Preface

Data-driven regression models such as hinging hyperplanes, neural networks and support vector machines are widely applied in control, optimization, and process monitoring. If we had some insight to these black boxes we could have the possibility to validate these models, extract hidden information about relationships among process variables, and support model identification by incorporating prior knowledge.

The key idea of this book is that hinging hyperplanes, neural networks, and support vector machines can be transformed into fuzzy models, and interpretability of the resulting rule-based systems can be ensured by special model reduction and visualization techniques.

The first part of the book deals with the identification of hinging hyperplane-based regression trees. The operating regime of the model is recursively partitioned by a novel fuzzy c-regression clustering-based technique. The resultant compact regression tree consists of local linear models whose model structure is favored in model-based control solutions, as in model predictive control.

The next section deals with the validation, visualization and structural reduction of neural networks based on the transformation of the hidden layer of the network into an additive fuzzy rule-based system.

Finally, based on the analogy of support vector regression and fuzzy models, a three-step model reduction algorithm will be proposed to get interpretable fuzzy regression models on the basis of support vector regression.

Real-life utilization of the developed algorithms is shown by section-wise examples taken from the area of process engineering. The discussion of the proposed algorithms is supported by over 35 figures; more than 90 references that give a good overview of the current state of nonlinear regression, and suggested further reading material for students and researchers interested in the details; algorithms that aim to understand the methods in detail and help implement them; and over ten examples with Matlab files downloadable from the authors' website (www.abonyilab.com).

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