



**Research Group
on
Simulation,
Optimization
and
Control**

**3 Day Short Course
ON**

OPTIMIZATION

**WEDNESDAY, JUNE 19th TO
FRIDAY, JUNE 21st, 1974**

**FACULTY OF
ENGINEERING**

**McMASTER UNIVERSITY
Hamilton, Ontario, Canada**

**McMaster University
Department of Electrical Engineering
Hamilton, Ontario
L8S 4L7**

COURSE OBJECTIVE

The course is designed to cover both theoretical and practical aspects of optimization. It is aimed at engineers and scientists in industry as well as educators in colleges or universities. The principal objective is to present state-of-the-art techniques and/or applications in a manner comprehensible to users or potential users of optimization methods.

PROGRAM OUTLINE

Tuesday, June 18th

REGISTRATION

For both Conference Sessions and University Accommodation.

In the Commons Building, Main Lobby, from 4:00 p.m. to 10:00 p.m.

DINNER will be provided to each registered resident guest from 5:00 p.m. to 6:00 p.m. in the Commons Building "Vallance Memorial Dining Hall".

All resident and non-resident delegates are invited to attend the 'Welcome Reception' to be held from 9:00 p.m. to 11:00 p.m. in the Commons "Vallance Memorial Dining Hall".

Wednesday, June 19th

REGISTRATION

For those persons attending Conference Sessions only, who did not register Tuesday evening.

In the Commons Building, Main Lobby, from 8:00 a.m. to 11:00 a.m.

Morning Sessions begin at 9:00 a.m.,
Afternoon Sessions at 2:00 p.m.

Wednesday, June 19th

Morning: Introduction to Optimization
(Dr. Bandler)

Coffee Break 10:30 a.m.

Gradient Minimization Methods
(Dr. Charalambous)

Lunch will be served from 12 noon to 1:30 p.m. and Dinner served from 5:00 p.m. to 6:30 p.m. in the Commons "Vallance Memorial Dining Hall".

Those non-resident convention delegates may join resident guests for either Lunches or Dinners in the Commons Dining Room by the purchase of meal tickets at the Commons Lobby 'Main Desk'. Lunch is offered at \$2.50 and Dinner at \$2.75.

Afternoon: Non-linear Minimax Optimization
(Dr. Charalambous)

Coffee Break 3:30 p.m.

Applications in Electrical
Circuit Design
(Dr. Bandler)

FESTIVAL THEATRE

Arrangements have been made for your attendance at the stage presentation of "The Imaginary Invalid" at the Stratford Festival Theatre.

Thursday, June 20th

Morning: Practical Aspects of Optimization in Design. Available Optimization Programs and Design Packages. Applications in Mechanical Engineering (Professor Siddall)

Coffee Break 10:30 a.m.

Lunch 12 noon to 1:30 p.m.

Afternoon: Linear, Nonlinear and Integer Programming. Applications in Management (Dr. Lasdon)

Coffee Break 3:30 p.m.

BANQUET NIGHT

Dinner will be served at 7:00 p.m. in the Commons 'Vallance Memorial Dining Room'.

Banquet Tickets are required to gain entrance to the Dining Room.

Friday, June 21st

Morning: Modeling and Control Applications in Chemical Engineering (Dr. Lapidus)

Coffee Break 10:30 a.m.

Lunch 12 noon to 1:30 p.m.

Afternoon: Panel Discussion (All Speakers)

PROGRAM DETAIL

Wednesday Morning

Dr. Bandler's talk will introduce the general area of numerical optimization techniques suitable for computer implementation. Basic concepts concerning objective functions, parameter vectors, constraints, minima and maxima, the gradient vector, the Jacobian matrix, the Hessian matrix, optimality, Lagrange multipliers, nonlinear equations and so on, will be introduced. Formulations of objectives and objective functions will be discussed with emphasis to approximation problems, e.g., least squares, least pth and minimax. The concept of algorithms involving steepest descent and direct search will be introduced. The ideas behind linear searches and conjugate directions will be discussed. Dr. Charalambous will give a survey and comparison of recent automatic gradient minimization methods which either have found or should find useful application in the area of computer-aided design. His talk will include: Huang's (1970) family of algorithms from which most of the existing conjugate-gradient algorithms can be obtained as particular cases, an explanation of Dixon's (1972) theorem which shows that most of the conjugate-gradient algorithms will produce the same sequence of points if "full linear search is used", Fletcher's (1970) algorithm and other algorithms which abandon the full linear search subproblem.

