Abstract Submitted
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Application of the order-of-magnitude analysis to a fourth-order RANS closure for simulating a 2D boundary layer[1] SVETLANA V. POROSEVA, University of New Mexico — Simulations of turbulent boundary-layer flows are usually conducted using a set of the simplified Reynolds-Averaged Navier-Stokes (RANS) equations obtained by order-of-magnitude analysis (OMA) of the original RANS equations. The resultant equations for the mean-velocity components are closed using the Boussinesq approximation for the Reynolds stresses. In this study OMA is applied to the fourth-order RANS (FORANS) set of equations. The FORANS equations are chosen as they can be closed on the level of the 5th-order correlations without using unknown model coefficients, i.e. no turbulent diffusion modeling is required. New models for the 2nd-, 3rd- and 4th-order velocity-pressure gradient correlations are derived for the current FORANS equations. This set of FORANS equations and models are analyzed for the case of two-dimensional mean flow. The equations include familiar transport terms for the mean-velocity components along with algebraic expressions for velocity correlations of different orders specific to the FORANS approach. Flat plate DNS data (Spalart, 1988) are used to verify these expressions and the areas of the OMA applicability within the boundary layer.

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