“High-Speed Fluid Dynamics Experiments at Sandia”

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Abstract
Flow over an open aircraft bay produces resonant tones leading to structural vibrations of an internal structure such as a store. Wind tunnel experiments focused on understanding these fluid-structure interactions (FSI) are performed where the aircraft bay is represented with a cavity cutout. Flowfield dynamics are quantified with time-resolved particle image velocimetry (TR-PIV) measurements using a pulse-burst laser. A model store is installed to understand how the flowfield couples to the structural response. Consistent with the flowfield, the store responds strongly to cavity tones in the streamwise and wall-normal directions, but not in the spanwise direction. Vibrations increase tenfold when a structural natural frequency matches a cavity resonance frequency.

Experiments on shock-induced particle dispersal with applications to energetics are then discussed. A curtain of 100-micron glass spheres, having a solid volume fraction of 20 percent, is generated using a gravity-fed method in a multiphase shock tube. Shock waves are driven into the dense curtain causing the particles to spread rapidly while propagating downstream. The dynamics of the interaction are studied using schlieren, flash X-ray radiography, and TR-PIV. The results show dense volume fraction effects result in increased interphase momentum transfer and a much more rapid dispersal of particles as compared to dilute distributions.

Bio
Justin Wagner is currently a principal member of the technical staff at Sandia National Laboratories. He received his PhD in 2009 from the University of Texas at Austin. His research interests include experiments in high-speed fluid dynamics that include multiphase flows, cavity flows, and fluid-structure interactions. In addition, his work focuses on the development and application of laser and x-ray based diagnostics.