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# Prediction of unsteady pressure loads on slender bodies using V-LES as an alternative to LES

C. Narayanan, M. Labois, and D. Lakehal
ASCOMP GmbH, Technoparkstrasse 1, 8005 Zürich, Switzerland (chidu@ascomp.ch)

The limits of the Reynolds Averaged (RANS) approach to turbulence modelling for transient, wind engineering flow have been reached. Today the trends are towards the use of new modeling strategies such as Large Eddy Simulation (LES) that put flow unsteadiness at the forefront. However, the LES strategy is still too expensive for various flows, in particular atmospheric flows where the Reynolds numbers are very high. This is the reason why alternative approaches based on scale separation are indispensable; for example the V-LES (Very Large Eddy Simulation) approach. The idea of V-LES is to combine RANS and LES where the cut-off scale is specified as a model parameter independent of the numerical mesh size (in contrast to the sub-grid scale in LES) but is dependent on the flow (for example, the characteristic size of an obstacle). The flow is decomposed into resolved and sub-scale parts. Length scales larger than the specific cut-off scale are directly solved for, whereas the sub-scale part is modeled with a RANS turbulence model as compared to the zero-equation Smagorinsky model used in LES. V-LES assumes that the Kolmogorov equilibrium spectrum applies to the sub-filter flow, which justifies the use of conventional RANS models for this portion of the flow. This will be detailed in the paper, along with the mathematical formulation of the problem. We discuss our latest results, in which we have conducted a systematic sensitivity analysis of the involved parameters. The V-LES is shown to be a viable alternative to LES for very high Reynolds flow conditions, providing key flow features like peak forces over bridges, buildings and slender towers such as wind turbines.