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A novel Lie-group analysis for wall-bounded turbulent flows XI CHEN, ZHEN-SU SHE, Peking University, FAZLE HUSSAIN, University of Houston, SHE TEAM — Symmetry analysis based on the Lie-group method is the most effective method for solving nonlinear problems. Here, we present a novel Lie-group analysis for wall-bounded turbulent flow in following ways: First, the governing equation for symmetry analysis is inner and outer mean momentum equation, instead of the Navier-Stokes equation. Second, the dilation and Galilean transformations are applied to space variable, mean velocity, and in particular to the mixing length and its spatial gradient. Finally, a transition ansatz is formulated, as a special choice of the similarity solution, which accomplishes a composite solution across adjacent layers. With all of these, we achieve a rare occasion that symmetry is used to construct the complete solution: an analytic expression for the entire mixing length profile and then the mean velocity profile. Thus, a classical turbulence closure problem is analytically solved by combining multi-layer perturbation with Lie-group analysis.

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