Kalman Filtering and Neural Networks, Edited by Simon Haykin

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Edited by

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CONTENTS

4 Chaotic Dynamics 83

Gaurav S. Patel and Simon Haykin

5 Dual Extended Kalman Filter Methods 123

Eric A. Wan and Alex T. Nelson

PREFACE

This self-contained book, consisting of seven chapters, is devoted to Kalman filter theory applied to the training and use of neural networks, and some applications of learning algorithms derived in this way.

It is organized as follows:

- Chapter 1 presents an introductory treatment of Kalman filters, with emphasis on basic Kalman filter theory, the Rauch–Tung–Striebel smoother, and the extended Kalman filter.
- Chapter 2 presents the theoretical basis of a powerful learning algorithm for the training of feedforward and recurrent multilayered perceptrons, based on the decoupled extended Kalman filter (DEKF); the theory presented here also includes a novel technique called multistreaming.
- Chapters 3 and 4 present applications of the DEKF learning algorithm to the study of image sequences and the dynamic reconstruction of chaotic processes, respectively.
- Chapter 5 studies the dual estimation problem, which refers to the problem of simultaneously estimating the state of a nonlinear dynamical system and the model that gives rise to the underlying dynamics of the system.
- Chapter 6 studies how to learn stochastic nonlinear dynamics. This difficult learning task is solved in an elegant manner by combining two algorithms:
  1. The expectation-maximization (EM) algorithm, which provides an iterative procedure for maximum-likelihood estimation with missing hidden variables.
  2. The extended Kalman smoothing (EKS) algorithm for a refined estimation of the state.

- Chapter 7 studies yet another novel idea – the unscented Kalman filter – the performance of which is superior to that of the extended Kalman filter.

Except for Chapter 1, all the other chapters present illustrative applications of the learning algorithms described here, some of which involve the use of simulated as well as real-life data.

Much of the material presented here has not appeared in book form before. This volume should be of serious interest to researchers in neural networks and nonlinear dynamical systems.

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INDEX