Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Closed- and Open-Loop Control of Isodensity Jets in Crossflow[1]

CORY HENDRICKSON, DANIEL GETSINGER, JULIETT DAVITIAN, ROBERT M'CLOSKEY, ANN KARAGOZIAN, UCLA Department of Mechanical and Aerospace Engineering — Recent experiments have explored the behavior of a gaseous, isodensity jet in crossflow, focusing in part on the jet's response to controlled, strategic acoustic forcing[2]. While it is possible for strong sinusoidal jet excitation to overtake the natural shear layer instability when the flow is globally unstable (for jet-to-crossflow velocity ratios $R < 3.2$), square wave excitation of the jet fluid is observed to have a more profound effect on jet penetration and spread. Although creating precise square wave excitation for a globally unstable jet is challenging, open-loop control is observed to have some success. Yet at very small values of R, open-loop control is less capable of overcoming the instabilities and hence closed-loop control, whereby the forcing conditions continuously adjust to track a desired output square wave, must be used. The closed-loop controller, employed especially for $R < 1.25$, is observed to eliminate much of the distortion seen in the open-loop generated square wave, more closely matching the ideal square wave given bandwidth limitations of the actuation system, and providing robust control of the flow.

[1]Supported by NSF grant CBET-0755104 and the NASA GSRP.
[2]J. Davitian, PhD dissertation, UCLA, 2008

Ann Karagozian
UCLA Department of Mechanical and Aerospace Engineering

Date submitted: 07 Aug 2009 Electronic form version 1.4