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Minimization of the Germano–identity error in the dynamic Smagorinsky model[1] KRISHNAN MAHESH, NOMA PARK, University of Minnesota — We revisit the Germano–identity error in the dynamic modeling procedure in the sense that the current modeling procedure to obtain the dynamic coefficient may not truly minimize the error in the mean and global sense. A "corrector step" to the conventional dynamic Smagorinsky model is proposed to obtain a corrected eddy viscosity which further reduces the error. The change in resolved velocity due to the coefficient variation as well as nonlocal nature of the filter and flow unsteadiness is accounted for by a simplified suboptimal control formalism without resorting to the adjoint equations. The cost function chosen is the Germano–identity error integrated over the entire computational volume and pathline. In order to determine corrected eddy viscosity, the Fréchet derivative of the cost function is directly evaluated by a finite–differencing formula in an efficient manner. The proposed model is applied to isotropic turbulence and turbulent channel flow at various Reynolds numbers and resolutions to obtain noticeable reduction in the Germano–identity error and significantly improved flow statistics.

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