domains of various shapes exist in uniaxial magnetic materials under uniform bias field conditions. An inhomogeneous applied field causes an instability in a strip or bubble domain. This deformation of domains can be used for the controlled generation of bubble domains which are used in bubble devices. This paper presents an analysis of the problem, formation of a physical model, constructing a mathematical model, and finally optimization ideas and techniques used to obtain optimum device geometries and ratings. This analysis has been limited to variational techniques. The objective function is related to the demagnetizing field, bias field, field inhomogeneity, effective wall field, and coercive force. Residual and discretization errors have been analyzed and extrapolation techniques have been used to minimize errors. The analysis and predictions have been verified experimentally.

Description:           Presented at the Symposium on Computers, Electronics and Control (Calgary, Canada, May 1974).

Related Work:        SOC-46, SOC-58, SOC-74, SOC-93.

Price:                \$ 2.00.

SOC-61

CANONICAL FORMS FOR LINEAR MULTIVARIABLE SYSTEMS

N.K. Sinha and P. Rozsa

October 1974, No. of Pages: 29

Revised:

Key Words: Canonical forms, state-space descriptions

Abstract: Six different canonical forms for the triple  $A, B, C$  of a linear multivariable system are discussed, namely (i) the column-companion form, (ii) the row-companion form, (iii) the output identifiable form, (iv) the input-identifiable form, (v) the controllable canonical form and (vi) the observable canonical form. Simple algorithms for transforming any system into these forms are proposed and illustrated by means of examples. Practical applications of the various forms are discussed.

Description: Shorter version presented at the 1975 IEEE International Symposium on Circuits and Systems (Boston, Mass., April 1975). Published in Int. J. Control, vol. 23, June 1976, pp. 865-883.

Related Work: SOC-32, SOC-45, SOC-57, SOC-89, SOC-165, SOC-168, SOC-172.

Price: \$ 5.00.

SOC-62

THE TOLERANCE-TUNING PROBLEM: A NONLINEAR PROGRAMMING APPROACH

J.W. Bander and P.C. Liu

October 1974, No. of Pages: 17

Revised:

Key Words: Engineering design, nonlinear programming, optimization theorems, tolerance assignment, worst case design

Abstract: A theory of optimal worst case design embodying centering, tolerancing and tuning is presented. Some simplified problems and special cases are discussed. Projections and slack variables are used to explain some of the concepts. The worst case tolerance assignment and design centering problem falls out as a special case. Possible practical implementation of the ideas in circuit design is suggested.

Description: Presented at the Twelfth Annual Allerton Conference on Circuit and System Theory (Urbana, Illinois, Oct. 1974).

Related Work: As for SOC-1.

Price: \$ 5.00.

SOC-63

IDENTIFICATION AND DIRECT DIGITAL STOCHASTIC CONTROL OF A CONTINUOUS  
STIRRED TANK PROCESS

H.M. Hong and J.F. MacGregor

November 1974, No. of Pages: 6

Revised:

Key Words: Identification, stochastic control, statistical  
modelling

Abstract: Several aspects associated with the identification and direct digital stochastic control of a steam-jacketed continuous stirred tank process are investigated. Using data collected under closed-loop conditions by an on-line mini-computer, statistical modelling procedures are used to identify, fit and check a discrete dynamic-stochastic model for the process and its disturbances. Based on these models an optimal stochastic feedback controller is implemented using the minicomputer. A practical modification of this optimal controller is suggested and the modified stochastic controller is implemented and compared with a well tuned PI controller.

Description: Reprint.  
Published in Canadian J. Chem. Eng., vol. 53, April  
1975, pp. 211-216.

Related Work:

Price: \$ 2.00.



SOC-64

UNIVERSAL BUBBLE CELL FOR RAM

W. Kinsner and E. Della Torre

November 1974, No. of Pages: 33

Revised:

Key Words: Magnetic bubbles, bubble manipulation, bubble RAM, multistatic storage element

Abstract: A multi-state memory cell is presented which uses magnetic domains (bubbles) in uniaxial magnetic materials. The bubbles can be moved to any discrete location by means of magnetic field gradients produced by the application of electric currents and stabilized by appropriately shaped soft-magnetic-materials. Impedances to motion between stable positions are arranged to permit memory operation on a threshold basis. The cell can operate with a single or many bubbles. The bubble-bubble interaction within a multi-bubble cell can either be effectively eliminated or used to advantage. The bubble interaction between bubbles of adjacent cells can also be eliminated or effectively used. This cell can be employed as a memory element in random access memories (RAM) with 2D, 3D or 2 1/2D organizations. It is particularly suitable for non-destructive readout (NDRO). Above all, the cell offers a multi-state random access memory for multiple-valued logic computers; in this it does not have an analog amongst existing memory elements.

Description: This patent application was filed at the McMaster University Committee for the Management of Research and Consulting Contracts and Patents on October 24, 1974; in the Canadian Patents and Development Ltd. on October 29, 1974.

Related Work: SOC-53, SOC-55, SOC-56, SOC-74, SOC-77, SOC-81, SOC-83.

Price: \$15.00.

SOC-65

PRACTICAL DESIGN CENTERING, TOLERANCING AND TUNING

J.W. Bandler, P.C. Liu and H. Tromp

November 1974, No. of Pages: 32

Revised:

Key Words:           Engineering design, nonlinear programming, worst case  
                          design, tolerancing and tuning

Abstract: This paper presents the results of a numerical investigation of simultaneous optimal design centering, tolerancing and tuning of circuits. The general worst-case optimal tolerance-tuning problem is briefly reviewed. Practical implementation requires a reasonable and relevant number of parameters and constraints to be identified to make the problem tractable. Two circuits, a simple LC lowpass filter and a realistic highpass filter, are studied under a variety of different problem situations to illustrate both the benefits to be derived from our approach and the difficulties encountered in its implementation.

Description:       Presented at the IEEE International Symposium on  
                          Circuits and Systems (Newton, Mass., April 1975).

Related Work:     As for SOC-1.

Price:             \$ 5.00.

SOC-66

APPLICATION OF HYBRID COMPUTATION TO THE STUDY OF ON-LINE IDENTIFICATION  
TECHNIQUES

N.K. Sinha, A. Sen and M.Y. Tang

November 1974, No. of Pages: 14

Revised:

Key Words: Hybrid computation, on-line identification

Abstract: A number of different methods for on-line system identification have been compared. Actual physical processes have been simulated on an analog computer and the input-output data, with external noise added to make the conditions more realistic, were fed to a digital computer through A/D converters.

Description: Proc. AICA Symposium on Hybrid Computation in Dynamic Systems Design (Rome, Nov. 1974), Paper B1-3.

Related Work:

Price: \$ 2.00.

SOC-67

A CRITICAL EVALUATION OF ON-LINE IDENTIFICATION METHODS

N. K. Sinha and A. Sen

November 1974, No. of Pages: 36

Revised:

Key Words: On-line system identification

Abstract: Seven different methods for on-line system identification are discussed and compared for the realistic case when the input-output data are contaminated with noise. The performance of each method is evaluated for different noise-to-signal ratios, for a simulated second-order system, as well as for data obtained from a two-stage heat-exchanger system under operating conditions. The comparison provides considerable insight into the application of these methods to the on-line identification of actual process.

Description: Shorter version in Proc. IEE, vol. 122, Oct. 1975, pp. 1153-1158.

Related Work: SOC-6, SOC-14, SOC-41, SOC-85, SOC-104, SOC-170.

Price: \$ 5.00.

SOC-68

NECESSARY CONDITIONS FOR MINIMAX OPTIMALITY

J.W. Bandler

November 1974, No. of Pages: 3

Revised:

Key Words:           Minimax optimization, optimality conditions, constraint qualification

Abstract: this letter shows that the necessary conditions for an optimum in nonlinear minimax approximation problems do not require a qualification analogous to the Kuhn-Tucker constraint qualification.

Description:

Related Work:       SOC-22, SOC-93, SOC-113.

Price:               \$ 2.00.

SOC-69

CANOP2 - INTERACTIVE CASCADED NETWORK OPTIMIZATION PACKAGE

J.W. Bandler and J.R. Popovic

December 1974, No. of Pages: 79

Revised:

Key Words: Electrical circuit design, cascaded circuits, optimization program, microwave circuit design, interactive design

Abstract: The program analyzes and optimizes, interactively or by batch processing, cascaded, linear, time-invariant networks in the frequency domain consisting of typical two-port elements, including resonant circuits, transmission-line elements and microwave C- and D-sections.

Description: Contains Fortran listing, user's manual.  
Source deck available for \$300.00.

Related Work: Represents further development of work reported in "Cascaded network optimization program", IEEE Trans. Microwave Theory and Techniques, vol. MTT-22, March 1974, pp. 300-308. SOC-42, SOC-93, SOC-102, SOC-113, SOC-131, SOC-155.

Price: \$60.00.

SOC-70

MINOPT - AN OPTIMIZATION PROGRAM BASED ON RECENT MINIMAX RESULTS

J.W. Bandler, C. Charalambous and J.H.K. Chen

December 1974, No. of Pages: 27

Revised:

Key Words: Minimax approximation, least pth approximation,  
approximation in modelling and design

Abstract: MINOPT is a package of subroutines for solving minimax problems. That is, it minimizes the function

$$Ma(x) \triangleq \max_{i \in I} a_i(x), \quad I \triangleq \{1, 2, \dots, m\}$$

where the  $a_i$ 's are differentiable functions of  $x \triangleq [x_1 \ x_2 \ \dots \ x_n]^T$ .

The minimax problem is formulated as a least pth objective due to Bandler and Charalambous. An algorithm recently proposed by Charalambous and the Fletcher minimization program are then adapted to solve the resulting least pth optimization problem.

Description: Contains Fortran listing, user's manual.  
Source deck available for \$50.00.

Related Work: SOC-3, SOC-12, SOC-13, SOC-29, SOC-80, SOC-84, SOC-88,  
SOC-93, SOC-108, SOC-113, SOC-131, SOC-151.

Price: \$15.00.

SOC-71

EXTRAPOLATION IN LEAST pTH APPROXIMATION AND NONLINEAR PROGRAMMING

W.Y. Chu

December 1974, No. of Pages: 69

Revised:

Key Words: Nonlinear programming, least pth approximation, extrapolation, minimax approximation, penalty function methods

Abstract: Theoretical considerations and computational merits of applying an extrapolation technique in solving minimax problems and nonlinear programming problems using a sequence of least pth approximations or sequential unconstrained minimization techniques is presented. Numerical results indicate that the new least pth approach using extrapolation is competitive with other established minimax algorithms. An efficient, user-oriented computer program, called FLNLP2, incorporating the extrapolation technique and other recent optimization techniques is also developed. The program is capable of solving constrained or unconstrained general optimization problems and is readily applicable to circuit design problems. The extrapolation technique has been illustrated in solving the Beale problem, the Rosen-Suzuki problem, an LC lowpass filter design problem and other test examples.

Description: M. Eng. Thesis.  
Contains Fortran listing, user's manual.  
Source deck available for \$50.00.

Related Work: SOC-2, SOC-12, SOC-15, SOC-29, SOC-42, SOC-78, SOC-80, SOC-84, SOC-93, SOC-108, SOC-113, SOC-151.

Price: \$30.00.



SOC-72

IN-MEMORY CODE CONVERTERS USING MAGNETIC BUBBLES

W. Kinsner and E. Della Torre

January 1975, No. of Pages: 6

Key Words: Magnetic bubbles, code conversions, in-memory logic

Abstract: An implementation of logic, based upon bubble-bubble interaction and topological distribution of bubbles, is proposed. A particular realization of in-memory code conversions between any pair of codes such as creeping, binary, BCD, Gray, etc. is given. The converters can utilize either field-access or conductor-access circuitry.

Description: Presented at the 8th Asilomar Conference on Circuits, Systems, and Computers (Pacific Grove, Calif., Dec., 1974). Published in the Asilomar Conf. Proc., pp 733-738.

Related Work:

Price: \$ 2.00.

SOC-73

BLOCK OUTPUT SUBROUTINES

W. Kinsner

February 1975, No. of Pages: 8

Revised:

Key Words: Array output, variable format

Abstract: The subroutines can print out any one-, two- or three-dimensional array in a block arrangement. The process of subdividing an array into blocks is automatic and satisfies the required format. The subroutines are written in Fortran IV.

Description: Contains Fortran listing, user's manual.  
Source deck available for \$15.00.

Related Work: SOC-43, SOC-93, SOC-96.

Price: \$15.00.

SOC-74

THE IMPACT OF BUBBLE MEMORIES ON COMPUTER SYSTEMS

V.T. Peltz and E. Della Torre

February 1975, No. of Pages: 9

Revised:

Key Words: Computer system performance, bubble memories

Abstract: An investigation of the effect of some properties of bubble memories on the performance, structure and configuration of computer systems is reported here. The faster access time and start-stop features of bubble memories if properly exploited will improve performance and provide new functional capabilities to direct access type of computer peripherals.

Description: Presented at the Asilomar Conference on Circuits, Systems and Computers (Pacific Grove, Calif., Dec. 1974).

Related Work: SOC-16, SOC-46, SOC-52, SOC-53, SOC-54, SOC-55, SOC-56, SOC-58, SOC-60, SOC-64.

Price: \$ 2.00.

SOC-75

ADAPTIVE NUCLEAR REACTOR CONTROL FOR MINFUEL-WEIGHTED ABSOLUTE ERROR AND  
MINIMAX CRITERIA

N.K. Sinha and G.T. Bereznai

February 1975, No. of Pages: 12

Revised:

Key Words: Adaptive control, nuclear reactors, minimax criteria

Abstract: Adaptive control of a nuclear power plant is considered for the case when it is required that the response to a change in the demanded power should be a close approximation to a ramp between the initial and final power levels. This is implemented by on-line identification of the parameters of an optimum second-order model for the system, followed by the computation of the feedback coefficients for optimum system response using either the integral absolute error or the minimax error criterion.

Description: Proc. 6th IFAC World Congress (Boston, Mass., Aug. 1975), paper no. 50.6.

Related Work: SOC-94, SOC-122.

Price: \$ 5.00.

SOC-76

AN ALGORITHM AND A PROGRAM FOR NETWORK ROUTING PROBLEMS

W. Kinsner

February 1975, No. of Pages: 40

Revised:

Key Words: Algebraic structures, shortest path problems

Abstract: This algorithm gives all the solutions for any minimal-cost network routing problem. The solutions are given in both the implicit and explicit forms. The algorithm is based on the Carré algebra. The program is written in standard Fortran.

Description: Contains Fortran listing, user's manual.  
Source deck available for \$50.00.

Related Work: SOC-93, SOC-147.

Price: \$15.00.

SOC-77

MAGNETOSTRICTIVE-PIEZOELECTRIC DETECTOR FOR BUBBLE DOMAINS

W.S. Ishak

February 1975, No. of Pages: 85

Revised:

Key Words: Magnetic bubble memories, computer memories, magnetic field measurements

Abstract: A magnetic bubble detector using the principles of magnetostriction and piezoelectricity has been constructed and tested. The features of the detector are discussed and a comparison to the methods presently used for detecting bubbles is developed.

The procedure which was followed during the fabrication process is described in detail. Different ideas for optimization of the device are discussed.

A separate chapter is devoted for the tests done on the thin films of the multi-layer detector. The results of the testing procedure of the detector are discussed.

Description: M.Eng. Thesis. Fuller version of paper presented at AIP Conference on Magnetism and Magnetic Materials (San Francisco, Dec. 1975). To appear in AIP Conf. Proceedings, April 1975.

Related Work: SOC-53, SOC-64.

Price: \$15.00.

SOC-78

NONLINEAR PROGRAMMING USING LEAST PTH OPTIMIZATION WITH EXTRAPOLATION

J.W. Bandler and W.Y. Chu

March 1975,            No. of Pages: 10

Revised:

Key Words:            Nonlinear programming, least pth approximation, extrapolation, minimax approximation, penalty function methods

Abstract:    We present a general approach for solving minimax and nonlinear programming problems through a sequence of least pth approximations with extrapolation. Several numerical examples illustrate the effectiveness of the present approach. A comparison with the well-known SUMT method of Fiacco and McCormick is made under the same conditions and employing Fletcher's quasi-Newton program.

Description:    Reprint.  
Published in Int. J. Systems Science, vol. 7, 1976, pp. 1239-1248.

Related Work:    SOC-2, SOC-15, SOC-71, SOC-80, SOC-84, SOC-93, SOC-108, SOC-113, SOC-151.

Price:            \$ 2.00.

SOC-79

ON-LINE ESTIMATION OF THE PARAMETERS OF A MULTIVARIABLE SYSTEM USING  
MATRIX PSEUDOINVERSE

A. Sen and N.K. Sinha

March 1975,           No. of Pages: 17

Revised:

Key Words:           On-line identification, multivariable systems, matrix  
pseudoinverse

Abstract:    A recursive pseudoinverse algorithm is presented for  
estimating the parameters of the transfer function matrix of a  
multiple-input multiple-output discrete-time system from the samples of  
the input-output data. The algorithm is suitable for on-line  
identification of linear multivariable systems.

Description:   A shorter version of this paper was presented at the  
1975 Milwaukee Symp. on Automatic Computation and  
Control (Milwaukee, Wis., April 1975). Published in  
Int. J. Systems Science, vol. 7, Apr. 1976, pp.  
461-471.

Related Work:   SOC-6, SOC-130, SOC-162, SOC-163.

Price:           \$ 5.00.



SOC-80

NEW RESULTS IN THE LEAST PTH APPROACH TO MINIMAX DESIGN

J.W. Bandler, C. Charalambous, J.H.K. Chen and W.Y. Chu

March 1975, No. of Pages: 16

Revised:

Key Words: Minimax design, least pth approximation, extrapolation, electrical circuit design

Abstract: We present two general approaches for obtaining minimax designs through a sequence of least pth approximations yielding significant improvement in computational efficiency over previous least pth algorithms as well as highly accurate solutions. One utilizes a method for estimating a lower bound on the minimum (which has important design implications in itself) and the other extrapolation of least pth solutions to  $p = \infty$ . Documented computer programs are available for both methods. A practical feature is the successive and automatic reduction in sample points used in the optimization process allowing minimax solutions to be reached with only moderately more effort than required by a single least pth approximation. The application of these new techniques is illustrated by microwave transformer and filter examples.

Description: Shorter version published in IEEE Trans. Microwave Theory and Techniques, vol. MTT-24, Feb. 1976, pp. 116-119.

Related Work: SOC-2, SOC-3, SOC-13, SOC-29, SOC-70, SOC-71, SOC-78, SOC-84, SOC-93, SOC-108, SOC-113, SOC-151.

Price: \$ 5.00.

SOC-81

ACOUSTIC BUBBLE DETECTOR

W. Kinsner and E. Della Torre

March 1975,           No. of Pages: 8

Revised:             June 1975

Key Words:           Magnetic bubbles, bubble sensing, major-minor loop  
                          memories

Abstract: This paper presents an NDRO, active, acoustic bubble detector with output signals estimated to be of the order of tens of millivolts. The detector is based on a magneto-elastic phenomenon and does not require an electric current to operate.

Description:         Presented at the INTERMAG Conference (London, England, April 1975), paper No. 25-12.

Related Work:        SOC-53, SOC-55, SOC-64.

Price:               \$ 2.00.

SOC-82

OPTIMAL CHOICE OF THE SAMPLING INTERVAL FOR DISCRETE PROCESS CONTROL

J.F. MacGregor

March 1975,           No. of Pages: 41

Revised:

Key Words:           Sampling interval, process control, stochastic control,  
ARMA time series models

Abstract: This paper is concerned with the choice of the sampling interval for use in discrete regulatory control of processes subject to stochastic disturbances where the purpose is to maintain the process output as close as possible to some fixed target value. The analysis is restricted to single input-single output systems sampled at discrete equi-spaced intervals of time.

Assuming that a discrete linear dynamic-stochastic model of the system has been identified from data collected at one sampling interval the question which often arises and to which this paper is addressed is: "How much worse off would we be (in the sense of our ability to control the process output) if we were to sample less frequently?" By showing how the form and parameters of the dynamic-stochastic models for the system will change as the sampling interval is increased to integer multiples of the basic interval, one is able to predict the performance of the optimal stochastic controller at these larger intervals and thereby make a reasonable choice of the best interval.

The method is applied to several real and hypothetical processes involving both stationary and nonstationary disturbances and various amounts of process dead time.

Description:           Presented at the IMS-ASA Meeting (Rochester, N.Y., May 1975).

Related Work:         This report supercedes SOC-30.

Price:                 \$ 5.00.

SOC-83

CHANNEL-BAR BUBBLE PROPAGATING CIRCUIT

E. Della Torre and W. Kinsner

April 1975, No. of Pages: 7

Revised:

Key Words: Magnetic bubbles, bubble propagation, major-minor loop  
bubble memories

Abstract: A channel with periodic traps coupled with asymmetrically placed bars of soft magnetic material can be used to propagate bubbles uni-directionally with an alternating transverse field. Straight line propagators, transfers and corners can be very compact with virtually identical operating margins. A major-minor loop memory structure with independent propagation in two types of loops, using two mutually perpendicular transverse fields, can be designed.

Description: Presented at the INTERMAG Conference (London, England, April 1975), paper No. 21-9.

Related Work: SOC-52, SOC-56, SOC-64.

Price: \$ 2.00.

SOC-84

FLOPT2 - A PROGRAM FOR LEAST PTH OPTIMIZATION WITH EXTRAPOLATION TO  
MINLMAX SOLUTIONS

J.W. Bandler and W.Y. Chu

April 1975,           No. of Pages: 51

Revised:

Key Words:           Unconstrained optimization, gradient minimization  
                      methods, penalty function methods, least pth optimi-  
                      zation, extrapolation

Abstract: FLOPT2 is a package of subroutines primarily for solving least pth optimization problems. Its main features include Fletcher's quasi-Newton subroutine, a least pth objective formulation subroutine, an extrapolation procedure and a scheme for dropping inactive functions. With appropriate utilization of these features, the program can solve a wide variety of optimization problems. These may range from unconstrained problems, problems subject to inequality or equality constraints to nonlinear minimax approximation problems. In solving constrained problems, the user may, for example, use the Fiacco-McCormick method with extrapolation or the Bandler-Charalambous minimax formulation and least pth approximation, also with extrapolation. The program has been used on a CDC 6400 computer. Several examples of varying complexity are used to illustrate the versatility of the program. A FORTRAN IV listing is included.

Description:         Contains Fortran listing, user's manual.  
                      Source deck available for \$50.00.

Related Work:        SOC-2, SOC-3, SOC-17, SOC-42, SOC-70, SOC-71, SOC-78,  
                      SOC-80, SOC-93, SOC-108, SOC-113, SOC-151.

Price:               \$30.00.

SOC-85

MODELLING AND ON-LINE IDENTIFICATION OF A CONTINUOUS STIRRED TANK REACTOR

N.K. Sinha and A. Sen

May 1975, No. of Pages: 11

Revised:

Key Words: On-line identification, continuous stirred-tank reactor

Abstract: The modelling and on-line identification of a continuous stirred tank process is considered from the input and output data. Several methods for on-line identification are considered, and the models thus obtained are compared with that using the highly regarded off-line method of time-series analysis developed by Box and Jenkins.

Description: Proc. 6th Pittsburgh Conference on Modeling and Simulation (Pittsburg, April 1975), pp. 145-150.

Related Work: SOC-34, SOC-63, SOC-67.

Price: \$ 2.00.

SOC-86

STATE ESTIMATION FOR SYSTEMS WITH UNKNOWN NOISE COVARIANCES

N.K. Sinha and A. Tom

May 1975,            No. of Pages: 11

Revised:

Key Words:            State estimation, adaptive estimation

Abstract: An adaptive scheme is proposed for obtaining the steady-state Kalman gain matrix for a discrete-time system without a priori knowledge of the noise covariance matrices. It is based on combining an algorithm proposed recently by Carew and Belanger with an algorithm based on stochastic approximation. Results of simulation are given comparing the proposed method with earlier algorithms.

Description:           Proc. 6th Pittsburgh Conference on Modeling and Simulation (Pittsburgh, April 1975), pp. 197-202. Published in Int. J. Systems Science, vol. 8, 1977, pp. 377-384.

Related Work:        SOC-5, SOC-95, SOC-121, SOC-139.

Price:                \$ 2.00.

SOC-87

A THEORY OF OPTIMAL WORST-CASE DESIGN EMBODYING CENTERING, TOLERANCING AND TUNING, WITH CIRCUIT APPLICATIONS

P.C. Liu

May 1975, No. of Pages: 186

Revised:

Key Words: Engineering design, nonlinear programming, optimization theorems, worst-case design, tolerancing and tuning

Abstract: This thesis presents a unified treatment of circuit and system design methods embodying centering, tolerancing and tuning. The approach incorporates the nominal parameter values, the corresponding tolerances and tuning variables simultaneously into an optimization procedure designed to obtain the best values for all of them in an effort to reduce cost, or make an otherwise impractically toleranced design more attractive. Intuitively, the aim is to produce the best nominal point to permit the largest tolerances and the smallest tuning ranges (preferably zero) such that one can guarantee, in advance, that in the worst case, the design will meet all the constraints and specifications.

Reduced problems are formulated for digital computer implementation. Interpretations are given. Implications of biquadratic functions in the circuit tolerance problems are investigated. Practical implementation in circuit design problems in the frequency domain is treated. The thesis also includes illustrative examples and two realistic problems.

Description: Ph.D. Thesis.

Related Work: As for SOC-1.

Price: \$30.00.



SOC-88

SQUARE - AN IMPLEMENTATION OF THE MASSARA-FIDLER ALGORITHM FOR LEAST-SQUARES PROBLEMS

W.S. Ishak

May 1975,            No. of Pages: 38

Revised:

Key Words:            Damped least-squares minimization, data fitting, system modelling

Abstract: SQUARE is a computer program primarily for solving least-squares problems. Its main features include Marquardt-Levenberg damped least-squares and Massara-Fidler algorithm for controlling the damping factor  $\lambda$ . The program can solve different optimization problems such as: minimization of functions in the form of sum of squares, data fitting problems and system modelling problems in the least-squares sense. The program has been used on a CDC-6400 computer and several examples are shown. A FORTRAN IV listing is included.

Description:            Contains Fortran listing, user's manual.  
Source deck available for \$30.00.

Related Work:        SOC-13, SOC-70.

Price:                \$15.00.

SOC-89

MINIMAL REALIZATION OF TRANSFER FUNCTION MATRICES: A COMPARATIVE STUDY  
OF DIFFERENT METHODS

N.K. Sinha

May 1975, No. of Pages: 16

Revised:

Key Words: Minimal realization, irreducible realizations, multi-  
variable systems

Abstract: A comparative study is made of three basically different methods for obtaining minimal-order realizations of linear multivariable systems in the form of state equations for specified rational transfer function matrices. Computational efficiency and suitability for practical implementation are the main criteria used for the comparison. The possibilities of direct realization in canonical forms suitable for special applications are also examined.

Description: Proc. 1975 Canadian Conference on Automatic Control (Vancouver, B.C., June 1975). Published in Int. J. Control, vol. 22, Nov. 1975, pp. 627-639.

Related Work: SOC-32, SOC-57, SOC-61.

Price: \$ 5.00.

SOC-90

SPEED CONTROL OF A D.C. SERVO MOTOR USING PHASE-LOCKED LOOP: SOME TEST RESULTS OF A PRACTICAL DESIGN

N.K. Sinha and N. Bailey

May 1975, No. of Pages: 15

Revised:

Key Words: Speed control, servomotor, phase-locked loop

Abstract: A practical implementation is described of the use of phase-locked loop for the control of a d.c. servomotor. Test results show that it is possible to get good performance while using cheap commercially available components, including integrated-circuit chips. Complete details of the design are given.

Description: Published in IEEE Trans. Industrial Electronics and Control Instrumentation, vol. IECI-23, Feb. 1976, pp. 22-26.

Related Work:

Price: \$ 5.00.

