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The Role of Nonlinear Dynamics in Improving Machine Learning for Modeling Dynamic Systems

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Abstract :

Machine learning and Artificial Intelligence are rapidly evolving and are increasingly being used for developing dynamic models and for analysis and diagnostics. However, these data-based models are often not robust and generalizable, and do not capture many observed phenomena. On the other hand, nonlinear dynamics is able to satisfactorily explain many complex phenomena we can document in the physical world. We will explore how these physics-derived insights can help improve data-based models and especially assist diagnostics. Engineering applications in vibration, machinery dynamics and flow modeling will be provided to discuss the promising synthesis of nonlinear dynamics and machine learning.

Bio

C. 'Nat' Nataraj is the Moritz Endowed Distinguished Professor of Engineered Systems at Villanova University, USA. Founding director of VCADS, an interdisciplinary research center of excellence. Published text book and 250+ papers and patents in dynamic systems, Life Fellow of ASME, and Editor-in-Chief of Springer-Nature's Journal of Vibration Engineering Technologies. Research contributions in modeling, analysis and diagnostics in dynamic systems including rotating machinery, robotics, unmanned systems & autonomy, electromechanical systems, electromagnetic bearings, etc. Received research funding from ONR, DARPA, NSF and NIH. Winner of the Villanova Outstanding Research Award. Founding host of the podcast Nodycast (sponsored by the journal Nonlinear Dynamics). TEDx talks on medical diagnostics and CPR, and media articles in US News and World Report, Forbes, Wired and Philadelphia Inquirer.