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Evaluation of a polynomial-chaos based multi-fidelity simulation framework for predicting wind pressure loads on buildings.[1] THEMISTOKLIS VARGIEMEZIS, CATHERINE GORLE, Stanford University — Wind-resistant design of buildings and their components plays an important role to reduce losses, fatalities, and business discontinuities. Large-eddy simulations (LES) provide a powerful tool to calculate wind loads on buildings, but the computational cost remains too high for widespread use during the building design process. The objective of this study is to investigate if multi-fidelity simulation techniques could be used to reduce the computational cost while maintaining the high accuracy required for design. The approach considers the wind direction as a random parameter, and constructs high-order polynomial chaos expansions (PCEs) for the mean pressure coefficients on the building as a function of the wind direction based on 15 Reynolds-averaged Navier-Stokes (RANS) simulations. To improve the accuracy of these PCE surrogate models, a subset of 3 LES is performed to construct low-order PCEs for the discrepancy between the RANS and LES predictions for the pressure coefficients. The sum of both PCEs was shown to provide surrogate models for the pressure coefficients that have a similar accuracy as high-order PCEs constructed using 15 LES, while reducing the computational cost by 60%.

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