Local state space reduction of multiscale systems

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Modelling reaction kinetics in a homogeneous medium usually leads to stiff systems of ordinary differential equations the dimension of which can be large. A well-known approach to reduce the dimension of such systems is the quasi-steady state assumption (QSSA): the derivative of fast variables is assumed to be zero. This procedure requires some knowledge of the underlying chemistry, moreover the corresponding differential system must be explicitely given.

In this talk we shall describe and justify a procedure for a local reduction of the dimension of state space which does not require chemical insight as well as an explicit knowlegde of the system in a singularly perturbed form.

Our method works in the case of autonomous and non-autonomous first order differential equation systems. This method exploits the wide range of characteristic time-scales in a chemical system and its mathematical justification is based on the theory of invariant manifolds. The procedure helps to get chemical insight into the intrinsic dynamics of a complex chemical process.