



## **SIMULATION OPTIMIZATION SYSTEMS** **Research Laboratory**

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### **OPTIMAL PROCESSING OF ENERGY IN POWER NETWORKS**

This project, supported by a Strategic Grant from the Natural Sciences and Engineering Research Council of Canada, was directed at producing general, portable user-oriented software incorporating recent theoretical and computational developments in (a) power system simulation, sensitivity analysis and planning, (b) design centering, tolerance assignment and network tuning, (c) fast algorithms for nonlinear constrained optimization. Accurate modelling, efficient simulation and fast optimization has been directed specifically at reducing energy waste within a power network while meeting constraints incorporating physical limitations on practical components.

Software for power system simulation and optimization has been developed. Data bases, sophisticated routines for data reading, manipulation and reprocessing, highly efficient, state-of-the-art packages for load flow analysis, system decomposition and equivalencing, contingency analysis and ranking as well as methods of power system optimization have been produced. Programs and packages have been prepared in Fortran IV, tested on the CDC 170/730 and CDC 170/815, and are fully supported by theory. Unique features include the exploitation of the Tellegen theorem method and the complex Lagrangian method originated by Bandler and El-Kady. Nonreciprocal power network elements comprising phase shifting transformers are handled elegantly and exactly.

Different problems of power system optimization have been solved using the software developed in conjunction with general optimization packages: the minimum loss problem, economic dispatch, minimization of line overloading and optimal load shedding under emergency conditions. General optimization software used include the MINOS/AUGMENTED system from Stanford as well as adaptations of the Han-Powell algorithm and the Hald-Madsen techniques.

The academic research work has been carried out under the collaborative direction of Dr. J.W. Bandler and Dr. M.A. El-Kady, in the Simulation Optimization Systems Research Laboratory of the Department of Electrical and Computer Engineering, McMaster University. Results of this and related research are available through regular publication of technical reports, papers, documented computer programs and user manuals for the purpose of private study, personal scholarship and research. For a list and conditions of release, please contact Dr. J.W. Bandler. Commercially useful spinoffs as well as special projects and consulting related to industrial requirements are handled by Optimization Systems Associates (J.W. Bandler, President).