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New Models for Velocity/Pressure-Gradient Correlations in Turbulent Boundary Layers[1] SVETLANA POROSEVA, University of New Mexico, SCOTT MURMAN, NASA Ames Research Center — To improve the performance of Reynolds-Averaged Navier-Stokes (RANS) turbulence models, one has to improve the accuracy of models for three physical processes: turbulent diffusion, interaction of turbulent pressure and velocity fluctuation fields, and dissipative processes. The accuracy of modeling the turbulent diffusion depends on the order of a statistical closure chosen as a basis for a RANS model. When the Gram-Charlier series expansions for the velocity correlations are used to close the set of RANS equations, no assumption on Gaussian turbulence is invoked and no unknown model coefficients are introduced into the modeled equations. In such a way, this closure procedure reduces the modeling uncertainty of fourth-order RANS (FORANS) closures. Experimental and direct numerical simulation data confirmed the validity of using the Gram-Charlier series expansions in various flows including boundary layers. We will address modeling the velocity/pressure-gradient correlations. New linear models will be introduced for the second- and higher-order correlations applicable to two-dimensional incompressible wall-bounded flows. Results of models' validation with DNS data in a channel flow and in a zero-pressure gradient boundary layer over a flat plate will be demonstrated.

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Svetlana Poroseva
University of New Mexico

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