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NONSMOOTH OPTIMIZATION ALGORITHMS, SYSTEM THEORY, AND SOFTWARE TOOLS

FOR OPTIMAL CONTROL OF FLEXIBLE STRUCTURES, INTEGRATED DESIGN OF FLEXIBLE STRUCTURES AND THEIR CONTROL SYSTEMS, AND SHAPE OPTIMIZATION

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RESEARCH OBJECTIVES

The broad research objective of this project was the development of optimization algorithms and related system-theoretic aspects for the integrated design of flexible structures and their control systems, and shape design. The specific aspects under consideration are *(i)* efficient, consistent discretization techniques for use in semi-infinite optimization, optimal control, and optimal shape design algorithms that solve problems with dynamics governed by partial differential equations, *(ii)* global techniques for finding design parameters satisfying specifications, *(iii)* optimal control algorithms for discrete and distributed systems with control, state and shape constraints.

ACCOMPLISHMENTS

With AFOSR support, T. Baker, J. Higgins, Y-P Harn, J. Wiest, and C. Kirjner-Neto have carried out research under my supervision that has resulted in the award of PhD degrees. C. Kirjner Neto has been awarded the Departmental David Sakrison prize for best PhD dissertation of the year. A 600+ page, book [26] has been completed, containing many original results in semi-infinite programming and optimal control. In particular, the book will be unique in the literature dealing not only with nonlinear programming algorithms, but also with implementable versions of semi-infinite optimization and optimal control algorithms with control and state space constraints. An important highlight of our research is a theory of consistent approximations for use in the solution of semi-infinite optimization, optimal control algorithms, and shape optimization problems which makes it possible to construct algorithms for the solution of these problems using nonlinear programming libraries as subroutines.

Over the years, our research has dealt with *(i)* efficient, consistent discretization techniques for use in semi-infinite optimization, optimal control and shape optimization, *(ii)* discretization techniques with guaranteed minimum rate of convergence properties, *(ii)* optimal control algorithms that solve problems with dynamics governed by partial differential equations, *(iii)* various techniques for finding design parameters satisfying specifications, *(iv)* algorithms for moving horizon control of dynamical systems, and *(v)* algorithms for structural optimization and control. The results of this research were presented in the papers listed below.

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