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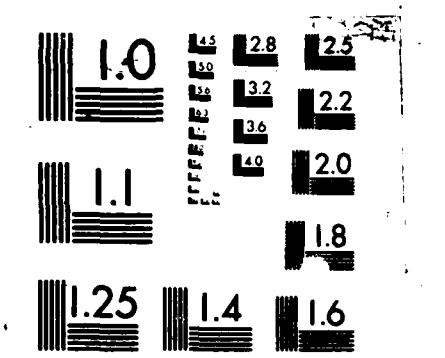

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CONTROL COORDINATION FOR HEREDITARY SYSTEMS

FINAL REPORT

July 1, 1984 - September 30, 1986

Principal Investigators: Robert E. Fennell and James A. Reneke
Department of Mathematical Sciences
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Clemson, SC 29634-1907

A control coordination strategy, which allows some level of autonomous component control for large scale hereditary systems, has been developed. The basic problem considered is how to add constraints to the component requirements and to exchange related information between components so that local control decisions can be made. The approach requires that component interactions be suitably limited so that variational methods can be used to determine component control laws independently. A reproducing kernel Hilbert space of Hellinger integrable functions provides the setting for the description of system operators and the analysis of optimization problems. For finite dimensional state space systems geometric, algebraic, and graph theoretic properties of system matrices can be used to describe allowable interactions between system components. Related problems considered involve the feedback stabilization of linear hereditary systems, the approximation and digital representation of feedback operators arising in the analysis of linear hereditary systems. Reproducing kernel Hilbert space methods have produced useful approximations for estimation and control problems for deterministic hereditary systems. By obtaining explicit reproducing kernel Hilbert space representations of stochastic processes governed by linear hereditary dynamics as spaces of Hellinger integrable functions such approximation methods have been applied to the problem of finding the covariance kernel given the model.

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RESEARCH PUBLICATIONS AND PRESENTATIONS.

"Control coordination for large scale systems," Proceedings 1985 American Control Conference (1985), 590-591, by R. E. Fennell, J. A. Reneke and S. B. Black. Conference presentation made by R. E. Fennell, June 1985.

"Decentralized control strategies for hereditary systems," Proceedings of the 1985 IEEE Conference on Decision and Control (1985), by J. A. Reneke and R. E. Fennell. Conference presentation made by R. E. Fennell, December 1985.

"Feedback stabilization of linear hereditary systems," Proceedings of Seventh International Symposium on Analysis and Optimization of Systems (1985), by J. A. Reneke and R. E. Fennell. Conference presentation made by J. A. Reneke, June 1986.

"RKH space methods for approximating the covariance kernels of a class of stochastic hereditary systems, II," Proceedings Seventh International Symposium on the Mathematical Theory of Networks and Systems, June1985. Conference presentation made by J. A. Reneke, June 1985.

"An optimal control problem for a class of nonlinear hereditary systems," to appear Proceeding 1986 IEEE Conference on Decision and Control, by J. A. Reneke and R. E. Fennell, Conference presentation to be made by J. A. Reneke, December 1986.

"Structured Hereditary Systems," Research monograph by J. A. Reneke, R . E. Fennell and R. B. Minton, to be published Pure and Applied Mathematics, A Series of Monographs, Textbooks, and Lecture Notes, Marcel Dekker, Inc., New York.

"RKH-Space approximations for the feedback operator in a linear hereditary control system," by J. A. Reneke and R. E. Fennell in preparation. Conference presentation made by J. A. Reneke, SIAM National Meeting October 1985.

"Canonical forms for decentralized control," by R. E. Fennell in preparation. Conference presentation made by R. E. Fennell, SIAM Meeting on Linear Algebra and Applications, April 1985.

STUDENT SUPPORT. Therese Shelton, a graduate student in the Department of Mathematical Sciences, has received support for two summers from this research grant. She has completed her Ph.D. Qualifying Exams and will present initial thesis research on Volterra-Stieltjes integral equations with unbounded kernels on inner product spaces at the Sixth Annual Southeastern Regional Conference on Differential Equations, October 1986.

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