Nonlinear dynamic systems: blind identification of block-oriented models, and instability under random inputs

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Nonlinear dynamic systems are everywhere present in our daily life: a microchip, a loudspeaker, a robot, a car, an airplane, a chemical plant, a bridge, ... These applications reveal both dynamic and nonlinear behaviour. "*Dynamic*" means that the system's response is frequency dependent and that the system has a memory, while "*nonlinear*" means that the response does not scale (linearly) with the input amplitude. Till now, system identification has been mainly focussing on linear modelling. These linear models, which try to give an accurate mathematical approximation of reality, can become inaccurate when used for nonlinear dynamical systems. Hence, nonlinear models are needed. Besides providing insight into the complex behaviour of dynamical systems, these (nonlinear) models can be used for simulation, prediction, design, optimisation and control purposes.

The first part of the thesis concentrates on the identification of certain types of nonlinear systems (e.g. Wiener and Hammerstein systems). Usually, in system identification, the system's input and output are both measured. But in some applications, one has no access to the input, e.g. the wind acting on a bridge or building, or the unknown stock market input. In the cases where only output data are available, *blind* identification becomes the only option. Blind identification is more involved than the classical identification theory. In this work, the theoretical properties and also the impact of measurement noise disturbances are analysed.

In a second part, the focus is put on the *(in)stability* of nonlinear dynamical systems. A system is called stable if the response to a bounded input is bounded. In practice, the stability or instability of a given physical system or model is often unknown. For linear systems the theory is well-established. In this work, the aim is to construct tools for (automated) retrieval of stability information of nonlinear systems (or models), assuming that the input is random.