Poster presentation | Poster session
Poster Session
Thu. Jul 18, 2024 4:30 PM - 6:30 PM Room P

[PO-05] Deep-learning-based reduced-order modeling to assess urban wind environment

Mingyu Yang[1], *Jungwoo Kim[1], Jung-Il Choi[1] (1. Yonsei University)

Keywords: Urban wind environment, POD-transformer, Urban air mobility

Twelfth International Conference on
Computational Fluid Dynamics (ICCFD12),
Kobe, Japan, July 14-19, 2024

Deep-learning-based reduced-order modeling to assess urban wind environment

M. Yang*, J. Kim* and J.-I. Choi*,
Corresponding author: jic@yonsei.ac.kr
* Yonsei University, Republic of Korea.

Assessing the wind environment in urban areas is crucial for planning smart cities and urban air mobility (UAM) [1]. This study proposes an advanced data-driven approach called proper orthogonal decomposition with transformer neural networks (POD-transformer) to address the high computational demands associated with traditional physics-based models [2]. First, the wind patterns in the Yongsan District of Seoul were extensively captured using a physics-based simulator [1]. Using these snapshots, a robust data-driven model was built and validated to evaluate different wind scenarios by incorporating turbulent intensity (I_u) and gust equivalent mean speed (V_{GEM}) at various heights. The results provide valuable information on urban wind environments for pedestrians and UAM operations. The study also shows a considerable acceleration in the POD-transformer model generation times compared to conventional physics-based model. Finally, potential applications, limitations, and areas for future research are discussed.

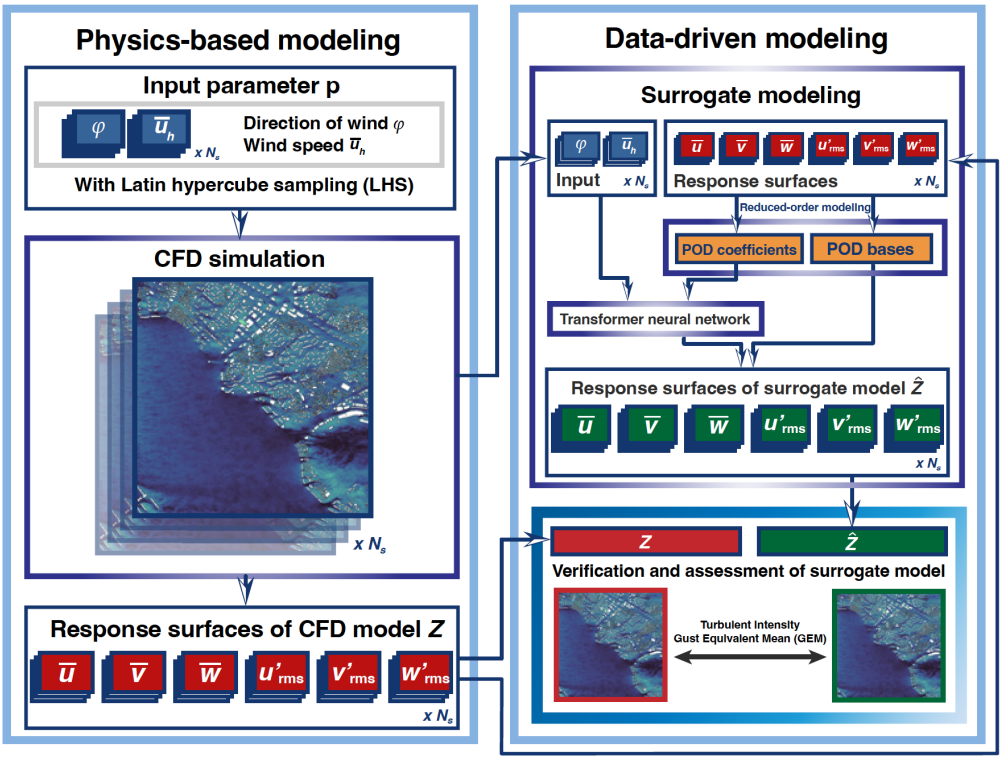

Figure 1: An Overall framework of deep-learning-based reduced order modeling.

References

[1] Mingyu Yang, Geunwoo Oh, Tiantian Xu, Jungwoo Kim, Ji-Hoon Kang, and Jung-Il Choi. Multi-gpu-based real-time large-eddy simulations for urban microclimate. *Building and Environment*, 245:110856, 2023.

[2] Mingyu Yang, Seongyoon Kim, Xiang Sun, Sanghyun Kim, Jiyong Choi, Tae Seon Park, and Jung-Il Choi. Deep-learning-based reduced-order modeling to optimize recuperative burner operating conditions. *Applied Thermal Engineering*, 236:121669, 2024.