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INVESTIGATING THE CAPABILITIES OF CFD-BASED DATA-DRIVEN MODELS FOR INDOOR ENVIRONMENTAL DESIGN AND CONTROL

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The air distribution in buildings is usually evaluated either by simplified reduced-order models or CFD. Simplified models can provide very rapid predictions but offer limited information due to assumptions required. On the other hand, CFD is a computationally expensive tool. Despite the growth in computational power and advances in numerical algorithms, high-fidelity CFD simulations are either too slow or too costly to be used as a primary tool for indoor environment design and control [1]. Moreover, our findings suggest that the growth of computational resources in the near future would not be enough to make CFD available for routine use in buildings. This means more work is required on developing better models to reduce the computational cost of the simulations while maintaining accuracy.

Data-driven models are steadily gaining popularity in the field of indoor environmental simulations, as they can provide rapid predictions at an accuracy comparable to CFD. In our study, we develop machine learning algorithms based on data from CFD simulations, which predict comfort-related airflow parameters in a ventilated room with a heated floor [2]. The main focus of our research is on investigating the capabilities and limitations of these algorithms as a cheaper alternative to CFD, taking into account specific requirements for indoor environmental applications. We compare the computational cost and accuracy of three different models, namely artificial neural network (ANN), support vector regression (SVR), and gradient boosting regression (GBR). We study how the quality of input data affects the quality of prediction, finding a trade-off between the number of simulations alimenting the model and their fidelity. Moreover, we analyze how discretization and turbulence modeling errors introduced in CFD simulations affect the error of the final data-driven prediction.

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