Title:	Forecasting Hamiltonian dynamics without canonical coordinates
Authors:	Sinha, Sudeshna (/jspui/browse?type=author&value=Sinha%2C+Sudeshna)
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Abstract:	Conventional neural networks are universal function approximators, but they may need impractically many training data to approximate nonlinear dynamics. Recently introduced Hamiltonian neural networks can efficiently learn and forecast dynamical systems that conserve energy, but they require special inputs called canonical coordinates, which may be hard to infer from data. Here, we prepend a conventional neural network to a Hamiltonian neural network and show that the combination accurately forecasts Hamiltonian dynamics from generalised noncanonical coordinates. Examples include a predator–prey competition model where the canonical coordinates are nonlinear functions of the predator and prey populations, an elastic pendulum characterised by nontrivial coupling of radial and angular motion, a double pendulum each of whose canonical momenta are intricate nonlinear combinations of angular positions and velocities, and real-world video of a compound pendulum clock.
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