Title:	Machine-learning potential of a single pendulum
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Keywords:	Machine-learning pendulum potential
Issue Date:	2022
Publisher:	American Physical Society
Citation:	Physical Review E, 105(5), 54203.
Abstract:	Reservoir computing offers a great computational framework where a physical system can directly be used as computational substrate. Typically a “reservoir” is comprised of a large number of dynamical systems, and is consequently high dimensional. In this work, we use just a single simple low-dimensional dynamical system, namely, a driven pendulum, as a potential reservoir to implement reservoir computing. Remarkably we demonstrate, through numerical simulations as well as a proof-of-principle experimental realization, that one can successfully perform learning tasks using this single system. The underlying idea is to utilize the rich intrinsic dynamical patterns of the driven pendulum, especially the transient dynamics which has so far been an untapped resource. This allows even a single system to serve as a suitable candidate for a reservoir. Specifically, we analyze the performance of the single pendulum reservoir for two classes of tasks: temporal and nontemporal data processing. The accuracy and robustness of the performance exhibited by this minimal one-node reservoir in implementing these tasks strongly suggest an alternative direction in designing the reservoir layer from the point of view of efficient applications. Further, the simplicity of our learning system offers an opportunity to better understand the framework of reservoir computing in general and indicates the remarkable machine-learning potential of even a single simple nonlinear system.
Description:	Only IISER Mohali authors are available in the record.
URI:	https://doi.org/10.1103/PhysRevE.105.054203 (https://doi.org/10.1103/PhysRevE.105.054203) http://hdl.handle.net/123456789/5083 (http://hdl.handle.net/123456789/5083)
Appears in Collections:	Research Articles (/jspui/handle/123456789/9)

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