Project Title: A novel nonlocal mesh-free continuum mechanics framework for simulating ballistic impacts: an integrated computational and experimental approach

Duration: 1st April 2024 – 31st March 2026

Objectives:

- Incorporation of a material length scale in a mesh-free framework for ballistic simulations
- Complete in-house development of the mesh-free code for simulations
- Estimation of the material length scale value from high strain rate experiments

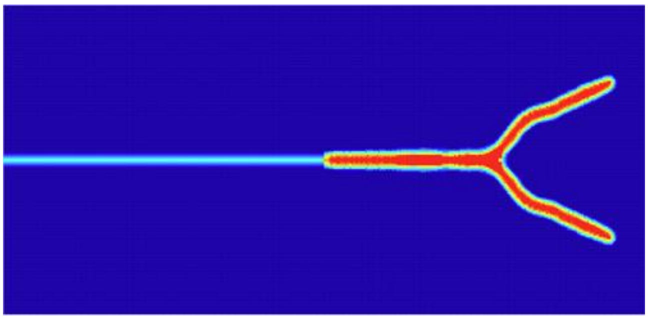
Deliverables: Indigenous development of the peridynamics based mesh-free code for ballistic simulations

Significant Achievements:

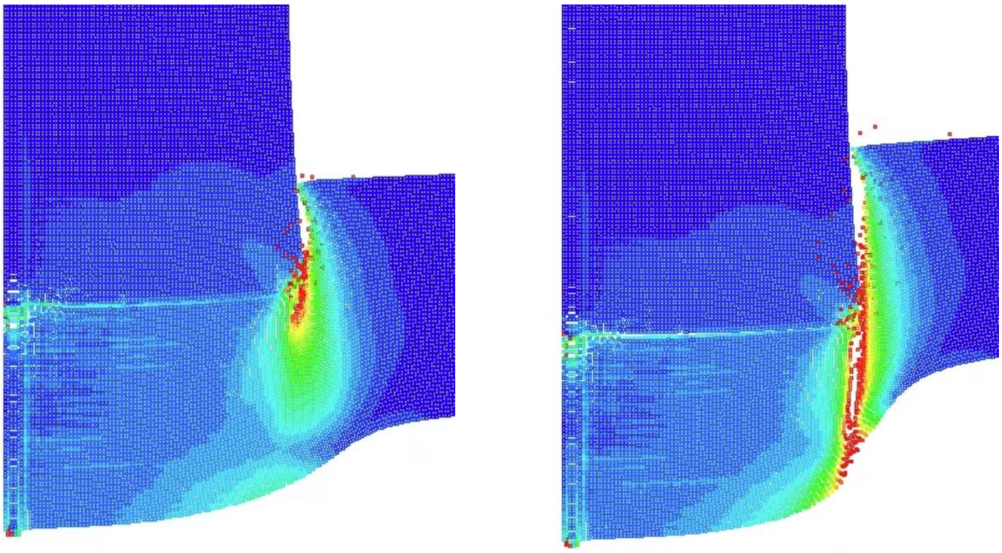
On completion of the project, a significant achievement has been the successful development of a mesh-free simulation framework based on Peridynamics to overcome the limitations of classical grid-based continuum mechanics in high strain-rate loading scenarios such as ballistic impacts and blasts. Unlike conventional formulations that suffer from mesh entanglement and lack representative volume information, the particle-based approach effectively captured large deformations and damage propagation. A material length scale was incorporated to regularize shear band and damage widths, ensuring physically consistent simulations. Furthermore, high-velocity ballistic impact experiments were conducted, and inverse techniques were employed to extract the material length scale directly from experimental data, thereby strengthening the predictive accuracy of the computational model.

Team:
Shri. Kanishka Bhattacharya (PI)
Dr. Amar Prakash (Co-PI)
Dr. Venkatesan J.
Shri V. Ramesh Kumar

Date: 10/06/2026



Crack growth and branching in a brittle material using the developed Peridynamics software



Plugging failure in a metallic plate under ballistic impact, simulated using the developed Peridynamics software