SOC-91

MODELING OF THE MYOELECTRIC SOURCE

M.S. Abdel-Azim

May 1975,            No. of Pages: 71

Revised:

Key Words:            Biomedical electronics, modelling e.m.g. sources

Abstract: The myoelectric signal source is modeled as a stochastic non-linear system whose input is determined by the required type of muscle activity. The model has enough details to give a realistic picture of the effect of different variables on the performance of a real system. The model output is compared with the real electromyogram on a statistical basis and then the values of the model parameters are obtained.

Description:           M.Eng. Thesis.

Related Work:

Price:                \$15.00.

SOC-92

TIME DOMAIN APPROXIMATION AND SYSTEM MODELING USING A DAMPED LEAST-SQUARES ALGORITHM

W.S. Ishak and N.K. Sinha

June 1975,            No. of Pages: 11

Revised:

Key Words:            Time domain approximation, system modeling, damped  
least-squares algorithm

Abstract:    The method of damped least-squares is proposed for the solution of time-domain approximation problems, system-modeling problems and data-fitting problems. The method is based on the Levenberg-Marquardt damping technique together with the recent Massara-Fidler algorithm. The method is very efficient and it can be applied to a variety of problems. A number of examples illustrate the method.

Description:    Published in Int. J. Systems Science, vol. 7, June 1976, pp. 635-649.

Related Work:    SOC-25, SOC-88.

Price:            \$ 2.00.

SOC-93

NOTES ON NUMERICAL METHODS IN ENGINEERING ANALYSIS AND DESIGN OF FIELDS,  
CIRCUITS AND SYSTEMS

W. Kinsner, Editor

June 1975,           No. of Pages: 550

Revised:

Key Words:           Optimization, field problems, digital systems,  
                  transportation problems, programming, numerical methods

Abstract: The notes cover the material presented at a five-day course and computer workshop entitled "Numerical Methods in Engineering Analysis and Design of Fields, Circuits and Systems", held at McMaster University, June 2-6, 1975. The notes present theoretical and practical aspects of modern numerical methods and techniques in engineering problems. They cover four general topics: optimization, solutions of field problems, design of digital systems, and network routing methods. The first section deals with unconstrained minimization, least pth minimax approximation, non-linear and discrete programming, optimal design centering, tolerancing and tuning, and efficient interactive design. The second section contains material on analytical principles in field problems, finite difference methods, finite element methods, and acceleration of slowly convergent iterative methods. The third section covers logic matrices and logic equations, unconstrained digital system design and efficient network routing techniques based on a new algebra. The notes also include documented listings of computer program packages relevant to the topics presented.

Description:         The notes were distributed to the participants of the short course. Contains Fortran listings, user's manuals. Source decks available for \$360.00.

Related Work:       SOC Reports: 1-4, 11-13, 15, 17-20, 24, 36-37, 42, 49, 62, 65, 68-71, 78, 80, 84, 87; 10, 16, 43, 46-47, 59-60, 73, 76, 96, 128, 151.

Price:               \$150.00.

SOC-94

ADAPTIVE CONTROL SYSTEMS (A Survey of Design Techniques and Applications)

P.N. Nikiforuk, M.M. Gupta and N.K. Sinha

June 1975, No. of Pages: 23

Revised:

Key Words: Adaptive control, survey

Abstract: A survey of the design techniques and applications of adaptive control has been presented. Two approaches to adaptive control have been considered, with greater emphasis on the model reference adaptive systems including the new ideas introduced in this area during the past decade. An example of the design of a two-level adaptive controller for a continuous stirred tank reactor has been discussed in detail, and it is typical of a model reference adaptive systems. A number of other examples have been briefly considered, and reference given for further details.

Description: Presented at the 1975 Canadian Conference on Automatic Control (Vancouver, B.C., June 1975). See also N.K. Sinha, M.M. Gupta and P.N. Nikiforuk, "Recent advances in adaptive control," J. Cybernetics, vol. 6, 1976, pp. 79-100.

Related Work: SOC-39, SOC-75, SOC-122.

Price: \$ 5.00.

SOC-95

IDENTIFICATION OF OPTIMAL FILTER GAIN WITH UNKNOWN WHITE AND COLOURED NOISE

N.K. Sinha and A. Tom

June 1975, No. of Pages: 10

Revised:

Key Words: Adaptive Kalman filtering

Abstract: An adaptive scheme is proposed for obtaining the steady-state Kalman gain matrix for a discrete-time system without a priori knowledge of the noise covariance matrices, with the assumption that the measurement noise is coloured. It is based on combining stochastic approximation with an algorithm proposed by Carew and Bélanger, and using some properties of the derived innovations sequence. In addition, a recent development in time series models is used for determining the matrix for modeling the measurement noise.

Description: Proc. Eighteenth Midwest Symposium on Circuits and Systems (Montreal, Canada, Aug. 1975), pp. 153-157.

Related Work: SOC-5, SOC-86, SOC-121, SOC-139.

Price: \$ 2.00.



SOC-96

A PROGRAM PACKAGE RELAX1 FOR X-Y FIELD PROBLEMS

W. Kinsner

June 1975,           No. of Pages: 47

Revised:

Key Words:           Laplace's equation, finite difference methods,  
Gauss-Seidel method, SOR method, raster scan, contour  
scan, over-relaxation factor optimization

Abstract:   The program package RELAX1 can solve Laplace's equation in  
the x-y plane using finite difference methods. Problems may be  
formulated within boundaries of any shape and Dirichlet and/or Neumann  
boundary conditions. The package contains the Gauss-Seidel method and  
the successive over-relaxation (SOR) method. Each method can use either  
the raster (natural) scan or the optimized contour scanning technique.  
The program is written in Fortran.

Description:        Contains Fortran listing, user's manual.  
Source deck available for \$200.00.

Related Work:      SOC-43, SOC-47, SOC-73, SOC-93, SOC-128, SOC-137,  
SOC-150.

Price:             \$30.00.

SOC-97

MINIMAX - AN IMPLEMENTATION OF THE CHARALAMBOUS-CONN MINIMAX ALGORITHM

M. Kamel

June 1975,           No. of Pages: 26

Revised:

Key Words:           Nonlinear minimax approximation

Abstract: A user oriented computer program written in FORTRAN IV to solve the nonlinear minimax problem directly using the algorithm presented by Charalambous and Conn has been developed. It is available for batch processing on the CDC 6400 computer of McMaster University.

Description:         Contains Fortran listing, user's manual.

Related Work:        SOC-22.

Price:               \$15.00.

SOC-98

Superseded by SOC-104.

SOC-99

PARAMETER ESTIMATION WITH CLOSED LOOP OPERATING DATA

G.E.P. Box and J.F. MacGregor

July 1975,            No. of Pages: 27

Revised:

Key Words:            Parameter estimation, closed-loop systems, minimum variance control

Abstract:    Data often must be collected under regulatory feedback control. After the form of the stochastic-dynamic model has been tentatively identified, estimates of system parameters are required from the data. It is important to separate the following distinct problems: (A) estimation of the dynamic and stochastic parameters of the system (B) estimation of only those functions of these parameters which occur in the control equation.

This paper considers and illustrates for each problem the effects of (i) optimality and suboptimality of control, (ii) addition of a known dither signal, (iii) dead time in the system. Necessary and sufficient conditions for estimability using data collected under conditions of optimal control are given.

Description:    Presented at 6th Triennial World Congress of International Federation of Automatic Control (IFAC) (Boston, Aug. 1975).

Related Work:    Also issued as Dept. of Statistics T.R. #401, University of Wisconsin, Madison, Wis.

Price:            \$ 5.00.

SOC-100

DIGITAL DESIGN USING EXISTING FUNCTIONAL ELEMENTS

W. Kinsner

July 1975,           No. of Pages: 33

Revised:

Key Words:           Digital design, logic equations

Abstract:   An algebraic method of digital design has been described. The method offers to a designer a complete set of solutions from which the optimal ones can be readily selected. Such solutions permit the use of given functional elements in the realization of any function. The method may eliminate guesswork from digital design utilizing existing elements. The method is based on the idea of designation numbers and their use in the solution of simultaneous logic equations.

Description:

Related Work:

Price:               \$ 5.00.

SOC-101

A PROGRAM TO DETERMINE THE LINEAR DEPENDENCY BETWEEN THE ROWS OF A  
RECTANGULAR MATRIX

M. Kamel

July 1975,           No. of Pages: 11

Revised:

Key Words:           Linear dependency, linear equations

Abstract: A program has been developed to find the linearly independent rows in a rectangular matrix and to express the linearly dependent rows as a linear combination of the independent rows. The source language of the program is FORTAN IV.

Description:           Contains Fortran listing, user's manual.  
                          Source deck available for \$5.00.

Related Work:

Price:                \$ 5.00.

SOC-102

EFFICIENT SIMULATION OF CIRCUITS FOR AMPLITUDE AND DELAY OPTIMIZATION IN  
THE FREQUENCY DOMAIN

M.R.M. Rizk

July 1975,            No. of Pages: 98

Revised:

Key Words:            Electrical circuit analysis, computer-aided design,  
sensitivity evaluation, sparse matrix methods, group  
delay

Abstract: This thesis considers efficient techniques used in computer-aided linear circuit analysis and design in the frequency domain. Nodal analysis using LU factorization and sparse matrix techniques is reviewed. An approach to the exact calculation of group delay and its sensitivities with respect to component parameters based on the adjoint network concept and applicable to arbitrary, linear, lumped and distributed, time-invariant circuits is presented. This approach has proved to be practical computationally as well as exact. The thesis also presents illustrative examples in circuit analysis and optimization as well as tables of useful sensitivity expressions. Consideration is given to the efficient simultaneous optimization of two or more circuit responses.

Description:           M.Eng. Thesis.

Related Work:        SOC-69.

Price:                \$10.00.

SOC-103

SENSITIVITY ANALYSIS IN GEOMETRIC PROGRAMMING

R.S. Dembo

July 1975,            No. of Pages: 84

Revised:

Key Words:            Geometric programming, optimality conditions,  
                         sensitivity analysis, reactor design

Abstract: a unified theory is developed for computing the first derivatives of any of the primal or dual variables of a geometric programming problem, with respect to any of the problem's parameters (term coefficients, exponents and constraint right hand sides) at an optimal solution to the problem. Also discussed is an efficient approach for solving the sensitivity equations that are obtained. The theory is illustrated in detail on an optimal reactor design problem. By means of this example it is shown how the sensitivity equations may be used to predict a new optimal solution from the current optimal solution for either small or large simultaneous parameter changes.

Description:

Related Work:

Price:                \$10.00.



SOC-104

OPTIMUM INPUT SIGNALS FOR PARAMETER IDENTIFICATION

B. Kuszta and N.K. Sinha

August 1975, No. of Pages: 13

Revised:

Key Words: System identification, input signal design

Abstract: A frequency-domain approach is presented to the design of optimum input signals for identifying the parameters of a linear system. This method is intuitively appealing, and can be applied to synthesize a binary input which is sufficiently close to the optimum. An example from an earlier paper is solved directly using this approach.

Description: A shorter version was presented at the Eighteenth Midwest Symposium on Circuits and Systems (Montreal, Canada, Aug. 1975). Published in Int. J. Systems Science, vol. 7, Aug. 1976, pp. 935-941.

Related Work: SOC-67, SOC-98, SOC-106, SOC-143.

Price: \$ 2.00.

SOC-105

TOLOPT - A PROGRAM FOR OPTIMAL, CONTINUOUS OR DISCRETE, DESIGN CENTERING  
AND TOLERANCING PART I - USER'S GUIDE, PART II - FORTRAN LISTING

J.W. Bandler, J.H.K. Chen, P. Dalsgaard and P.C. Liu

September 1975, No. of Pages: Part I 47  
Part II 27

Revised:

Key Words: Tolerancing, centering, continuous and discrete  
optimization, worst-case design

Abstract: This report describes the development, organization and implementation of a user-oriented computer program package called TOLOPT (TOLerance OPTimization), which can solve continuous and/or discrete worst-case tolerance assignment problems. Worst-case vertices can be automatically selected and optimization will lead to the most favorable nominal design simultaneously with the largest possible tolerances on specified toleranced components. The program contains recent techniques and algorithms for nonlinear programming. The optimization is carried out by subprograms substantially the same as ones in the DISOPT package. The full Fortran IV listing is included in this report as well as three circuit examples illustrating the use of and typical printouts from TOLOPT.

Description: Part I contains user's manual.  
Part II contains Fortran listing.  
Source deck available for \$300.00.

Related Work: Represents further development of work reported in IEEE  
Trans. Microwave Theory and Techniques, vol. MTT-23,  
Aug. 1975, pp. 630-641. As for SOC-1.

Price: Part I \$15.00.  
Part II \$85.00.

SOC-106

OPTIMAL STAIRCASE INPUT SIGNAL FOR SYSTEM IDENTIFICATION

B. Kuszta and N.K. Sinha

September 1975, No. of Pages: 10

Revised:

Key Words: Optimal input, system identification, staircase signals

Abstract: The design of an optimal staircase input signal for the identification of linear systems is considered for practical situations, where both the maximum amplitude as well as the duration must be constrained to finite values. A simple criterion for computing the minimum observation time is also proposed.

Description: To be published in Int. J. Systems Science.

Related Work: SOC-98, SOC-104, SOC-143.

Price: \$ 2.00.

SOC-107

APPLICATIONS OF PROJECTIVE REDUCTION METHODS TO ESTIMATION AND CONTROL

J. Hickin and N.K. Sinha

September 1975, No. of Pages: 20

Revised:

Key Words: Reduction methods, state aggregation

Abstract: In the past decade, the problem of system reduction has received much attention. Until recently, most reduction techniques have found only limited application. In this paper it is shown that the method of reduction by orthogonal projection may be adapted to fulfill the goal of broad application under the unifying framework of state aggregation. Applications include eigenvalue placement sub-optimal control, and reduced order filtering.

Description:

Related Work: SOC-140, SOC-164.

Price: \$ 5.00.

SOC-108

FLOPT3 - AN INTERACTIVE PROGRAM FOR LEAST PTH OPTIMIZATION WITH EXTRA-  
POLATION TO MINIMAX SOLUTIONS

J.W. Bandler and W.Y. Chu

October 1975, No. of Pages: 52

Revised:

Key Words: As for SOC-84

Abstract: FLOPT3 is a package of subroutines primarily for solving least pth optimization problems. Its main features include interactive input/output information exchange, Fletcher's quasi-Newton subroutine, a least pth objective formulation subroutine, an extrapolation procedure and a scheme for dropping inactive functions. With appropriate utilization of these features, the program can solve a wide variety of optimization problems. These may range from unconstrained problems, problems subject to inequality or equality constraints to nonlinear minimax approximation problems. In solving constrained problems, the user may, for example, use the Fiacco-McCormick method with extrapolation or the Bandler-Charalambous minimax formulation and least pth approximation, also with extrapolation. The program has been used on a PDP 11/45 computer. Three examples of varying complexity are used to illustrate the versatility of the program. A FORTRAN IV listing is included.

Description: Contains Fortran listing, user's manual.

Related Work: As for SOC-84.

Price: \$60.00.

SOC-109

BUBMAT - AN INTERACTIVE PROGRAM FOR CALCULATION OF BUBBLE MATERIALS  
PARAMETERS

W.S. Ishak

October 1975, No. of Pages: 27

Revised:

Key Words: Bubble materials, bubble memories, uniaxial magnetic  
materials

Abstract: BUBMAT is a package of subroutines for evaluation of various  
parameters of bubble materials.

The calculations inside the package BUBMAT are based on the theory  
of cylindrical magnetic domains derived by Thiele [1]. Corrections have  
been introduced based on the four-parameters variational model of the  
twisted domain wall structure for stripe domains reported by DeBonte  
[2].

The package can calculate different parameters, which are useful  
for the evaluation of bubble materials, such as: Bulk Wall energy  
density, material characteristic length, twist angle of domain walls,  
average domain wall energy density, wall thickness, bubble collapse  
field and diameter, bubble run-out field and diameter as well as  
different stable points for different bubble diameters.

Description: Contains Fortran listing, user's manual.

Related Work: SOC-77.

Price: \$15.00.

SOC-110

EFFICIENT, AUTOMATED DESIGN CENTERING AND TOLERANCING

J.W. Bandler, P.C. Liu and H. Tromp

October 1975, No. of Pages: 37

Revised:

Key Words: Worst case design, centering, tolerancing

Abstract: We present an efficient approach to the optimal assignment of component tolerances along with centering and, eventually, tuning. The main objective is to automate the process without sacrificing computational efficiency. The development of selection schemes for critical vertices of the tolerance region is discussed in detail. As the process proceeds vertices can be added or purged automatically. The exploitation of symmetry in design problems is considered at length. The presentation is illustrated by a five-section transmission-line lowpass filter, where both characteristic impedances and section lengths are toleranced and parasitic junction effects are simulated. Finally, capacitive tuning is also considered. The paper contains numerous tables comparing the effectiveness and efficiency of different schemes.

Description: Presented at IEEE International Symposium on Circuits and Systems (Munich, Apr. 1976).

Related Work: As for SOC-1.

Price: \$ 5.00.

SOC-111

INTEGRATED APPROACH TO MICROWAVE DESIGN

J.W. Bandler, P.C. Liu and H. Tromp

November 1975, No. of Pages: 29

Revised: March 1976

Key Words: Worst case design, centering, tolerancing, tuning, model uncertainties, mismatches, microwave circuits

Abstract: A new, integrated approach to microwave design is presented involving concepts such as optimal design centering, optimal design tolerancing, optimal design tuning, parasitic effects, uncertainties in circuit models, and mis-matched terminations. The approach is of the worst case type, and previously published design schemes fall out as particular cases of the ideas presented. The mathematical and computational complexity as well as the benefits realized by our approach is illustrated by transformer examples, including a realistic stripline circuit.

Description: Published in IEEE Trans. Microwave Theory and Techniques, vol MTT-24, Sept. 1976, pp. 584-591.

Related Work: As for SOC-1.

Price: \$ 5.00.



SOC-112

CONTROL CARDS AND DECK STRUCTURES UNDER SCOPE 3.4 OPERATING SYSTEM

W. Kinsner

November 1975, No. of Pages: 36

Revised:

Key Words: CDC-6400 operating system, card processing

Abstract: This short guide describes how to prepare a deck of cards to be run on the CDC-6400 computer at McMaster University. It also discusses user's capabilities to manipulate input/output storage devices. The use of program libraries is described.

Description: The guide was used as an aid in getting programs on the air during a five-day course and computer workshop on "Numerical Methods in Engineering Analysis and Design of Fields, Circuits, and Systems", McMaster University, June 1975, and in an undergraduate course "Electromagnetic Fields and Waves", 1976.

Related Work: SOC-93.

Price: \$15.00.

SOC-113

NOTES ON NUMERICAL METHODS OF OPTIMIZATION WITH APPLICATIONS IN OPTIMAL DESIGN

J.W. Bandler, Editor

November 1975, No. of Pages: 396

Revised:

Key Words: Optimization, approximation, computer-aided circuit design

Abstract: The notes cover material presented at a five-day course on "Numerical Methods of Optimization", held at the University of Manitoba, December 8-12, 1975. It is a collection of unpublished notes, reports, conference papers, reprints and computer program descriptions. It includes SOC-84 as one of 30 articles.

Description: These notes were distributed to the participants of the short course.  
Source deck for SOC-84 available for \$50.00.

Related Work: As for SOC-1, SOC-2, SOC-3, SOC-11, SOC-17, SOC-19, SOC-20, SOC-84, SOC-131, SOC-151, SOC-155, SOC-158.

Price: \$150.00.

SOC-114

STATE SPACE MODELLING FOR THE CONTROL OF A NON-ADIABATIC PACKED BED CATALYTIC REACTOR

A. Jutan, J.P. Tremblay, J.F. MacGregor and J.D. Wright

January 1976, No. of Pages: 43

Revised:

Key Words: Reactor, nonadiabatic, packed bed, state space control

Abstract: A state space model is developed for an existing non adiabatic packed bed reactor which experiences steep radial concentration and temperature gradients resulting from highly exothermic reactions involving several chemical species. The set of partial differential equations are reduced from three to two dimensions using orthogonal collocation. Further use of orthogonal collocation on the quasi steady state version of the differential equations results in a set of coupled algebraic and differential equations from which a linearised low order state space model is obtained. A discrete form of the state space equations is generated and an optimal discrete control problem is solved for this system. Simulations showing steady state and dynamic behaviour are presented. In addition, a control simulation based on the state space model is presented.

Description:

Related Work: A. Jutan, Ph.D. Thesis, McMaster University, 1976. SOC-152, SOC-153, SOC-154, SOC-157.

Price: \$ 5.00.

SOC-115

ALGORITHMS FOR COMPUTATION OF INVERSE HYPERBOLIC FUNCTIONS

W.S. Ishak

February 1976, No. of Pages: 15

Revised:

Key Words: Special functions, inverse hyperbolic functions

Abstract: This report deals with the computation of the inverse hyperbolic functions such as  $\sinh^{-1}(x)$ ,  $\cosh^{-1}(x)$  and  $\tanh^{-1}(x)$ . The computation of such functions are based on using Chebyshev series expansions to compute  $\sinh^{-1}(x)$  and then to compute  $\cosh^{-1}(x)$  and  $\tanh^{-1}(x)$  using the common relationships between these different functions. FORTRAN IV programs were written to compute  $\sinh^{-1}(x)$  and  $\cosh^{-1}(x)$  for the range:  $-\infty < x < \infty$  and the programs were tested on a PDP-11/45 computer using double precision arithmetic. The results were compared to existing tables of special functions. It is concluded that those programs can compute  $\sinh^{-1}(x)$  and  $\cosh^{-1}(x)$  to a very high accuracy.

Description: Contains Fortran listing, user's manual.

Related Work: SOC-116.

Price: \$ 5.00.

SOC-116

ALGORITHMS FOR COMPUTATION OF THE GENERALIZED AND COMPLETE ELLIPTICAL  
INTEGRALS OF THE FIRST, SECOND AND THIRD KINDS

W.S. Ishak and E. Della Torre

February 1976, No. of Pages: 23

Revised:

Key Words: Elliptic functions, elliptic integrals, bubble-wall  
calculations

Abstract: In this report a discussion of the theory of numerical computations of elliptic integrals and elliptic functions is given. A very important fact about these integrals is the modulus transformation discovered in 1775 by LANDEN. However, after the discovery of the Theta function and its fast converging series, the computation by modulus transformation was considered out of date. BARTKY published a paper generalizing the idea of the modulus transformation to a large class of integrals not necessarily elliptic. These transformations will be revised here and the resulting algorithms for the computation of the generalized and complete elliptic integrals of the first, second and third kinds will be given. FORTRAN IV programs were written to test these algorithms and very satisfactory results were obtained. The complete elliptic integrals of the first, second and third kinds were used in computing the axial & radial components of the stray field of a magnetic bubble domain.

Description: Contains Fortran listing, user's manual.

Related Work: SOC-115, SOC-141.

Price: \$ 5.00.

SOC-117

A PARAMETER ESTIMATION PROGRAM FOR MULTIRESPONSE DATA USING A BAYESIAN APPROACH

A. Jutan

February 1976, No. of Pages: 31

Revised:

Key Words: Estimation, multiresponse, Bayes

Abstract: Least squares parameter estimation in systems where a single response is measured is a well known procedure. Justification for this method relies on the assumption that the measurement errors are independent, normally distributed random variables with zero mean and constant variance.

The least squares criterion for single response systems can be derived using a Bayesian approach. Box and Draper(1) have used a Bayesian approach to obtain a criterion to be minimised, when estimating common parameters in multiresponse systems.

Description: Contains Fortran listing, user's manual.

Related Work: SOC-152, SOC-153, SOC-154, SOC-157.

Price: \$30.00.

SOC-118

OPTIMAL CENTERING AND TOLERANCING UTILIZING AVAILABLE ANALYSIS PROGRAMS

J.W. Bandler and H.L. Abdel-Malek

February 1976, No. of Pages: 9

Revised:

Key Words: Modeling, tolerancing, centering, yield estimation

Abstract: a major obstacle to efficient optimal design and tolerance assignment, particularly in the microwave area, is the scarcity of simulation programs incorporating both the efficient analysis of circuits and response sensitivities, for example, with respect to physical design parameters which are to be toleranced. It is the aim of this paper to bridge the gap between available analysis programs (for both circuits and fields) by suitable modeling of the functions to be optimized using low-order multidimensional approximations. As a result, rapid and accurate determination of design solutions, including yield estimation and optimization, should be facilitated, even with relatively inefficiently written analysis programs, or with experimentally obtained data. Subsequent tuning may also be more readily effected.

Description:

Related Work: As for SOC-1.

Price: \$ 2.00.

SOC-119

OPTIMAL DESIGN VIA MODELING AND APPROXIMATION

J.W. Bandler, H.L. Abdel-Malek, P.B. Johns and M.R.M. Rizk

February 1976, No. of Pages: 4

Revised:

Key Words: Modeling, transmission-line matrix method, tolerancing,  
centering

Abstract: Recent ideas and results developed by the authors involving concepts of modeling and approximation are reviewed. The approaches taken include abstract ones as well as a physically meaningful one in the area of time domain circuit analysis involving transmission-line modeling of lumped circuits. Optimal centering and tolerancing is also considered.

Description: Proc. IEEE Symp. on Circuits and Systems (Munich, Apr. 1976), pp. 767-770.

Related Work: As for SOC-1, SOC-133.

Price: \$ 2.00.



SOC-120

AN INTRODUCTION TO SIMULATION AND OPTIMIZATION

J.W. Bandler

February 1976, No. of Pages: 3

Revised:

Key Words: Engineering design, optimization

Abstract: A review of recent work in simulation and optimization is made with the aim of introducing the designer to the benefits of automating optimal design procedures and to indicate limitations imposed by the current state of the art.

Description: IEEE Int. Microwave Symp. Digest (Cherry Hill, N.J., June 1976), pp. 204-206.

Related Work: SOC-1, SOC-12, SOC-93, SOC-113, SOC-155.

Price: \$ 2.00.

SOC-121

COMPUTER PROGRAMS FOR CONTROL APPLICATIONS

J. Hickin, N.K. Sinha, S. Law and A. Tom

March 1976,           No. of Pages: 53

Revised:

Key Words:           Computer programs, control theory

Abstract:   Programs have been written in standard Fortran for applications of modern control theory. Applications include state estimations, regulator problem and minimal realization of linear, time-invariant, multivariable systems. The programs are available for batch processing on the CDC 6400 computer.

Description:       Contains Fortran listing, user's manual.  
                  Source deck available for \$25.00.

Related Work:     SOC-5, SOC-32, SOC-86, SOC-95, SOC-139, SOC-166.

Price:            \$25.00.

SOC-122

ADAPTIVE NUCLEAR REACTOR CONTROL WITHOUT EXPLICIT IDENTIFICATION

N.K. Sinha and S. Law

May 1976,            No. of Pages: 18

Revised:

Key Words:            Adaptive control, model reference

Abstract: Adaptive control of a nuclear power plant, the parameters of which may vary slowly with time, is considered without requiring explicit identification. It is based on the use of a reference model representing the desired behaviour of the system. Stability of the adaptive loop is guaranteed by Liapunov's second method. The scheme is applied to control the power level changes of the nuclear reactor and a two-level controller is designed using signal-synthesis adaptation. Extensive results of simulation using a realistic model of the reactor at the Douglas Point power station indicate that the performance of the scheme is satisfactory.

Description:

Related Work:        SOC-75, SOC-94.

Price:                \$ 5.00.

SOC-123

POWER SYSTEM STABILITY INCLUDING SHAFT AND NETWORK DYNAMICS

P.J. Nolan

March 1976,           No. of Pages: 179

Revised:

Key Words:           Power systems, dynamic stability, modeling, eigenvalue analysis, shaft dynamics, network dynamics, sub-synchronous resonance

Abstract: Dynamic stability of balanced multimachine power systems is considered. System models, which in addition to detailed electric machine, turbine governor and exciter models, incorporate dynamic representation of the mechanical shaft systems and of the electric network, are developed.

Eigenvalue methods are employed for the stability predictions. The relationships between modelling complexity and the aspects of stability reflected, are investigated.

