# Global reconstruction of dynamical systems by weekly nonstationary noisy chaotic time series

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The method of reconstruction of an unknown dynamical system (DS) by a weekly nonstationary chaotic time series (TS) corrupted by significant measurement noise is suggested. The method is based on construction of a time-dependent parameterized model of a discrete evolution operator which is able to reproduce the nonstationary dynamics of reconstructed DS. The modified Bayesian approach to inverse problem solving is used. This approach provides a statistically correct way to take into account both the information about the noise and a priori knowledge about the (reconstructed) system, while allowing one to analyze noisy chaotic TS.

The application of the method to the problem of predicting DS behavior by a TS whose characteristic scale of nonstationarity is much greater than the observation time is considered, and an appropriate non-autonomous parameterized model is constructed in the form of an artificial neural network. Such a model is used to analyze TS corrupted by measurement noise and generated by classic dynamical systems (Henon map and R?ssler system) with slowly changing control parameters. Probabilistic prognosis of the behavior of these systems outside the observed TS is presented for the times exceeding the observation time interval. The prognosis includes prediction of the bifurcation sequences, indication of the expected instants of specific bifurcation transitions and the accuracy of determining these instants, calculation of the probabilities to observe the predicted regimes of the system Rs behavior at the time of interest, etc. Some restrictions are discussed, as well as possible advances of the proposed method.