A First-Order Method for Extrapolating Pressure-Time Histories

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A frequently encountered problem in blast computations is the pressure-time (p-t) histories were collected at locations slightly off the desired. In a field test, the gage locations may need to be slightly adjusted in the field due to practical constraints. In a blast load calculation on a structure, the initial set of selected points for the CFD code to collect the p-t histories (i.e. the set of p-t points) may have been too coarse or misplaced. Repeating the entire CFD calculation for a few corrected locations may take days to weeks causing undue delays in engineering projects. For the case where the misplaced p-t points (locations where p-t histories are collected) are not too far from the corresponding desired p-t points, we propose a first-order method to extrapolate the p-t history of one location to another. To evaluate its accuracy, we compare the extrapolated p-t histories to the p-t histories from a new calculation (with the p-t points at the desired locations). Next, we proceed to evaluate the method for blast loads on the surface of a structure. We extrapolated a coarse p-t lattice from an initial calculation to a fine p-t lattice, and compared both the coarse lattice load and the coarse-to-fine extrapolated load to the new calculated load with the fine p-t lattice. In the point-to-point case, our results suggest the extrapolated pressure-time history has the same time-of-arrival as the exact calculated one but the impulse peak may differ by as much as two percent in our selected geometry. In the coarse-to-fine case, the gradient of the blast impulse across the surface has a strong effect on the error incurred in using the coarse lattice for design. This load gradient also affects the accuracy of the extrapolated load.