Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Toward a generalized equation for the Reynolds stress: Turbulence momentum balance in non-canonical flows. T.-W. LEE, Arizona State Univ — Recently, we developed a theoretical basis for determination of the Reynolds stress in canonical flows. Writing momentum balance for a control volume moving at the local mean velocity, along with a differential transform $\frac{\partial}{\partial x} = C_1 U \frac{\partial}{\partial y}$, a turbulence momentum balance is discovered which includes the Reynolds stress as a function of root turbulence parameters: $\frac{\partial (u'v')}{\partial y} = -C_1 U \frac{\partial u'^2}{\partial y} + \nu_m \frac{\partial^2 u'_{rms}}{\partial y^2}$. Then, the Reynolds stress can simply be computed by integrating in the y-direction using the right-hand side (RHS). This is obviously a far simplification of complex modeling of the Reynolds stress, but contains the correct physics, as borne out by comparisons with experimental and DNS data in canonical flows in our earlier works (e.g. in APS 2016). The RHS contains only two parameters, U and u'. In this work, we seek extensions of this solution to non-canonical flows such as wakes, flow over a step, and mixing layers. Comparisons with experimental and DNS data will be presented.

T.-W. Lee
Arizona State Univ

Date submitted: 26 Jul 2017 Electronic form version 1.4