Estimating the State of Large, Complex, Spatio-Temporally Chaotic Systems: Weather Forecasting, Etc.

Edward Ott*

Institute for Research in Electronics and Applied Physics, University of Maryland, College Park, Maryland 20742
* Electronic Address: edott@umd.edu

For the purposes of scientific investigation, forecasting and control (among others) it is crucial to be able to determine a good approximation to the state of a dynamical system of interest from measured data. Often such data is noisy and incomplete. Given an approximate model for the evolution of the system, there are effective classical methods for treating the state estimation problem. However, these classical methods become infeasible for dynamical systems that are large, in the sense that it is necessary to give the values of a very great number of variables in order to effectively specify the system state. In this talk, we discuss a technique [1] for accurately treating large, spatio-temporally chaotic systems. The main application and motivation has been in weather forecasting, but the technique is more general, and we will also report on a recent application to laboratory experiments on Rayleigh-Benard convection in a large aspect ratio cell.

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[1] E. Ott et al., Tellus A **56**, 415 (2004); Phys. Lett. A **330**, 365 (2004).