Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

LSTM based nonintrusive ROM of convective flows[1] SHADY AHMED, SK. MASHFIQUR RAHMAN, OMER SAN, School of Mechanical and Aerospace Engineering, Oklahoma State University, Stillwater, OK 74078, USA., ADIL RASHEED, Department of Engineering Cybernetics, Norwegian University of Science and Technology, N-7465, Trondheim, Norway. — A feasible digital twin of any complex system necessitates computationally efficient and accurate simulations possibly without a complete mathematical form of the driving physics. Conventional projection-based reduced order modeling (ROM) techniques can satisfy the first two requirements, but usually fail at the third one. In the present study, we aim at addressing all the three components within a nonintrusive ROM framework. Proper orthogonal decomposition (POD) is well-known for its optimality in representing complex systems. However, its intrinsic global nature often causes a deformation of the generated bases, especially in convective flows. Based on dimensionality reduction using POD, we introduce a long short-term memory (LSTM) neural network architecture along with a principal interval decomposition (PID) framework as an enabler to account for localized modal deformation. We describe the concept of buffer zone, where a reconstruction step is performed at the interface between any two consecutive partitions. We test our framework using different convection-dominated, unsteady-flow problems.

[1]This material is based upon work supported by the U.S. Department of Energy, Office of Science, Office of Advanced Scientific Computing Research under Award Number DE-SC0019290.

Shady Ahmed
School of Mechanical and Aerospace Eng, Oklahoma State University

Date submitted: 01 Aug 2019 Electronic form version 1.4