How to reconstruct the nonlinearity within a system of oscillators

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Physical models often contain unknown functions and relations. The goal of our work is to answer the question of how one should excite the system under consideration in an appropriate way to reconstruct an unknown nonlinear relation. To answer this question, we propose a greedy recon- struction algorithm within an offline-online strategy [1]. This strategy, we apply to a system of coupled harmonic and anharmonic oscillators [2]. In this model, we assume the restoring force to be unknown. Our identification is based on the application of several time-dependent excitations (also called controls) to the system during a given time interval. These specific controls are de- signed by the algorithm in order to provoke a deeper insight into the underlying physical problem and a more precise reconstruction of the unknown force. Afterwards, the resonance of this system at certain frequencies is measured, i.e. the Fourier transform is obtained. We perform numerical simulations which demonstrate the effectiveness of our approach that is not limited to systems of oscillators. Since our algorithm provides not only a way to determine unknown operators by existing data but also protocols for new experiments, it is a holistic concept to tackle the problem of improving physical models.

References:

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