A number of practical applications are considered in particular situations involving insufficient synchronizing and damping torques, turbine generator and control equipment interactions, torsional sub-synchronous resonance, turbine generator and asynchronous motor load interactions and shaft dynamic interactions in closely coupled generators.

Description:        Ph.D. Thesis.

Related Work:

Price:               \$15.00.

SOC-124

NONLINEAR OPTIMIZATION OF ENGINEERING DESIGN WITH EMPHASIS ON CENTERING,  
TOLERANCING AND TUNING

J.W. Bandler

June 1976,            No. of Pages: 9

Revised:

Key Words:            Engineering optimization, centering, tolerancing,  
                         tuning

Abstract: This paper addresses the engineering problem of optimal design from the standpoint of minimizing cost of production subject to acceptable performance in the worst case under as many unknowns and nonideal outcomes that can be reasonably accommodated in the design process in an integrated fashion. Optimal design centering, optimal assignment of component tolerances and optimal tuning (including tuning by both the manufacturer and by the customer) in the face of uncertainties in the model and external factors affecting the performance are considered. It is explained how even for a relatively small number of components a very large number of constraints and variables may have to be considered.

Following the introduction a general statement of the requirements of the worst-case approach to the problem is made. A number of observations on important points concerning the size of the problem and its effective solution are made. A brief review of theoretical and computational work carried out by the author and his colleagues is presented.

Description:           Presented at the International Symposium on Large  
                         Engineering Systems (Winnipeg, Manitoba, Aug. 1976).

Related Work:        As for SOC-1.

Price:                \$ 2.00.

SOC-125

LISTING AND CODE TRANSLATION UTILITY ROUTINES

W. Kinsner

June 1976,           No. of Pages: 45

Revised:

Key Words:           Code translation, listings, utility programs, operating  
                          system

Abstract: This report describes two source card listing routines and an IBM to CDC code translation program. Both listing subprograms produce computer card images and simulated card sequence numbers appropriately edited on separate pages. High quality listings are printed on a Versatec plotter by the first routine, and on a line printer by the other routine. The code translation routine converts programs punched in code 029 or 026 with the standard IBM character set to the 64-character set used on the CDC-6000 computers. The routines are written in an Extended Fortran IV.

Description:       Includes Fortran listing, user's manual.

Related Work:      SOC-145.

Price:             \$30.00.

SOC-126

SIGNAL PROCESSING OF SURFACE DETECTED ELECTROMYOGRAPHIC ACTIVITY

J. Whitman

July 1976, No. of Pages: 121

Revised: December 1976

Key Words: EMG signal analysis, on-line computer analysis

Abstract: A technique is presented for assessing the relative performance of various signal processors of the surface detected electromyographic signal (EMG) in the gross skeletal muscles of man. A minicomputer is used to sample, store, and to later process the EMGs for agonists of the upper arm for various net forces, as measured at the wrist, under a condition of isometric tension. A two dimensional analysis of the flexor and extensor EMGs is performed for each force level. The number of force levels from which distinct, high confidence, control signals may be derived is used as a figure of merit to determine the superior of the signal processors studied and the superior of various electrode sites considered. For prosthetic use it is often desirable to maximize the number of control signals per muscle site.

Description: M.Eng. Thesis.

Related Work: SOC-127.

Price: \$10.00.

SOC-127

HARDWARE AND SOFTWARE FOR SIGNAL PROCESSING OF SURFACE DETECTED ELECTRO-  
MYOGRAPHIC ACTIVITY

J. Whitman

July 1976,            No. of Pages: 144

Revised:

Key Words:            EMG signal analysis, on-line computer analysis

Abstract: A detailed description is presented of the amplifiers constructed to detect surface electromyographic (EMG) signals from the gross skeletal muscles of man as monitored by dry surface electrodes. The properties of an inexpensive force transducer which permitted the measurement of forces in the range of -8.0 to +11.0 kilograms and which provided a voltage suitable for use as feedback when maintaining a constant force are given. A NOVA 830 minicomputer is used equipped with an eight channel analog to digital converter, a four channel digital to analog converter, a storage oscilloscope terminal with graphics capabilities, and a 1.25 megaword capacity disk. A data acquisition and storage program is presented which allowed sampling of two EMG signals and of the force transducer voltage. An interactive analysis package is described which ultimately permitted the definition of a large number of different control levels from the EMG of an agonist muscle pair. Program documentations include verbal descriptions, sample input/output, listings, and flow diagrams.

Description:            Contains Fortran listing, user's manual.

Related Work:            SOC-126.

Price:                    \$25.00.



SOC-128

THE FINITE DIFFERENCE METHOD WITH GRADED LATTICES

E. Della Torre and W. Kinsner

July 1976,            No. of Pages: 25

Revised:

Key Words:            Finite difference methods, nonuniform lattices, graded operators, SOR

Abstract: This paper presents a new technique for formulating uniformly graded lattices. The corresponding finite difference operators are invariant and possess Young's Property A. A numerical example illustrates the reduction of the number of iterations, execution time, and the absolute error achieved when solving Laplace's equation by the SOR method on uniformly graded lattices as compared to uniform lattices.

Description:           Presented at the International Symposium on Large Engineering Systems (Winnipeg, Manitoba, Aug. 1976).

Related Work:        SOC-93, SOC-96.

Price:                \$ 5.00.

SOC-129

FIRST AND SECOND ORDER EIGENVALUE SENSITIVITIES OF LARGE MULTIPLE-LOOP SYSTEMS

H.M. Zein El-Din and R.T.H. Alden

August 1976, No. of Pages: 17

Revised:

Key Words: Eigenvalues, second order sensitivities, power systems

Abstract: Expressions are derived for first and second order terms of a Taylor series expansion for eigenvalue sensitivities with respect to system parameters. A systematic procedure is given for arranging the equations in state space form and computing the matrix derivatives and the eigenvalue sensitivities. A full description is given of a Fortran subroutine to evaluate the sensitivities. The use of the method is portrayed using an example of dynamic stability calculations for an electric power system.

Description: Includes Fortran listing, user's manual.

Related Work: SOC-44.

Price: \$ 5.00.

SOC-130

IDENTIFICATION OF MULTIVARIABLE SYSTEMS: A CRITICAL REVIEW

N.S. Rajbman and N.K. Sinha

September 1976, No. of Pages: 20

Revised:

Key Words: Identification, multivariable systems

Abstract: A critical survey is presented of the existing literature on the identification of multivariable systems from input-output data, along with some new directions for further research in the field. Emphasis is placed on realistic cases where the measurements are contaminated with noise.

Description: A shorter version to be presented at the Fourteenth Annual Allerton Conference on Circuit and System Theory (Urbana, Ill., Oct. 1976).

Related Work: SOC-67, SOC-79, SOC-162, SOC-163.

Price: \$ 5.00.

SOC-131

TEACHING OPTIMAL DESIGN

J.W. Bandler

September 1976, No. of Pages: 7

Revised:

Key Words: Optimal design, optimization programs, engineering education

Abstract: Experiences and views related to teaching optimal design to electrical engineering undergraduates as well as course content are discussed in the context of numerical methods of analysis and design. A number of documented user-oriented computer programs extensively used by students in modeling and optimization of circuits and systems are referenced and are available from the author. Two of them, namely CANOP2 and MINOPT, are briefly described.

Description: Reprint.  
Published in IEEE Trans. Education, vol. E-20, Feb. 1977, pp. 34-40.

Related Work: SOC-69, SOC-70, SOC-113, SOC-138.

Price: \$ 2.00.

SOC-132

OPTIMAL CENTERING, TOLERANCING AND YIELD DETERMINATION USING MULTI-DIMENSIONAL APPROXIMATIONS

J.W. Bandler and H.L. Abdel-Malek

September 1976, No. of Pages: 36

Revised: June 1977

Key Words: Tolerance assignment, design centering, yield estimation, worst-case design, modeling

Abstract: A method is described for efficient optimal design centering and tolerance assignment. In order to overcome the obstacle of scarcity of simulation programs incorporating both the efficient analysis of performance and its sensitivities, a suitable modelling of the functions involved using low-order multidimensional approximations is used. As a result, rapid and accurate determination of design solutions are facilitated, even with relatively inefficiently written analysis programs or with experimentally obtained data. An efficient technique for evaluating the multidimensional approximations and their derivatives is also given. Formulas for yield and yield sensitivities in the case of independent designable parameters, assuming uniform distribution of outcomes between tolerance extremes, are also presented. In addition, this procedure facilitates an inexpensive yield estimate using Monte Carlo analysis in conjunction with the multidimensional approximations. Simple circuit examples illustrate worst-case design and design with yields of less than 100%. The examples also provide verification of the formulas and algorithms.

Description: Superseded by SOC-173. A paper based on SOC-132 was presented at IEEE International Symposium on Circuits and Systems (Phoenix, Apr. 1977). See also the symposium proceedings, pp. 219-222.

Related Work: As for SOC-1.

Price: \$ 5.00.

SOC-133

TRANSMISSION-LINE MODELING AND SENSITIVITY EVALUATION FOR LUMPED NETWORK  
SIMULATION AND DESIGN IN THE TIME DOMAIN

J.W. Bandler, P.B. Johns and M.R.M. Rizk

September 1976, No. of Pages: 35

Revised:

Key Words: Modeling, simulation, transient analysis, transmission  
lines

Abstract: A new approach for time-domain analysis and design of lumped networks is considered. The lumped elements are modeled by transmission-line sections or stubs and the modeled network is analysed by the transmission-line matrix (TLM) method, which provides an exact solution to the model. Compensation of errors arising in modeling the network elements is discussed. Sensitivities w.r.t. design variables can easily be obtained and thus used in optimization. Sensitivities w.r.t. time and the time step are also obtained and used to improve the model's response.

Description: Presented at the Conference on Computer-aided Design of Electronic and Microwave Circuits and Systems (Hull, England, July 1977). Published in J. Franklin Institute.

Related Work: SOC-119.

Price: \$ 5.00.

SOC-134

THE IMPACT OF THE ELECTRONIC POCKET CALCULATOR ON ELECTRICAL ENGINEERING  
EDUCATION

N.K. Sinha

September 1976, No. of Pages: 13

Revised:

Key Words: Calculators, education, electronic pocket calculators,  
electrical engineering

Abstract: The availability of electronic pocket calculators, at prices which the students can afford, has had a considerable impact on electrical engineering education. Not only has the drudgery from computations been eliminated but it is also possible now to give meaningful and nontrivial problems which test the students' understanding of the details and subtleties of the discipline. A number of topics from circuit and systems theory are used as illustrative examples to demonstrate how the advent of the pocket calculator has changed "formidable" and "tedious" problems to the category "straight-forward", and provided a better grasp of the theory.

Description: Published in IEEE Trans. Education, vol. E-20, Feb. 1977, pp. 6-9.

Related Work:

Price: \$ 2.00.

SOC-135

DISCRETE STOCHASTIC CONTROL WITH INPUT CONSTRAINTS

J.F. MacGregor and P.W. Tidwell

October 1976, No. of Pages: 10

Revised:

Key Words: Digital control, linear systems, control-system synthesis

Abstract: Methods of designing digital controllers for linear processes subject to stochastic disturbances which minimize the quadratic cost function  $E\{y_{t+k}^2 + \lambda u_t^2\}$  are discussed. A recent method proposed by Clarke et al,<sup>1,2</sup> for synthesising such controllers is shown to be incorrect in that it does not optimize the stated cost function. Examples given include a controller used for the control of viscosity in an industrial polymerization reactor.

Description:

Related Work:

Price: \$ 2.00.



SOC-136

TEACHING UNDERGRADUATES TO SOLVE FIELD PROBLEMS NUMERICALLY

E. Della Torre and W. Kinsner

October 1976, No. of Pages: 10

Revised:

Key Words: Education, electromagnetic theory, numerical methods,  
batch and interactive processing

Abstract: This paper describes the development of a teaching unit on numerical solutions of field problems. The relationship of the unit to the a course on electromagnetism, the method of its implementation, and its duration are discussed.

Description: Published in IEEE Trans. Education, vol. E-20, Feb. 1977, pp. 52-54.

Related Work: SOC-137.

Price: \$ 2.00.

SOC-137

COMPUTER PROGRAMS FOR UNDERGRADUATE TEACHING OF FIELD PROBLEMS

W. Kinsner

October 1976, No. of Pages: 22

Revised:

Key Words: Education, electromagnetic theory, numerical methods,  
program structure, mathematical software

Abstract: This paper describes a set of computer programs used in a teaching unit on numerical solutions of fields embedded in a course on electromagnetic fields and waves. The logical development of various algorithms pertinent to the numerical methods discussed in the course is emphasized. The progression of the program structures is designed to facilitate a variety of tests and experiments related to the theoretical problems discussed in class. The use of the packages in such a teaching unit improves students' comprehension and skills in solving field problems. The programs have been written in standard Fortran.

Description: Published in IEEE Trans. Education, vol. E-20, Feb. 1977, pp. 54-60.

Related Work: SOC-96, SOC-136.

Price: \$ 5.00.

SOC-138

EIGHTY PROBLEMS IN COMPUTATIONAL METHODS AND DESIGN

J. W. Bandler

December 1976, No. of Pages: 28

Revised:

Key Words: Circuit theory, circuit design, numerical methods, systems analysis, optimization, approximation

Abstract: This report was designed to supplement course material in the undergraduate courses on Computational Methods and Design in the Department of Electrical Engineering at McMaster University. The problems cover topics in circuit design, efficient programming, numerical analysis, matrix methods, relaxation methods, network sensitivity analysis, least pth and minimax approximation, nonlinear programming, frequency domain and time domain simulation, tolerance assignment and design centering. The material is heavily oriented towards automating optimal engineering design. Many problems require available computer packages for their solution.

Description:

Related Work: SOC-131.

Price: \$ 5.00.

SOC-139

ADAPTIVE STATE ESTIMATION FOR SYSTEMS WITH COLOURED OBSERVATION NOISE

N.K. Sinha and A.F.W. Tom

December 1976, No. of Pages: 22

Revised:

Key Words: State estimation, adaptive estimation

Abstract: An adaptive scheme is proposed for obtaining the steady-state optimal filter gain matrix for a linear time-invariant discrete-time system when it is assumed that the observations are contaminated with unknown coloured noise. An autoregressive vector moving average model is proposed for the coloured observation noise and the parameters of this model are estimated by using a recent multivariate linear least-squares estimation technique. This is followed by an algorithm for tracking the gain matrix and correcting it for optimality. Results of simulation of an inertial navigation system are included.

Description: Published in Int. J. Systems Science.

Related Work: SOC-86, SOC-95, SOC-121, SOC-144.

Price: \$ 5.00.

SOC-140

CANONICAL FORMS FOR AGGREGATED MODELS

J. Hickin and N.K. Sinha

December 1976, No. of Pages: 19

Revised:

Key Words: Canonical forms, aggregation, system models

Abstract: It is shown that starting with canonical forms of linear multivariable systems, it is possible to obtain an aggregated reduced-order model which retains the same structure as the original canonical form but with smaller blocks. Besides retaining the desired eigenvalues of the original system, the reduced-order model also matches some time moments or Markov parameters. Moreover, the proposed method has many computational advantages over the normal procedures for determining the aggregation matrix.

Description: Shorter version presented at the International Conference on Information Sciences and Systems (Patras, Greece, Aug. 1976).

Related Work: SOC-107, SOC-164.

Price: \$ 5.00.

SOC-141

DEMAGNETIZATION TENSORS FOR CYLINDRICAL BODIES

C.J. Hegedus, G. Kadar and E. Della Torre

December 1976, No. of Pages: 42

Revised:

Key Words: Demagnetization tensors, magnetic bubbles, elliptic integrals

Abstract: Demagnetization tensors are defined for cylindrical rings. It is assumed that the magnetization pattern has cylindrical symmetry. An examination of the symmetry properties of these tensors shows that certain components are zero. The components of the demagnetization terms can be expressed as elliptic integrals. If the cross sections of the rings are rectangular then the results are expressed in terms of the parameters which describe the ring. Computational algorithms are discussed.

Description:

Related Work: SOC-10, SOC-31, SOC-43, SOC-46, SOC-116, SOC-156, SOC-171.

Price: \$ 5.00.

SOC-142

YIELD ESTIMATION FOR EFFICIENT DESIGN CENTERING ASSUMING ARBITRARY  
STATISTICAL DISTRIBUTIONS

H.L. Abdel-Malek and J.W. Bandler

December 1976, No. of Pages: 29

Revised: June 1977

Key Words: Design centering, yield estimation, statistical design,  
Monte Carlo analysis

Abstract: Based upon a uniform distribution inside an orthocell in the toleranced parameter space, it is shown how production yield and yield sensitivities can be evaluated for arbitrary statistical distributions. Formulas for yield and yield sensitivities in the case of a uniform distribution of outcomes between the tolerance extremes are given. A general formula for the yield, which is applicable to any arbitrary statistical distribution, is presented. An illustrative example for verifying the formulas is given. Karafin's bandpass filter has been used for applying the yield formula for a number of different statistical distributions. Uniformly distributed parameters between tolerance extremes, uniformly distributed parameters with accurate components removed and normally distributed parameters were considered. Comparisons with Monte Carlo analysis were made to contrast efficiency.

Description: Presented at the Conference on Computer-aided Design of Electronic and Microwave Circuits and Systems (Hull, England, July 1977).

Related Work: As for SOC-1, in particular, SOC-132, SOC-173.

Price: \$ 5.00.

SOC-143

DESIGN OF OPTIMAL INPUT SIGNALS FOR THE IDENTIFICATION OF DISTRIBUTED  
PARAMETER SYSTEMS

B. Kuszta and N.K. Sinha

December 1976, No. of Pages: 10

Revised:

Key Words: Optimal input design, identification, distributed  
parameter systems

Abstract: A frequency-domain approach is presented for the design of optimal input signals for identifying the parameters of a linear distributed parameter system. It is assumed that the set of possible values of the parameters of the unknown system is given.

Description: Shorter version presented at Fourteenth Annual Allerton Conference on Circuit and System Theory (Urbana, Ill., Oct. 1976).

Related Work: SOC-104, SOC-106.

Price: \$ 2.00.



SOC-144

ADAPTIVE ESTIMATION OF THE STATES OF A SYNCHRONOUS-ORBIT SATELLITE

N.K. Sinha and S.A. Azim

December 1976, No. of Pages: 11

Revised:

Key Words: Adaptive estimation, satellites

Abstract: An adaptive algorithm for the identification of the optimal filter gains, when 'a priori' statistical information about the measurement is not available, is applied to the estimation of the states of a synchronous orbit satellite from measurements contaminated with unknown coloured measurement noise. Results of simulation are presented, using this approach with Altman's unified state model of the orbital trajectory and the corresponding observation model. These results indicate that the proposed algorithm gives fairly accurate estimates of the states from ground-based observations.

Description: Shorter version presented at Nineteenth Midwest Symposium on Circuits and Systems (Milwaukee, Wis., Aug. 1976).

Related Work: SOC-139, SOC-169.

Price: \$ 2.00.

SOC-145

THE USE OF VERSATEC PRINTER PLOTTER AND VARIABLE FORMATS IN COMPLEX PLOTTING ROUTINES

W. Kinsner

December 1976, No. of Pages: 49

Revised:

Key Words: Graphics, VERSATEC printer-plotter, in-memory encoding and decoding, one- and two-dimensional plotting

Abstract: This report describes a program which plots multiple charts containing three sinusoidal curves and an analysis corresponding to these curves. The curves and the analysis change in each chart. Many additional details of the plots do not change. The plotting and printing is accomplished on a Versatec 1200A printer-plotter. The printing requires variable formats and in-memory transfers of data. All the plots have unparalleled quality and repeatability. The program is written in Extended Fortran IV and can be run on a CDC 6400 computer without any modification.

Description: Includes Fortran listings of two programs (884 and 972 cards).

Related Work: SOC-125.

Price: \$60.00.

SOC-146

FSK DIGITAL DATA CONVERTER FOR CASSETTE TAPE RECORDER

W. Kinsner, D. Seiler and R. Britt

December 1976, No. of Pages: 18

Revised:

Key Words: Digital recording, audio recording, interfacing, frequency shift keying, UART

Abstract: This paper describes an inexpensive but accurate system permitting digital data from a mini- or microcomputer to be recorded on an ordinary cassette recorder. The recorded files can be read back by the same system. The design is based on a frequency shift keying (FSK) modulator and demodulator and a universal asynchronous receiver and transmitter (UART). The system can substitute current loop and other input/output devices. It was built to provide a program exchange medium and an external data storage device. All the tests were carried out on a PDP-8/L computer. Although the components of the converter have wide bandwidths, the parameters of a cassette tape and a cassette tape recorder imposed a limit on the transmission rate at approximately 1500 baud. The system is compatible with the existing input/output PDP-8 software, thus programs can be written out and read in with no additional cost.

Description: Presented at International Symposium on Mini- and Microcomputers (Toronto, Nov. 1976). To appear in the symposium proceedings, Jan. 1977 (IEEE publication). Includes device photographs, waveforms and circuit diagrams.

Related Work:

Price: \$ 5.00.

CATALOG

Part II

January 1977 - December 1981

SOC-147 to SOC-285

SOC-147

A MINICOMPUTER PROGRAM FOR MINIMAL DISTANCE NETWORK PROBLEMS

W. Kinsner

January 1977, No. of Pages: 18

Revised:

Key Words: Shortest path, directed graphs, algebras

Abstract: The program described in this paper has been designed to demonstrate the capabilities of the Carre algebra in the determination of a succession of shortest or least-cost paths between commodity sources and sinks. The algorithm employed yields the global minimum of any shortest-path problem. The solution is arrived at in a relatively short time. Although dynamic programming and other techniques of operations research lead to a minimum or even to the global minimum of a shortest-path problem, their computer implementations are difficult and require large storage. The algorithm implemented in this program always results in the global solution and does not require large storage. The program has been written in PAL III and tested on a PDP-8/L computer. The program may be modified and used in transportation assignment and scheduling problems. An extension of the program may permit its use in the design of logic networks and in routing messages through congested communication networks.

Description: Presented at International Symposium on Mini- and Microcomputers (Toronto, Nov. 1976). To appear in the symposium proceedings, Jan. 1977 (IEEE publication).

Related Work: SOC-76.

Price: \$ 5.00.

SOC-148

THE ANALYSIS AND DESIGN OF BINARY VAPOUR-LIQUID EQUILIBRIUM EXPERIMENTS  
PART I: PARAMETER ESTIMATION AND CONSISTENCY TESTS

T.L. Sutton and J.F. MacGregor

January 1977, No. of Pages: 32

Revised:

Key Words: Vapour-liquid equilibrium, parameter estimation,  
consistency tests

Abstract: When estimating the unknown parameters in semi-empirical relationships from vapour-liquid equilibrium experiments, it has been common practice to minimize the sum of squares of some arbitrary function of one or more of the measured variables ( $x$ ,  $y$ ,  $P$ ,  $T$ ), without regard to the statistical consequences of such a procedure. It is shown that because these arbitrary procedures incorrectly account for the errors in all the variables in the functional relationship they can lead to very poor parameter estimates when compared to a statistically sound procedure based on maximum likelihood. The analysis of some binary data sets and a simulation study based on one of them are used to demonstrate the kinds of errors that arise.

Use of the maximum likelihood method of estimation also aids one in checking the adequacy of the model used, and in testing the consistency of the experimental data. This is accomplished by comparing the deviations between predicted and measured responses with their computed confidence limits.

Description:

Related Work: SOC-149.

Price: \$ 5.00.

SOC-149

THE ANALYSIS AND DESIGN OF BINARY VAPOUR-LIQUID EQUILIBRIUM EXPERIMENTS  
PART II: THE DESIGN OF EXPERIMENTS

T.L. Sutton and J.F. MacGregor

January 1977, No. of Pages: 21

Revised:

Key Words: Vapour-liquid equilibrium, design of experiments

Abstract: Statistical theory on the optimal design of experiments is used to demonstrate how one might design binary vapour-liquid equilibrium experiments to yield the greatest amount of information on the unknown parameters in semi-empirical thermodynamic models. The design of an isothermal or isobaric equilibrium experiment is considered to involve the choice of the liquid phase composition at which the experiment should be performed. Examples are used to illustrate how these procedures can be used to select experimental regions which would yield the most information on the parameters and to reveal regions in which very little information would be obtained.

Description:

Related Work: SOC-148.

Price: \$ 5.00.

SOC-150

MINICOMPUTER IMPLEMENTATIONS OF PROGRAMS FOR FIELD PROBLEMS

W. Kinsner and A.T. Kamel

January 1977, No. of Pages: 12

Revised:

Key Words: Field problems, numerical solutions, minicomputer programs

Abstract: Numerical solutions of electromagnetic field problems usually require very large computer storage. This paper describes an efficient user-oriented minicomputer program, employing various iterative finite-difference algorithms. The program is capable of computing two-dimensional fields within boundaries of arbitrary shape. The procedure of constructing overlay and direct access memory systems is presented. Minimization of the working memory area, required to solve very large problems, is discussed. Practical limitations of both the overlay and the direct access memory techniques are given. The program has been written in Fortran IV and runs on a PDP-11/45 with 20k words of MOS/core memory and 5 M words disk.

Description: Presented at International Symposium on Mini- and Microcomputers (Toronto, Nov. 1976). To appear in the symposium proceedings, Jan. 1977 (IEEE publication).

Related Work: SOC-43, SOC-47, SOC-96.

Price: \$ 2.00.



SOC-151

FLOPT4 - A PROGRAM FOR LEAST PTH OPTIMIZATION WITH EXTRAPOLATION TO  
MINIMAX SOLUTIONS

J.W. Bandler and D. Sinha

January 1977, No. of Pages: 136

Revised: August 1977

Key Words: Unconstrained optimization, gradient minimization  
methods, penalty function methods, least pth  
optimization, extrapolation

Abstract: FLOPT4 is a package of subroutines primarily for solving least pth optimization problems. Its main features include Fletcher's quasi-Newton subroutine, a least pth objective formulation subroutine, an extrapolation procedure and a scheme for dropping inactive functions. With appropriate utilization of these features, the program can solve a wide variety of optimization problems. These may range from unconstrained problems, problems subject to inequality or equality constraints to nonlinear minimax approximation problems. In solving constrained problems, the user may, for example, use the Fiacco-McCormick method with extrapolation or the Bandler-Charalambous minimax formulation and least pth approximation, also with extrapolation. The program has been used on a CDC 6400 computer. Several detailed examples of varying complexity are used to illustrate the versatility of the program. A FORTRAN IV listing is included. FLOPT4 replaces a previous package on which it is based, namely, FLOPT2.

Description: Contains Fortran listing, user's manual.  
Source deck available for \$100.00.  
The listing contains 780 statements of which 366 are  
comment cards.

Related Work: As for SOC-84. Represents further development of the  
work presented in SOC-84.

Price: \$60.00.

SOC-152

MULTIVARIABLE COMPUTER CONTROL OF A BUTANE HYDROGENOLYSIS REACTOR  
PART I: STATE SPACE REACTOR MODELLING

A. Jutan, J.P. Tremblay, J.F. MacGregor and J.D. Wright

January 1977, No. of Pages: 44

Revised:

Key Words: Packed bed catalytic reactor, orthogonal collocation, model reduction, nonlinear partial differential equations, inferential measurements, state space models, pilot plant

Abstract: A state space model is developed for an existing non adiabatic packed bed reactor which experiences steep radial concentration and temperature gradients resulting from highly exothermic reactions involving several chemical species. The set of partial differential equations are reduced from three to two dimensions using orthogonal collocation. Further use of orthogonal collocation on the quasi steady state version of the differential equations results in a set of coupled algebraic and differential equations from which a linearised low order state space model is obtained. The model parameters can be estimated from real plant data and the fitted model can be used for design and implementation of multivariable control schemes on the reactor.

Description: Presented at the 69th Annual AIChE Conference (Chicago, Nov. 1976).

Related Work: SOC-50, SOC-114, SOC-117, SOC-153, SOC-154, SOC-157.

Price: \$ 6.00.

