**Nonlinear system identification and its applications**

This is a 10-lecture course. The area of the nonlinear system identification is so diverse and the aim of the course is to provide students the basic understanding of the area and the available methods in the literature. Then, the course focuses on some selected methods for detailed discussions. The first 3-4 lectures will be on general nonlinear system identification. In addition to brief introduction of existing methods, topics that will be discussed include the minimum mean squared error estimator, the direct weight optimization approach, generalized additive nonlinear systems, systems with short term memory and low degree of interactions, tradeoff between the goodness of fit and the model complexity and noise especially outlier effects. The next 3-4 lectures cover various identification methods for the block-oriented nonlinear systems. Examples are decoupling of linear and nonlinear parts, blind approach, frequency method, iterative algorithms and others. Towards identification of Wiener systems with the least amount a priori information will also be discussed. The final three lectures are devoted to the applications of nonlinear system identification. A number of examples will be illustrated including adaptive bolus chasing angiography, identification of a modified Wiener-Hammerstein system in electrically stimulated paralyzed skeletal muscle modeling, modeling of a cell system and other nonbio-medical applications.

Textbook: none, however reference papers will be provided.

Assessment: There will be a take home project. Students will have 6pt(??) credits if they pass the course.

General

Recursive direct weight optimization in nonlinear system identification: a minimal probability approach

• Identification of IIR nonlinear systems without a priori structural information

Representation and Identification of Nonparametric Nonlinear Systems of Short Term Memory and Low Degree of Interactions

• An Interactive Term Representation and Estimation Approach to Non-Parametric FIR Nonlinear System Identification

• Non-Parametric Nonlinear System Identification: a Data-Driven Orthogonal Basis Function Approach

• Identification of Non-parametric Nonlinear Systems with Low Degree Interactive Terms

Non-Parametric Nonlinear System Identification: An Asymptotic Minimum Mean Squared Error Estimator

Identification of an additive nonlinear system and its application in generalized Hammerstein models

• Identification of additive nonlinear systems

Estimation of nonlinear systems without a priori structural information and its application in Hammerstein model identification with dynamic nonlinearities

Optimization with Few Violated Constraints and Its Application in Bounded Error System Identification

Convergence Results of Analytic Center Estimator

Basis approach and Lasso

Block oriented

Decoupling the Linear and Nonlinear Parts in Hammerstein Model Identification

Identification of Linear System with Hard Input Nonlinearities

A Blind Approach to Hammerstein Model Identification

• A Blind Approach to Hammerstein-Wiener Model Identification

Frequency Domain Identification of Wiener Models

• A Frequency Domain Approach to Hammerstein Model Identification

Convergence of the Iterative Hammerstein System Identification Algorithm

• Iterative identification of Hammerstein systems

• Convergence of the iterative algorithm for a general Hammerstein system identification

• Making parametric Hammerstein system identification a linear problem

Towards identification of Wiener systems with the least amount of a priori information on the nonlinearity

• Towards identification of Wiener systems with the least amount of a priori information on the nonlinearity: IIR cases

Applications

Adaptive bolus chasing

Identification of a Modified Wiener-Hammerstein System and Its Application in Electrically Stimulated Paralyzed Skeletal Muscle Modeling

Modeling of a cell system

Positive Lasso and its application in nuclear nonproliferation

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