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Probing Hamiltonian dynamics by means of the 0-1 test for chaos

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A recently proposed test for chaos [Gottwald G A and Melbourne I 2004 *Proc. R. Soc. London A* **460** 603-611] is employed to probe the Hamiltonian dynamics of a one-dimensional anharmonic oscillator lattice. For a homogeneous (uniform mass) lattice in the weakly chaotic regime and for a heavy impurity embedded in the lattice, the results stemming from the time record of the position and momentum of a single oscillator in the former case, and for that same variables corresponding to the impurity in the latter, are inconclusive to determine the dynamical regime of the system. This seemingly odd behavior has its origin in the insufficient time series length employed. Nevertheless, for both cases the necessary time record length needed to obtain the correct result renders the test impractical. In particular, for the second case, specially in the large system size limit (which is the physically relevant one due to its connection with Brownian motion), the estimated length of the position time series required by the test to correctly classify the signal is beyond the reach of present-day computer capability. Thus our results indicate that the proposed test, for the aforementioned cases of Hamiltonian chaos, affords no clear advantage over conventional phase space reconstruction methods.

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