SOC-153

MULTIVARIABLE COMPUTER CONTROL OF A BUTANE HYDROGENOLYSIS REACTOR  
PART II: DATA COLLECTION, PARAMETER ESTIMATION AND STOCHASTIC  
DISTURBANCE IDENTIFICATION

A. Jutan, J.F. MacGregor and J.D. Wright

January 1977, No. of Pages: 36

Revised:

Key Words: Parameter estimation, pilot plant, packed bed catalytic reactor, stochastic disturbances, principle component model reduction, canonical reduction, multivariate estimation

Abstract: A space state model, developed for multivariable control studies on a pilot plant packed bed reactor for the hydrogenolysis of butane, is fitted to experimental temperature and concentration data collected under unsteady-state conditions. The parameters estimated are the fundamental transport parameters of the packed bed reactor and a catalyst activity parameter. A discrete stochastic model for the process disturbances is also identified, and a principle component type of procedure is used to reduce its dimensionality and gain insight into the nature of these disturbances.

Description: Presented at the 69th Annual AIChE Conference (Chicago, Nov. 1976).

Related Work: SOC-50, SOC-114, SOC-117, SOC-152, SOC-154, SOC-157.

Price: \$ 6.00.

SOC-154

MULTIVARIABLE COMPUTER CONTROL OF A BUTANE HYDROGENOLYSIS REACTOR  
PART III: ON-LINE LINEAR QUADRATIC STOCHASTIC CONTROL STUDIES

A. Jutan, J.D. Wright and J.F. MacGregor

January 1977, No. of Pages: 44

Revised:

Key Words: Pilot plant, packed bed catalytic reactor, computer control, linear quadratic stochastic controller, state space models, Kalman filter, white noise, inferential measurements

Abstract: A linear low order state space dynamic model for a catalytic butane hydrogenolysis reactor which has been fitted to reactor dynamic data is used to develop a linear multivariable, quadratic feedback control algorithm for regulatory control of the reactor exit concentrations using temperature measurements only. Kalman filter theory is used to obtain state estimates for the system. Two approaches are used in designing the Kalman filter from the reactor model. Noise terms in the stochastic state space model are approximated by adding white noise terms with diagonal covariance matrices directly to the dynamic model. Alternatively, an identified, reduced-dimensional noise model is used directly to derive an augmented state space model.

Control algorithms developed from the two approaches are implemented on the pilot plant reactor in a series of DDC control studies. The two controllers are shown to perform very well and considerably better than a single loop PI controller with feedback on the hotspot temperature. Performance is evaluated both under the normal stochastic disturbances in the system and under a severe deterministic load disturbance. Exit concentrations predicted by the model and used in the performance index are shown to compare very favourably with actual concentrations obtained from a process gas chromatograph.

Description: Presented at the 69th Annual AIChE Conference (Chicago, Nov. 1976).

Related Work: SOC-50, SOC-114, SOC-117, SOC-152, SOC-153, SOC-157.

Price: \$ 6.00.

SOC-155

BIBLIOGRAPHY IN COMPUTATIONAL METHODS, DESIGN AND OPTIMIZATION

J.W. Bandler

January 1977, No. of Pages: 32

Revised:

Key Words: Bibliography, references, numerical methods,  
engineering design, optimization

Abstract: This work represents a personal collection of references to books, chapters or articles in books, papers and conference presentations. Over 400 items are cited in the areas of numerical analysis, optimization, computer aided design, circuit theory and optimization of circuits and systems. Not included are references to reports or computer program descriptions.

Description: Bibliography.

Related Work: As for SOC-1, SOC-2, SOC-3, SOC-19, SOC-20, SOC-22,  
SOC-29, SOC-69, SOC-113, SOC-120, SOC-124, SOC-158.

Price: \$ 5.00.

SOC-156

CYLINDRICAL DEMAGNETIZATION MATRIX

G. Kadar, C.J. Hegedus and E. Della Torre

January 1977, No. of Pages: 8

Revised: January 1978

Key Words: Programs for demagnetization matrices, magnetic bubbles, elliptic integrals

Abstract: A program description and a full listing of the program for the computation of cylindrical demagnetization matrices is presented. These matrices are defined in the related report SOC-141.

Description: Contains Fortran listing, user's manual.

Related Work: SOC-141, SOC-171.

Price: \$ 5.00.

SOC-157

MULTIVARIABLE MODEL REFERENCE ADAPTIVE CONTROL OF A PILOT SCALE PACKED  
BED TUBULAR REACTOR

J.P. Tremblay and J.D. Wright

January 1977, No. of Pages: 14

Revised:

Key Words: Pilot plant, model reference adaptive control,  
exothermic reactor, nonlinear system, on-line recursive  
least squares, minicomputer, parameter estimation,  
multivariable controllers

Abstract: A pilot scale nonadiabatic packed bed tubular reactor carrying out the hydrogenolysis of butane over a nickel on silica gel catalyst is used to evaluate the performance of a multivariable model reference adaptive control algorithm. The multiple reactions are highly exothermic causing steep radial gradients within the reactor. Measurements of temperature along the center of the reactor bed and of exit concentrations are used. The model reference algorithm is based upon Liapunov's direct method. The reference model is based upon a low order state space model derived from a three dimensional partial differential equation description of the process. Model parameters were fitted to reactor data to form the basic model.

The model reference algorithm is implemented on a minicomputer which is interfaced to the reactor. The performance of the control algorithm is compared with results from low order conventional controllers and with an empirical low order controller. Problems related to derivation for, implementation on, and performance of the model reference technique on the highly nonlinear reactor system are discussed.

Description: Presented at Fifth IFAC/IFIP Conference on Digital Computer Applications to Process Control (The Hague, June 1977).

Related Work: SOC-50, SOC-114, SOC-117, SOC-152, SOC-153, SOC-154.

Price: \$ 5.00.

SOC-158

A REVIEW OF CONCEPTS IN LINEAR, NONLINEAR AND DISCRETE OPTIMIZATION

J.W. Bandler

January 1977, No. of Pages: 32

Revised:

Key Words: Mathematical programming, sensitivity evaluation, branch and bound, minimax approximation, linear programming, optimality, unconstrained optimization

Abstract: A brief review of mathematical concepts in linear, nonlinear and discrete optimization is made. Following statements and classifications of problems in optimization, convexity and partial derivative concepts are discussed. An abstract approach to evaluation of first-order sensitivities is presented, indicating its relationship with the adjoint network method. Branch and bound concepts for discrete optimization are sketched out. Linear inequalities, along with descent, optimality conditions and feasible direction approaches are noted. Definitions are given of the Lagrangian function, primal and dual problems. A discussion of quadratic models, scaling and transformations leads the reader to Newton, modified Newton and quasi-Newton algorithms. Consideration of linearly constrained problems is followed by linear programming.

Description: Review.

Related Work: SOC-113, SOC-155.

Price: \$ 5.00.



SOC-159

ASPECTS OF ANALYSIS AND PROCESSING OF ELECTROMYOGRAPHIC SIGNALS

H. de Bruin

March 1977,           No. of Pages: 244

Revised:

Key Words:           Electromyographic signals, modelling, analysis,  
computer processing, EMG control strategies, pattern  
recognition

Abstract:   Skeletal muscles produce detectable electrical currents and voltages when they contract from any cause. The electrical potentials or electromyographic (EMG) signal is recorded from the muscle using suitable electrodes. The research presented in this thesis is concerned with the analysis and processing of electromyographic signals with a view to their use as a source of control for environmental control or other rehabilitation devices. An application of myo-electric control of a simple communication device for a cerebral palsied patient is presented. A model of the myo-electric source which can be used to simulate EMG signals in real-time is proposed. The model algorithm has been tested for two different electrodes systems and the results compared with real signals recorded using these electrode systems. A number of statistical parameters of the surface recorded EMG signal have been examined to determine which parameter is most suitable for myo-electric control. Finally, a pattern recognition algorithm is proposed which attempts to extract the motor unit recruitment and discharge frequency information present in the surface recorded EMG signal. The statistical parameters and the algorithm have been tested for six normal subjects, under isometric conditions.

Description:       Ph. D. Thesis.

Related Work:     SOC-160.

Price:            \$30.00.

SOC-160

DERIVATION OF CONTROL INFORMATION FROM ELECTROMYOGRAPHIC PATTERNS

H. de Bruin and E. Della Torre

March 1977,           No. of Pages: 2

Revised:

Key Words:           Electromyographic signals, analysis, pattern  
                          recognition, isometric contraction

Abstract: The electromyographic (EMG) signal has gained wide acceptance as a source of control for powered prostheses, orthoses and communication devices. For these applications, the mean absolute value or average of the rectified EMG signal is the most commonly used detector of the muscle force. The two mechanisms by which muscle tension can be increased during voluntary contraction: increased discharge frequency of active motor units; and recruitment of additional units have been studied by many researchers. This paper proposes a simple pattern recognition algorithm which attempts to extract the motor unit recruitment and discharge frequency information present in surface recorded EMG and use it as a control source. This algorithm has been implemented on a mini-computer and tested for different subjects over a range of light to moderate contractions.

Description:         Digest of the 11th International Conference on Medical  
                          and Biological Engineering (Ottawa, 1976), pp. 364-365.

Related Work:        SOC-159.

Price:               \$ 2.00.

SOC-161

NUMERICAL SOLUTIONS TO A SINGULAR DIFFERENTIAL GAME IN ADVERTISING

K.R. Deal and S. Zionts

April 1977,            No. of Pages: 13

Revised:

Key Words:            Differential games, singular, numerical solutions, two  
player, non-zero-sum, advertising, competition

Abstract:    A numerical algorithm for determining Nash Equilibrium advertising strategies for singular two person non-zero-sum differential games is presented. Each of the competing brands is portrayed as attempting to determine its time varying advertising expenditures in order to maximize its total discounted profits over a future planning horizon of finite duration. The market dynamics are described by a system of differential equations that depict the interrelationships between the firm's advertising strategies and sales levels. The numerical solution procedure produces both numerical and graphical output.

Description:    Presented at the Fall 1976 National Joint Meeting of the Operations Research Society of America and the Institute of Management Science (Miami, Florida, Nov. 1976).

Related Work:

Price:                \$ 5.00.

SOC-162

STOCHASTIC APPROXIMATION FOR IDENTIFICATION OF MULTIVARIABLE SYSTEMS

H.E. El-Sherief

April 1977,            No. of Pages: 68

Revised:

Key Words:            System identification, stochastic approximation,  
                         canonical forms, non-parametric representation,  
                         normalized mean-square error criterion

Abstract:    In this thesis a non-parametric normalized stochastic approximation algorithm has been developed for the identification of multivariable systems from noisy data without prior knowledge of the statistics of measurement noise.

The system model is first transformed into a special canonical form, then it is formulated in a non-parametric form. The parameters of this model are estimated through a normalized stochastic approximation algorithm. Finally, the system parameters are recovered from these estimates by another transformation.

The proposed algorithm is applied to the identification of two simulated systems.

Conclusions of this work and suggestions for future work are given.

Description:        M.Eng. Thesis.

Related Work:      SOC-79, SOC-130, SOC-163.

Price:              \$ 10.00.

SOC-163

STOCHASTIC APPROXIMATION ALGORITHM FOR THE IDENTIFICATION OF MULTI-VARIABLE SYSTEMS

H.E. El-Sherief and N.K. Sinha

May 1977,            No. of Pages: 18

Revised:

Key Words:            Stochastic approximation, identification, multivariable systems

Abstract: A non-parametric normalized stochastic approximation algorithm is presented for on-line identification of linear, multi-variable, discrete-time systems from noisy data without prior knowledge of the statistics of measurement noise. This algorithm requires simple computations and it uses a normalized mean-square error criterion which improves the initial convergence of the identification scheme. The results of two simulated examples are given which indicate that the proposed algorithm provides good estimates even for large noise-to-signal ratios.

Description:

Related Work:        SOC-79, SOC-130, SOC-162.

Price:                \$ 5.00.



SOC-165

EFFICIENT ALGORITHM FOR TRANSFORMATION OF LINEAR MULTIVARIABLE SYSTEMS  
TO CANONICAL FORMS

J. Hickin and N.K. Sinha

May 1977,            No. of Pages: 23

Revised:

Key Words:            Canonical forms, multivariable systems, transformations

Abstract: An algorithm is presented which enables the transformation of the state equations of linear multivariable systems to any of six canonical forms. It is based on transformation of a matrix to the Hermite normal form, and does not require matrix inversion.

Description:

Related Work:        SOC-32, SOC-57, SOC-61.

Price:                \$ 5.00.

SOC-166

NUMERICAL SOLUTIONS OF THE MATRIX EQUATION  $AX + XB = C$

S. Law and N.K. Sinha

May 1977,            No. of Pages: 35

Revised:

Key Words:            Computer programs, matrix Liapunov equation

Abstract: This report describes the numerical solution of the matrix equation  $AX + XB = C$  using similarity transformation of matrices A and B into real Schur forms. A similar approach is used to solve the matrix Liapunov equation  $A^T P + PA = S$ . Programs are written in standard Fortran IV to solve both equations.

Description:            Contains Fortran listing, user's manual.  
Source deck available for \$50.00.

Related Work:        SOC-121.

Price:                \$ 15.00.



SOC-167

MODELING AND APPROXIMATION FOR STATISTICAL EVALUATION AND OPTIMIZATION  
OF MICROWAVE DESIGNS

J.W. Bandler and H.L. Abdel-Malek

May 1977,            No. of Pages: 5

Revised:

Key Words:            Engineering design, tolerance assignment, statistical  
design, yield estimation, worst-case design

Abstract: This paper shows how, by suitably updated approximations, one may surmount the obstacle of expensive experimental tuning or repeated computer simulations of trial designs when optimal designs or statistical analyses are required. The authors address themselves to the efficient use of available software by designers wishing to exploit the current state of the art in techniques of statistical design, tolerance assignment and optimal tuning. The ideas and results are new to microwave design.

Description:           Proc. European Microwave Conference (Copenhagen,  
Denmark, Sept. 1977).

Related Work:        As for SOC-1.

Price:                \$ 2.00.



SOC-169

DECOUPLING THE CONTROL OF THE ORBIT AND THE ATTITUDE OF A COMMUNICATIONS  
SATELLITE

N.K. Sinha and J.Y. Yau

May 1977,            No. of Pages: 13

Revised:

Key Words:            Decoupling, orbit and attitude, satellite control

Abstract: The problem of decoupling the control of the orbit and the attitude of a satellite is examined, using the linearized form of the unified state and observation models proposed by Altman. Two approaches to decoupling and pole placement are considered, and it is shown that while it is possible to decouple the system by using state variable feedback and a static linear transformation of the inputs, it is not possible to simultaneously decouple and place all the poles. However, a state feedback matrix can be found which will give a stable decoupled system.

Description:

Related Work:        SOC-45, SOC-144.

Price:                \$ 2.00.

SOC-170

STOCHASTIC APPROXIMATION ALGORITHMS FOR SYSTEM IDENTIFICATION

N.K. Sinha and H. El-Sherief

May 1977            No. of Pages: 5

Revised:

Key Words:            Stochastic approximation algorithms, system  
                         identification, convergence rates

Abstract: Six different stochastic approximation algorithms for system identification have been discussed. Simulation studies of a first-order and a second-order discrete-time system with various output noise levels have been used for comparing the relative performances of the different methods for on-line applications.

Description:           Presented at the 8th Pittsburgh Conf. on Modeling and  
                         Simulation (Pittsburgh, April 1977).

Related Work:        SOC-7, SOC-39, SOC-67.

Price:                \$ 2.00.

SOC-171

EFFICIENT CALCULATION OF BUBBLE FUNCTIONS

C.J. Hegedus and E. Della Torre

June 1977,            No. of Pages: 12

Revised:

Key Words:            Magnetic bubbles, elliptic integrals, demagnetization,  
                         stability functions

Abstract:    The various magnetic bubble stability functions as well as  
the field due to a bubble are all expressed in terms of a single  
generalized complete elliptic integral. This integral can be computed  
efficiently to arbitrary accuracy using the Bartky transformation.

Description:    Contains a program for HP 65 Calculator to compute  
                         ncel.

Related Work:    SOC-141, SOC-156.

Price:            \$5.00.

SOC-172

FEEDBACK CONTROL OF MULTIVARIABLE SYSTEMS FOR SPECIFIED OUTPUT CHARACTERISTICS

A.K. Mahalanabis and N.K. Sinha

June 1977, No. of Pages: 26

Revised:

Key Words: Multivariable systems, specified output characteristics

Abstract: A new approach to the problem of stationary feedback control of linear time invariant multivariable systems in the discrete time domain is studied. Consider first the deterministic system  $x(k+1) = A x(k) + Bu(k)$ ,  $y(k) = C x(k)$ , where  $k = 0, 1, 2, \dots$  is the discrete time index,  $x(k) \in R^n$  is the state,  $u(k) \in R^m$  is the control input and  $y(k) \in R^m$  is the output of the system,  $m < n$ . Assume  $(A, B, C)$  to be a completely controllable and observable triple and that the observability index of  $y_i(k)$  (the  $i$ th component of  $y(k)$ ) is  $p_i(70)$ . It is shown that the  $m \times n$  matrix  $K$  that defines the feedback control law  $u(k) = K x(k)$  can be determined so as to ensure that  $p_i$  successive values of the sequence  $y_i(k)$ , viz.,  $y_i(p_i), y_i(p_i+1) \dots y_i(2p_i-1)$ , can be arbitrarily selected by the designer for  $i = 1, 2, \dots m$ .

The proposed design technique is also extended to cover the stochastic system  $y(k+1) = A x(k) + Bu(k) + w(k)$ ,  $y(k) = C x(k) + v(k)$ , where  $w(k)$  and  $v(k)$  are zero-mean independent white gaussian sequences. It is assumed that the desired control law is of the form  $u(k) = M \hat{x}(k|k-1)$ , where  $M$  is the feedback matrix to be determined and  $\hat{x}(k|k-1)$  is the optimal prediction of  $x(k)$  based on the measurements  $y(0), y(1), \dots y(k-1)$ . It is shown that  $M$  can be computed so as to ensure that  $p_i$  successive values of the correlation sequence  $r_{ij}(\tau_i) = E \{y_i(k+\tau_i)y_j(k)\}$  for fixed  $j$  in the range  $1 \leq j \leq m$  and for  $i = 1, 2, \dots m$ , can be arbitrarily selected by the designer.

The results are illustrated numerically.

Description:

Related Work: SOC-61.

Price: \$ 5.00.

SOC-173

OPTIMAL CENTERING, TOLERANCING AND YIELD DETERMINATION VIA UPDATED APPROXIMATIONS AND CUTS

J.W. Bandler and H.L. Abdel-Malek

June 1977,            No. of Pages: 84

Revised:            December 1977

Key Words:            Tolerance assignment, design centering, yield estimation, worst-case design, modeling

Abstract: This paper presents a new approach to optimal design centering, the optimal assignment of parameter tolerances and the determination and optimization of production yield. Based upon multidimensional linear cuts of the tolerance orthotope and uniform distributions of outcomes between tolerance extremes in the orthotope, exact formulas for yield and yield sensitivities w.r.t. design parameters are derived. The formulas employ the intersections of the cuts with the orthotope edges, the cuts themselves being functions of the original design constraints. Our computational approach involves the approximation of all the constraints by low-order multidimensional polynomials. These approximations are continually updated during optimization. Inherent advantages of the approximations which we have exploited are that explicit sensitivities of the design performance are not required, available simulation programs can be used, inexpensive function and gradient evaluations can be made, inexpensive calculations at vertices of the tolerance orthotope are facilitated during optimization and, subsequently, inexpensive Monte Carlo verification is possible. Simple circuit examples illustrate worst-case design and design with yields of less than 100%. The examples also provide verification of the formulas and algorithms.

Description:            Supercedes SOC-132.

Related Work:            As for SOC-1.

Price:                \$12.00.

SOC-174

DISOPT3 - A USER-ORIENTED PACKAGE FOR NONLINEAR CONTINUOUS AND DISCRETE  
OPTIMIZATION PROBLEMS

J.W. Bandler and D. Sinha

July 1977,           No. of Pages: 188

Revised:

Key Words:           Engineering optimization, nonlinear programming,  
discrete optimization, least pth optimization, branch  
and bound method, computer programs

Abstract: A package of FORTRAN subroutines called DISOPT3 for solving continuous and discrete, constrained or unconstrained general optimization problems is presented. The method used for arriving at the discrete solution involves conversion of the original constrained problem into a minimax problem by the Bandler-Charalambous technique, solving the continuous minimax problem using the latest (1977) Charalambous least pth algorithm, Fletcher's 1972 method for unconstrained minimization and use of the Dakin branch and bound technique to generate the additional constraints. These steps are iteratively implemented until all the discrete solutions have been found. DISOPT3 is based conceptually on the DISOPT program developed by Bandler and Chen. All of the desirable features of DISOPT have been retained in DISOPT3 and some more have been added. DISOPT has been used as a yardstick against which the performance and validity of DISOPT3 have been measured. A CDC 6400 computer was used for developing and running this program.

Description:           Contains Fortran listing, user's manual.  
Source deck available for \$400.00.  
The listing contains 1707 cards, of which 708 are  
comment cards.

Related Work:         As for SOC-29. Represents a complete restructuring and  
redevelopment of work presented in SOC-29.

Price:                 \$ 150.00.



SOC-175

EFFICIENT ALGORITHM FOR DETERMINING CONTROLLABILITY AND OBSERVABILITY OF  
LARGE-SCALE COMPOSITE SYSTEMS

N.K. Sinha and H. El-Sherief

July 1977,            No. of Pages: 13

Revised:

Key Words:            Controllability, observability, composite systems

Abstract:    The investigation of controllability and stability of large composite systems requires the determination of the rank of large sparse matrices. A computationally efficient algorithm is presented, which is based on the application of reduced outer products for transforming the matrix into an upper triangular form.

Description:

Related Work:    SOC-32, SOC-57.

Price:                \$ 5.00.

SOC-176

ON THE DESIGN OF STATIONARY FEEDBACK REGULATORS FOR LINEAR DISCRETE SYSTEMS

A.K. Mahalanabis and N.K. Sinha

July 1977,            No. of Pages: 26

Revised:

Key Words:            Feedback regulators, linear discrete systems, matching output sequence

Abstract:    A new approach to the problem of stationary feedback controller design for linear time invariant systems in the discrete time domain is presented. A single-input single-output deterministic system is considered first and it is shown that the gain vector that defines a state feedback controller is conveniently computed if the design criterion corresponds to the specified values of  $n$  members of the output sequence,  $n$  being the order of the given system. Extension of the proposed method to the case of single-input single-output stochastic systems is studied next. Finally, the case of multi-input multi-output systems is dealt with by converting the given system into an equivalent single-input system. The results are illustrated through numerical examples.

Description:

Related Work:        SOC-61, SOC-168, SOC-172.

Price:                \$ 5.00.

SOC-177

OPTIMAL CENTERING, TOLERANCING AND TUNING IN ENGINEERING DESIGN

J.W. Bandler, Editor

August 1977, No. of Pages: 197

Revised:

Key Words: Centering, tolerancing, tuning, engineering design, optimization

Abstract: This collection sixteen papers and reports represents the development of work in computer-aided design oriented around optimal centering, tolerancing and tuning carried out by the editor and his colleagues over several years. This report essentially contains the material of the following reports: SOC-1, SOC-18, SOC-24, SOC-37, SOC-49, SOC-62, SOC-65, SOC-110, SOC-111, SOC-118, SOC-119, SOC-120, SOC-124, SOC-131, SOC-132, SOC-142, SOC-167 and SOC-173.

Description:

Related Work: SOC-87, SOC-105, SOC-113.

Price: \$ 30.00.

SOC-178

RECURSIVE ESTIMATION OF THE PARAMETERS OF LINEAR MULTIVARIABLE SYSTEMS

N.K. Sinha and Y.H. Kwong

August 1977,      No. of Pages: 20

Revised:

Key Words:          Recursive estimation, on-line identification, linear  
multivariable systems

Abstract: A recursive algorithm is proposed for the identification of linear multivariable systems. Utilization of a canonical state space model minimizes the number of parameters to be estimated. The problem of identification in the presence of noise is solved by using a recursive generalized least-squares method.

Description:          Presented at the IFAC Symposium on Multivariable  
Technological Systems (Fredericton, NB, July 1977).

Related Work:        SOC-79, SOC-130, SOC-162.

Price:                \$ 5.00.

SOC-179

BIBLIOGRAPHY IN COMPUTATIONAL METHODS, DESIGN AND OPTIMIZATION

J.W. Bandler

August 1977,      No. of Pages: 37

Revised:          January 1978

Key Words:        Bibliography, references, numerical methods,  
engineering design, optimization, computer-aided  
design, circuit analysis and design

Abstract: This work represents a personal collection of references to books, chapters or articles in books, theses, internal reports, papers, conference presentations and computer programs. Over 500 items are cited in the areas of numerical analysis, approximation, optimization, computer-aided design, circuit theory, optimization of circuits and optimization of power systems.

Description:      Bibliography.

Related Work:    SOC-155, which this report updates and supercedes.

Price:            \$ 5.00.

SOC-180

A NONPARAMETRIC APPROACH TO THE IDENTIFICATION OF LINEAR MULTIVARIABLE SYSTEMS

N.K. Sinha, A.K. Mahalanabis and H. El Sherief

September 1977, No. of Pages: 9

Revised:

Key Words: Identification, multivariable systems, nonparametric approach

Abstract: A nonparametric approach is proposed for the identification of linear time-invariant discrete-time multivariable systems. It is based on the estimation of the Markov parameters of the system by cross-correlation between the output and a white noise input and can also be used with the system under operation if a dither signal can be added for identification. Results of simulation are included indicating that the scheme works successfully even when the output measurements are contaminated with considerable amounts of noise.

Description: Published in Int. J. Systems Science.

Related Work: SOC-79, SOC-130, SOC-163, SOC-178.

Price: \$2.00.

SOC-181

BUBMAT2 - A PACKAGE FOR BUBBLE MATERIALS PARAMETERS CALCULATION

W.S. Ishak and E. Della Torre

October 1977, No. of Pages: 27

Revised:

Key Words: Bubble memories, bubble materials

Abstract: BUBMAT2 is a package of subroutines for evaluation of various parameters of bubble materials. It is a modified version of BUBMAT.

The calculations inside the package BUBMAT2 are based on the theory of cylindrical magnetic domains derived by Thiele. Corrections have been introduced based on the four-parameters variational model of the twisted domain wall structure for stripe domains reported by DeBonte.

The package can calculate different parameters, which are useful for the evaluation of bubble materials, such as: Bulk Wall energy density, material characteristic length, twist angle of domain walls, average domain wall energy density, wall thickness, bubble collapse field and diameter, bubble run-out field and diameter as well as different stable points for different bubble diameters.

New algorithms for computing the various force and stability functions are included.

Description: Contains Fortran listing, user's manual.

Related Work: SOC-109.

Price: \$ 15.00.

SOC-182

A UNIFIED TREATMENT OF YIELD ANALYSIS, WORST-CASE DESIGN AND YIELD OPTIMIZATION

H.L. Abdel-Malek

November 1977, No. of Pages: 205

Revised:

Key Words: Yield analysis, worst-case design, design centering, tolerance assignment, multidimensional approximation optimization algorithms, circuit design

Abstract: This thesis addresses itself to what is considered to be one of the most general theoretical problems associated with the art of engineering design. A unified treatment is presented of production yield evaluation, worst-case design and yield optimization. The formulation is suited to nonlinear programming methods of solution.

Viewed in its entirety the approach integrates the following concepts: design centering, assignment of component tolerances, post-production tuning, yield estimation for realistic distributions and modeling of response functions. Many of the ideas can also be used separately depending on the type of design evaluation required, the number of degrees of freedom involved and the availability and properties of suitable simulation programs.

The thesis presents an analytical approach to yield and yield sensitivity evaluation. Basic to the approach is the discretization of the distributions by use of orthotopic cells to which suitable uniform distributions are applied. Multidimensional polynomials provide approximations to actual functions, which may be expensive to compute. Algorithms for updating and evaluating these polynomials are developed to permit efficient use of gradient optimization methods.

