

Judging Model Reduction of Chaotic Systems via Optimal Shadowing Criteria

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A common goal in the study of high dimensional and complex system is to model the system by a low order representation. In this letter we propose a general approach for assessing the quality of a reduced order model for high dimensional chaotic systems. The key of this approach is the use of optimal shadowing, combined with dimensionality reduction techniques. Rather than quantify the quality of a model based on the quality of predictions, which can be irrelevant for chaotic systems since even excellent models can do poorly, we suggest that a good model should allow shadowing by modeled data for long times; this principle leads directly to an optimal shadowing criterion of model reduction. This approach overcomes the usual difficulties encountered by traditional methods which either compare systems of the same size by normed-distance in the functional space, or measure how close an orbit generated by a model is to the observed data. Examples include interval arithmetic computations to validate the optimal shadowing.

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