



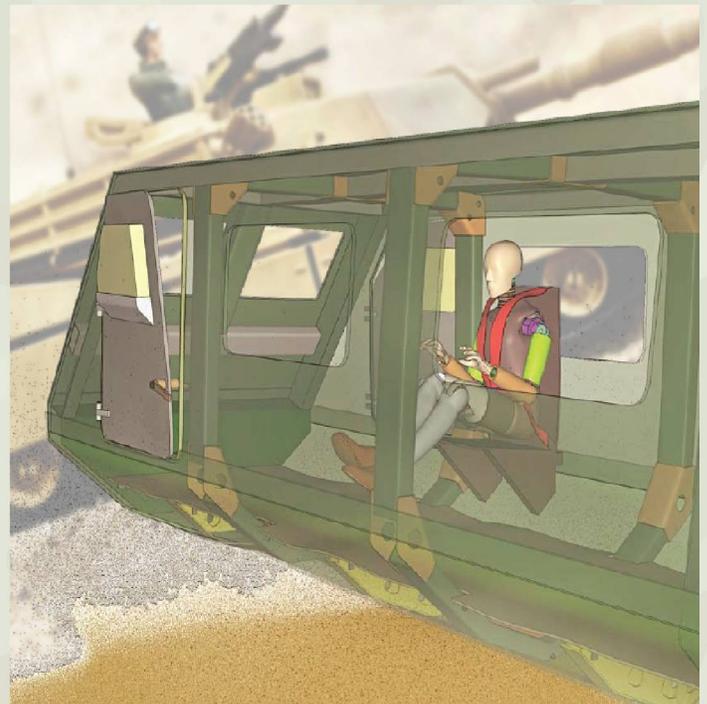
Modeling Mine Blast Events

Modeling Buried Mine Blast events such as Improvised Explosive Devices (IED's) is very difficult due to complexity of the event, including non-linear large deformation and short time duration. This is why the Next Generation Solver, the IMPETUS Afea Solver® has the module IMPETUS DEFENSE where a Discrete Particle Method (DPM) is implemented to simulate the soil, High Explosive (HE) and air with discrete particles. The IMPETUS Afea Solver® is a non-linear transient dynamic explicit Finite Element solver.

The basis for the DPM approach is centered around the fact that soil under blast loading is NOT a continuum and each Discrete Particle represents thousands of soil grains. The soil and HE are treated for what they are – loading mechanisms to the structure in question. The DPM algorithm takes full advantage of GPU Technology for parallelization, making it computationally very efficient resulting in fast runtimes.

Only one command is necessary, the *PBLAST command, which together with automatic particle filling for the soil, HE and air at initialization, adds flexibility and leads to less time to build a model. Many IED's are irregular shapes, examples being an artillery shell or an oil container. The difficult step of filling an odd shape with HE is made easy because IMPETUS automatically fills the container at runtime.

The module has been proven to be very accurate, matching experiments very well. This is possible because everything is modeled realistically. Blast Impulse is a common Response Parameter in the blast event and the IMPETUS Solver GUI includes the ability to easily display "Blast" output parameters that are necessary for the engineer to effortlessly assess the results. The Blast Impulse can be plotted both as contour and history plots. Furthermore, energy, momentum and the impulse transfer from the various domains can be easily visualized.



The model set-up is very simple. Geometric domains are given for the soil bed and HE together with a global domain. The user specifies the total number of discrete particles and IMPETUS automatically distributes and generates the discrete particles. The HE can be any geometrical shape and orientation and objects can be embedded in the soil bed, representing such things as rocks or random objects.



Key Features and Benefits:

- ◆ Easy set-up and generation of particle domains.
- ◆ Built-in calibrated soil models for wet and dry soil.
- ◆ Straight forward user defined soil calibration based on a blast test of a rigid plate. Only a few parameters are used for soil calibration including density and inner soil particle friction.
- ◆ GPU Technology for efficient massively parallel processing resulting in very fast runtimes.
- ◆ Most common HE types are built-in and calibrated – ready to use.
- ◆ User defined HE option available for non-traditional HE types. No compiling necessary.
- ◆ Contact between discrete particles and structure is simply done by specifying the structural ID – no contact specification necessary. Algorithm is optimized for discrete particle to structure contact.
- ◆ Accurate DPM method together with the very accurate ASET™ Finite Element technology provides for an accurate structural response.
- ◆ High order ASET™ elements combined with the IMPETUS node splitting algorithm makes it possible to model fragmentation of an IED.
- ◆ Tailored state-of-the-art post-processor to assess the simulation results.



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