

Providing Innovative Solutions

The IMPETUS Afea Solver® Modeling Fragmentation

Simulation of material fragmentation is difficult because it involves damage that exhibits very large non-linear deformation. Modeling with a Lagrangian approach requires Finite Elements that can handle this extreme case and the classic Finite Elements found in Legacy Solvers are not up to the task. This is why IMPETUS developed new Finite Element Technology to handle the task and provide accurate and robust elements designed specifically for Dynamic events that exhibit very large deformations. The Aset® Elements which includes quadratic and cubic Hexahedron, Tetrahedron and Pentahedron Elements are fully integrated so they eliminate the classic shortcomings of hourglass modes, element inversion, etc. They have been successfully applied to modeling warhead fragmentation. IMPETUS is a general purpose non-linear transient dynamic explicit Finite Element solver, a truly Next Generation Solver which also takes advantage of Next Generation Hardware "GPU Technology". GPU Technology provides massively parallel processing which is always load balanced unlike cluster based solutions and only requires a standard workstation or a single node of a cluster.



In the field of fragmentation analysis, the fragment size, velocity and mass is of vital importance. In fact, in experimental studies of fragmentation, the fragments are located, measured and weighed. During the tests, velocity and location are recorded as well. Thus, when a numerical tool is applied to simulate this event, it needs to have the ability to reproduce these key features. It is obvious that numerical ad-hoc eroding of elements and thus removing of mass in the model must be kept to a minimum. The approach used in IMPETUS for

modeling fragmentation is the IMPETUS Node Splitting Algorithm, which splits elements along the length of the higher order elements and hence conserves the mass in the system. This feature can be added to any of the implemented damage criteria. The IMPETUS Afea Solver GUI for post-processing has a tailored interface for fragmentation. Due to the nature of the parameters investigated, an application specific post-processing interface is necessary to improve productivity. The GUI makes it easy to obtain mass distribution, number of fragments, fragment velocity and a list of the fragments. The Fragmentation Post-Processing features are all located in a Fragmentation Analysis Interface, easy to access and use.



Key Features and Benefits:

- With the use of the ASET[™] Family of Finite Elements, large deformation can be obtained without hourglassing and element inversion.
- Invoking the Node Splitting Algorithm makes it possible to generate fragments and conserve the mass.
- Since the Aser[™] Tetrahedron elements are good in bending and plasticity they can be used to create a more random element pattern to better represent fracture of the material.
- GPU Technology provides massively parallel processing which is efficient and always load balanced.





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