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Numerical methods for bifurcation problems

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Abstract

In the first lecture I will review some basic concepts and techniques used in the numerical computation of families of solutions to systems of nonlinear equations. These include parameter continuation, and, more importantly, pseudo-arclength continuation. Elementary examples will be given. As a particular example, I will consider continuation of families of periodic solutions of systems of nonlinear ordinary differential equations.

The second lecture will deal with solutions of general boundary value problems, with emphasis on discretization using high order accurate finite element collocation methods with adaptive meshes. As a recent application I will discuss the numerical computation of 2D manifolds that arise in dynamical systems; in particular, stable and unstable manifolds of stationary points and of periodic orbits. The specific approach considered is especially effective for problems having eigenvalues of greatly different magnitude and for very stiff systems. Illustrative examples will be presented.