Industrially oriented design examples are furnished to justify the theory. A telephone channel (lossy) bandpass filter is considered with relative insertion loss specifications to illustrate the analysis of yield. The cascade connection of nonideal, inhomogeneous sections of rectangular waveguides is considered from the worst-case design point of view. A current switch emitter follower involving transistors, a diode and a transmission line provides a challenging example for yield optimization including parameter correlations.

Description: Ph.D. Thesis.

Related Work: As for SOC-1.

Price: \$ 30.00.



SOC-183

OPTIMIZATION OF ELECTRICAL CIRCUITS

J.W. Bandler and M.R.M. Rizk

November 1977, No. of Pages: 123

Revised: November 1978

Key Words: Mathematical programming, electrical circuit optimization, filter design, power system optimization, tolerance assignment

Abstract: This paper reviews applications of optimization methods in the area of electrical circuit design. It is addressed to engineers in general as well as mathematical programmers. As a consequence, a brief introduction to electrical circuits is presented, including analog, digital and power concepts. Network analysis techniques along with response evaluation and the determination of partial derivatives (useful in gradient methods of optimization) provide the nonelectrical reader with some necessary background. Different types of specifications which may be imposed, for design purposes, on network performance are presented. The approaches by many contributors to optimal circuit design are outlined, concentrating on general methods within the domain of nonlinear programming, nonlinear approximation and nonlinear discrete optimization techniques. A complete section is devoted to recent work in design centering, optimal assignment of manufacturing tolerances and postproduction tuning. The inclusion of model and environmental uncertainties is discussed. Practical examples illustrate the current state of the art. Difficulties facing the design optimizer as well as directions of possible future research are elaborated on. A long but by no means exhaustive list of references is appended.

Description: Subject review.

Related Work: SOC-113, SOC-155, SOC-177.

Price: \$ 15.00.

SOC-184

YIELD OPTIMIZATION FOR ARBITRARY STATISTICAL DISTRIBUTIONS  
PART I: THEORY

H.L. Abdel-Malek and J.W. Bandler

November 1977, No. of Pages: 34

Revised: June 1978, March 1979

Key Words: Yield analysis, design centering, tolerance assignment,  
multidimensional approximation, sparse matrix methods

Abstract: This paper generalizes certain analytical formulas for yield and yield sensitivities so that design centering and yield optimization can be effectively carried out employing given statistical parameter distributions. The tolerance region of possible outcomes is discretized into a set of orthotopic cells. A suitable weight is assigned to each cell in conjunction with an assumed uniform distribution on the cell. Explicit formulas for yield and its sensitivities w.r.t. nominal parameter values and component tolerances are presented for linear cuts and sensitivities of these cuts based upon approximations of the boundary of the constraint region. To avoid unnecessary evaluations of circuit responses, e.g., integrations for nonlinear circuits, multidimensional quadratic interpolation is performed. Sparsity is exploited in the determination of these quadratic models leading to reduced computation as well as increased accuracy.

Description: Presented at the IEEE International Symposium on Circuits and Systems (New York, May 1978). See the symposium proceedings, pp. 664-669.

Related Work: SOC-182, SOC-185, SOC-190, SOC-191.

Price: \$ 6.00.

SOC-185

YIELD OPTIMIZATION FOR ARBITRARY STATISTICAL DISTRIBUTIONS  
PART II: IMPLEMENTATION

H.L. Abdel-Malek and J.W. Bandler

November 1977, No. of Pages: 43

Revised: June 1978, March 1979

Key Words: Yield analysis, design centering, tolerance assignment,  
numerical integration, nonlinear network design

Abstract: A suggested test problem for proposed algorithms in yield optimization is described in detail. The problem is a current switch emitter follower (CSEF) circuit originally described by Ho, which includes a transmission line. The ideas presented in Part I of this paper are applied to this circuit in order to obtain an optimal statistical design. Production yield is maximized taking into consideration statistical distributions of circuit parameters and realistic correlations between transistor model parameters. Nonlinear programming employing the analytical formulas for yield and its sensitivities is used to provide optimal nominal values for the circuit parameters. Different design specifications are assumed and corresponding optimal designs are obtained.

Description: Presented at the IEEE International Symposium on Circuits and Systems (New York, May 1978). See the symposium proceedings, pp. 670-674.

Related Work: SOC-182, SOC-184, SOC-191, SOC-192, SOC-193, SOC-194.

Price: \$ 6.00.

SOC-186

NONLINEAR MODELING OF FIELD-ACCESS BUBBLE DEVICES

W. Ishak and E. Della Torre

November 1977, No. of Pages: 33

Revised:

Key Words: Bubble memories, bubble devices, bubble circuit modeling

Abstract: A model for analyzing the permalloy circuits in magnetic bubble domain field-access devices is presented. The model is numerical in nature and an iterative scheme is used to determine the magnetization distribution in the permalloy. The permalloy nonlinear characteristics are represented by an arbitrary M-H curve and the local field is computed using an accurate and efficient algorithm. The model, which includes bubble-permalloy interaction, is capable of handling any arbitrary permalloy shape in two dimensions and hence a wide variety of bubble circuits can be analyzed.

Description:

Related Work: SOC-43, SOC-116.

Price: \$ 6.00.

SOC-187

CONTINUOUS EMULSION POLYMERIZATION - MODELLING OSCILLATIONS  
IN VINYL ACETATE POLYMERIZATION

C. Kiparissides, J.F. MacGregor and A.E. Hamielec

January 1978, No. of Pages: 37

Revised:

Key Words: Emulsion polymerization, polyvinyl acetate latex,  
particle size distribution, sustained oscillations,  
continuous stirred tank reactors, modelling of latex  
reactors

Abstract Herein is reported a theoretical investigation of the emulsion polymerization of vinyl acetate in a continuous stirred tank reactor operating under conditions of sustained oscillations. Models of two levels of sophistication are developed; a comprehensive model which solves for the age distribution function of polymer particles, and a simplified model which assumes discrete nucleation periods. The latter model should find use in adaptive control of latex reactors. These models adequately simulate experimental data after Green et al. for the emulsion polymerization of vinyl acetate under conditions of sustained oscillations.

Description:

Related Work:

Price: \$ 6.00.

SOC-188

SIXTY PROBLEMS IN COMPUTATIONAL METHODS, DESIGN AND OPTIMIZATION

J.W. Bandler

January 1978, No. of Pages: 38

Revised:

Key Words: Circuit theory, circuit design, numerical methods, systems analysis, optimization, approximation

Abstract: This report was designed to supplement course material in the undergraduate courses on Computational Methods and Design in the Department of Electrical Engineering at McMaster University. The problems cover topics in analog, digital and microwave circuit design, numerical analysis, mathematical methods, matrix methods, contour plotting, sensitivity analysis, least pth and minimax approximation, nonlinear programming, frequency domain and time domain simulation, tolerance assignment, design centering and tuning. The material is heavily oriented towards automating optimal engineering design. Many problems require available computer packages for their solution.

Description:

Related Work: SOC-131, SOC-138.

Price: \$ 6.00.

SOC-189

MICROMAGNETIC MODELING OF SUBMICRON BUBBLE CIRCUITS

W. Ishak and E. Della Torre

March 1978,           No. of Pages: 33

Revised:

Key Words:           Magnetization distributions, micromagnetics, bubble memories, propagation circuits

Abstract:    A micromagnetic model for the computation of the magnetization distribution in general shapes of permalloy overlays is presented. The total energy of the permalloy, which includes interaction, demagnetizing, magnetoelastic, magnetocrystalline anisotropy and exchange terms, is minimized with respect to small variations in the magnetization. The ferromagnetic properties of the permalloy require that the magnitude of the magnetization vector is constant over each elementary subvolume in the permalloy. Only the direction of this vector is allowed to vary.

Description:

Related Work:    SOC-116 and SOC-186.

Price:           \$ 6.00.

SOC-190

NEW RESULTS IN NETWORK SIMULATION, SENSITIVITY AND TOLERANCE ANALYSIS  
FOR CASCADED STRUCTURES

J.W. Bandler, M.R.M. Rizk and H.L. Abdel-Malek

March 1978,           No. of Pages: 40

Revised:             June 1978

Key Words:           Sensitivity analysis, tolerance analysis, cascaded  
                          networks

Abstract:    An attractive, exact and efficient approach to network analysis for cascaded structures is presented. It is useful for sensitivity and tolerance analyses, in particular, for a multiple of simultaneous large changes in design parameter values. It also facilitates the exploitation of symmetry to reduce computational effort for the analysis. Responses at different loads in branched networks, which may be connected in series or in parallel with the main cascade, can be obtained analytically in terms of the variable elements. Sensitivity and large-change effects with respect to these variables can be easily evaluated. The approach is not confined to 2-port elements but can be generalized to 2p-port cascaded elements.

Description:       Presented at the IEEE International Microwave Symposium (Ottawa, Canada, June 1978). See the symposium digest.

Related Work:      SOC-184.

Price:             \$ 6.00.



SOC-191

SUBROUTINES FOR IMPLEMENTING QUADRATIC MODELS OF SURFACES IN OPTIMAL DESIGN

H.L. Abdel-Malek and J.W. Bandler

April 1978,        No. of Pages: 11

Revised:

Key Words:        Surface fitting, quadratic approximation, polynomial evaluation

Abstract: This collection of subroutines is primarily for approximating functions of many variables by quadratic polynomials as well as evaluating them. They are oriented for use in a tolerance optimization process. The quadratic approximation is obtained, exploiting sparsity, in Subroutine MODEL4. The evaluation of the resulting polynomial at the vertices of the tolerance orthotope is performed using an efficient technique.

Description:       Contains Fortran Listing, user's manual.  
The listing contains 355 cards, of which 164 are comment cards.

Related Work:     SOC-118, SOC-173, SOC-182, SOC-184, SOC-185.

Price:            \$15.00.

SOC-192

STATE EQUATION ANALYSIS AND COMPUTER PROGRAM FOR A CURRENT SWITCH  
EMITTER FOLLOWER

H.L. Abdel-Malek and J.W. Bandler

April 1978,        No. of Pages: 31

Revised:

Key Words:        Nonlinear circuit analysis, state equation formulation,  
                  integraton methods

Abstract:        The analysis of a current switch emitter follower (CSEF)  
circuit originally given by Ho is described. State equations in  
conjunction with Gear's integration method are used to obtain the output  
response.

Description:       Contains Fortran listing, user's manual.  
                  The listing contains 586 cards, of which 235 are  
                  comment cards.

Related Work:     SOC-182, SOC-184, SOC-185.

Price:            \$15.00.

SOC-193

ANALYSIS OF A CURRENT SWITCH EMITTER FOLLOWER USING THE COMPANION NETWORK APPROACH

M.R.M. Rizk

April 1978,           No. of Pages: 33

Revised:

Key Words:           Nonlinear circuit analysis, companion network formulation, integration methods

Abstract:   This report demonstrates, in a tutorial fashion, the transient analysis of a nonlinear circuit, namely a current switch emitter follower. The response obtained was checked against other responses obtained by a program which uses the state space formulation for the analysis and by SPICE2.

Description:        Contains Fortran listing, user's manual.  
                  The listing contains 336 cards, of which 68 are comment cards.  
                  There are also 79 lines of data for SPICE2.

Related Work:       SOC-182, SOC-185, SOC-192, SOC-194.

Price:             \$15.00.

SOC-194

OPTIMIZATION AND DESIGN CENTERING OF ACTIVE AND NONLINEAR CIRCUITS  
INCLUDING COMPONENT TOLERANCES AND MODEL UNCERTAINTIES

J.W. Bandler, H.L. Abdel-Malek, P. Dalsgaard, Z.S. El-Razaz  
and M.R.M. Rizk

April 1978,            No. of Pages: 32

Revised:

Key Words:            Engineering optimization, centering, tolerancing,  
                         tuning

Abstract:    Significant new results permit exploitation of general and special-purpose simulators to optimally center, tolerance and tune circuits including statistics, parasitics and model uncertainties. A nonlinear switching circuit and a tunable active filter demonstrate the procedure. The filter has been optimized in a variety of ways taking into account nonideal operational amplifiers employing both SPICE2 and a specially written analysis program. The switching circuit has been treated via the state equations, the companion network approach with results confirmed separately by SPICE2.

Description:    Presented at the International Symposium on Large Engineering Systems (Waterloo, Canada, May 1978).

Related Work:    SOC-87, SOC-105, SOC-124, SOC-182, SOC-185, SOC-191,  
                         SOC-192, SOC-193.

Price:                \$ 6.00.

SOC-195

A UNIFIED THEORY OF MODEL REDUCTION FOR LINEAR TIME INVARIANT DYNAMICAL SYSTEMS

J.D. Hickin

April 1978, No. of Pages: 163

Revised:

Key Words: Model reduction, aggregation, eigenvalue preservation, moments matching, canonical forms, Padé approximation, partial realization

Abstract: The approximation of linear, time-invariant, dynamical systems by similar systems having fewer state variables is investigated. A class of reduced-order approximants called nonminimal partial realizations is introduced which includes many published methods as special cases, and thus represents a unification of the theory of model reduction. Since the concept of linear state variable feedback is central to many of the design procedures of modern control theory, the behaviour of the approximated system to such feedback laws derived from analysis of the approximating system is studied. The specific results derived give a credibility heretofore nonexistent to the class of reduced models called minimal partial realizations by virtue of the fact that they form a subclass of the nonminimal partial realizations. The use of canonical form state equations is advocated as a means of simplifying the computational procedure for an important class of reduced models termed aggregated partial realizations. Such realizations are shown to be useful for designing suboptimal linear quadratic servomechanism compensators, since guaranteed stability of the large-scale system is possible.

Description: Ph.D. Thesis.

Related Work: SOC-61, SOC-89, SOC-107, SOC-121, SOC-129, SOC-140, SOC-164, SOC-165.

Price: \$20.00.

SOC-196

MODELING AND OPTIMIZATION OF BUBBLE MEMORY FIELD ACCESS PROPAGATION  
CIRCUITS

W.S. Ishak

April 1978,           No. of Pages: 166

Revised:

Key Words:           Bubble memories, propagation circuits, modeling,  
                          optimization, bubble size fluctuations

Abstract: The work presented in this thesis relates to one of the most important problems in the design of high-density, high-speed bubble memory systems. A new approach for the analysis, design and optimization of bubble circuits is developed. This formulation is suited to computer-aided methods of solution.

A micromagnetic approach to the modeling of permalloy bubble circuits is examined. This method of analysis is very useful in studying submicron bubble circuits. However, the excessive computer time required for such analysis led to careful consideration of possible approximations. A continuum model for analyzing field access bubble circuits has, thus, been developed and used to characterize arbitrary shaped permalloy structures. Various propagation circuits, including gap tolerant circuits, and bubble replicators are analyzed and the results compared to experimentally available data. A model for studying bubble size and position fluctuations is introduced. The model assumes that the bubble domain is circular. However, with slight modifications it can accept general elliptical shapes. For various propagation circuits, the model results are in excellent agreement with experimental measurements in the literature.

An algorithm for bubble circuit optimization is developed and discussed in detail. The problem is formulated as a constrained minimax objective which is suited to nonlinear programming methods of solution. Typical examples of T-I propagation circuits are furnished to illustrate the approach.

Description:        Ph.D. Thesis.

Related Work:      SOC-116, SOC-186, SOC-189.

Price:             \$50.00.

SOC-197

STEADY STATE SOLUTION OF THE MATRIX RICCATI EQUATION

H.L. Abdel-Malek

April 1978,        No. of Pages: 34

Revised:

Key Words:        Linear optimal control, linear regulators, quadratic  
matrix equations

Abstract: A brief review of methods proposed for solving the matrix Riccati equation is given. A FORTRAN listing of a computer program based on Kleinman iterative technique is included. It is shown how to formulate the system of simultaneous linear equations to be solved in the Kleinman method. Some illustrative examples are also given.

Description:       Contains Fortran listing, user's manual.  
The listing contains 474 statements of which 137 are  
comment cards.

Related Work:     SOC-121.

Price:             \$30.00.

SOC-198

FIRST- AND SECOND-ORDER EIGENVALUE SENSITIVITIES OF AGGREGATED MODELS

N.K. Sinha and Z. Elrazaz

May 1978,            No. of Pages: 16

Revised:

Key Words:            Eigenvalue sensitivities, aggregated models

Abstract: Analytical expressions are derived for first- and second-order eigenvalue sensitivities of aggregated models with respect to the parameters of the original high-order system. It is shown that these sensitivities are identical with the corresponding sensitivities of the original system and independent of the choice of the aggregation matrix. A numerical example is included to illustrate the results.

Description:           Shorter version published as a letter in Proc. IEEE.

Related Work:        SOC-129, SOC-140.

Price:                \$ 6.00.



SOC-199

LOCAL AND GLOBAL CONTROLLERS USING DECENTRALIZED CONTROLLABLE CANONICAL  
FORM

Z. Elrazaz and N.K. Sinha

May 1978,            No. of Pages: 11

Revised:

Key Words:            Decentralized control, large-scale systems

Abstract:    Decentralized controllable canonical form is used to stabilize decentralized large-scale system by assigning local and global controllers in a very simple way. A numerical example is also presented.

Description:

Related Work:    SOC-32, SOC-57, SOC-61.

Price:                \$ 3.00.

SOC-200

A UNIFIED THEORY OF MODEL REDUCTION FOR LINEAR MULTIVARIABLE SYSTEMS

J. Hickin and N.K. Sinha

May 1978,            No. of Pages: 44

Revised:

Key Words:            Unified theory, aggregation, model reduction

Abstract: A theory of model reduction for linear multivariable systems is developed which represents a unification of much existing literature. A powerful analytical framework allows the design of compensators for large scale systems based on consideration of the reduced order model. The reduction method, termed nonminimal partial realization, is shown to encompass the methods of aggregation (or eigenvalue preservation), moments matching (Pade type approximation about more than one point), and Routh approximation. The method of singular perturbations for the linear case is also shown to be related. A promising subclass of reduced models, termed aggregated partial realizations, is treated in detail. This reduction technique is applied to the design of a suboptimal compensator for the linear quadratic servomechanism problem for a multivariable system of order 33.

Description:

Related Work:        SOC-107, SOC-140, SOC-195.

Price:                \$ 6.00.

SOC-201

IDENTIFICATION AND MODELING FOR LINEAR MULTIVARIABLE DISCRETE-TIME  
SYSTEMS: A SURVEY

H. El-Sherief and N.K. Sinha

May 1978,            No. of Pages: 35

Revised:

Key Words:            Identification, multivariable systems, survey

Abstract: A survey is presented of the existing literature on the identification of linear multivariable discrete-time systems from input-output data. The existing algorithms are classified according to the model used in the identification problem and a comparison is made between the different models. Emphasis is given to on-line algorithms for the identification from noisy data. Some new ideas for solving the problem are also presented.

Description:

Related Work:        SOC-130, SOC-162, SOC-202, SOC-203.

Price:                \$ 6.00.

SOC-202

ALGORITHM FOR IDENTIFICATION OF MULTIVARIABLE SYSTEMS COMBINING  
STOCHASTIC APPROXIMATION AND PSEUDO-INVERSE

H. El-Sherief and N.K. Sinha

May 1978,            No. of Pages: 10

Revised:

Key Words:            Identification, multivariable systems, stochastic  
                         approximation, pseudo-inverse

Abstract:    A new algorithm is proposed for on-line identification of  
linear, multivariable, discrete-time systems from noisy data. This  
algorithm combines stochastic approximation with the recursive least-  
squares method. The results of a simulated example indicate that the  
proposed algorithm provides good estimates.

Description:        To be published in Automatic Control Theory and  
                         Applications.

Related Work:        SOC-162, SOC-163, SOC-170, SOC-201, SOC-203.

Price:                \$ 3.00.



SOC-204

SYNTHESIS OF OPTIMAL INPUT SIGNALS FOR SYSTEM IDENTIFICATION

B. Kuszta and N.K. Sinha

May 1978,            No. of Pages: 12

Revised:

Key Words:            Optimal inputs, system identification

Abstract: A procedure for designing the optimal input signal for the identification of the parameters of a linear system is described. This procedure is easily implemented in practice.

Description:           Shorter version presented at 9th Pittsburgh Conf. on Modeling and Simulation (Pittsburgh, April 1978).

Related Work:        SOC-104, SOC-106.

Price:                \$ 3.00.

SOC-205

SOME STOCHASTIC MODELLING TECHNIQUES AND THEIR APPLICATIONS

N.K. Sinha and T. Prasad

June 1978,            No. of Pages: 17

Revised:

Key Words:            Modelling, forecasting

Abstract: Several different types of stochastic models for estimation and forecasting have been described. The presentation is fairly general so as to be useful to applied scientists from different fields. The methods used for validation and diagnostic checks of the models have also been discussed. The formulae can even be implemented on a programmable pocket calculator. As an example of the procedure, twelve different models are obtained for predicting the annual flow of the Nile river at Aswan Dam, based on data obtained for the period 1903 to 1944.

Description: Shorter version presented at the 9th Pittsburgh Conference on Modeling and Simulation (Pittsburgh, April 1978). Published in J. Applied Mathematical Modeling.

Related Work:        SOC-38.

Price:                \$ 3.00.

SOC-206

AN EFFICIENT APPROACH FOR DYNAMIC STABILITY ANALYSIS OF POWER SYSTEMS -  
INCLUDING LOAD EFFECTS

H.M. Zein El-Din

June 1978,            No. of Pages: 209

Revised:

Key Words:            Power systems, dynamic stability, state space  
                          formulation, load effects, load representation,  
                          eigenanalysis, second-order sensitivities

Abstract:            Dynamic (small) signal stability of multimachine power  
systems is considered. Efficient techniques for modeling and analysing  
this class of stability are developed.

System dynamics are analysed using eigenvalue methods. Eigenvalue  
sensitivity techniques are developed and employed for stability  
predictions. The relationships between different mode dynamics and  
components in the system are investigated.

These computational techniques are applied to a number of practical  
problems - in particular situations involving insufficient damping  
torques due to system composite loads and control interactions,  
subsynchronous resonance and dynamic induction motor loads.

Description:            Ph.D. Thesis.

Related Work:            SOC-44, SOC-123, SOC-129.

Price:                 \$30.00.



SOC-207

A PROGRAM FOR ANALYSIS OF BUBBLE CIRCUITS: A USER'S MANUAL

W. Ishak and E. Della Torre

June 1978,           No. of Pages: 68

Revised:

Key Words:           Bubble memories, propagation circuits, circuit modeling

Abstract:   This report describes a computer program primarily for modeling and analysis of permalloy field access bubble propagation circuits. Its main features include: the computation of the potential well profile of an arbitrary shaped permalloy overlay and the effect of bubble size fluctuations. The program has been used on a CDC-6400 computer (using 60 bit words) to analyze various circuits such as: T-I, Y-I, half-disks and chevrons. Two examples are used to illustrate the use of the program.

Description:       Contains Fortran listing, user's manual.

Related Work:     SOC-186.

Price:            \$50.00.

SOC-208

DISOPT3 - A USER-ORIENTED PACKAGE FOR NONLINEAR CONTINUOUS AND DISCRETE  
OPTIMIZATION PROBLEMS

J.W. Bandler and D. Sinha

June 1978,            No. of Pages: 7

Revised:

Key Words:            Engineering optimization, nonlinear programming,  
discrete optimization, least pth optimization, branch  
and bound method, computer programs

Abstract: A package of FORTRAN subroutines called DISOPT3 for solving continuous and discrete, constrained or unconstrained general optimization problems is presented. The method used for arriving at the discrete solution involves conversion of the original constrained problem into a minimax problem by the Bandler-Charalambous technique, solving the continuous minimax problem using a recent least pth algorithm by Charalambous, Fletcher's 1972 method for unconstrained minimization and the Dakin branch and bound technique to generate the additional constraints.

Description:           Proc. Twenty-first Midwest Symposium on Circuits and  
Systems (Ames, Iowa, Aug. 1978).

Related Work:        SOC-174.

Price:                \$ 3.00.

SOC-209

ALGORITHMS FOR DESIGN CENTERING INVOLVING YIELD AND ITS SENSITIVITIES

J.W. Bandler and H.L. Abdel-Malek

June 1978,            No. of Pages: 7

Revised:

Key Words:            Yield analysis, design centering, tolerance assignment,  
                         multidimensional approximation

Abstract:    This paper reviews the approach to design centering and optimal assignment of component tolerances adopted by the authors. In particular, this paper surveys suitable algorithms for carrying out yield optimization involving explicit formulas for evaluating yield and its sensitivities with respect to the designable parameters. Examples and available programs are referenced. A comparison with the simplicial approximation is attempted.

Description:    Proc. Twenty-first Midwest Symposium on Circuits and Systems (Ames, Iowa, Aug. 1978).

Related Work:    SOC-182, SOC-184, SOC-185, SOC-190, SOC-191, SOC-192,  
                         SOC-193, SOC-194.

Price:                \$ 3.00.

SOC-210

ADVANCES IN THE MATHEMATICAL PROGRAMMING APPROACH TO DESIGN CENTERING,  
TOLERANCING AND TUNING

J.W. Bandler and H.L. Abdel-Malek

July 1978,            No. of Pages: 16

Revised:

Key Words:            Engineering design, optimization, tolerance assignment,  
                         tuning

Abstract: The nonlinear programming approach to the optimal worst-case assignment of parameter tolerances along with design centering taken by Bandler and extended to include tuning by Bandler, Liu and Tromp is reviewed. This work was directed at worst-case design in which, after tuning if necessary, all design outcomes must not fail to meet the specifications. A logical further extension by the present authors which relaxes the requirement of 100% yield is also outlined. Exact descriptions of the boundary of the constraint region via a generalized function of the least pth type are discussed. Consideration of such a function leads to new results applicable to postproduction tuning. Here, a tolerance problem equivalent to the tolerance and tuning problem of Bandler and Liu is presented. Based on this equivalence a mathematical definition of postproduction yield is developed and interpreted.

Description:           Presented at the Joint Automatic Control Conference  
                         (Philadelphia, PA, Oct. 1978).

Related Work:        SOC-182, SOC-184, SOC-185, SOC-194, SOC-209, SOC-211.

Price:                \$ 6.00.

SOC-211

CENTERING, TOLERANCING, TUNING AND MINIMAX DESIGN EMPLOYING BIQUADRATIC MODELS

H.L. Abdel-Malek and J.W. Bandler

July 1978,            No. of Pages: 32

Revised:            September 1978

Key Words:        Design centering, tolerancing, tuning, minimax design, biquadratic functions, one-dimensional optimization

Abstract:        This paper exploits the biquadratic behaviour w.r.t. a variable exhibited in the frequency domain by certain lumped, linear circuits. Boundary points of the constraint region of acceptable designs are explicitly calculated w.r.t. any such variable at any sample point in the frequency domain. An algorithm to exactly determine the constraint region itself for the general nonconvex case is presented and illustrated. This type of analysis leads to the determination of circuit tunability and to decisions on design center and tolerance assignment. A globally convergent and extremely efficient minimax algorithm is developed and tested to optimize the frequency response w.r.t. any circuit parameter.

Description:

Related Work:    SOC-37, SOC-87, SOC-182, SOC-194, SOC-210.

Price:            \$ 6.00.

SOC-212

REDUCTION OF HIGH-ORDER LINEAR SYSTEMS: A CRITICAL SURVEY

N.K. Sinha

July 1978,            No. of Pages: 14

Revised:

Key Words:            Model reduction, aggregation, approximation

Abstract: Various methods for obtaining low-order models for high-order linear dynamic systems are discussed, along with their possible application to estimation and control.

Description:            A shorter version to be presented at the 21st Midwest Symposium on Circuits and Systems (Ames, Iowa, Aug. 1978).

Related Work:            SOC-22, SOC-25, SOC-107, SOC-140, SOC-164, SOC-195, SOC-200.

Price:                 \$ 3.00.