Wednesday Afternoon

In this talk special emphasis will be devoted by Dr. Charalambous to a variety of formulations and algorithms for nonlinear least squares, nonlinear least pth and nonlinear minimax optimization which can be readily programmed and used. It will be shown how constrained minimax problems can be solved exactly as unconstrained minimax problems. The close relationship between minimax approximation and nonlinear programming (constrained optimization) will be explained. It will be shown how, for example, least squares approximation algorithms can be applied iteratively to solve minimax and other optimization problems. Applications of optimization in electrical circuit design will be presented by Dr. Bandler. Examples of analog and digital filter design using least pth or minimax objectives as well as component tolerance optimization will be featured.

Thursday Morning

Professor Siddall will review the formulation of optimization expressions from design configurations. Problems with functions containing square roots and logs of negative quantities and the use of variable transformations will be discussed. Scaling of variables and constraints and problems where some variables are not in the optimization function will be considered. Problems with empirical expressions and local approximations and the use of charts and tables are to be described. Prof. Siddall will discuss the problem of finding global solutions, problems with multiple objectives and the choice of a method. Other topics to be discussed are: Sources of optimization programs, whether the user should write his own, user-oriented packages, the use of optimization in computer aided design, the use of computer graphics, as well as applications in Mechanical Engineering.

Thursday Afternoon

The fundamentals of linear programming will be presented by Dr. Lasdon including a discussion of: simple geometric examples, extreme points and basic solutions, and the simplex method. The formulation of some important classes of management problems as linear programs: production planning and distribution, optimal blending, scheduling, etc., will be highlighted. Characteristics of commercial computer codes for linear programming: matrix generators, solution procedures, and report writers will be discussed. Dr. Lasdon will talk about basic ideas of branch and bound search algorithms and the use of linear programming. A significant example is optimal design of a product distribution system: location and sizing of warehouses, and transportation patterns of multiple commodities from plants, to warehouses, to customers, at minimal total cost. Nonlinear integer programs will be mentioned. Dr. Lasdon will present if the time permits an extension of the basic ideas of the simplex method to nonlinear programming — the generalized reduced gradient method.

Friday Morning

Dr. Lapidus will focus his attention on the modeling of linear and nonlinear systems: 1. When the model is known but the parameters must be adjusted to fit experimental data. Application to chemical kinetic

systems, computer programs and computer-aided design of experiments. 2. When the model is unknown but the system is linear. Application of various input forcing functions on realistic complex reaction systems. 3. When the model is unknown but the system is nonlinear. Application to realistic black-box type of modeling. With the model specified, the discussion will then turn to the control of linear and nonlinear and small and large dimensional systems. Dynamic programming and the linear-quadratic algorithm are to be outlined. Applications to singular problems, to constrained problems and to other non-chemical problems are to be developed.

Friday Afternoon

The panel discussion will provide an additional opportunity for those attending the course to question the speakers on problems not necessarily covered in the course.

SPEAKERS

John W. Bandler received the B.Sc. (Eng.) and Ph.D. degrees of the University of London in Electrical Engineering at the Imperial College of Science and Technology in 1963 and 1967, respectively. From 1966 to 1967 he was with Mullard Research Laboratories, Redhill, Surrey, England. He was a Post-doctorate Fellow and Sessional Lecturer at the University of Manitoba from 1967 to 1969. He became Assistant Professor in 1969 and Associate Professor in 1971 at McMaster University in Electrical Engineering. He is an Associate Member of the Department of Applied Mathematics and Coordinator of the Group on Simulation, Optimization and Control. He is a contributor to **Modern Filter Theory and Design** (G. C. Temes and S. K. Mitra, Eds.), Wiley-Interscience, 1973, and is author or co-author of 4 papers appearing in **Computer-Aided Filter Design** (G. Szentirmai, Ed.), IEEE Press, 1973. Dr. Bandler is Guest Editor of the IEEE Transactions on Microwave Theory and Techniques Special Issue on Computer-Oriented Microwave Practices (March 1974). His interests include circuits and systems, computer-aided design, approximation and optimization methods. He has many publications in technical journals and has been an invited speaker at several international symposia.

