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A CFD-BASED MULTI-FIDELITY SURROGATE MODEL FOR PREDICTION OF FLOW PARAMETERS IN A VENTILATED ROOM

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Computational fluid dynamics (CFD) is a very powerful tool for evaluating indoor air distribution. However, accurate CFD simulations are still prohibitively expensive for routine use in indoor environment design and control [1]. As a result, new models capable of providing CFD-level accuracy at considerably lower computational cost are needed. In this regard, data-driven models (DDMs) are getting popular as indoor environment modeling tools due to their accuracy and low computational cost. However, the performance of DDMs directly depends on the quality of training data. Vast computational resources are needed for obtaining high-quality training data. The amount of such data could be decreased by applying a multi-fidelity approach, combining high and low fidelity data.

This work aims to propose multi-fidelity DDM combining a small number of high-fidelity grid-independent large-eddy simulations (LES) with a large number of coarse grid (twice coarser in each direction) LES to predict comfort-related flow parameters in a ventilated room with a heated floor [2]. The developed model is based on multi-fidelity Gaussian process regression. The dataset is constructed by changing the room width, inlet velocity, and wall temperature difference. These are the model input parameters together with temperature and velocity magnitude values at various room locations, which imitate the sensor readings. The developed model is analyzed in terms of computational cost and accuracy and later applied for optimization of operating room conditions, minimizing the vertical temperature gradient and the duration of the steady regime establishment. This model is applicable for indoor airflows with complex physical phenomena such as natural and forced convection and commonly used room geometries. The model could be used for applications where a combination of fast and accurate predictions is required, for example, for building model predictive control or conceptual design of the indoor environment.

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