

Nonautonomous Bifurcation Theory and Vortex Merging

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Abstract

Nowadays huge amounts of observational and numerical data are available to reconstruct and predict the behaviour of an underlying dynamical system, e.g. velocity fields in oceanography. However, the dynamics is typically non-stationary, i.e. time-varying and the available data is discrete in time and space and available only over a finite time interval. As a consequence the classical asymptotic methods of dynamical systems theory do not apply.

In this talk we clarify this point of view by studying the merging of two vortices modelled by the Poisson and Vorticity equation. Since the vortices merge in time, the velocity field of the particles is not stationary and is given numerically as the solution of the PDE and hence gives rise to a time-dependent (nonautonomous) ODE which is discretized in time and space and is known only on a finite-time interval. This nonautonomous ODE undergoes a so-called "nonautonomous bifurcation" in time as two vortices come close together and merge to one big vortex. The description of this merging process in the framework of nonautonomous dynamical systems leads to a new aspect of nonautonomous bifurcation theory, an actual topic of research.