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Prediction of Relaminarization on Favorable Pressure Gradient Turbulent Boundary Layers RAUL BAYOAN CAL, Rensselaer Polytechnic Institute, XIA WANG, Oakland Univeristy, LUCIANO CASTILLO, Rensselaer Polytechnic Institute — Turbulent boundary layers subjected to favorable pressure gradients (FPG) tend to relaminarize when a sufficiently strong external pressure gradient is imposed on the flow. Traditionally, an acceleration parameter is used to predict relaminarization. Considering a wide array of existent data, it has been found that many quantities pertaining to the turbulent boundary layer provide information about the onset of relaminarization. On the verge of relaminarization, it is shown that the Reynolds stresses diminish drastically to nearly zero and the shape of the profile is different from other FPG profiles. Furthermore, the mean deficit velocity profiles are also found to be attenuated when scaled using the Castillo and George scaling, U_∞, or the Zagarola and Smits scaling, $U_\infty \frac{\delta_*}{\delta}$. Also, further information is obtained through the examination of boundary layer parameters. Using similarity analysis, Castillo and George concluded that in order to achieve an equilibrium flow, the pressure parameter defined as, $\Lambda = -\frac{\delta}{U_\infty \frac{d\delta}{dx}} \frac{dU_\infty}{dx} = \frac{\delta}{\rho U_\infty^2 \frac{d\delta}{dx}} \frac{dP_\infty}{dx}$ must be a constant; thus a power relation between the boundary layer thickness, δ, and the free-stream velocity, U_∞, exists. The power is given by the pressure parameter, Λ, as $\delta \sim U_\infty^{-1/\Lambda}$. Consequently, two quadrants have been found: one describing equilibrium and non-equilibrium FPG turbulent flows and a second quadrant describing relaminarized FPG flows.

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