Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Predicting Critical Transitions in Multiscale Dynamical Systems Using Reservoir Computing[1] SOON HOE LIM, LUDOVICO GIORGINI, WOOSOK MOON, Nordita, JOHN WETTLAUFER, Yale University — Critical transitions are widespread in many systems in nature. Often times these transition events are induced by a fast driving signal, and are rare and random. Since such events could lead to significant effects, it is important to develop effective methods to predict signal-induced critical transitions early. We study the problem of predicting rare critical transition events for a class of slow-fast nonlinear dynamical systems. The state of the system of interest is described by a slow process, whereas a faster chaotic process drives its evolution and induces critical transitions. By taking advantage of recent advances in reservoir computing, we present a data-driven method to predict the future evolution of the state. We show that our method is capable of predicting a critical transition event at least several numerical time steps in advance. We demonstrate the success as well as limitations of our method using numerical experiments on three examples of systems, ranging from low dimensional to high dimensional.

[1]The authors acknowledge Swedish Research Council grant no. 638-2013-9243.

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Date submitted: 02 Aug 2020 Electronic form version 1.4