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Determining the spectrum of the nonlinear local Lyapunov exponents in a multidimensional chaotic system

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For an n-dimensional chaotic system, the authors recently extended the definition of the nonlinear local Lyapunov exponent (NLLE) from one- to n-dimensional spectra, and presented a method of computing the NLLE spectrum. The method was tested on three chaotic systems with different complexity. The results indicate that the NLLE spectrum realistically characterizes the growth rates of initial error vectors along different directions from the linear to nonlinear phases of error growth, which is an improvement over the traditional Lyapunov exponent spectrum that only characterizes the error growth rates during the linear phase of error growth. In addition, compared with the traditional Lyapunov exponent spectrum, the NLLE spectrum has been shown to be more suitable for estimating the predictability limit of chaotic systems for initial perturbations along different directions.