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On the Numerical Modelling of Blast Loading: Accuracy and Modelling Choices

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Blast loading represents a challenging scenario for numerical modelling, as it involves highly non-linear, high-intensity and short-duration events, typically at scales that are too small to resolve with practical numerical discretization and further complicated by material behaviour and strain-rate effects. Even for relatively simple structural configurations, obtaining consistent agreement between simulations and experiments requires a nuanced modelling approach.

This work investigates the numerical modelling of blast-loaded plates with a specific focus on the influence of modelling choices on predictive accuracy. A computational framework is developed and assessed against laboratory-scale blast experiments, involving steel plate specimens of different thicknesses and subjected to various load intensities. The experimental dataset is relatively large and varied in comparison with what is typically available in the literature, and includes high strain rate characterization data, thus providing a broad and detailed benchmark. Particular attention is devoted to numerical parameters governing shock wave propagation and to the calibration of constitutive models, as these play a key role in the consistency of the simulations. The results show that the loading is reproduced with good accuracy, with impulse predictions within a few percent across the range of conditions considered. The structural response is captured with a typical error of approximately 8%, preserving the correct trends and scaling observed experimentally.

Overall, the study highlights the role of modelling choices in increasing the accuracy of blast simulations and demonstrates that consistent predictions can be achieved when these aspects are properly addressed.

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