SOC-213

SOME SYSTEM THEORY APPLICATIONS OF EGERVARY'S ALGORITHM FOR  
TRANSFORMATION OF A MATRIX TO THE HERMITE NORMAL FORM

N.K. Sinha

July 1978,            No. of Pages: 14

Revised:

Key Words:            Hermite normal form, applications to systems

Abstract: Egerváry's outer product algorithm for the transformation of a matrix to the Hermite normal form is reviewed. Four applications of this algorithm to system theory are described. These are (1) minimum realization of a transfer function matrix in the state space form, (2) transformation of state equations to canonical forms, (3) reduction of high-order systems by partial realization, and (4) determination of controllability and observability of large scale composite systems.

Description:            Text of lecture given in Budapest on May 26, 1978 at the invitation of the Bolyai Janos Mathematical Society, and to be published by the Society.

Related Work:            SOC-32, SOC-57, SOC-61, SOC-89, SOC-165, SOC-175, SOC-195.

Price:                 \$ 3.00.





SOC-215

ANALYSIS OF GAP TOLERANT BUBBLE CIRCUITS

W. Ishak and E. Della Torre

August 1978,      No. of Pages: 18

Revised:

Key Words:          Bubble memories, modeling, bias margins

Abstract:    A technique is presented for the analysis of bubble propagating circuits using a numerical model previously discussed. Various gap tolerant bubble circuits are analyzed using this model and potential well profiles are plotted. The analysis of these circuits clearly shows the advantages of the asymmetrical structure over the symmetrical ones. By postulating the various failure modes, bias margins are computed which are in good agreement with experimental results.

Description:

Related Work:      SOC-207.

Price:              \$ 6.00.

SOC-216

A NEW APPROACH FOR DESIGNING STATE FEEDBACK REGULATORS FOR DISCRETE  
TIME MULTIVARIABLE SYSTEMS

A.K. Mahalanabis, N.K. Sinha and S. Varshney

August 1978,      No. of Pages: 26

Revised:

Key Words:            Regulators, state feedback, multivariable systems,  
discrete-time systems

Abstract: This paper presents a new technique for designing stationary state feedback control for linear time invariant discrete time multivariable systems. Two canonical forms of state variable representation are utilized along with a model output (which contains the actual output in the sense defined by Davison [1]). It is shown that the pole positioning state feedback control law can be significantly generalized to achieve better control. The proposed design technique is illustrated by considering the problem of regulator design for a synchronous machine with two axis excitation.

Description:           Presented at the Joint Automatic Control Conference  
(Philadelphia, PA, Oct. 1978).

Related Work:        SOC-165, SOC-168, SOC-172, SOC-176.

Price:                \$ 6.00.

SOC-217

ALGORITHMS FOR TOLERANCE AND SECOND-ORDER SENSITIVITIES OF CASCADED STRUCTURES

J.W. Bandler and M.R.M. Rizk

October 1978, No. of Pages: 27

Revised:

Key Words: Sensitivity analysis, tolerance analysis, cascaded networks

Abstract: An exact and efficient approach to network analysis for cascaded structures has been suggested by Bandler et al. They demonstrated that it is useful for sensitivity and tolerance analyses, in particular, for a multiple of simultaneous large changes in design parameter values. This paper extends their work to second-order sensitivities, as well as to the evaluation of the response and its first-order sensitivity at the vertices of a tolerance region located in the space of toleranced design parameters. This information is needed in a worst-case search algorithm for design centering and tolerance assignment. A substantial saving in computational effort is achieved by using the new approach over the basic approach of reanalyzing the circuit at every vertex.

Description:

Related Work: SOC-190.

Price: \$ 6.00.

SOC-218

FLOPT5 - A PROGRAM FOR MINIMAX OPTIMIZATION USING THE ACCELERATED LEAST  
PTH ALGORITHM

J.W. Bandler and D. Sinha

December 1978, No. of Pages: 92

Revised:

Key Words: Unconstrained optimization, gradient minimization  
methods, penalty function methods, least pth  
optimization, minimax optimization, multiplier methods

Abstract: FLOPT5 is a package of subroutines primarily for solving  
least pth optimization problems. Its main features include Fletcher's  
quasi-Newton subroutine, a least pth objective formulation subroutine  
and the recent Charalambous least pth algorithm designed specifically  
for minimax problems. With appropriate utilization of these features,  
the program can solve a wide variety of optimization problems. These  
may range from unconstrained problems, problems subject to inequality or  
equality constraints to nonlinear minimax approximation problems. The  
program has been developed on a CDC 6400 computer. Some detailed  
examples of varying complexity are used to illustrate the versatility of  
the program. A FORTRAN IV listing is included. FLOPT5 may be regarded,  
from the user's point of view, as an upgraded FLOPT4, a previous  
package. Some results of performance comparison with FLOPT4 are also  
included.

Description: Contains Fortran listing, user's manual.  
Source deck available for \$100.00.  
The listing contains 777 cards of which 280 are  
comments.

Related Work: SOC-151, SOC-174.

Price: \$80.00.

SOC-219

OPTIMAL ASSIGNMENT OF GENERATION TOLERANCES AND COST REDUCTION IN POWER  
SYSTEM EXPANSION PLANNING

J.W. Bandler and M.A. El-Kady

December 1978, No. of Pages: 8

Revised:

Key Words: Power system planning, tolerance assignment, economic  
dispatch, design centering, optimization methods

Abstract: A formulation of the generation expansion planning problem in  
the form of a tolerance assignment problem is presented. The general  
features of the approach are discussed. The principle of a combined  
tolerance/generation cost problem is stated. The inclusion of other  
aspects to achieve generality of the formulation is discussed. A new  
package called FLOPT5 is used to produce the numerical results.

Description:

Related Work: SOC-87, SOC-183, SOC-218.

Price: \$ 3.00.

SOC-220

THIRD- AND HIGHER-ORDER EIGENVALUE SENSITIVITIES APPLIED TO POWER SYSTEM DYNAMICS

Z. Elrazaz and N.K. Sinha

January 1979, No. of Pages: 23

Revised:

Key Words: Eigenvalue sensitivity, large parameter variations, applications to power systems, dynamic stability

Abstract: A new method that enables the calculation of the third- and higher-order eigenvalue sensitivities with respect to actual system parameters is described. The practical importance of the technique is illustrated using simple examples. The new method requires only small additional computational effort.

Description:

Related Work: SOC-123, SOC-129, SOC-198.

Price: \$ 6.00.

SOC-221

A COLLECTION OF COMPUTER PROGRAMS FOR OPTIMIZATION

A. Husain, Ed.

January 1979, No. of Pages: 196

Revised:

Key Words: Search methods, gradient methods, linear programming, dynamic programming, maximum principle, penalty functions

Abstract: Several tested computer programs (written in FORTRAN) for applying various methods of function and functional optimization are listed in this monograph. A number of these are general purpose programs to be supplied with a user written subroutine for evaluating the objective function of his choice, while a few are specific programs developed for computing control policies in typical chemical engineering problems. Collectively, they contain a vast amount of numerical effort and provide the user with the benefit of all such experience in the applications of linear/nonlinear, constrained and unconstrained, multidimensional as well as multistage optimization techniques.

The listings are preceded by a short description of each method along with its algorithm. Several examples are included. In a few cases, sample inputs and outputs are also listed.

Description: Contains Fortran listings, user's manual.

Related Work:

Price: \$50.00.

SOC-222

MICROCOMPUTER-BASED ON-LINE STATE-ESTIMATION (Part I)

S. Law and N.K. Sinha

January 1979, No. of Pages: 36

Revised:

Key Words: State estimation, microcomputer applications, adaptive filter, Luenberger observer

Abstract: On-line state estimation of linear, time-invariant, discrete system using observer is reported. The system under consideration can be completely deterministic or stochastic in nature. The estimation scheme uses the inputs and outputs of the system only.

For completely deterministic systems, the approach due to Luenberger is used. In the case of stochastic systems, the scheme consists of Luenberger observer and adaptive filtering in tandem. Such a cascaded system is shown to be stable. Simulations for a second-order single-input-single-output, linear, time-invariant are shown using Intel's MDS-800 microcomputer.

This report consists of two parts. Part I deals with the theoretical aspect of the observer, whereas Part II contains the program documentation in Intel's 8080 Assembly Language.

Description:

Related Work: SOC-86, SOC-121, SOC-139, SOC-223.

Price: \$ 6.00.



SOC-223

MICROCOMPUTER-BASED ON-LINE STATE-ESTIMATION (Part II)

S. Law and N.K. Sinha

January 1979, No. of Pages: 126

Revised:

Key Words: State estimation, microcomputer applications, adaptive filter, Luenberger observer

Abstract: This report documents the programs for the simulation of the Luenberger observer for a second order, SISO, linear time-invariant system as documented in Part I. The programs are written in Intel 8080 Assembly Language with relocatable capability. Programs (source) are available in diskette.

Description:

Related Work: SOC-86, SOC-121, SOC-139, SOC-222.

Price: \$25.00.

SOC-224

REDUCED-ORDER DYNAMIC MODELS OF LARGE-SCALE POWER SYSTEMS

N.K. Sinha and Z. Elrazaz

January 1979, No. of Pages: 20

Revised:

Key Words: Power systems, model reduction, aggregation, nth-order eigenvalue sensitivities, large-scale systems

Abstract: Reduced-order dynamic models of large-scale power systems have been considered. The aggregation method, combined with the sensitivities of the critical eigenvalues to parameter variations provides a good insight into the dynamic behaviour of the system. It is shown that for aggregated models, the nth-order eigenvalue sensitivities are identical to those of the original system. An example of a fifteenth-order single-machine model is included.

Description: To be presented at the IFAC Symposium on Computer Applications in Large Scale Power Systems (New Delhi, India, August 1979).

Related Work: SOC-123, SOC-200, SOC-212.

Price: \$ 6.00.

SOC-225

DETERMINATION OF THE STRUCTURE OF A CANONICAL MODEL FOR THE  
IDENTIFICATION OF LINEAR MULTIVARIABLE SYSTEMS

H. El-Sherief and N.K. Sinha

January 1979, No. of Pages: 19

Revised:

Key Words: Multivariable systems, identification, structure  
determination

Abstract: An algorithm is presented for determining the structural parameters of a canonical form which has been used much for the identification of linear multivariable discrete-time systems. The cases of noise-free as well as noisy data are considered. The algorithm utilizes the residual error technique and does not need the knowledge of the noise characteristics. The proposed algorithm is applied to the identification of simulated examples with different noise levels.

Description: To be presented at the 5th IFAC Symposium on Identification and System Parameter Estimation (Darmstadt, W. Germany, Sept. 1979).

Related Work: SOC-79, SOC-130, SOC-163, SOC-178, SOC-180, SOC-201, SOC-202, SOC-203, SOC-226.

Price: \$ 3.00.

SOC-226

ON-LINE IDENTIFICATION OF LINEAR DISCRETE-TIME MULTIVARIABLE SYSTEMS

H. El-Sherief and N.K. Sinha

January 1979, No. of Pages: 22

Revised:

Key Words: Multivariable systems, identification, transfer function models, discrete-time systems

Abstract: A recursive algorithm is presented for identifying linear discrete-time multivariable systems from the input-output data which may be contaminated with noise. The system is represented in the form of a transfer function matrix, and decomposed into subsystems corresponding to each row. The proposed algorithm is based on determining the order of each subsystem utilizing the residual error technique. This is followed by estimation of parameters using a recursive adaptive least squares algorithm. Results of simulation are included.

Description:

Related Work: SOC-79, SOC-130, SOC-163, SOC-178, SOC-180, SOC-201, SOC-202, SOC-203, SOC-225.

Price: \$ 3.00.

SOC-227

ON THE DECENTRALIZED STABILIZATION OF CONTROL SYSTEMS VIA PARTIAL MODAL  
CONTROL AND EIGENVALUE SENSITIVITIES

Z. Elrazaz and N.K. Sinha

January 1979, No. of Pages: 11

Revised:

Key Words: Decentralized stabilization, local state feedback,  
global state feedback, partial modal control, large-  
scale systems, eigenvalue sensitivities

Abstract: A new approach for designing local and global state feedback  
for decentralized stabilization of large-scale systems via partial modal  
control, and eigenvalue sensitivities is described. This approach can  
handle the constraints on the gain vectors as well as the direction of  
information flow between the subsystems. Examples are included to  
illustrate the procedure.

Description: A shorter version was presented at the 16th Annual  
Allerton Conference on Communications, Control and  
Computing (Urbana, IL, Oct. 1978).

Related Work: SOC-129, SOC-198, SOC-199.

Price: \$ 3.00.

SOC-228

THE IMPACT OF GENERALIZED SYMMETRY ON COMPUTER-AIDED DESIGN OF CASCADED STRUCTURES

J.W. Bandler, R.M. Biernacki and M.R.M. Rizk

Janaury 1979, No. of Pages: 3

Revised:

Key Words: Cascaded structures, computer-aided design, sensitivity evaluation, symmetry, optimization

Abstract: New theoretical and computational tools are presented which deal with generalized symmetry concepts related to the computer-aided design of cascaded structures. The presentation includes the computational implications of networks consisting of symmetrically located reverse adjoint subnetworks with and without scaling, as well as antisymmetry. Formulas presented are designed to be used in simulation, sensitivity and tolerance analyses as well as in optimal design.

Description: Presented at the IEEE International Microwave Symposium (Orlando, FL, Apr.-May 1979).

Related Work: SOC-190, SOC-217, SOC-219.

Price: \$ 3.00.

SOC-229

PROOF OF GLOBAL CONVERGENCE AND RATE OF CONVERGENCE FOR A  
ONE-DIMENSIONAL MINIMAX ALGORITHM

H.L. Abdel-Malek, J.W. Bandler and R.M. Biernacki

February 1979, No. of Pages: 20

Revised:

Key Words: Design centering, tolerancing, tuning, minimax design,  
biquadratic functions, one-dimensional optimization

Abstract: This report studies the convergence properties of the one-dimensional minimax algorithm developed by Abdel-Malek and Bandler to handle biquadratic functions. It is shown, as expected, that the algorithm converges from any set of starting conditions. Furthermore, under mild conditions we show that the rate of convergence is at least of second order. The rare case when the minimax solution is defined by functions whose derivatives vanish at that solution is considered in some detail. Minor modifications to improve the algorithm are suggested.

Description:

Related Work: SOC-211.

Price: \$ 6.00.

SOC-230

MODELLING AND SIMULATION OF POWER SYSTEMS FOR DYNAMIC ANALYSIS

Z. Elrazaz and N.K. Sinha

July 1979,            No. of Pages: 20

Revised:

Key Words:            Dynamic analysis, eigenvalue sensitivities, optimal  
                         parameter setting, modelling precision

Abstract: The adequacy of linear models of power systems for dynamic analysis is considered. The effect of variations in parameters is studied through higher-order sensitivities of the critical eigenvalues. This allows accurate mode identification, optimal parameter setting and determination of modelling precision. As an example, a single synchronous machine model, including the exciter and the governor, connected to an infinite bus, is analyzed. This model utilizes a recent approach (Anderson 1977) based on orthogonal transformation and the choice of base quantities for both the stator and the rotor which introduces considerable simplification in modelling as well as simulation.

Description:           Presented at the IFAC Symposium on Computer  
                         Applications to Large-Scale Power Systems (New Delhi,  
                         India, Aug. 1979)

Related Work:        SOC-220, SOC-224, SOC-227.

Price:                \$ 6.00.



SOC-231

ON IDENTIFICATION OF LINEAR SYSTEMS WITH FEEDBACK: HIGH GAIN FEEDBACK  
CASE

B. Kuszta and N.K. Sinha

July 1979,            No. of Pages: 10

Revised:

Key Words:            Feedback systems, identification, high-gain feedback,  
design of optimal input signal, two time-scale systems

Abstract: The design of optimal input signals for the identification of linear systems with feedback is considered for the case when the loop gain is large. The latter condition permits simplification of the description of the complete system and leads to a practical procedure for the design of the optimal input signal. Results of application to a diffusion furnace are included.

Description:

Related Work:        SOC-104, SOC-106, SOC-224.

Price:                \$ 3.00.

SOC-232

ADVANCES IN SIMULATION AND OPTIMIZATION OF ELECTRICAL NETWORKS

M.R.M. Rizk

August 1979, No. of Pages: 224

Revised:

Key Words: Simulation, optimization, analysis, sensitivity, centering, tolerancing, tuning, transmission-line modeling, general simulators, cascaded networks

Abstract: This thesis addresses itself to two main veins of computer-aided design of electrical networks, namely, simulation and optimization. A critical review of the state of the art in simulation approaches to networks for analysis and sensitivity evaluation, design concepts and optimization algorithms, is presented. A new approach for the simulation and design of lumped networks in the time domain is presented. The approach is based on the transmission-line matrix method of numerical analysis. The exploitation of general simulators which can be used as a tool in the integrated design process of electrical networks is given with specific examples. A new approach for the analysis and design of cascaded networks has been developed. This approach proves to be efficient and very useful for sensitivity and tolerance analysis. The approach has also been generalized to 2p-port cascaded networks.

Description: Ph.D. Thesis.

Related Work: SOC-1, SOC-113, SOC-177, SOC-183, SOC-190, SOC-193, SOC-194, SOC-217.

Price: \$30.00.

SOC-233

POSTPRODUCTION TUNING AND FAULT LOCATION OF ANALOG CIRCUITS

R.M. Biernacki and J.W. Bandler

August 1979, No. of Pages: 83

Revised:

Key Words: Fault analysis, parameter identification, network element-value solvability, tuning, computer aided design

Abstract: This report deals principally with two problems: postproduction identification of network parameters and fault detection for linear analog circuits. A number of different approaches are discussed and several methods proposed. The methods are based on measurements of voltage using mainly current excitations. The capabilities and limitations of these approaches are investigated and partially solved. Some unsolved problems are also indicated. Finally, some topics related to postproduction tuning are briefly discussed.

Description:

Related Work: SOC-65, SOC-124, SOC-183, SOC-194, SOC-210, SOC-214.

Price: \$12.00.

SOC-234

A NEW, A.C. APPROACH TO POWER SYSTEM SENSITIVITY ANALYSIS AND PLANNING

J.W. Bandler and M.A. El-Kady

September 1979, No. of Pages: 9

Revised:

Key Words: Power system analysis, network planning, sensitivity analysis, optimal load flow, contingency analysis, Tellegen's theorem

Abstract: This paper presents an approach for sensitivity analysis and gradient evaluation required in power system analysis and planning. The approach utilizes Tellegen's theorem in an augmented form which allows different power system problems to be handled based on the a.c. power flow model in general and without any approximations.

The approach provides the flexibility of including line responses directly while preserving the advantages of compactness, sparsity and simplicity of the adjoint system. Numerical results are presented for illustration and comparison.

Description:

Related Work: SOC-237, SOC-238.

Price: \$ 3.00.

SOC-235

POSTPRODUCTION PARAMETER IDENTIFICATION OF ANALOG CIRCUITS

R.M. Biernacki and J.W. Bandler

September 1979, No. of Pages: 38

Revised:

Key Words:       Fault analysis, parameter identification, network  
                  element-value solvability, tuning, computer aided  
                  design

Abstract:       This paper deals with postproduction identification of  
network parameters for linear analog circuits. Methods for selected as  
well as for the identification of all parameters are discussed.  
Generalized hybrid equivalents are used to check whether identification  
of selected parameters can be carried out. The methods are based on  
measurements of voltage using mainly current excitations. Tests are  
assumed to be performed at a single frequency. The well known nodal  
approach is used to formulate the appropriate systems of equations for  
identification of all parameters for passive as well as active circuits.  
A ladder network example is studied in some detail. The capabilities  
and limitations of the approaches are investigated and partially solved.  
Some unsolved problems are also indicated.

Description:

Related Work:    SOC-233, SOC-236.

Price:           \$ 6.00.

SOC-236

FAULT LOCATION OF ANALOG CIRCUITS

R.M. Biernacki and J.W. Bandler

September 1979, No. of Pages: 31

Revised:

Key Words:           Fault analysis, testing, circuit theory, computer aided design

Abstract:   This paper deals with fault detection for linear analog circuits. The described methods are based on measurements of voltage using current excitations and have been developed for the location of single as well as for multiple faults. They utilize certain algebraic invariants of faulty elements. Computationally, they depend on checking the consistency or inconsistency of suitable sets of linear equations. The equations themselves are formulated via adjoint circuit simulations.

Description:

Related Work:    SOC-233, SOC-235.

Price:           \$ 6.00.

SOC-237

A UNIFIED APPROACH TO POWER SYSTEM SENSITIVITY ANALYSIS AND PLANNING  
PART I: FAMILY OF ADJOINT SYSTEMS

J.W. Bandler and M.A. El-Kady

September 1979, No. of Pages: 46

Revised:

Key Words: Power system analysis, adjoint networks, Tellegen's theorem, sensitivity analysis, conjugate notation, optimal load flows

Abstract: Efficient sensitivity analysis and gradient evaluation, essential in power system studies such as optimal power flow, contingency analysis and planning, is the subject of this paper. We present an approach based upon a generalized adjoint network concept. It exploits all the powerful features of Tellegen's theorem by suitable extensions through which the a.c. load flow model can be used without any approximations. We introduce the conjugate notation used in formulating the Tellegen expressions for general complex functions. We also introduce the concept of group terms which facilitate control of the adjoint system so that a wide variety of particular cases can be handled. We derive and tabulate standard sensitivity expressions common to all relevant power system studies.

Description:

Related Work: SOC-234, SOC-238.

Price: \$ 6.00.

SOC-238

A UNIFIED APPROACH TO POWER SYSTEM SENSITIVITY ANALYSIS AND PLANNING  
PART II: SPECIAL CLASS OF ADJOINT SYSTEMS

J.W. Bandler and M.A. El-Kady

September 1979, No. of Pages: 33

Revised:

Key Words: Power system analysis, adjoint networks, Tellegen's theorem, sensitivity analysis, optimal load flows, contingency analysis

Abstract: A unified approach to power system sensitivity analysis and planning has been presented in a companion paper, where a family of adjoint systems based on the exact a.c. power flow model was described. Here, we consider a class of this family in which the extended Tellegen sum is a real quantity. An important practical case is discussed in which the adjoining complex coefficients are set to particular values, which result in an adjoint system of a special structure. The adjoint matrix of coefficients is shown to be of the same size and sparsity as the Jacobian matrix of the original power network. The required sensitivity expressions are derived and tabulated for direct use in sensitivity analysis and gradient evaluation and are common to all relevant power system studies. Numerical examples are presented based on a 6-bus sample power system.

Description:

Related Work: SOC-234, SOC-237.

Price: \$ 6.00.



SOC-239

IDENTIFICATION OF LINEAR MULTIVARIABLE DISCRETE-TIME SYSTEMS

H.E. El-Sherief

September 1979, No. of Pages: 163

Revised:

Key Words: System identification, multivariable systems, canonical forms, least squares, stochastic approximation, combined state and parameter estimation, structure determination

Abstract: The problem of on-line identification of linear multivariable discrete-time systems from input-output data is considered. A study has been made of the relative effectiveness of the four different models used in the area of identification of linear multivariable systems (transfer-function matrix, impulse response matrix, input-output difference equation and state space). The features of each model and its effect on the complexity of the identification algorithm as well as the bias of the parameter estimates while using the ordinary least-squares method have been studied. Different on-line algorithms have been proposed for the identification of the given system directly in each of the four different model representations. These algorithms estimate the parameters of the system from noisy measurements and no knowledge of the noise characteristics is required. The identification of a given multivariable system has been decomposed into the identification of  $m$  subsystems (where  $m$  is the number of outputs) and the parameters of each subsystem are estimated independently from each other. The problem of structure determination has been considered, and algorithms have been proposed for the estimation of the structural parameters of the transfer-function matrix and the state space representations from noise-free as well as noisy measurements. Also, a two-stage bootstrap algorithm has been derived for combined parameter and state estimation of linear multivariable systems.

Description: Ph.D. Thesis.

Related Work: SOC-79, SOC-162, SOC-163, SOC-170, SOC-180, SOC-201, SOC-202, SOC-203, SOC-225, SOC-226.

Price: \$20.00.

SOC-240

A ONE-DIMENSIONAL MINIMAX ALGORITHM BASED ON BIQUADRATIC MODELS AND ITS APPLICATION IN CIRCUIT DESIGN

H.L. Abdel-Malek, J.W. Bandler and R.M. Biernacki

November 1979, No. of Pages: 36

Revised:

Key Words: Design centering, tolerancing, tuning, minimax design, biquadratic functions, one-dimensional optimization

Abstract: This paper exploits the biquadratic behaviour w.r.t. a variable exhibited in the frequency domain by certain lumped, linear circuits. A globally convergent and extremely efficient minimax algorithm is developed and tested to optimize the frequency response w.r.t. any circuit parameter. It is shown that the algorithm converges to the global minimax optimum and that the rate of convergence is at least of second order. The algorithm is based on the linearization of error functions at boundary points of valid intervals. Boundary points of the region of acceptable designs are explicitly calculated and an algorithm to exactly determine the region itself for the general nonconvex case is presented and illustrated.

Description:

Related Work: SOC-37, SOC-87, SOC-211, SOC-229.

Price: \$ 6.00.

SOC-241

A UNIFIED APPROACH TO POWER SYSTEM SENSITIVITY ANALYSIS AND PLANNING  
PART III: CONSISTENT SELECTION OF ADJOINING COEFFICIENTS

J.W. Bandler and M.A. El-Kady

January 1980, No. of Pages: 32

Revised:

Key Words: Power system analysis, adjoint networks, sensitivity analysis, conjugate notation, modelling, consistency criteria

Abstract: A unified approach to power system sensitivity analysis and planning has been presented in Part I of the paper. The approach utilizes a generalized adjoint network concept with complex adjoining coefficients set to proper values which allow the required sensitivity evaluation. Here, we present a unified study for consistent selection of the adjoining coefficients where the restrictions imposed by the type of system and the particular function considered are investigated. The study, hence, justifies the use of the approach described in Part I as a general network approach.

Description:

Related Work: SOC-234, SOC-237, SOC-238.

Price: \$ 6.00.

SOC-242

NEWTON'S LOAD FLOW IN COMPLEX MODE

J.W. Bandler and M.A. El-Kady

January 1980, No. of Pages: 17

Revised:

Key Words: Load flow analysis, conjugate notation, complex analysis, elimination techniques

Abstract: This paper investigates direct solution techniques for an unfamiliar form of linear complex equations expressed in terms of a set of complex variables and their complex conjugate. This complex form may represent linearized power network equations.

The well-known Newton-Raphson method is described and applied, with the aid of a novel elimination technique, in a compact complex form, to the load flow problem described in power system studies.

Description:

Related Work: SOC-237, SOC-241.

Price: \$6.00.

SOC-243

POWER NETWORK SENSITIVITY ANALYSIS AND FORMULATION SIMPLIFIED

J.W. Bandler and M.A. El-Kady

January 1980, No. of Pages: 9

Revised:

Key Words: Power network analysis, conjugate notation, Newton's load flow, sensitivity analysis, optimal power flow

Abstract: An approach for direct and compact derivation of sensitivity expressions in electrical power networks is presented. The approach utilizes a compact complex notation to facilitate the derivation and subsequent formulation. It employs only complex matrix manipulations and exploits the elements of the Jacobian matrix already available from the solution of the load flow problem.

Description:

Related Work: SOC-237, SOC-241, SOC-242.

Price: \$ 3.00.

SOC-244

SUFFICIENT TEST CONDITIONS FOR PARAMETER IDENTIFICATION OF ANALOG  
CIRCUITS BASED ON VOLTAGE MEASUREMENTS

R.M. Biernacki and J. Starzyk

March 1980,            No. of Pages: 9

Revised:

Key Words:            Fault analysis, parameter identification, network  
                         element-value solvability, testing

Abstract:            In this paper sufficient test conditions for identification of component values of linear analog circuits are investigated. Tests under consideration are assumed to be performed at a single frequency and consist of voltage measurements using different current excitations. Based on the fact that it is sufficient for this identification to perform nodal voltage measurements using all possible independent current excitations a systematic way to eliminate some unnecessary tests is proposed. A simple method for checking whether a reduced number of tests is sufficient for the identification is then formulated.

