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APPLICABILITY OF DISCRETE ADJOINTS FOR WIND COMFORT OPTIMIZATION

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Analysing wind comfort around a building in an urban environment is an important aspect during design. It is beneficial for information about the sensitivity of such comfort-related aspects to be considered during various stages of the process. Wind comfort primarily depends on the flow patterns around the structure, while being also affected to subjectiveness due to human perception, up to a certain degree. The complex physical effect, to its totality, further includes temperature and humidity variations [1]. In this study, we mainly focus on wind-driven aspects of perceived comfort by human occupants or pedestrians nearby. Respective objectives imply considering the overall magnitude as well as the magnitude of fluctuations (as a measure of smoothness), both ideally minimal. We choose a prototypical generic low-rise structure to showcase the developments.

The initial stage requires flow simulations, to investigate wind flow around the chosen example followed by sensitivity analysis using the adjoint approach, both steady state at this phase. However, wind is characterized as being chaotic by nature, therefore, the same experiment is extended to transient sensitivity analysis. This information is used to obtain an optimized structural design for the following optimization steps of the problem, thereby gradually improving the wind comfort by incremental shape modifications. Vertex morphing [2] is used to smoothen out the noisy sensitivity field obtained in both steady and transient sensitivity analysis. The resulting shapes from each approach are thoroughly compared and discussed.

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