Computing Slowly Advancing Features in Fast-Slow Systems without Scale Separation- A Young Measure Approach

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Abstract:

In the first part of the talk, and in order to set the stage, we will offer a multi-scale and averaging strategy to compute the solution of a singularly perturbed system when the fast dynamics oscillates rapidly; namely, the fast dynamics forms cycle-like limits which advance along with the slow dynamics. We describe the limit as a Young measure with values being supported on the limit cycles, averaging with respect to which induces the equation for the slow dynamics. In particular, computing the tube of the limit cycles establishes a good approximation for arbitrarily small singular parameters. We will demonstrate this by exhibiting concrete numerical examples.

In the second part of the talk we will examine singularly perturbed systems which may not possess a natural split into fast and slow state variables. Once again, our approach depicts the limit behavior as a Young measure with values being invariant measure of the fast contribution to the flow. These invariant measures are drifted by the slow contribution to the value. We keep track of this drift via slowly evolving observables. Averaging equations for the latter lead to computation of characteristic features of the motion and the location the invariant measures.

To demonstrate our ideas computationally, we will present some numerical experiments involving a system derived from a spatial discretization of a Korteweg-de Vries-Burgers type equation, with fast dispersion and slow diffusion.

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