SOME DECENTRALIZED ESTIMATION AND CONTROL SCHEMES

WITH APPLICATION TO POWER SYSTEMS

BY

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Thesis submitted
in fulfilment of the requirements of the degree of

DOCTOR OF PHILOSOPHY

DEPARTMENT OF ELECTRICAL ENGINEERING
INDIAN INSTITUTE OF TECHNOLOGY DELHI

1984

CERTIFICATE

This is to certify that the THESIS entitled, SOME DECENTRALIZED ESTIMATION AND CONTROL SCHEMES : WITH APPLICATION TO POWER SYSTEMS being submitted by RAJENDRA PRASAD for the award of the degree of DOCTOR OF PHILOSOPHY to the INDIAN INSTITUTE OF TECHNOLOGY:DELHI is a record of bonafide research work he has carried out under our supervision. The results obtained in this thesis have not been submitted to any other University or Institute for award of a degree or diploma.

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TO

MAAN SHARDE

The goddess of wisdom

कर्मण्येवाधिकारस्ते मा फलेषु कदाचन।
मा कर्मफलहेतुर्भूर्मा ते सङ्गोऽस्त्वकर्मणि॥

— भागवद्गीता

"Your right is to work only, but never to the fruit thereof. Let not the fruit of action be your object, nor let your attachment be to inaction"

— Bhagvadgeeta

ACKNOWLEDGEMENTS

I am grateful to my supervisors, Professor A.K.Mahalanabis, Department of Electrical Engineering, Pennsylvania State University, U.S.A. and Dr. S.I.Ahson, Assistant Professor, Department of Electrical Engineering, Indian Institute of Technology,Delhi, INDIA, for their continual encouragement, invaluable guidance and useful discussions during the course of this research work.

I am thankful to my wife Shanti for her patience, encouragement and cheerful company and my children Sushma, Shailendra, Anamika and Akhilendra for keeping me young and energetic. Thanks are also due to all my friends and colleagues both at the Indian Institute of Technology,Delhi and Bihar College of Engineering, Patna for their good wishes.

Finally, I wish to thank Shri J.N. Saini for neatly typing the manuscript.

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I.I.T. Delhi
December,1984

A B S T R A C T

The size and complexity of large-scale interconnected systems have stimulated the search for new methods for their modeling, state-estimation, and control. For such systems (including the electric power system) a decentralized control scheme represents a natural realization. This thesis is aimed at providing new methods for the design of decentralized estimation and control schemes for deterministic as well as stochastic systems. The approach of decentralization through dynamic equivalencing of the external subsystem and identification-based model-order reduction techniques is used. The detailed internal model and the external equivalent model are adjoined together to get a completely decentralized model. The decentralized models are used for designing decentralized estimators and controllers.

Three different types of output structure are considered, resulting in a number of estimators. While designing decentralized controllers for stochastic and deterministic cases, we consider minimization of a quadratic performance index with integral action such that an optimal control law is obtained that is linear in structure and produces zero steady-state errors in the outputs. For the sake of comparison an alternative approach for designing a decentralized deterministic

estimator (observer) is proposed. The decentralized estimation and control algorithms proposed in this thesis are tested on a simulated four-area load-frequency-control (LFC) model. Their performance is evaluated in terms of storage requirements, computation time and ease of implementation. For this an ICL 2960 digital computer is employed. A discrete-time formulation has been used throughout the thesis. For completeness of the thesis, proper background material, reviews and suggestions for further work in this area are included.

C O N T E N T S