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SIMULATION OF WAVE PROPAGATION AND IMPACT DAMAGE IN BRITTLE MATERIALS USING THE PERIDYNAMICS TECHNIQUE

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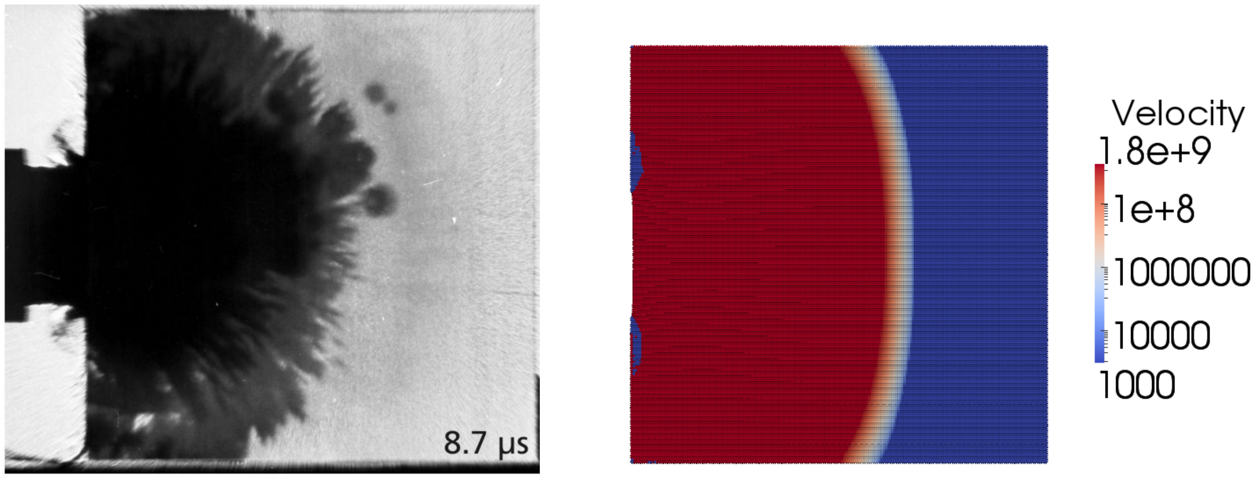
We present the simulation of wave propagation and impact damage in brittle materials, e.g. ALON or fused silcia.

For the visualization of impact damage in ceramics the Ernst-Mach-Institute (EMI) developed the Edge-On Impact (EOI) technique [1]. In this experiment a steel projectile impacts a ceramic plate and the growth of the primary crack is observed with a high-speed camera. The results from the EOI experiment are shadow graphs (figure 1(a)) of the evolving wave and the wave front velocity.

To simulate the evolving of the wave the Peridynamic technique [4], an alternative non local theory in solid mechanics is used. This theory formulates the problem with integral equations instead of partial differential equations. This allows discontinuities in the displacement fields and the branching of cracks is directly possible. Figure 1(b) shows the first simulation results with an simple material model of the wave velocity at t=8.7μs. With the first simulation the extracted wave front velocity converge to an numerical value of the front wave velocity. The numerical value differs by 10% to 20% from the measured wave front velocity in the experiments.

We implemented two extensions for the Peridynamic technique to improve the convergence of the wave front velocity to the measured wave front velocity of the EOI experiment. The first extensions is to use the normalized bond-based Peridynamics model for the energy density W^{PD}. With this model the deficit of the Energize is reduced compared to the density. The second extension is to replace the contact potential between particles with an hertzian potential.



(a) Shadow graph of the ALON specimen at t=8.7μs. Image taken from [3].

(b) The velocity of the evolving wave at t=8.7μs.

Figure 1: Shadow graph of the evolving wave of the EOI experiment and the velocity of the evolving wave at t=8.7μs.

With these extensions we hope to improve the convergence of the numerical value of the wave front velocity.

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