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Subgrid-stress experimental analysis based on second order structure functions in grid turbulence

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Measurements are carried out in a turbulent flow behind a grid of dimensions: 150 mm X 300 mm with a squared mesh size of M=40mm. A Dantec 55P11 hot-wire is used with a time resolution frequency much smaller than than the Kolmogorov turnover time scale (5%).

Different mean flow speeds are tested from 13 m/s to 20 m/s corresponding to Taylor Reynolds number values between 190 and 360. The measurements are conducted at different streamwise positions between x/M=7.4 and x/M=19.9. A Taylor hypothesis is used to evaluate the second order structure functions scalings with dissipation.

The mean subgrid-stress contribution is observed to be well predicted by the Smagorinsky model with the same coefficient as the one measured in Meneveau (1994) but the Smagorinsky model local fluctuations are completely different to the real subgrid-stress contribution.

An exact decomposition of the subgrid stress based on the exact Germano (2007) equation is analysed with the experimental data and this decomposition is found to split the subgrid-stress into a dissipative and a non-dissipative part. A new mixed LES model formulation is proposed inspired by these results.

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