

Gibbs, Bruce P. *Advanced Kalman Filtering, Least-Squares and Modeling*. Hoboken, New Jersey: John Wiley & Sons, Inc., 2011, 605 pp. \$145.00 (Hardbound).

This book provides a complete explanation of estimation theory and application, modeling approaches, and model evaluation. Each topic starts with a clear explanation of the theory (often including historical context), followed by application issues that should be considered in the design. Different implementations designed to address specific problems are presented, and numerous examples of varying complexity are used to demonstrate the concepts.

It focuses on practical methods for developing and implementing least-squares estimators, Kalman filters, and newer filtering techniques. Since model development is critical to a successful implementation, the book discusses first-principle approaches, basis function expansions, stochastic models, and ARMA-type structures. Computation of empirical models and determination of “best” model structures and order are also discussed. The text is written to help the reader design an estimator that meets all application requirements.

Specifically addressed are methods for developing models that meet estimation goals, procedures for making the estimator robust to modeling and numerical errors, extensions of the basic methods for handling non-ideal systems, and techniques for evaluating performance and analyzing accuracy problems. Including many real-world examples, the book:

- Presents little-known extensions of least-squares estimation and Kalman filtering that provide guidance on model structure and parameters
- Explains numerical accuracy, computational burden, and modeling tradeoffs for real-world applications
- Discusses implementation issues that make the estimator more accurate or efficient, or that make it flexible so that model alternatives can be easily compared
- Offers guidance in evaluating estimator performance and in determining/correcting problems
- A related Web site provides a subroutine library that simplifies implementation, as well as general purpose high-level drivers that allow for the easy analysis of alternative models and access to extensions of the basic Kalman filtering

Drawing from four decades of the author’s experience with the material, *Advanced Kalman Filtering, Least-Squares and Modeling* is a comprehensive and detailed explanation of these topics. Practicing engineers, designers,

analysts, and students using estimation theory to develop practical systems will find this a very useful reference.

Bruce P. Gibbs has forty-one years of experience applying estimation and control theory to applications for NASA, the Department of Defense, the Department of Energy, the National Science Foundation, and private industry. He is currently a consulting scientist at Carr Astronautics, where he designs image navigation software for the GOES-R geosynchronous weather satellite. Gibbs previously developed similar systems for the GOES-NOP weather satellites and GPS.