Seminar

Introduction to Subspace Identification Methods

Paulo Lopes dos Santos
Faculdade de Engenharia da Universidade do Porto

E-mail: pjsantos@fe.up.pt

Abstract
Dynamic models for prediction and control include transfer functions, state space models, time-series models, which are parametrized in terms of finite number of parameters. System identification is a methodology developed mainly in the area of automatic control, by which we can choose the best model(s) from a given model set based. Subspace identification methods are a class of identification algorithms, originally developed for linear-time-invariant systems (LTI), which estimate state-space models from the input-output data. These methods intensively use advance algebra concepts such as singular value decomposition (SVD), orthogonal and oblique projections, etc. They only produce suboptimal estimates but their main advantage is that are not iterative and they do not suffer from parameterization problems because the estimated state-space realization is data-driven, i.e., is determined by the data. In most application they can be used as standalone identification methods. However, if optimal accuracy is required they can also be used to initialize optimal iterative algorithms such the prediction error algorithms.

In this talk it is made an introduction to subspace identification methods. First the Identification problem is addressed and the Ho-Kalman deterministic-realization algorithm is explained. This algorithm uses the most common tools of the LTI subspace methods such as SVD and the exploitation of the shift invariance of the observability and controllability matrices to estimate the state-space model parameters. Then deterministic versions of the N4SID and MOESP methods are presented.

References

Theme proposal

LPV Systems Identification

Advisor(s): Paulo Lopes dos Santos, pjsantos@fe.up.pt

Aims: A critical issue for modern methods for robust and gain scheduled controller design deriving models in which the dependence from operating point information and/or uncertain parameters is explicit. The Linear Parameter (LPV) System paradigm is a well succeeded attempt to solve this problem. The number of applications using the modelling approach is growing steadily covering an wide range of applications such as biomedical, aeronautics, internet control, energy, etc. In this work it is aimed to study a class of identification algorithms for LPV systems. These algorithms estimate state-space LPV models in canonical forms. The model structures seem to be simple but they can efficiently model systems with complex time varying dynamics. These algorithms have been applied to model the effect of a drug in fibromyalgia treatment with encouraging results.

References: