Chapter 5

Tensor-diffusivity mixed model: balancing reconstruction and truncation

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Abstract Large-Eddy Simulation (LES) with regular explicit filtering is investigated. The partial reconstruction of the filtered-scale stress is done through the tensor-diffusivity model of Leonard: it provides for backscatter along the stretching direction(s), and for global dissipation, both also attributes of the exact filtered-scale stress. The necessary truncations (LES grid and numerical method) are responsible for an effective subgrid-scale stress. The explicit filter width must be chosen in relation to the grid size. A natural mixed model is then the tensor-diffusivity model supplemented by a dynamic Smagorinsky term. This model is reviewed, together with useful connections to other models, and is tested against Direct Numerical Simulation (DNS) of turbulent isotropic decay starting with $Re_\lambda = 90$: LES is started from a 256^3 DNS truncated to 64^3 or 48^3 and Gaussian filtered. Diagnostics in this test include energy decay, enstrophy decay and energy spectra. After an initial transient of the dynamic procedure, the mixed model is found to produce good results. The results are similar to those obtained when using the dynamic Smagorinsky model without explicit filtering. The dynamic mixed model appears as a good compromise between sufficient reconstruction of the filtered-scale stress and modeling of the subgrid-scale stress.

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