STUDIES IN PARAMETER ESTIMATION USING WALSH FUNCTIONS APPROACH

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C E R T I F I C A T E

This is to certify that the thesis entitled,"STUDIES IN PARAMETER ESTIMATION USING WALSH FUNCTIONS APPROACH", being submitted by Mr. Anand Swarup Saxena for the award of the degree of DOCTOR OF PHILOSOPHY to the Indian Institute of Technology, Delhi, is a record of the original bonafide research work carried out by him under our guidance and supervision. The results contained in this thesis have not been submitted to any other University or Institute for the award of any degree or diploma.

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DEDICATED TO

PARENTS,

SUMAN, MY WIFE

AND

AKHIL, ANURAG AND AMIT, MY SONS

A C K N O W L E D G E M E N T S

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ABSTRACT

The thesis addresses the problem of parameter estimation in lumped and distributed parameter systems employing Walsh functions. The method used is based on the use of orthogonal functions (Walsh functions) in reducing lumped and distributed parameter systems models to algebraic equations. Greville's algorithm is used to develop a recursive algorithm to get an estimate of the parameters of the model. The recursive algorithms, developed for various types of system considered, have the features of computational simplicity and finite memory requirement. The algorithm can be used to identify the unobservable systems also. These algorithms enable the estimation of initial and boundary conditions along with the unknown parameters.

In all six problems have been considered in this thesis. Firstly, a recursive least-squares estimation algorithm has been developed for evaluating the coefficients of Walsh functions expansion of a signal. This algorithm is extended to cover the two-variable case. In the second problem, parameter estimation procedures for linear distributed parameter systems of first-order and second-order have been presented using recursive algorithms.

Next two problems consider the parameter estimation in bilinear lumped systems, a class of non-linear lumped systems with fractional powers in non-linearity and non-linear distributed parameter systems. Recursive algorithms have been developed for estimation procedure of all these problems. Appropriate numerical examples have been included to illustrate the use of algorithms.

The last two problems deal with the parameter estimation in linear lumped time-varying system and linear time-varying distributed parameter systems. Estimation procedures for these systems are based on the recursive algorithms developed.

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