LS-DYNA Air Blast Techniques: Comparisons with Experiments

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Abstract

Numerical simulations used to predict events are always challenging. Among the challenges is establishing some basis for confidence in the results when no experimental results exist, i.e. a prediction. While there is no assurance that all the necessary physics have been included in the model, e.g. strain rate effects, until the experimental results are available for comparison, there are procedures the user can adopt in model development that will build confidence in the modeling.

The first of these confidence building procedures is mesh refinement. In refining the mesh, or key parts of the mesh, the key results *should* converge. The results may not converge to the experimental result, due to possible missing physics or data, but a convergent model is an indication of a well posed model. Conversely, if the mesh refinement does not produce a converged result, this is an indication of an ill posed model.

While some (all too few) users understand the value of mesh refinement, even fewer users appreciate the confidence provided by solving the problem at hand using different solution strategies. Too many users apply the method they know, even if alternative, or possibly better, solution techniques exist. LS-DYNA offers a menu of solution strategies and the knowledgeable user takes advantage of several of the solution strategies when predictions are required.

In this manuscript three[1] solution strategies for air blast loading of structures are presented. The techniques are: Load Blast Enhance (LBE), Multi-Material Arbitrary Lagrange Eulerian (MM-ALE) and Particle Blast (PB). The first is an engineering model requiring minimal input and with minimal CPU requirements. The latter three are so called 'first principal' models requiring fairly extensive user input, e.g. equations of state for the explosive and air. The computing resources required by these techniques are substantial.

To provide a platform for comparing these air blast techniques and describing their advantages and disadvantages, two similar experiments, i.e. air blast loading of a metal plate, are modeled. The methods are compared with the experiments and with each other.

The goal is not to tune each method to the provided known experimental results, but to use as much as possible an "out-of-the-box" simulation. Then the result can possibly be 'tuned' with

[1] Smooth Particle Hydrodynamics (SPH) results were planned, but we not available at the time the manuscript was submitted.

the explanation of the tuning invoked. The same target mesh and material model/parameters and explosive (PETN & TNT) EOS where applicable will be used in all four methods.