A PRE-FILTER FOR RECURSIVE CONTINUOUS-TIME-MODEL PARAMETER ESTIMATION

A thesis presented in partial fulfilment of the requirements for the degree of

Doctor of Philosophy in Technology

at Massey University

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1995

ABSTRACT

This thesis reports the development of a prefiltering technique for estimating the parameters of continuous-time models given by differential equations. This technique is based on some special integrals, named the Fixed Interval Integrals (FII), which result from multiple integrations over intervals of fixed length. An estimation method using this prefiltering technique has several significant features:

- it is capable of estimating both system delay and the parameters of a second order dynamical model.
- it is able to be implemented on discrete-time digital devices.
- it is independent of initial conditions, hence these do not need to be known.
- it uses well-established discrete-time estimation algorithms.

This development starts with the definition of a new operator notation system. It then studies in detail the properties of the fixed interval integration and its relationship to traditional calculus operations. Several possible methods to realize the FII operation using analog and digital filters are also given.

Using these results and some simulation examples, the use of FII in parameter and delay estimation of continuous-time models is demonstrated.

Since the FII is likely to be useful in engineering and mathematics beyond parameter estimation, some other possible applications of the FII are outlined.

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ACKNOWLEDGEMENT

I have been waiting for this opportunity to express my appreciation to my supervisors, namely, Dr. Paul C. Austin, Dr. Huub H. C. Bakker and Prof. Robert M. Hodgson for their assistance and support. A special thanks is owed to my chief supervisor, Dr. Paul C. Austin for his help in applying for funding for my research and for his great friendship that made my study a pleasant time.

My appreciation is also due to the University Grants Committee of New Zealand for the awarding of the Postgraduate Scholarship which enabled me to undertake this research.

I would like to thank Gail E. Sherson formerly of Tasman Pulp and Paper, without whom my industrial study would not have been successful, and also all the supporting staff of the Production Technology Department of Massey University.

My appreciation is also expressed to Prof. Graeme C. Wake and Dr. Mike R. Carter of the Department of Mathematics and Statistics for their advice and teaching in differential equations.

Finally, I wish to thank my family for their support and understanding, and also all my course-mates and friends for making my stay at Massey University so wonderful and fruitful.

LIST OF CONTRIBUTIONS

The major contributions in this thesis are :

1. the development of an operator notation system for some calculus operations which is convenient for both theoretical and implementational work.

2. the determination of the relationships between Fixed Interval Integration and some other calculus operations.

3. the development of several realization methods for Fixed Interval Integration.

4. the development of a prefiltering technique based on the Fixed Interval Integration, for estimating parameters and pure delay of continuous-time models described by differential equations.

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