Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Integral Analysis of Boundary Layer Flows with Pressure Gradient TIE WEI, New Mexico Institute of Mining and Technology, YVAN MACIEL, Universit Laval, JOSEPH KLEWICKI, University of New Hampshire; University of Melbourne — Boundary layer flows with pressure gradient is investigated using a novel similarity/integral analysis of the continuity equation and momentum equation in the streamwise direction. The analysis yields useful analytical relations for V_e, the mean wall-normal velocity at the edge of the boundary layer, and for the skin friction coefficient, C_f, in terms of the boundary layer parameters and in particular β_{RC}, the Rotta-Clauser pressure gradient parameter. The analytical results are compared with experimental and numerical data and are found to be valid. One of the main findings is that for large positive β_{RC}, the friction coefficient is closely related to β_{RC} as $C_f \propto 1/\beta_{RC}$, because δ/δ_1, $\delta_1/\delta_2 = H$ and $d\delta/dx$ become approximately constant. Here δ is the boundary layer thickness, δ_1 is the displacement thickness, δ_2 is the momentum thickness and H is the shape factor. Another finding is that the mean wall-normal velocity at the edge of the boundary layer is related to other flow variables as $U_e V_e/u_\tau^2 = H + (1 + \delta/\delta_1 + H)\beta_{RC}$, where U_e is the streamwise velocity at the edge of the boundary layer.

Tie Wei
New Mexico Institute of Mining and Technology

Date submitted: 01 Aug 2017 Electronic form version 1.4