Coupling of Computational Solid and Fluid Dynamics for the Simulation of Blasting Operations in Tunnels

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ABSTRACT

In many tunnel excavation situations gas pressure from explosions is used to break up the rock close to the tunnel front. In order to simulate properly the complex physics of this class of problems, the following tools have been coupled:

a) For the rock: An adaptive FEM-DEM procedure that automatically transitions failed Finite Elements into Discrete Elements;
b) For the explosion and the ensuing gases: a monotonicity preserving Euler solver that allows for adaptive unstructured grids and embedded or immersed moving solids;
c) For the coupling: a fast, scalable transfer library that transfers and interpolates/projects positions and loads between the fluid and the solid.

Figure 1 shows a typical example. The final paper will contain all relevant details for the algorithms and codes employed, as well as more engineering runs.

Figure 1 Crack Opening Under Blast Pressure: Velocity and Pressure at $T = 0, 10, 20, 30 \, \mu\text{sec}$