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Unsteady Flow Field Predictions Using Multi-level Deep Convolutional Autoencoder Networks[1] JIAYANG XU, KARTHIK DURAISAMY, University of Michigan — A machine learning framework is proposed for unsteady flow field predictions. Three levels of deep neural networks are used, with the goal of predicting the future state of the flow for unseen global parameters. A Convolutional autoencoder is used as the top level to encode the high-dimensional data sequence along spatial dimensions into a sequence of latent variables. A temporal convolutional autoencoder serves as the second level, which further encodes the output sequence from the first level along the temporal dimension, and outputs a set of latent variables that fully captures the spatio-temporal evolution of the flow field. A fully connected network is used as the third level to learn the mapping between these latent variables and the global parameters from training data, and predict them for new parameters. For future state predictions, the second level uses temporal convolutional network to predict subsequent steps of the output sequence from the top level. Outputs at the bottom level are decoded to obtain the high-dimensional flow field sequence at unseen global parameters and/or future states.

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