Christakis Charalambous received the B.Sc. degree in Electronics and Electrical Engineering from the University of Surrey, Surrey, England, in 1969. He received the Ph.D. degree in Electrical Engineering at McMaster University in 1973, approximately 2½ years after commencing graduate studies. He currently holds a National Research Council of Canada Post-doctorate Fellowship and is with the Department of Combinatorics and Optimization, University of Waterloo, Waterloo, Ontario, Canada. Dr. Charalambous is co-author of 3 papers appearing in **Computer-Aided Filter Design** (G. Szentirmai, Ed.), IEEE Press, 1973. He is the author of "A unified review of optimization" appearing in the IEEE Transactions on Microwave Theory and Techniques Special Issue on Computer-Oriented Microwave Practices (March 1974). His main research interests are in the areas of unconstrained optimization, nonlinear programming, integer programming, approximation theory and their applications in computer-aided circuit and system design.

Leon Lapidus received the B.S. and M.S. degrees in Chemical Engineering from Syracuse University and the Ph.D. in Chemical Engineering from the University of Minnesota. He has carried out Post-doctorate studies at M.I.T. Dr. Lapidus is currently Professor and Chairman of the Department of Chemical Engineering, Princeton University, Princeton, N.J. He has been the recipient of several professional awards and is consultant to a number of corporations. He is Associate Editor of the Chemical Engineering Journal, the AIChE Journal and the International Journal of Systems Science, as well as Consulting Editor to Blaisdell and Addison-Wesley Publishing Companies. His publications include **Digital Computation for Chemical Engineers**, McGraw-Hill, 1962; **Optimal Control of Engineering Processes**, Blaisdell, 1967; **Numerical Solution of Ordinary Differential Equations**, Academic Press, 1971; and **Mathematical Modeling in Chemical Engineering**, Prentice-Hall, 1973. Dr. Lapidus has to date over 120 publications appearing in various technical journals, and is a well-known international speaker in his fields of interest.

Leon Lasdon received the B.S. degree in Electrical Engineering from Syracuse University and the M.S. degree in Electrical Engineering and the Ph.D. degree in Systems Engineering from Case Institute of Tech-

nology. He spent the 1968-69 academic year as UNESCO's technical expert in computer sciences at the Technion, Haifa, Israel. He is currently Professor of Operations Research at Case Western Reserve University, Cleveland, Ohio. His book, **Optimization Theory for Large Systems**, Macmillan, 1970, was awarded honorable mention in the 1970 Lanchester Prize competition for the year's best publication in operations research. Dr. Lasdon's areas of research and consulting are in the theory and application of mathematical programming, large scale systems, and in the application of operations research methodology to problems of health care delivery and court management. He has authored many papers in technical journals.

James N. Siddall received the B.Sc. in Mechanical Engineering from the University of Saskatchewan in 1944, and the S.M. degree in Mechanical Engineering from M.I.T. in 1948. He has held several industrial positions. He was a visiting Professor at Queen's University, Belfast, from 1967 to 1968. He is currently Professor and Chairman of the Department of Mechanical Engineering, McMaster University. He is author of **Mechanical Design Reference Sources**, University of Toronto Press, 1967, and **Analytical Decision-Making in Engineering Design**, Prentice-Hall, 1972. His teaching and research interests include design and development of user-oriented optimization packages, value theory in design and studies of combined reliability theory and probabilistic approaches to analysis and design.

HOW TO REGISTER

For Convention Sessions Only

Applicants must complete and return the attached Session Registration Form with full payment by **Friday, May 31st, 1974.**

Your 'Registration' Fee of \$150.00 covers your attendance at all sessions, provides course material and selected reports and includes all coffee service. You are also entitled to attend the closing Banquet to be held Thursday night.

An evening at the Stratford Festival has been planned on Wednesday, June 19th, for the stage production of Moliere's "The Imaginary Invalid".

A limited number of tickets are available, so please register early if you wish to attend. The price of \$12.00 includes both your transportation and an orchestra seat ticket.

