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Development of a Surrogate Reduced Order Model for Predicting Urban Air Pollution Transport using Computational Fluid Dynamics

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Transport of pollution in urban areas has been identified as a major contributor to various health issues. Computational Fluid Dynamics (CFD) is a powerful tool for predicting the propagation of aerosols and pollutants; however, its computational cost poses a significant challenge for real-world applications.

This ongoing study aims to develop the offline phase of surrogate reduced order model (ROM) by constructing a database of wind distribution and air pollution patterns. We employ a simplified urban test case, featuring a single building, the Hotel de Ville of Paris, at a resolution of 0.5 m. An in-house code is utilized for mesh construction, addressing incomplete building geometries.

Computations are performed according to predefined meteorological conditions, with parallel spatiotemporal proper orthogonal decomposition (POD) and dynamic mode decomposition (DMD) calculated during the CFD process. The results are automatically stored in an SQL database, while POD basis interpolation is executed during the online phase of the surrogate model.

To validate the model's physicality, mesh sensitivity tests are conducted, comparing two different mesh resolutions (400k cells and 700k cells). Our findings demonstrate similarity in results, supporting the reliability of the proposed approach.

Keywords: Urban scale modelling, code_saturne, CFD, Database

References