Abstract Submitted
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Friction velocity estimation using Reynolds shear stress profile data[1] RALPH VOLINO, MICHAEL SCHULTZ, U. S. Naval Academy — A method for using profiles of the mean streamwise velocity and the Reynolds shear stress to estimate the friction velocity, u_τ, is presented. The Reynolds averaged two-dimensional streamwise momentum equation is solved for the Reynolds shear stress term. The remaining terms in the equation are separated into those which depend on the local gradient of the mean streamwise velocity profile and those which do not. Using only the terms retained with the Couette flow assumption, the Reynolds shear stress profile can be matched in the inner 10 percent of the boundary layer with the appropriate choice of u_τ. Including the other terms which do not depend on the streamwise velocity profile gradient, the fit can be extended to the inner 30 percent of the boundary layer. Using all terms the full Reynolds shear stress profile can be fit. The method is verified using laminar solutions for zero and non-zero pressure gradient boundary layers, and with ZPG turbulent DNS results. It is then applied to zero, favorable and adverse pressure gradient experimental data from smooth and rough walls. Results obtained for local friction velocities agree well with those obtained by other techniques. The method may prove useful when other methods are not practical or fully appropriate.

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