Description:

Related Work:        SOC-233, SOC-235, SOC-236.

Price:                \$ 3.00.

SOC-245

SHORT-TERM LOAD FORECASTING FOR MULTINODE INTERCONNECTED POWER SYSTEMS

M. Abu-El-Magd and N.K. Sinha

April 1980,            No. of Pages: 6

Revised:

Key Words:            Load-forecasting, short-term forecasts, multi-node  
                         power systems

Abstract: The problem of one-step-ahead forecasting of the load demand at all the major loading nodes of an interconnected power system is studied. A multivariable state space mode is proposed. The innovations representation is utilized, so that an ordinary recursive least-squares algorithm can be used to give unbiased estimates of the model parameters. State estimation is carried out by using adaptive estimation techniques. The parameter identification and state estimation algorithms are combined in a bootstrap manner.

Description:            To be presented at the 3rd Int. Symp. on Large  
                         Engineering Systems (St. John's, Newfoundland, July  
                         1980).

Related Work:

Price:                 \$ 3.00.

SOC-246

COMPUTER PROGRAM FOR TRANSFORMATION TO LINEAR MULTIVARIABLE SYSTEM  
TO CANONICAL FORMS

M.H. Li and N.K. Sinha

April 1980,           No. of Pages: 16

Revised:

Key Words:           Computer program, transformation, canonical forms,  
                  multivariable systems

Abstract: This report describes the computer programs that transform a linear multivariable system to various canonical forms. The programs are written in standard Fortran IV and are available for batch processing on the CDC 6400 computer.

Description:

Related Work:       SOC-121, SOC-165.

Price:               \$ 6.00.



SOC-247

A COMPLEX LAGRANGIAN APPROACH WITH APPLICATIONS TO POWER NETWORK  
SENSITIVITY ANALYSIS

J.W. Bandler and M.A. El-Kady

June 1980,            No. of Pages: 17

Revised:            December 1980

Key Words:            Complex analysis, conjugate notation, sensitivity  
analysis, Lagrange multipliers, power flow equations,  
Tellegen's theorem

Abstract: The well-known Lagrangian approach, traditionally described in real form, for calculating first-order changes and gradients of functions of interest subject to equality constraints is generalized and applied in a compact complex form. Hence, general complex functions and constraints can be handled directly while maintaining the original complex mode of formulation. The theoretical foundations of the approach are stated. An application to power network sensitivity analysis and gradient evaluation is presented.

Description:

Related Work:        SOC-237, SOC-241, SOC-242, SOC-243, SOC-253, SOC-256.

Price:                \$6.00.



SOC-249

GENERALIZED POWER NETWORK SENSITIVITIES  
PART II: ANALYSIS

J.W. Bandler and M.A. El-Kady

June 1980,            No. of Pages: 37

Revised:

Key Words:            Power system analysis, complex matrix manipulations,  
                         complex adjoint analysis, sensitivity analysis, reduced  
                         gradients

Abstract:    Generalized sensitivity expressions for calculating first-order changes and gradients of functions of interest in different power system applications are derived. We utilize the special complex notation and the transformations between different modes of formulation described in Part I of the paper to compactly derive the required sensitivity expressions. These generalized sensitivity expressions are common to all modes of formulation, e.g., polar and cartesian, common to both real and complex functions and common to all real and complex variables defined in a particular study. The Jacobian matrix of the load flow solution by the Newton-Raphson method is used to define the adjoint system of linear equations required to be solved.

Description:

Related Work:        SOC-237, SOC-242, SOC-247, SOC-248.

Price:                \$6.00.

SOC-250

LAGRANGIAN VS. TELLEGEN APPROACHES TO NETWORK SENSITIVITY ANALYSIS -  
A UNIFIED, COMPREHENSIVE COMPARISON

J.W. Bandler and M.A. El-Kady

June 1980,            No. of Pages: 9

Revised:

Key Words:            Lagrange multipliers, Tellegen's theorem, network  
analysis, sensitivity analysis

Abstract: We present a comprehensive comparison between the widely used Lagrange multipliers and Tellegen's theorem approaches to sensitivity calculations in electrical networks. The two approaches are described on a unified basis, hence different aspects of comparison can be clearly investigated.

Description:

Related Work:        SOC-234, SOC-237, SOC-238, SOC-241, SOC-243, SOC-247,  
SOC-248, SOC-249.

Price:                \$3.00.

SOC-251

POSTPRODUCTION PARAMETER IDENTIFICATION AND TUNING OF ANALOG CIRCUITS

J.W. Bandler and R.M. Biernacki

June 1980,            No. of Pages: 16

Revised:

Key Words:            Tuning, parameter identification, fault analysis,  
testing, computer-aided design

Abstract: This paper discusses some topics related to postproduction tuning and repairing of analog electrical circuits. Suitable design techniques are reviewed and a general formulation of the tuning problem is given. Appropriate testing conditions are discussed. Recent developments in the field of postproduction tuning and fault analysis are reviewed.

Description:            Invited paper presented at the 1980 European Conf. on  
Circuit Theory and Design, (Warsaw, Poland, Sept.  
1980).

Related Work:            SOC-233, SOC-235, SOC-236, SOC-244.

Price:                 \$ 6.00.

SOC-252

QUSNTN - A PROGRAM FOR UNCONSTRAINED FUNCTION MINIMIZATION

J.W. Bandler, M.A. El-Kady and M.R.M. Rizk

September 1980, No. of Pages: 22

Revised:

Key Words: Unconstrained optimization, quasi-Newton method,  
gradient minimization

Abstract: QUSNTN is a package of a compiled library subroutine and a user-supplied subroutine. The package implements the 1972 version of Fletcher's quasi-Newton method for unconstrained optimization [1] with the minor changes outlined in FLOPT5 [2], a previously produced package for minimax optimization. The program has been tested on a CYBER 170 computer. The report includes a FORTRAN listing of the program, a user's guide and illustrating examples.

Description: Contains FORTRAN listing, user's manual.  
Source deck available for \$50.00  
The listing contains 203 statements of which 30 are comments.

Related Work: SOC-151, SOC-218.

Price: \$30.00.

SOC-253

A UNIFIED APPROACH TO GENERALIZED NETWORK SENSITIVITIES WITH  
APPLICATIONS TO POWER SYSTEM ANALYSIS AND PLANNING

M.A. El-Kady

October 1980, No. of Pages: 234

Revised:

Key Words: Power system analysis, power system planning, gradient-type optimization, network analysis, sensitivity calculations, complex analysis

Abstract: This thesis presents a new methodology for describing adjoint network approaches to sensitivity calculations performed in various power system analysis and planning studies. Difficulties observed by previous workers regarding the exact modelling of some power network elements are overcome by proper techniques employed with special complex notation. A generalized version of the Tellegen's theorem-based approach is developed which provides the required sensitivities based on the exact a.c. load flow model for any chosen set of real and/or complex variables of practical interest. A theoretical consistency study is performed to allow proper modelling of adjoint elements for direct treatment of general complex functions. A simplified version with many desirable features is described for real function sensitivities. It employs a simple adjoint network. General sensitivity expressions common to all relevant power system studies are derived and tabulated. A new method for solving the load flow problem using Tellegen's theorem is described with several advantages claimed. A special elimination technique is used to describe the Newton-Raphson method for load flow solution in a compact complex mode. A complex version of the Lagrange multiplier approach is developed and applied to allow a general number of complex dependent variables to be defined in a particular problem. A generalized version of the class of methods of sensitivity calculations which exploit the Jacobian matrix of the load flow analysis in formulating the adjoint equations is developed. Generalized sensitivity expressions common to different modes of formulating power flow equations, e.g., cartesian and polar, are derived and tabulated for direct programming use. A unified comprehensive comparison between the Lagrange multiplier and Tellegen's theorem approaches to sensitivity calculations in electrical networks is presented.

Description: Ph.D. Thesis.

Related Work: SOC-234, SOC-237, SOC-238, SOC-241, SOC-242, SOC-243,  
SOC-247, SOC-248, SOC-249, SOC-250

Price: \$30.00.

SOC-254

A NEW METHOD FOR COMPUTERIZED SOLUTION OF POWER FLOW EQUATIONS

J.W. Bandler and M.A. El-Kady

October 1980, No. of Pages: 10

Revised: February 1981

Key Words: Load flow analysis, adjoint network, decoupled load flow, power network sensitivities

Abstract: We employ an adjoint network concept based on an augmented form of Tellegen's theorem to describe a novel method for solving the load flow problem. The method incorporates successive adjoint network simulations with a sparse, mostly constant matrix of coefficients, the majority of its elements representing basic data of the problem already stored in computer memory. Nevertheless, the exact version of the method enjoys the same rate of convergence as the Newton-Raphson method. Moreover, it automatically supplies the sensitivities of all system states with respect to adjustable variables at the load flow solution without any additional adjoint simulation. An approximate version of the method is also presented. It partly employs very fast repeat forward and backward substitutions with constant LU factors of a reduced matrix of coefficients and is applicable to both the rectangular and the polar formulations of the power flow equations. Numerical examples are presented for illustration and comparison.

Description: 12th Power Industry Computer Application Conf. (Philadelphia, PA, May 1981), pp. 27-35.

Related Work: SOC-237, SOC-238, SOC-253, SOC-255.

Price: \$6.00.



SOC-255

THE ADJOINT NETWORK APPROACH TO POWER FLOW SOLUTION AND SENSITIVITIES  
OF TEST POWER SYSTEMS: DATA AND RESULTS

J.W. Bandler and M.A. El-Kady

December 1980, No. of Pages: 47

Revised:

Key Words: Power system analysis, adjoint network simulation,  
gradient-type optimization, contingency analysis,  
sensitivity calculations

Abstract: The exact, recently developed adjoint network approach to power network analysis is applied, in this paper, to a variety of test power systems ranging from the simplest 2 bus/3 line system to a 26 bus/32 line system. The full bus and line data as well as a single line diagram for all systems are provided. Results of the load flow analysis for all systems are presented. Detailed load flow sensitivities as well as contingency calculations for some of the systems are also presented. The general analytical aspects of the adjoint network approach are outlined. Some of its computational features are discussed for different test systems. We also illustrate the use of the results in further relevant applications.

Description:

Related Work: SOC-234, SOC-237, SOC-238, SOC-241, SOC-253.

Price: \$30.00.

SOC-256

THE METHOD OF COMPLEX LAGRANGE MULTIPLIERS WITH APPLICATIONS

J.W. Bandler and M.A. El-Kady

December 1980, No. of Pages: 20

Revised:

Key Words: Complex analysis, conjugate notation, sensitivity analysis, Lagrange multipliers, power flow equations, Tellegen's theorem

Abstract: The well-known Lagrangian approach, traditionally described in real form, for calculating first-order changes and gradients of functions of interest subject to equality constraints is generalized and applied in a compact complex form. Hence, general complex functions and constraints can be handled directly while maintaining the original complex mode of formulation. The theoretical foundations of the approach are stated. Applications in power network sensitivity analysis and gradient evaluation are presented.

Description: Full version of Proc. IEEE Int. Symp. Circuits and Systems (Chicago, IL, April 1981), pp. 773-777. Edited and augmented version of SOC-247.

Related Work: SOC-237, SOC-241, SOC-242, SOC-243, SOC-247, SOC-253.

Price: \$6.00.

SOC-257

A GENERALIZED, COMPLEX ADJOINT APPROACH TO POWER NETWORK SENSITIVITIES

J.W. Bandler and M.A. El-Kady

December 1980, No. of Pages: 60

Revised:

Key Words: Power system analysis, adjoint networks, complex analysis, matrix transformations, sensitivity analysis, reduced gradients

Abstract: A unified study of the class of adjoint network approaches to power system sensitivity analysis which exploits the Jacobian matrix of the load flow solution is presented. Generalized sensitivity expressions which are easily derived, compactly described and effectively used for calculating first-order changes and gradients of functions of interest are obtained. These generalized sensitivity expressions are common to all modes of formulating the power flow equations, e.g., polar and cartesian. The approach exploits a special complex notation and complex matrix manipulations to define the adjoint system and to derive the sensitivity formulas. The approach is applicable to both real and complex function sensitivities.

Description:

Related Work: SOC-237, SOC-242, SOC-243, SOC-247, SOC-248, SOC-249, SOC-253, SOC-256

Price: \$6.00.

SOC-258

EXACT POWER NETWORK SENSITIVITIES VIA GENERALIZED COMPLEX BRANCH  
MODELLING

J.W. Bandler and M.A. El-Kady

December 1980, No. of Pages: 39

Revised: September 1981

Key Words: Tellegen's theorem, complex branch modelling, adjoint  
system, power system simulation, power network  
sensitivities, reduced gradients

Abstract: This paper presents an application of the Tellegen's theorem  
approach to power network sensitivity calculations. Our theory employs  
an adjoint network concept based upon a novel, generalized complex  
branch modelling procedure allowing the exact steady-state component  
models of power networks to be considered without any approximation.  
Exact formulas for first-order change and reduced gradients are derived  
and tabulated. The theoretical results are fully verified numerically  
on a 6-bus system and on a 26-bus, 32 line system. The full bus and  
line data are provided for the examples to permit independent  
verification of our results.

Description: Reformed and simplified version of SOC-237, SOC-238 and  
SOC-241. Contains new material.

Related Work: SOC-237, SOC-238, SOC-241, SOC-253, SOC-255.

Price: \$6.00.

SOC-259

A LINEAR PROGRAMMING APPROACH TO FAULT LOCATION IN ANALOG CIRCUITS

J.W. Bandler, R.M. Biernacki and A.E. Salama

December 1980, No. of Pages: 21

Revised: June 1981

Key Words: Fault analysis, analog circuit testing, circuit theory,  
computer-aided design, tolerance analysis

Abstract: This paper deals with fault isolation in linear analog circuits with design tolerances on nonfaulty elements and inaccurate measurements taken into account. Using a single current excitation and corresponding voltage measurements a system of linear equations is constructed. This underdetermined system of linear equations is solved using optimization to find the most likely faulty elements. Then, algebraic invariant equations associated with the estimated faulty set are constructed to verify the results obtained.

Description: Revised version of Proc. IEEE Int. Symp. Circuits and Systems (Chicago, IL, April 1981), pp. 256-260.

Related Work: SOC-233, SOC-235, SOC-236, SOC-244, SOC-251.

Price: \$6.00.

SOC-260

AN INTERACTIVE ALGORITHM FOR SHORT-TERM LOAD FORECASTING IN MULTINODE  
POWER SYSTEMS

M.A. Abu-El-Magd and N.K. Sinha

March 1981,            No. of Pages: 26

Revised:

Key Words:            Load forecasting, power systems control, modeling,  
                         on-line operation, short-term prediction, stochastic  
                         systems

Abstract: The problem of on-line short-term load demand forecasting at all the major loading nodes of an interconnected power system is studied. A multivariable state space model is proposed. The innovations representation is utilized, so that an ordinary recursive least-squares algorithm can be used to give unbiased estimates of the model parameters. State estimation is carried out by using adaptive estimation techniques. The parameter identification and state estimation algorithms are combined in a bootstrap manner. Also, a scheme for detecting abnormal load behaviour is proposed. Actual data provided by the Ontario Hydro for four loading buses is used for five-minute, ten-minute and hourly forecasts. The results show that the proposed approach is very attractive.

Description:           Part of this work was presented at the 3rd Int. Symp.  
                         on Large Engineering Systems (St. John's, Newfoundland,  
                         July 1980).

Related Work:        SOC-226, SOC-245.

Price:                \$6.00.

SOC-261

MODELLING AND FORECASTING SHORT-TERM LOAD DEMAND: A MULTIVARIATE APPROACH

M.A. Abu-El-Magd and N.K. Sinha

March 1981, No. of Pages: 25

Revised:

Key Words: Multivariable identification, short-term prediction, modelling, order determination, stochastic systems, load forecasting

Abstract: A multivariable time series model is proposed for short-term load demand forecasting. Unlike other approaches, the order of the model is determined without first finding the coefficients of the model. The Hankel matrix used for determining the order is also utilized for estimating the parameters of the model. This is then compared with order determination using the AIC criterion. Actual data provided by the Ontario Hydro for four loading buses is used for five-minute and hourly forecasts. The results show that the proposed approach is very attractive.

Description: A short version of work to be presented at the 8th World IFAC Congress, Japan, Aug. 1981

Related Work: SOC-226, SOC-245, SOC-260.

Price: \$6.00.

SOC-262

SHORT-TERM LOAD DEMAND MODELLING AND FORECASTING: A REVIEW

M.A. Abu-El-Magd and N.K. Sinha

March 1981, No. of Pages: 47

Revised:

Key Words: Load modelling, short-term forecasting, on-line prediction, power system control, time-series analysis, system identification

Abstract: This paper reviews both the off-line and on-line methods for short-term electric load forecasting. Since identifying an adequate model is the most important problem of any forecasting technique, the literature is classified according to the modelling approaches used for representing the load demand. The merits and drawbacks of each approach and how different authors have applied it to the problem under consideration are stressed. Also included is recent work where multivariable identification techniques are used to model the load demand of all the major loading nodes of a large power system. The advantages and the difficulties of applying such techniques are discussed. As a conclusion, directions for future research and future development of available algorithms, which can improve the state of the art, are suggested.

Description:

Related Work: SOC-226, SOC-245, SOC-260, SOC-261.

Price: \$6.00.



SOC-263

AN INTERACTIVE OPTIMAL POSTPRODUCTION TUNING TECHNIQUE UTILIZING  
SIMULATED SENSITIVITIES AND RESPONSE MEASUREMENTS

J.W. Bandler, M.R.M. Rizk and A.E. Salama

March 1981,            No. of Pages: 3

Revised:

Key Words:            Postproduction tuning, minimax optimization, tolerance  
assignment, amplifier design, network tuning

Abstract: An interactive postproduction tuning technique is presented. The technique uses linear programming iteratively for estimating necessary tuning amounts. It is completely general and is applicable to reversible and irreversible tuning processes. By eliminating completely the common trial and error approach it optimally exploits network response measurements.

Description:           IEEE Int. Microwave Symp. Digest (Los Angeles, CA, June  
1981), pp. 63-65.

Related Work:        SOC-251, SOC-264.

Price:                \$3.00.

SOC-264

POSTPRODUCTION TUNING EMPLOYING NETWORK SENSITIVITIES

J.W. Bandler and A.E. Salama

April 1981, No. of Pages: 6

Revised:

Key Words: Postproduction tuning, tolerance assignment, tuning algorithms, active filter tuning

Abstract: This paper deals with the postproduction tuning assignment problem for electrical circuits. A review of recent tuning algorithms that utilize sensitivity data is presented. We first consider functional tuning methods to which we contribute a new algorithm. Then we discuss deterministic tuning algorithms, in particular those of Alajajian et al. and Lopresti, and a modification to Lopresti's algorithm is proposed. Finally, we test three of the algorithms considered by examining their performance in tuning an active filter.

Description: Proc. European Conf. Circuit Theory and Design (Hague, Netherlands, August 1981), pp. 704-709.

Related Work: SOC-251, SOC-263.

Price: \$3.00.

SOC-265

SENSITIVITY ANALYSES AND REDUCED GRADIENT EVALUATION FOR OPTIMIZATION OF  
POWER SYSTEMS

J.W. Bandler and M.A. El-Kady

April 1981,            No. of Pages: 6

Revised:

Key Words:            Sensitivity calculations, sensitivity matrix, Lagrange  
multipliers, Tellegen's theorem method, reduced  
gradients, power system sensitivities

Abstract:            This paper reviews important approaches to sensitivity  
calculations in power system analysis and design problems. We employ a  
unified notation to classify, describe and compare methods of evaluating  
first-order changes and reduced gradients of functions of interest with  
respect to power system control and design variables. The contribution  
of these methods to solving some practical problems is also outlined.

Description:           Proc. European Conf. Circuit Theory and Design (Hague,  
Netherlands, August 1981), pp. 69-74.

Related Work:           SOC-237, SOC-238, SOC-243, SOC-247, SOC-250, SOC-253,  
SOC-256, SOC-257, SOC-258.

Price:                \$3.00.

SOC-266

DESIGN OF TESTS FOR PARAMETER IDENTIFICATION BY VOLTAGE MEASUREMENTS

J.A. Starzyk, R.M. Biernacki and J.W. Bandler

July 1981,            No. of Pages: 32

Revised:

Key Words:            Fault diagnosis, analog testing, test generation,  
                         topological methods, computer-aided design, network  
                         analysis

Abstract: This paper presents the theoretical background and resulting algorithm for generating tests which are topologically sufficient for identification of parameter values in linear circuits. Voltage measurements at all the nodes are assumed. The main thrust of this paper is to minimize the number of necessary measurements at different current excitations. Coates flow-graph representation of a network is used.

Description:

Related Work:        SOC-233, SOC-235, SOC-236, SOC-244, SOC-251.

Price:                \$6.00.

SOC-267

MULTIPOINT APPROACH TO MULTIPLE-FAULT LOCATION IN ANALOG CIRCUITS

J.A. Starzyk and J.W. Bandler

September 1981, No. of Pages: 14

Revised:

Key Words:           Fault analysis, analog circuits, hybrid multipoint  
                          equations, linear algebra, network topology

Abstract: This paper deals with the multipoint method for multiple-fault location in linear analog circuits. A hybrid multipoint description of the linear network has been used in the presentation, which generalizes and explains proposals made by Biernacki and Bandler. The problem of consistency of the chosen set of equations used for fault identification is discussed. The restrictions of the method are explained on the basis of network topology.

Description:           Comments on and extends SOC-236.

Related Work:       SOC-233, SOC-235, SOC-236, SOC-244, SOC-251, SOC-259,  
                          SOC-266, SOC-268, SOC-271.

Price:               \$ 6.00.

SOC-268

NODAL APPROACH TO MULTIPLE-FAULT LOCATION IN ANALOG CIRCUITS

J.A. Starzyk and J.W. Bandler

September 1981, No. of Pages: 20

Revised:

Key Words:       Fault analysis, analog circuits, nodal equations,  
                  network topology, graph theory

Abstract: The multiple-fault location problem for analog circuits is treated on the basis of the nodal equations. The availability of voltage measurements due to current excitations is assumed by the method. Topological restrictions on the possibility of fault location for a given set of measurements are formulated. Effects of tolerances and measurement errors are discussed in the context of a practical example. Coates flow-graph representation of a network is used for topological considerations.

Description:

Related Work:    SOC-233, SOC-235, SOC-236, SOC-244, SOC-251, SOC-259,  
                  SOC-266, SOC-267, SOC-271.

Price:           \$ 6.00.

SOC-269

A HIERARCHICAL DECOMPOSITION APPROACH FOR NETWORK ANALYSIS

H. Gupta, J.W. Bandler, J.A. Starzyk and J. Sharma

September 1981, No. of Pages: 26

Revised:

Key Words: Network decomposition, hierarchical analysis of linear networks, multilevel algorithms, subnetworks and multipoles

Abstract: A novel approach for analyzing large electrical networks is presented in which the network is decomposed into subnetworks in a hierarchical manner by removing few interconnections. These subnetworks are solved separately. The results are then interconnected at a number of computing levels. The solution of the original network is thereby obtained.

Description:

Related Work:

Price: \$ 6.00.

SOC-270

PRACTICAL COMPLEX SOLUTION OF POWER FLOW EQUATIONS

J.W. Bandler, M.A. El-Kady and H. Gupta

September 1981, No. of Pages: 29

Revised:

Key Words: Load flow analysis, conjugate notation, complex analysis, elimination techniques, power systems analysis

Abstract: This paper applies the compact, complex notation introduced by Bandler and El-Kady to the practical solution of the power flow equations. The solution of the complex linearized power flow equations, which is required by the iterative Newton-Raphson method, is obtained by a direct method. The method, fully and exactly, incorporates generator buses as well as dummy load buses. An elimination scheme is applied to diagonalize the conjugate tableau, which contains the complex coefficients associated with the conjugate of the perturbed bus voltages. This conjugate tableau is then eliminated, simultaneously reducing the basic tableau, which contains the complex coefficients associated with the perturbed bus voltages, to upper triangular form. Alternatively, the conjugate tableau is explicitly eliminated, exposing a set of linear, complex equations in the perturbed complex bus voltages. The theoretical results are illustrated by solving the load flow equations for a 6-bus, 23-bus and a 26-bus system.

Description:

Related Work: SOC-242, SOC-243, SOC-253, SOC-254, SOC-255, SOC-256, SOC-257.

Price: \$ 6.00.



SOC-271

FAULT ISOLATION IN LINEAR ANALOG CIRCUITS USING THE  $L_1$  NORM

J.W. Bandler, R.M. Biernacki, A.E. Salama and J.A. Starzyk

September 1981, No. of Pages: 14

Revised:

Key Words: Fault analysis, analog circuits, linear programming,  
iterative algorithms

Abstract: This paper deals with fault isolation in linear analog circuits under an insufficient number of independent voltage measurements. The  $L_1$  norm is utilized in isolating the most likely faulty elements. Earlier work is extended by allowing measurements to be taken for more than a single excitation. An iterative procedure is followed in which we utilize linear programming as a powerful tool in solving the problem. Convergence is fast and the results of circuit examples subject to practical tolerances on components are much sharper than in our earlier method.

Description:

Related Work: SOC-233, SOC-235, SOC-236, SOC-244, SOC-251, SOC-259,  
SOC-263, SOC-266, SOC-267, SOC-268.

Price: \$ 6.00.

SOC-272

AN ADAPTIVE PREDICTOR FOR SPEECH ENCODING

Z.H.A. Abu-El-Magd

September 1981, No. of Pages: 80

Revised:

Key Words: Adaptive predictor, speech modelling, on-line identification

Abstract: In order to improve the performance of differential encoding systems, the encoding and decoding models have to change according to the speech waveform. The speech signal can be treated as quasi-stationary processes, which over a short period of time can be modelled by a certain set of parameters. Adaptive algorithms should be viewed as a means of adjusting the system parameters.

In this thesis, a 2.048 sec. long sentence has been studied by the Box-Jenkins time series procedure to determine the order of the linear prediction model and to investigate the need for adding moving average terms. The algorithm suggested by Box-Jenkins for parameter estimation has been employed to update the parameters of the predictor of a prediction error coder each specific period of time.

Since it is difficult to implement this algorithm on-line, an alternative scheme has been studied. It is based on using the Box-Jenkins procedure to determine a suitable ARMA model and then updating the parameters of this model using a good on-line estimation algorithm. The applicability of the recursive least-squares and the stochastic approximation algorithms has been investigated. Stochastic approximation appears more promising as it takes less time for computation with an acceptable performance.

As a result of this study, the addition of moving average terms to the predictor's model are shown to be necessary. But when Box-Jenkins' algorithm was tested with an ARMA model with adaptive and fixed initial parameters, it did not outperform the pure autoregressive model used with the same algorithm.

The application of the three adaptive algorithms, the Box-Jenkins' approach, the recursive least-squares and the stochastic approximation, has been studied for the PEC configuration and the performance of the predictor was evaluated in each case. The results of this study indicate that combining stochastic approximation with the time series, and including an adaptive quantizer is applicable to differential encoder configurations, mainly the DPCM, with slight modifications, and would yield better signal-to-noise ratio.

Description: M.Eng. Thesis

Related Work: SOC-86, SOC-203, SOC-239.

Price: \$20.00.

SOC-273

UPWARD TOPOLOGICAL ANALYSIS OF LARGE CIRCUITS USING DIRECTED GRAPH REPRESENTATION

J.A. Staryzk and E. Sliwa

November 1981, No. of Pages: 33

Revised:

Key Words: Topological methods, linear network analysis, unistor graph, symbolic analysis of large networks, computer aided techniques

Abstract: This paper presents the method of topological analysis of large LLS networks with the use of hierarchical decomposition of the network graph. It is assumed that the network is represented by a directed graph. A new approach, using Coates signal-flow graphs, to the element modelling is described.

An algorithm of upward hierarchical analysis of partitioned graph is presented. The algorithm allows symbolic analysis of large networks with the number of elements kept as symbols practically unlimited. The computational time linearly depends on the network size. A computer program using techniques described is also presented.

