NUMERICAL SIMULATIONS OF WEAPON/TARGET INTERACTION USING A COUPLED CFD/CSD METHODOLOGY

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A recently developed loose-coupling algorithm that combines state-of-the-art Computational Fluid Dynamics (CFD) and Computational Structural Dynamics (CSD) methodologies has been applied to the simulation of weapon detonation and fragmentation, and airblast interaction with a reinforced concrete wall. The coupled methodology enables cost-effective simulation of fluid-structure interactions with a particular emphasis on detonation and shock interaction. The coupling incorporates two codes representing the state-of-the-art in their respective areas: FEFL098 for the Computational Fluid Dynamics and DYNA3D for the Computational Structural Dynamics simulation. FEFL098 solves the time-dependent, compressible Euler and Reynolds-Averaged Navier-Stokes equations on an unstructured mesh of tetrahedral elements. The DYNA3D explicit solver handles simulations of large deformation, large strain formulation equations also on an unstructured grid composed of bricks and hexahedral elements. The two codes exchange information at the interface: the structure side provides displacement and velocity for the boundary of the fluid domain while the fluid domain returns pressure and shear loads to the structure. Fast interpolation and conservative techniques are used to handle the non-matching meshes at the interface.

An application of the methodology to a case of weapon detonation and fragmentation is presented. The results demonstrate the ability of the coupled methodology to handle these processes and yield results that are in good agreement with experimental data. Finally, we present results of simulating airblast interaction with a reinforced concrete wall, in which concrete and steel rebar failure and concrete break-up to thousands of chunks and dust particles are demonstrated.