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A Deep Learning based Approach to Reduced Order Modeling of Fluids using LSTM Neural Networks ARVIND MOHAN, DATTA GAITONDE, The Ohio State University — Reduced Order Modeling (ROM) can be used as surrogates to prohibitively expensive simulations to model flow behavior for long time periods. ROM is predicated on extracting dominant spatio-temporal features of the flow from CFD or experimental datasets. We explore ROM development with a deep learning approach, which comprises of learning functional relationships between different variables in large datasets for predictive modeling. Although deep learning and related artificial intelligence based predictive modeling techniques have shown varied success in other fields, such approaches are in their initial stages of application to fluid dynamics. Here, we explore the application of the Long Short Term Memory (LSTM) neural network to sequential data, specifically to predict the time coefficients of Proper Orthogonal Decomposition (POD) modes of the flow for future timesteps, by training it on data at previous timesteps. The approach is demonstrated by constructing ROMs of several canonical flows. Additionally, we show that statistical estimates of stationarity in the training data can indicate a priori how amenable a given flow-field is to this approach. Finally, the potential and limitations of deep learning based ROM approaches will be elucidated and further developments discussed.

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