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Subgrid-scale models for large-eddy simulation of rotating turbulent channel flows[1] MAURITS H. SILVIS, University of Groningen, The Netherlands, HYUNJI JANE BAE, Center for Turbulence Research, Stanford University, F. XAVIER TRIAS, Technical University of Catalonia, Spain, MAHDI ABKAR, Aarhus University, Denmark, PARVIZ MOIN, Center for Turbulence Research, Stanford University, ROEL VERSTAPPEN, University of Groningen, The Netherlands — We aim to design subgrid-scale models for large-eddy simulation of rotating turbulent flows. Rotating turbulent flows form a challenging test case for large-eddy simulation due to the presence of the Coriolis force. The Coriolis force conserves the total kinetic energy while transporting it from small to large scales of motion, leading to the formation of large-scale anisotropic flow structures. The Coriolis force may also cause partial flow laminarization and the occurrence of turbulent bursts. Many subgrid-scale models for large-eddy simulation are, however, primarily designed to parametrize the dissipative nature of turbulent flows, ignoring the specific characteristics of transport processes. We, therefore, propose a new subgrid-scale model that, in addition to the usual dissipative eddy viscosity term, contains a nondissipative nonlinear model term designed to capture transport processes, such as those due to rotation. We show that the addition of this nonlinear model term leads to improved predictions of the energy spectra of rotating homogeneous isotropic turbulence as well as of the Reynolds stress anisotropy in spanwise-rotating plane-channel flows.

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