Description:

Related Work:

Price: \$ 6.00.

SOC-274

THE MUMMAS PROGRAM PACKAGE FOR POWER SYSTEM APPLICATION

R.T.H. Alden and F.A. Qureshy

October 1981, No. of Pages: 38

Revised:

Key Words: Power systems, load flow, dynamic stability, eigenvalues, time response, machine torque

Abstract: An overview of the MUMMAS set of programs for power system analysis including: load flow; state matrix formation, reduction, and eigen analysis; time response; torque component analysis; utility programs for data file preparation etc.

Description:

Related Work: SOC-129, SOC-275, SOC-276, SOC-277, SOC-278.

Price: \$15.00.

SOC-275

LOAD FLOW COMPUTER PROGRAM FOR POWER SYSTEM APPLICATION

F.A. Qureshy and R.T.H. Alden

October 1981, No. of Pages: 33

Revised:

Key Words: Load flow, matrix reduction, Gauss-Seidel, VAR assignment, economic dispatch

Abstract: Describes the use of a load flow and network reduction program, utilizing Gauss-Seidel iteration, VAR assignment and economic dispatch. Interaction with the rest of the MUMMAS set of interactive power system analysis programs is described.

Description:

Related Work: SOC-274, SOC-276, SOC-277, SOC-278.

Price: \$15.00.

SOC-276

A PQR MATRIX ASSEMBLY COMPUTER PROGRAM FOR POWER SYSTEM APPLICATION

H.G. Hamed and R.T.H. Alden

October 1981, No. of Pages: 36

Revised:

Key Words: Power system dynamic stability, state matrix formation,  
PQR method

Abstract: Describes the use of an interactive program to form the A, B, C coefficient matrices for power system dynamic stability evaluation using the PQR method.

Description:

Related Work: SOC-206, SOC-274, SOC-275.

Price: \$15.00.

SOC-277

A TIME RESPONSE COMPUTER PROGRAM FOR POWER SYSTEM APPLICATION

M.E. Shadeed and R.T.H. Alden

October 1981, No. of Pages: 32

Revised:

Key Words: Time response, matrix transition, state matrix

Abstract: Describes the use of an interactive program to compute step or impulse responses of a system described in state matrix form using a matrix transition technique.

Description:

Related Work: SOC-274, SOC-276, SOC-278.

Price: \$15.00.

SOC-278

A TORQUE COMPONENT ANALYSIS COMPUTER PROGRAM FOR POWER SYSTEM  
APPLICATION

M.E. Shadeed and R.T.H. Alden

October 1981, No. of Pages: 50

Revised:

Key Words: Power systems, synchronous machines, damping torque,  
synchronizing torque, stability

Abstract: Describes the use of an interactive program to compute  
damping and synchronizing torque components in synchronous machines  
using time responses of electrical torque, rotor angle and speed.

Description:

Related Work: SOC-218, SOC-274, SOC-277.

Price: \$15.00.



SOC-279

A DIRECT ELIMINATION MATRIX ASSEMBLY COMPUTER PROGRAM FOR POWER SYSTEM APPLICATION

H.G. Hamed and R.T.H. Alden

December 1981, No. of Pages: 30

Revised:

Key Words: Power system dynamic stability, state matrix formation, direct elimination method

Abstract: This report provides documentation for the interactive computer program package "ELIM", used in the formation of the power system state matrix, A, for dynamic stability applications. The data is supplied from two data files: one for machine parameters and the other from load flow data. The output is stored in an output file which can be used as input for subsequent programs. This interactive program can be executed for a variety of subsystem models, and requires approximately 100 k core memory for execution of a fifty-fourth order system program.

Description: Includes a user guide and program flowchart.

Related Work: SOC-274, SOC-275, SOC-276.

Price: \$15.00.

SOC-280

MINI5W - A FORTRAN PACKAGE FOR MINIMAX OPTIMIZATION

K. Madsen (Adapted and Edited by J.W. Bandler and W.M. Zuberek)

December 1981, No. of Pages: 31

Revised:

Key Words:           Minimax optimization, nonlinear optimization, computer-aided design, optimization program

Abstract: MINI5W is a package of subroutines for solving unconstrained, nonlinear minimax optimization problems. First derivatives of all functions w.r.t. all variables are assumed to be known. The solution is found by an iteration that uses either linear programming applied in connection with first derivatives or a Newton step applied in connection with first derivatives and approximate second derivatives. The method has been described by Hald and Madsen. The Fortran IV package and documentation have been adapted for the CDC 170/730 system.

Description:           Contains Fortran listing, user's manual.  
Source deck or magnetic tape available for \$100.00.  
The listing contains 930 lines, of which 261 are comments.

Related Work:        SOC-218, SOC-281.

Price:                \$ 30.00.

SOC-281

MMLA1Q - A FORTRAN PACKAGE FOR LINEARLY CONSTRAINED MINIMAX  
OPTIMIZATION

J. Hald (Adapted and Edited by J.W. Bandler and W.M. Zuberek)

December 1981, No. of Pages: 45

Revised:

Key Words:       Minimax optimization, constrained optimization,  
                  nonlinear programming, computer-aided design,  
                  optimization program

Abstract: This report provides a user-oriented description of a program package written in Fortran IV for linearly constrained minimax optimization. The new subroutine MMLA1Q is very similar to MINLA1, which was presented by Madsen and Schjaer-Jacobsen, the main difference being that MMLA1Q accumulates and uses approximate second-order information as described by Hald and Madsen. Both routines require first-order partial derivatives of the nonlinear functions defining the minimax problem. The list of parameters is described herein, and a listing of the complete program package including the linear programming part is given. Instead of the revised simplex algorithm used in MINLA1, a reduced gradient algorithm has been developed. Finally, a couple of simple examples illustrate the use of the program. The program and documentation have been adapted for the CDC 170/730 system.

Description:       Contains Fortran listing, user's manual.  
                  Source deck or magnetic tape available for \$150.00.  
                  The listing contains 1544 lines, of which 358 are  
                  comments.

Related Work:     SOC-218, SOC-280.

Price:            \$ 30.00.

SOC-282

EIGENVALUE SENSITIVITIES APPLIED TO POWER SYSTEM DYNAMICS

Zagloul S. Elrazaz

December 1981, No. of Pages: 177

Revised:

Key Words: Eigenvalue sensitivities, large-scale systems, power systems

Abstract: In the search for an adequate and efficient method for power system dynamic stability analysis, it is illustrated in this thesis that eigenvalues, eigenvectors and their sensitivities with respect to system parameters are very important and useful tools.

The eigenvalue-eigenvector sensitivities are generalized by deriving expressions for the Nth-order sensitivities. These expressions are recursive in nature, hence the calculations of the high-order terms do not involve too much additional computation, but lead to considerable improvements in evaluating the actual changes in the eigenvalues and eigenvectors due to large variations in the system parameters.

A comprehensive and efficient eigenvalue tracking approach has been presented to track a subset of the system eigenvalues over a wide range of parameter variations.

We have achieved an interesting result that the first- and the Nth-order sensitivities of any eigenvalue of the aggregated model with respect to a certain parameter of the original system are identical to the corresponding sensitivities of the same eigenvalue of the original system with respect to that parameter regardless the choice of the aggregation matrix.

A criterion has been developed for answering one of the most demanding questions in the model reduction area, which is how to choose the order of the reduced model.

The significance and applicability of the previous theoretical achievements have been tested by considering different problems in power system dynamic studies. These show consistency with previous results.

Description: Ph.D. Thesis.

Related Work: SOC-198, SOC-206, SOC-220, SOC-230.

Price: \$ 30.00.

SOC-283

XLF1 - A PROGRAM FOR COMPLEX LOAD FLOW ANALYSIS BY CONJUGATE ELIMINATION

J.W. Bandler, M.A. El-Kady and H. Gupta

December 1981, No. of Pages: 74

Revised:

Key Words: Load flow analysis, conjugate notation, complex analysis, power systems analysis

Abstract: XLF1 is a package of five compiled library subroutines for solving steady-state power flow equations in the compact complex mode. A user-supplied main program provides the necessary dimensional storage and system data. The program implements the recently developed algorithm for practical complex solution of power flow equations presented by Bandler, El-Kady and Gupta. Sensitivities of system states with respect to system control variables can also be evaluated by the program using a perturbation method. The program is written in Fortran IV, documented and tested on a CYBER 170 computer. The report includes a listing of the program, a user's guide and some illustrative examples.

Description: Contains Fortran program, user's manual.  
Source deck or magnetic tape available for \$150.00.  
The listing contains 839 lines, of which 338 are comments.

Related Work: SOC-242, SOC-243, SOC-253, SOC-254, SOC-255, SOC-256,  
SOC-257, SOC-258, SOC-270.

Price: \$100.00.

SOC-284

NONLINEAR PROGRAMMING USING LAGRANGIAN FUNCTIONS

J.W. Bandler

December 1981, No. of Pages: 16

Revised:

Key Words: Nonlinear programming, Lagrangian functions, quasi-Newton methods, Han-Powell algorithm, optimality conditions

Abstract: A brief review of major features of nonlinear programming methods which employ Lagrangian functions is presented. Following statements and discussion of necessary and sufficient conditions for a solution, the augmented Lagrangian method is described. This method adds a penalty term to permit a sequence unconstrained optimizations to be applied. The motivation behind the formulation and a discussion of Newton and quasi-Newton approaches is given. The Han-Powell algorithm is subsequently presented. This algorithm employs a quadratic approximation to the objective function, describes linearized constraints which leads to a quadratic program to be solved. The results provide the next search direction and appropriate Lagrange multipliers. After a one-dimensional search, the second derivative approximation is updated by a BFGS formula, with steps taken to ensure positive definiteness.

Description: Review.

Related Work: SOC-158, SOC-183.

Price: \$ 6.00.

SOC-285

LOCATION OF FAULT REGIONS IN ANALOG CIRCUITS

J.A. Starzyk and J.W. Bandler

December 1981, No. of Pages: 31

Revised:

Key Words: Fault analysis, analog circuits, network topology,  
graph theory, computer-aided design

Abstract: The multiple-fault location problem for analog circuits is treated on the basis of the nodal equations. The availability of voltage measurements due to current excitations is assumed by the method. Topological restrictions on the possibility of fault location for a given set of measurements are formulated. The emphasis in this paper is on locating subnetworks or regions containing all the faults of the network. Two algorithms are presented for this purpose. Coates flow-graph representation of a network is used for topological considerations.

Description:

Related Work: SOC-233, SOC-235, SOC-236, SOC-244, SOC-251, SOC-259,  
SOC-266, SOC-267, SOC-268, SOC-271.

Price: \$ 6.00.

SOC-286

THE COMPLEX ADJOINT APPROACHES TO NETWORK SENSITIVITIES

J.W. Bandler and M.A. El-Kady

January 1982, No. of Pages: 10

Revised:

Key Words: Lagrange multipliers, Tellegen's theorem, network analysis, sensitivity analysis, conjugate notation, complex variables

Abstract: We present a comprehensive comparison between the widely used Lagrange multiplier and Tellegen's theorem approaches to sensitivity calculations in electrical networks. The two approaches are described on a unified basis using the conjugate notation. Different aspects of comparison can thereby be investigated. The linear electronic circuit analysis case is seen to be a special case.

Description: Extension of SOC-250.

Related Work: SOC-234, SOC-237, SOC-238, SOC-241, SOC-243, SOC-247, SOC-248, SOC-249, SOC-253, SOC-254, SOC-255, SOC-256, SOC-257, SOC-258, SOC-265.

Price: \$6.00.



SOC-287

DISCRETE-TIME APPROXIMATION OF MULTIVARIABLE CONTINUOUS-TIME SYSTEMS

N.K. Sinha and Zhou Qi-Jie

March 1982,           No. of Pages: 23

Revised:

Key Words:           Modeling, digital simulation, multivariable systems,  
discrete-time systems

Abstract:   Five different methods for obtaining discrete-time approximations of multivariable continuous-time systems are discussed. Three of these have been proposed by the authors. A comparison between the methods is presented through numerical examples. The results should be valuable for the digital simulation of multivariable systems as well as for computer control.

Description:

Related Work:       SOC-203, SOC-226, SOC-239.

Price:               \$ 6.00.

SOC-288

IDENTIFICATION OF MULTIVARIABLE CONTINUOUS-TIME SYSTEMS FROM SAMPLES OF  
INPUT-OUTPUT DATA

N.K. Sinha and Zhou Qi-Jie

April 1982,           No. of Pages: 26

Revised:

Key Words:           Identification, multivariable systems, continuous-time  
                          systems, sampled-data systems

Abstract:   Several methods for the identification of linear multi-  
variable continuous-time systems from the samples of input-output data  
are discussed. These include three new methods proposed by the authors.  
The suitability of these methods for estimating the parameters of the  
system using recursive least-squares algorithm is compared using a simu-  
lated example. The results indicate that the best results are obtained  
using the block pulse function method as proposed by the authors.

Description:

Related Work:       SOC-203, SOC-226, SOC-239, SOC-287.

Price:               \$ 6.00.

SOC-289

SSLE - A FORTRAN PACKAGE FOR SOLVING SPARSE LINEAR EQUATIONS

J.A. Starzyk and J.W. Bandler

April 1982            No. of pages: 42

Revised:

Key Words:            Linear systems, sparse matrices, solution of real or  
                         complex linear equations

Abstract:    SSLE is a package of subroutines for solving systems of  
sparse linear equations. The bi-factorization method is used for  
systems having a symmetrical structure of the coefficient matrix. The  
method is based on Zollenkopf's algorithm. In the case of a non-  
symmetrical structure necessary zero elements are added. There are four  
versions of the principal subroutine appropriate for a symmetrical or  
nonsymmetrical as well as for a real or complex coefficient matrix.

Description:   Contains Fortran listing, user's manual.  
                         Source deck or magnetic tape available for \$100.00. The  
                         listing contains 1527 lines, of which 595 are comments.

Related Work:

Price:                \$100.00.

SOC-290

REDUCTION OF HIGH-ORDER MULTIVARIABLE SYSTEMS: A CRITICAL SURVEY

Naresh K. Sinha

May 1982,            No. of pages: 20

Revised:

Key Words:            Model reduction, multivariable systems

Abstract: Various methods for obtaining reduced models for high-order multivariable systems are discussed. A critical comparison is made of the extent to which the reduced model can be successfully used for design purposes. Also, a new method, which removes some of the existing drawbacks, is introduced.

Description:           Presented at the First Conference of the Canadian Industrial Computer Society (McMaster University, Hamilton, May 1982).

Related Work:        SOC-140, SOC-164, SOC-195, SOC-200.

Price:                \$6.00.

SOC-291

MMUM - A FORTRAN PACKAGE FOR UNCONSTRAINED MINIMAX OPTIMIZATION

J.W. Bandler and W.M. Zuberek

May 1982, No. of Pages: 74

Revised:

Key Words: Minimax optimization, nonlinear programming,  
optimization program, computer-aided design

Abstract: MMUM is a package of subroutines for solving unconstrained minimax optimization problems. It is an extension and modification of the MINI5W package due to Madsen. First derivatives of all functions with respect to all variables are assumed to be known. The solution is found by an iteration that uses either linear programming applied in connection with first-order derivatives or a quasi-Newton method applied in connection with first-order and approximate second-order derivatives. The method has been described by Hald and Madsen. The package and documentation are developed for the CDC 170/730 system with the NOS 1.4 operating system and the Fortran 4.8508 compiler.

Description: Contains Fortran listing, user's manual.  
Source deck or magnetic tape available for \$150.00.  
The listing contains 1397 lines, of which 342 are comments.

Related Work: SOC-218, SOC-280, SOC-281, SOC-292, SOC-294.

Price: \$100.00.

SOC-292

MMLC - A FORTRAN PACKAGE FOR LINEARLY CONSTRAINED MINIMAX OPTIMIZATION

J.W. Bandler and W.M. Zuberek

May 1982,            No. of Pages: 78

Revised:

Key Words:            Minimax optimization, constrained optimization,  
nonlinear programming, optimization program, computer-  
aided design

Abstract:    MMLC is a package of subroutines for solving linearly constrained minimax optimization problems. It is an extension and modification of the MMLA1Q package due to Hald. First derivatives of all functions with respect to all variables are assumed to be known. The solution is found by an iteration that uses either linear programming applied in connection with first-order derivatives or a quasi-Newton method applied in connection with first-order and approximate second-order derivatives. The method has been described by Hald and Madsen. The package and documentation are developed for the CDC 170/730 system with the NOS 1.4 operating system and the Fortran 4.8508 compiler.

Description:        Contains Fortran listing, user's manual.  
Source deck or magnetic tape available for \$150.00.  
The listing contains 1972 lines, of which 427 are  
comments.

Related Work:        SOC-218, SOC-280, SOC-281, SOC-291, SOC-294.

Price:                \$100.00.

SOC-293

XLF2 - A PROGRAM FOR ANALYSIS AND SENSITIVITY EVALUATION OF COMPLEX  
LOAD FLOWS BY THE COMPLEX LAGRANGIAN METHOD

J.W. Bandler, M.A. El-Kady and H. Gupta

June 1982,            No. of Pages: 81

Revised:

Key Words:            Load flow analysis, nonlinear equations, power system  
                         simulation, contingency analysis, power system  
                         optimization

Abstract: XLF2 is a package of six compiled library subroutines for solving steady-state power flow equations in the compact complex mode and/or to determine exact sensitivities of any number of functions w.r.t. the control variables. The user is simply required to supply the main program and the derivatives of the specified functions w.r.t. complex bus voltages and their conjugates. The program prepares the complex consistent form of the power flow equations and solves them using the Harwell package ME28. The sensitivities are determined by implementing formulas recently developed in the generalized, complex adjoint approach to power network sensitivities by Bandler and El-Kady. The program is written in Fortran IV, documented and tested on the CYBER 170/730 computer. This report includes a listing of the program, a user's guide, and some illustrative examples involving contingency analysis and power system optimization.

Description:           Contains Fortran listing, user's manual.  
                         Source deck or magnetic tape available for \$200.00.  
                         The listing contains 1089 lines, of which 567 are  
                         comments.

Related Work:        SOC-242, SOC-243, SOC-253, SOC-254, SOC-255, SOC-256,  
                         SOC-257, SOC-258, SOC-270, SOC-283, SOC-296.

Price:                \$150.00.

E053-25

SOC-294

MFNC - A FORTRAN PACKAGE FOR MINIMIZATION WITH GENERAL CONSTRAINTS

J.W. Bandler and W.M. Zuberek

June 1982, No. of Pages: 75

Revised:

Key Words: Constrained optimization, nonlinear programming, optimization program, computer-aided design, Han-Powell algorithm

Abstract: MFNC is a package of subroutines for minimization of a nonlinear objective subject to nonlinear constraints. It is an extension and modification of a set of subroutines from the Harwell Subroutine Library (subroutines VF02AD, VF02BD, VF02CD, VE02A, LA02A, MB01C, FM02AS). First derivatives of all functions with respect to all variables are assumed to be available. The solution is found by an iteration that minimizes a quadratic approximation of the objective function subject to linearized constraints. The method was presented by Han and Powell. The package and documentation have been developed for the CDC 170/730 system with the NOS 1.4 operating system and the Fortran 4.8508 compiler.

Description: Contains Fortran listing, user's manual. Source deck or magnetic tape available for \$150.00. The listing contains 1772 lines, of which 394 are comments.

Related Work: SOC-218, SOC-280, SOC-281, SOC-291, SOC-292.

Price: \$100.00.



SOC-295

A NEW APPROACH TO MODEL REDUCTION

G.J. Lastman, N.K. Sinha and P. Rosza

June 1982,           No. of Pages: 33

Revised:

Key Words:           Model reduction, aggregation, effective participation,  
                          singular perturbation

Abstract:    A criterion is proposed for selecting the most important states of a high-order system to be retained in a reduced model. The effective participation of each state is estimated by evaluating its contribution to the total impulse response energy at the output of the system. A procedure for obtaining the reduced model, based on this criterion, is described. This method may be regarded as the combination of singular perturbation and aggregation. An error analysis is included, along with examples comparing the proposed approach with existing methods.

Description:   A shorter version was presented at the 13th Annual Modeling and Simulation Conference (Pittsburgh, PA, April 1982).

Related Work:   SOC-164, SOC-195, SOC-200, SOC-212.

Price:           \$ 6.00.

SOC-296

LFLFD - A FORTRAN IMPLEMENTATION OF THE FAST DECOUPLED LOAD  
FLOW TECHNIQUE

J.W. Bandler and W.M. Zuberek

July 1982,           No. of Pages: 35

Revised:

Key Words:           Load flow analysis, fast decoupled method, power  
                      systems analysis

Abstract: LFLFD is a package of subroutines for solving load flow problems by the well-known fast decoupled technique. The method has been described by Stott and Alsac, and is implemented with minor modifications only. Sparse matrix techniques are used to represent the power system's bus admittance matrix as well as the approximate Jacobian matrices required by the method, and the Harwell Package MA28 is called to solve the systems of linear equations with real coefficients. The package and documentation have been developed for the CDC 170/730 system with the NOS 1.4 operating system and the Fortran 4.8508 compiler.

Description:        Contains Fortran listing, user's manual.  
                      Source deck or magnetic tape available for \$100.00.  
                      The listing contains 322 lines, of which 95 are  
                      comments.

Related Work:       SOC-283, SOC-293.

Price:               \$50.00.

SOC-297

A NEW LOOK AT THE AGGREGATION METHOD FOR MODEL REDUCTION

G.J. Lastman, N.K. Sinha and P. Rozsa

July 1982,            No. of Pages: 25

Revised:

Key Words:            Model reduction, aggregation, multivariable systems

Abstract:    The aggregation procedure, for obtaining a reduced-order model from a large-scale system, is re-examined. Two new methods are proposed for obtaining an aggregation output equation which matches steady-state solutions. A numerical example of a 7-th order system is used to compare the new methods to the basic aggregation method and to aggregation with partial realization.

Description:

Related Work:    SOC-164, SOC-165, SOC-195, SOC-200, SOC-290, SOC-295.

Price:                \$6.00.

SOC-298

DECOUPLING OF LARGE-SCALE TIME-INVARIANT LINEAR SYSTEMS

G.J. Lastman, N.K. Sinha and P. Rozsa

August 1982, No. of Pages: 21

Revised:

Key Words: Decoupling, model reduction, large-scale systems,  
chained aggregation

Abstract: A general linear decoupling transformation for linear time-invariant systems is considered. The decoupling can be realized through the solution of an algebraic matrix Riccati equation and the solution of an algebraic matrix Lyapunov equation. If the purpose of the decoupling is to separate the "slow" and the "fast" modes of the original system, then there exists a solution of the Riccati equation that accomplishes the separation. When this Riccati solution is used, there is a solution of the Lyapunov equation that makes the decoupling a special case of the aggregation method. If the unknown matrices in the decoupling transformation are specified in a certain way, we obtain a procedure equivalent to the chained aggregation method. If the "slow" and "fast" modes are to be separated we show, by an example problem, that other solutions to the Riccati equation give inappropriate decouplings.

Description:

Related Work: SOC-140, SOC-164, SOC-195, SOC-200, SOC-290, SOC-295.

Price: \$ 6.00.

SOC-299

A COMPUTER PROGRAM FOR OBTAINING AGGREGATED MODELS OF A MULTIVARIABLE  
(LINEAR) SYSTEM BY MATCHING SPECIFIED TIME MOMENTS AND MARKOV PARAMETERS

I. El-Nahas, N.K. Sinha and R.T.H. Alden

August 1982,      No. of Pages: 38

Revised:

Key Words:      Model reduction, aggregation, computer program

Abstract:      This report describes a computer program that produces aggregated reduced order models of a multivariable (linear) system by matching specified time moments and Markov parameters. The program is written in standard Fortran IV for interactive use on the CDC Cyber 170/730 computer.

Description:

Related Work:      SOC-140, SOC-164, SOC-195, SOC-200, SOC-290, SOC-295.

Price:              \$25.00.

SOC-300

A UNIFIED DECOMPOSITION APPROACH FOR FAULT LOCATION  
IN LARGE ANALOG CIRCUITS

J.A. Starzyk, A.E. Salama and J.W. Bandler

September 1982, No. of Pages: 53

Revised:

Key Words:           Fault location, analog circuit analysis, hierarchical  
                          decomposition, parameter identification, network  
                          decomposition

Abstract: This paper deals with the problem of fault location in analog circuits. The circuit under test is decomposed into subnetworks using the measurement nodes. We localize the faults to within the smallest possible subnetworks according to the final decomposition. Then, further identification of the faulty elements inside the subnetworks is carried out. The method is applicable to large networks, linear or nonlinear. It requires a limited number of measurement nodes and its on-line computation requirements are minimal. The method is based on checking the consistency of KCL in the decomposed circuit. A measure of the effect of tolerances on the elements is introduced, and a number of examples are considered to illustrate the application of the method in both the linear and the nonlinear cases.

Description:

Related Work:       SOC-233, SOC-235, SOC-236, SOC-244, SOC-251, SOC-259,  
                          SOC-266, SOC-267, SOC-268, SOC-269, SOC-271, SOC-285.

Price:               \$ 12.00.

SOC-301

A MINIMAX APPROACH TO THE BEST MECHANICAL ALIGNMENT PROBLEM

J.W. Bandler, M.A. El-Kady, W. Kellermann and W.M. Zuberek

September 1982, No. of Pages: 39

Revised:

Key Words: Mechanical design, computer-aided design, tuning, alignment, minimax optimization

Abstract: This paper provides an attempt to formulate and to solve the best mechanical alignment problem, which arises in many practical situations when a relatively expensive manufactured product does not meet design specifications and a decision is to be made for partial retreatment of the product. We define and use concepts of regular points, reference points and referenced points for a mechanical design. These points represent important features which must be reproduced subject to tolerances, which are defined w.r.t. various coordinate systems. The algorithm proposed identifies candidates for reworking using minimax optimization. While the concepts introduced and the method presented resulted from a variety of approaches to solving mechanical problems in two dimensions, this class of problem can arise in other areas and further generalization is possible.

Description:

Related Work:

Price: \$10.00.

SOC-305

EVALUATION OF FAULTY ELEMENTS WITHIN LINEAR SUBNETWORKS

J.A. Starzyk, R.M. Biernacki and J.W. Bandler

January 1983, No. of Pages: 33

Revised:

Key Words: Fault location, analog circuit analysis, hierarchical decomposition, parameter identification, network decomposition

Abstract: This paper presents the theoretical background for designing tests which are topologically sufficient for identification of faulty parameter values in linear subnetworks. Nodal voltages are assumed to be obtainable either by measurements or, indirectly, as a result of a nodal fault analysis. A formulation of nodal fault analysis for subnetworks is presented. It is shown how this approach can be used to evaluate faulty elements within inaccessible faulty subnetworks. The objective of this work is the reduction of the number of required current excitations and, thereby, the number of voltage measurements. Coates flow-graph representation of a network is used.

Description:

Related Work: SOC-233, SOC-235, SOC-236, SOC-244, SOC-251, SOC-259, SOC-266, SOC-267, SOC-268, SOC-269, SOC-271, SOC-285.

Price: \$10.00.



SOC-306

FLOWGRAPH ANALYSIS OF LARGE ELECTRONIC NETWORKS

J.A. Starzyk and A. Konczykowska

January 1983, No. of Pages: 87

Revised:

Key Words: Topological methods, linear network analysis, signal flowgraphs, symbolic analysis of large networks, computer aided techniques

Abstract: The paper presents a new complete method for signal flowgraph analysis of large electronic networks. Two efficient methods of flowgraph formation that can easily represent decomposed networks are introduced. Hierarchical decomposition approach is realized using the so-called upward analysis of decomposed network. This approach removes the limitations on topological analysis and allows to obtain fully symbolic network formulas in time which is linearly proportional to the size of the network. The approach can be used to obtain symbolic solutions of any linear system of equations.

Description:

Related Work: SOC-244, SOC-266, SOC-268, SOC-269, SOC-273, SOC-285, SOC-300.

Price: \$ 12.00.