

Characterizing chaos in Hamiltonian systems subjected to parameter drift

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Abstract

In low-dimensional Hamiltonian systems subjected to parameter drifts we show, based on papers [1, 2, 3], that the dynamics can best be understood by following ensembles of initial conditions corresponding to tori of the initial (drift-free) system. When such ensembles are followed, torus-like objects called snapshot tori are obtained, which change their location and shape. Sub-ensembles corresponding to chaotic seas of the drift-free problem can also be followed in any scenario. We call these sub-ensembles snapshot chaotic seas, while the joint ensemble of them and of the tori is called the snapshot phase portrait. After some time, most of the tori break up and become entrained into the snapshot chaotic seas. Such chaotic seas are shown to be foliated by time-dependent unstable and stable foliations, supporting time-dependent Smale horseshoes. The average pairwise distance initiated on an original torus hardly changes in time at first, but crosses over into an exponential growth when the snapshot torus breaks up. The crossover time can be predicted based on the time-dependent stable foliation.

References

- [1] János D., and Tél T.: Chaos in Hamiltonian systems subjected to parameter drift, *Chaos* **29**, 121105 (2019)
- [2] János D., Károlyi Gy. and Tél T.: Climate change in mechanical systems: the snapshot view of parallel dynamical evolutions, *Nonlinear Dynamics* **106**, 2781-2805 (2021)
- [3] János D. and Tél T.: Characterizing chaos in systems subjected to parameter drift, *Phys. Rev. E*, preprint (2022)