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Extending the Generalized Logarithmic Law to the Wall

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An advanced, Reynolds-number-dependent, logarithmic law for the overlap region of the canonical turbulent boundary layer is presented. The law includes an additional constant in the argument of the logarithm, which extends the profile toward the buffer layer, but precludes a straight-line in a semi-log plot of the profile. As compared to either the traditional log law or power law, the generalized log law exhibits a superior fit to existing experimental data and DNS results. For practical applications, such as calibration of certain near-wall probes and appropriate construction of CFD codes for turbulent boundary layers, it is desired to derive an analytical relation for the velocity profile that would extend all the way to the wall. Employing a “mixing length approach”, we extend the generalized log law down to $y = 0$. Unlike some previous attempts, our approach is designed to have the physically correct y^{+3} dependence for the Reynolds stress.

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