Recursive Identification and Parameter Estimation

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Publication date: June 23, 2014
Publisher: CRC Press, Taylor & Francis
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ISBN: 9781466568846 - CAT# K16406

A book review

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This book describes a recursive and unified approach on resolving system identification and parameter estimation problems raised from diverse areas such as identification of ARMAX systems, identification of block-oriented nonlinear systems, adaptive regulation for nonlinear stochastic systems, principal component analysis, and many others. The basic idea of the approach is to transform the problems under consideration to seeking roots of one or several regression functions.

The supporting tool for the proposed approach is SAAWET (stochastic approximation algorithm with expanding truncations) described in Chapter 2. SAAWET is a root-seeking algorithm for a regression function, which can be observed at any argument with observation errors. Since the observation is allowed to have the structural error and the random noise as well, selection of the regression function is rather flexible, and this makes wide applicability of the approach. The conditions required for convergence of SAAWET are considerably weaker than those for the original stochastic approximation algorithm, so they can be verified when SAAWET is applied to identifying linear systems (Chapter3), nonlinear systems (Chapter 4), and various parameter estimation problems (Chapter 5).

The feature of the proposed method is as follows: i) Estimates produced by the algorithms are recursively updated; ii) They converge to the true values with probability one; iii) The conditions guaranteeing convergence usually are rather weak, for example, for identification of ARMAX systems the restrictive SPR (strictly positive realness) condition is not needed, while it has to be assumed when the conventional ELS (extended least squares) is applied.

In order to verify the noise condition required for convergence, the necessary information from probability theory and non-negative matrix theory is provided in Chapter 1 and Appendices.

In summary this book helps practitioners and researchers find ways to resolve challenging linear and nonlinear system identification problems using the well-established SAAWET method. It is a description of a class of recursive system identification and parameter estimation algorithms that can be used to identify dynamic models from measured data. Written with an emphasis on making algorithms and methods accessible so that they can be applied and used in practice, this book also includes the comprehensive theoretical support, which can provide significant insights into complex system modelling.

I recommend the book for widespread readership including anyone who has data and wants to fit a dynamic model, from almost all scientific and engineering disciplines — see the examples and step by step procedures included for the breadth of potential subject application areas.