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An improved method for nonlinear parameter estimation: A case study of the Rössler model

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Parameter estimation is an important research topic in nonlinear dynamics. Based on the evolutionary algorithm (EA), Wang et al. (2014) present a new scheme for nonlinear parameter estimation and numerical tests indicate that the estimation precision is satisfactory. However, the convergence rate of the EA is relatively slow when multiple unknown parameters in a multi-dimension dynamical system are estimated simultaneously. To solve this problem, an improved method for parameter estimation of nonlinear dynamical equations is provided in the present paper. The main idea of the improved scheme is to use all of the known time series for all of the components in some dynamical equations to estimate the parameters in single component one by one, instead of estimating all of the parameters in all of the components simultaneously. Thus, we can estimate all of the parameters stage by stage. The performance of the improved method was tested using a classic chaotic system-Rössler model. The numerical tests show that the amended parameter estimation scheme can greatly improve the searching efficiency and that there is a significant increase in the convergence rate of the EA, particularly for multi-parameter estimation in multi-dimension dynamical equations. Moreover, the results indicate that the accuracy of parameter estimation and the CPU time consumed by the presented method have no obviously dependence on the sample size.