NUCLEAR BLAST EFFECTS IN URBAN AND MARITIME ENVIRONMENT

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Abstract:
Since the war in Ukraine, the effects of tactical nuclear weapons gain more attention. Due to the limited realizability of experiments, numerical simulation methods are key for understanding the effects of nuclear weapons in realistic environments. This paper aims to study the nuclear blast effects in both an urban and a maritime environment using the Apollo BlastSimulator developed at Fraunhofer EMI. Due to its adaptive mesh refinement capability the interaction of nuclear blast waves with realistic environments can be efficiently modelled and resolved in detail. A source model based on compiled nuclear test and simulation data enables the modelling of small to medium sized nuclear explosions at relevant heights of burst. Hence, detailed geometries and free water surfaces can be handled effectively.

In our paper we present results of an investigation which considered the propagation of the nuclear blast waves in two different realistic scenarios: an urban environment and a maritime environment. While in the urban environment the blast wave interacts with a wide-spread array of many rigid buildings, the interaction with a free water surface is dominated by refraction and energy transfer to the water. These scenarios well be compared to the propagation over a rigid flat ground. The analysis for the urban scenarios includes the evaluation of pressure-impulse based damage models, which provide estimates of the hazard to people and structural damages to buildings. For a single building in the urban environment the destruction of door and windows as well as the blast propagation within the building will be resolved.

The initial blast wave is approximately rotationally symmetrical. Thus, it can be simulated using a 2D domain. The blast effects in urban and maritime environments are driven by complex interactions of the blast wave with the buildings or water surfaces. Hence, these complex domains have to be modelled in 3D. The coupling of a 2D and a 3D domain enables the efficient simulation of complex scenarios.