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Composite mean velocity profile for zero pressure gradient turbulent boundary layers KAPIL CHAUHAN, HASSAN NAGIB, Illinois Institute of Technology, Chicago, PETER MONKEWITZ, Swiss Federal Institute of Technology, Lausanne — A new composite form for the mean velocity profile in zero pressure gradient turbulent boundary layers is developed based on recent high Reynolds number data. The inner expression using a Padé 45 expansion describes the profile in the sublayer and the logarithmic law of the wall. In accordance with the idea of a wake function, the outer expression is an exponential function which is added to the inner expansion. The composite profile satisfies all the necessary physical boundary conditions. The new profile is fitted to various experimental measurements to determine their respective δ, u_τ and Π. The behavior of these parameters is found to be consistent with classical understanding. In addition, the composite velocity profiles of George & Castillo [App. Mech. Rev. 1997] and Nickels [J. Fluid Mech. 2004] are also fitted to find their respective parameters. We find that all three composite forms agree remarkably well when fitted to data with equivalent accuracies. However, the extracted skin- friction velocity exhibits considerable disagreement. We find that the composite profiles based on the logarithmic form predicts accurate u_τ when compared to recent oil-film measurements.

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