Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Axisymmetric Synthetic Jets: A Momentum-based Modeling Approach XI XIA, Department of Mechanical and Aerospace Engineering, University of Florida, KAMRAN MOHSENI, Department of Mechanical and Aerospace Engineering and Department of Electrical and Computer Engineering, University of Florida — A dimensional analysis approach is presented in order to offer a unified modeling approch for axisymmetric continuous and synthetic jets. The synthetic jet is injected into a quiescent air environment and the flow field is measured in the far field using hot-wire anemometry. Four parameters are identified to control the far field of the jet. These are: the spatial position, jet width, centerline velocity, and momentum flux. The functional dependency of these parameters is given by dimensional analysis. Experimental data show that in the far field, the spreading rate and decay rate of the jet are constants and the momentum flux is also conserved. Therefore, two nondimensional parameters are proposed to represent the characteristics of the far field of a synthetic jet. Furthermore, the relationship between the two constants are given theoretically and verified experimentally in this study. The results of several continuous jets are also presented for comparison. The validity of this work provides universal model for the far field of both synthetic jets and continuous jets regardless of the configurations of jet actuators or the activation conditions. It can be also concluded from this model that the momentum flux and the virtual eddy viscosity are actually the key parameters controling the characteristics of a synthetic jet far field.

Xi Xia
University of Florida

Date submitted: 15 Aug 2011 Electronic form version 1.4