Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Turbulent subsonic particle-laden flow over an open backward-facing step with and without countercurrent shear at Re=3000 GUSTAAF JACOBS, Brown University, DAVID KOPRIVA, Florida State University, FARZAD MASHAYEK, University of Illinois at Chicago, JACOBS, G TEAM[1], KOPRIVA COLLABORATION[2], MASHAYEK TEAM[3] — We present a numerical study of the subsonic particle-laden flow over an open backward-facing step at a Reynolds number of Re=3000. The compressible Navier-Stokes equations are simulated without turbulence models using a multidomain spectral method. Point particles are tracked assuming a Stokes flow model. We focus on the compressibility effects and the effect of countercurrent shear on the zero and first order turbulence statistics and flow topology for low to moderate Mach numbers. At $Mach$=0.1 our results compare well with published incompressible numerical simulations and experiments. At $Mach$=0.4 we show that the shear layer reattaches 10% closer the step than at the nearly incompressible $Mach$=0.1 as a result of transient compressibility effects related to pressure-dilatational dissipation. The application of a moderate level of countercurrent shear destabilizes the shear layer immediately increasing turbulence intensity and particle deposition behind the step, and decreasing the reattachment length with 12%. Countercurrent shear also creates large structures that shed with a distinct period frequency.

[1]Applied Math
[2]Math
[3]Mechanical Engineering

Gustaaf Jacobs
Brown University

Date submitted: 29 Jul 2005 Electronic form version 1.4