

Visualising bifurcations in high dimensional systems: The spectral bifurcation diagram

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Int. J. Bif Chaos 13 (10): 3015-3027, Feb 2003

Abstract

Bifurcation diagrams which allow one to visualise changes in the behaviour of low dimensional nonlinear maps as a parameter is altered are common. Visualisation in higher dimensional systems is more difficult. A straightforward method to visualize bifurcations in flows of high dimensional nonlinear dynamical systems is presented, using the Lorenz '96 systems with dimension 8 and dimension 40 as examples. Three techniques are considered; the first two, density and max/min diagrams, are analogous to the traditional bifurcation diagrams used for maps. These diagrams are generally more difficult to interpret than the corresponding diagrams of maps, however, due to projection effects and the continuous nature of the flow. The third technique introduces an alternative approach: by calculating the power spectrum at each value of the control parameter, a plot is produced which clearly shows the changes between periodic, quasi-periodic, and chaotic states; these spectral bifurcation diagrams reveal structure not shown by the other methods.

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