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Session T29: Geophysical Fluid Dynamics: General
12:40 PM–3:16 PM, Tuesday, November 23, 2021
Room: North 229 A

Chair: Pedram Hassanzadeh, Rice

Abstract: T29.00005 : Realistic Wind Data Generation for Small Unmanned Air Systems in Urban Environment using Convolutional Autoencoders *

1:32 PM–1:45 PM

← *Abstract* →

Presenter:
Rohit Kameshwara Sampath Sai Vuppala
(Oklahoma State University-Stillwater)

Authors:
Rohit Kameshwara Sampath Sai Vuppala
(Oklahoma State University-Stillwater)

Kursat Kara
(Oklahoma State University-Stillwater)

In urban areas, where obstacles are large and abundant, computational fluid dynamics (CFD) would be the best choice for simulating and analyzing complex scenarios for safe wind aware navigation of Small Unmanned Systems. However, owing to the large computation time required for CFD simulation, it is unfeasible for real-time predictions or close to real-time predictions for creating pilot awareness especially for avoiding gusts. In this study, we present a preliminary work on using a data-driven non-linear surrogate model based on deep learning to efficiently generate realistic wind data for urban environments. Using high-fidelity CFD data from Large Eddy Simulations (LES) and Convolutional Auto-Encoders (CAE) for non-linear surrogate modeling, we attempt to generate realistic wind data for urban environment. The non-linear surrogate model is used to extract underlying non-linear modes from the high-resolution data snapshots and LSTM network is trained on these specific modes. Modal predictions for future time-steps are then obtained using this trained LSTM network similar to time-series prediction, without the need of computationally expensive CFD simulations. These modes could then be decoded back into the physical space to obtain the relevant wind field data predictions. Since no prior information about the underlying governing equations are utilized for the predictions, the method is a completely non-intrusive in approach and could be easily extended for other applications with minimal changes.

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