RAPID BLAST V/L ASSESSMENTS USING MACHINE LEARNING – PART 2: MULTIVARIATE QUADRATIC REGRESSION MODEL

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ABSTRACT

Internal blast loading from the detonation of a high explosive charge within a structure provides complex pressure and shock wave dynamics. The ability to capture pressure profiles of these complex blast scenarios is useful for determining the peak pressure, impulse and quasi-static loading experienced by structures such as bulkheads, doors and hull as well as equipment, and people within confined spaces. This two-part series looks at a methodology for generating rapid blast loading parameters to be used in whole platform vulnerability/lethality (V/L) modelling. Part 1 presented the process of generating high-fidelity modelling data and the development of a data filtering algorithm to extract peak pressures, total impulse and quasi-static pressure from an internal blast explosion. In this paper (Part 2), the filtered data is utilised along with the Friedlander–Heaviside (FH) series to generate a machine learning model capable of providing full pressure-time history plots to be used in V/L assessments to assess the extent of damage to structures and components. This filtered data comprised of characteristic parameters from pressure-time history curves of a diverse range of representative naval ship compartments (1.5 m – 7.5 m wall dimension) subjected to internal detonations. Concurrently, FH series were fitted to the pressure-time history curves yielding approximate mathematical representations of the original curves. Once the characteristic parameters have been determined, they are used for training multivariate quadratic regression models that can be used in predictive analyses of the FH parameters and thus be used for constructing estimated pressure-time history profiles. The developed machine learning model is then evaluated against the original pressure-time history data from the numerical simulations.