GENERAL INFORMATION

Hamilton, Transportation

Hamilton is situated midway between Toronto and Niagara Falls on the Queen Elizabeth Highway (QEW). McMaster University is located at the west end of the city in a clean, wooded area.

It can be reached:

By Car: The QEW connects at the north end to the 403 highway and at the south to Interstate 90.

By Air: The nearest large airport is the Toronto International. A limousine leaves every full and every half hour to downtown Hamilton. The ride takes one hour. From downtown Hamilton a taxi may be taken to the campus.

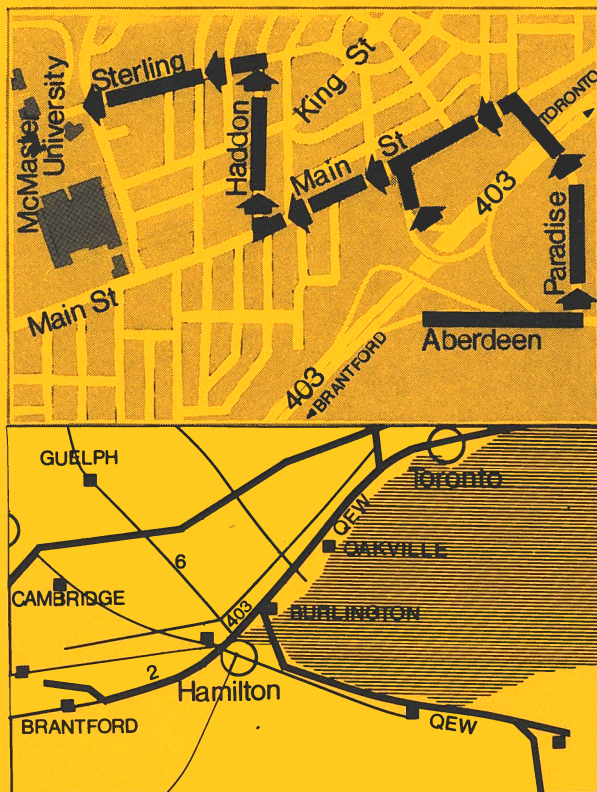
Hamilton has its own airport served by only one airline, NORDAIR, which flies to Pittsburg, Ottawa, Montreal and Windsor.

If you are driving from Toronto (or East);

- Take the 403 Highway
- Off at the Main Street West exit
- Left at the stop light onto Main Street
- Right at the next light, Haddon Avenue
- Left on Sterling Street into the University entrance.
- The guard on the gate will direct you to the Commons Building.

If you are driving from Brantford (or West):

- Take the 403 Highway
- Off at Aberdeen Avenue exit
- Left at the light, Longwood Road
- Left at the next light, Main Street
- (Proceed as above)



**OPTIMIZATION – SESSION
REGISTRATION FORM**

June 19th to 21st, 1974

**PLEASE FORWARD TO:
Dr. J. W. Bandler
Dept. of Electrical Engineering
McMaster University, Hamilton, Canada
L8S 4L7**

Name & Title _____

Company _____

Address _____

Telephone _____ (Business) _____ (Home)

Registration Deadline Date *I wish to register for:* **A Convention Sessions \$ 150.00**
Friday, May 31st, 1974 **B Stratford Festival Ticket \$ 12.00**
Total Amount Enclosed \$ _____

Cheques made payable to: McMaster University

REGISTRATION APPLICATION FOR UNIVERSITY RESIDENCE/FOOD ACCOMMODATION

**McMASTER UNIVERSITY
CONFERENCE OFFICE
The Commons Building
McMaster University
Hamilton, Ontario L8S 4K1**

The Optimization Course – June 19th to 21st, 1974

PLEASE PRINT

Name(s): _____

Address: _____

Prov./Country: _____ Zip Code: _____

Telephone: _____ (Business) _____ (Residence)

- Please remit application form to McMaster University – address above.
- Cheques to be made payable to McMaster University.
- Deadline for receipt of Registration Application is June 7th, 1974.

Cheque enclosed

Will pay upon arrival

Please indicate your preferred choice of accommodation:

A PACKAGE PLAN (Sharing Residence Bedroom Space) \$45.50 per person, \$91.00 per couple **B PACKAGE PLAN (Single Bedroom Accommodation) \$51.50 per person**

Expected Arrival Time: _____ Method of Transportation _____