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DEVELOPMENT AND VALIDATION OF A HYBRID METHOD FOR MODELLING HIGH EXPLOSIVE DETONATIONS IN COMPLEX GEOMETRIES

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Abstract: Times New Roman, size 12

Explosion consequences resulting from high explosive detonations are commonly analysed using two distinct approaches. The first approach employs analytical 1-D radially symmetric relations, which can be implemented manually or through various software packages. Although these methods do not explicitly model the explosion process, they accurately capture the maximum pressure attained within the gas cloud, which holds significant practical importance. The second approach relies on Computational Fluid Dynamics (CFD) and entails a purely numerical methodology. However, this method often necessitates the incorporation of sub-grid models (experimental curve-fits) to enable feasible computations within practical timeframes.

Both approaches exhibit relative advantages and drawbacks contingent on the specific case under analysis. Generally, CFD provides more intricate results at the cost of computational time and expenses. This paper presents the development and validation of a hybrid method for modelling high explosive detonations within domains featuring complex geometries. The hybrid method combines an analytical model based on TNT equivalence for the explosive charge with an open-source CFD solver. The analytical calculation results are employed as input for the CFD solver, which is configured as a 2D calculation for enhanced efficiency. Consequently, this hybrid approach yields significantly more detailed outcomes than pure analytical methods while being marginally more conservative than state-of-the-art CFD solutions, all within an acceptable margin of uncertainty.

This paper outlines the methodology of the hybrid approach and demonstrates its application through compelling case studies. The presented results showcase the efficacy of the hybrid method in accurately modelling high explosive detonations within complex geometries, thereby offering valuable insights for practical engineering scenarios.
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