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**Xuesong Wu\*** ([x.wu@ic.ac.uk](mailto:x.wu@ic.ac.uk)), Department of Mechanics, School of Mechanical Engineering, Tianjin University, Tianjin, 300072, Peoples Rep of China. *Some Integro-differential Equations Describing Nonlinear Evolution of Instability Waves on Shear Flows.*

Transition of a laminar shear flow to a turbulent state is a complex nonlinear phenomenon. Critical to its understanding and prediction is the nonlinear evolution of initially small-amplitude perturbations, or the so-called instability modes. In the past two decades, some interesting integro-differential equations were derived from the Navier-Stokes equations by using sophisticated asymptotic analysis. A common novel feature is that they all consist of history dependent nonlinear terms. The physical context of these equations and their main mathematical properties will be reviewed with a call for more attention to these equations from applied analysts. The focus will be on a set of equations which describe the interaction and coupling of the small- and large-scale motions. Numerical solutions will be presented to demonstrate that they are able to capture spectral broadening and randomization of free shear layers as observed in experiments. (Received September 22, 2011)