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Efficient POD-based ROMs to approximate bifurcation diagrams

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— Computing transitions and instabilities is a relevant issue in many fields, whose analysis usually involves time dependent nonlinear models. Thus, construction of bifurcation diagrams in extended systems may require huge computational resources. In dissipative problems, proper orthogonal decomposition (POD) may provide a low dimensional manifold containing the large-time dynamics of the system. In this talk, simple ideas are exploited in order to get flexible and accurate POD-based reduced order models (ROMs). The proposed method relies on the observation that POD manifolds resulting from snapshots calculated from a generic initial condition, a non-small time span, and specific values of the parameters contain the attractors for a wide range of parameter values. Appropriate POD manifolds can then be constructed with great flexibility and used to fast compute bifurcations. This is illustrated for fairly complex bifurcation diagrams (involving chaotic attractors) in the complex Ginzburg-Landau equation, in which a good set of snapshots can be calculated from either parameter values yielding simple dynamics, or rough numerical solvers, or different equations.

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