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Blast Wave of Guns : Flow Phenomenology, Computational Fluid Dynamics and Experimental Validations

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ABSTRACT

In a fully unsteady way, the interior, intermediate and exterior ballistics were modeled as well as the weapon system environment. The complex phenomena encountered are investigated by an adapted numerical simulation approach using the Euler equations for two immiscible gases and therefore separated by an interface. In this paper, theoretical developments and computations have been applied mainly to the simulation of the firing gun process.
In comparison with firing experiments, first computation validation results concerning interior ballistics, muzzle brake flow, and blast wave propagation and reflection are presented and are very satisfactory.
The first part of the paper is devoted to the description of the physical mechanisms governing the unsteady intermediate ballistics flow (precursor flow, main propellant flow, blast wave, Mach disk, barrel shock, etc.). The second part of the paper is devoted to the numerical prediction and validation of these complex flows.

Keywords: interior ballistics, intermediate ballistics, exterior ballistics, Euler equations, computational fluid dynamics, blast and shock waves

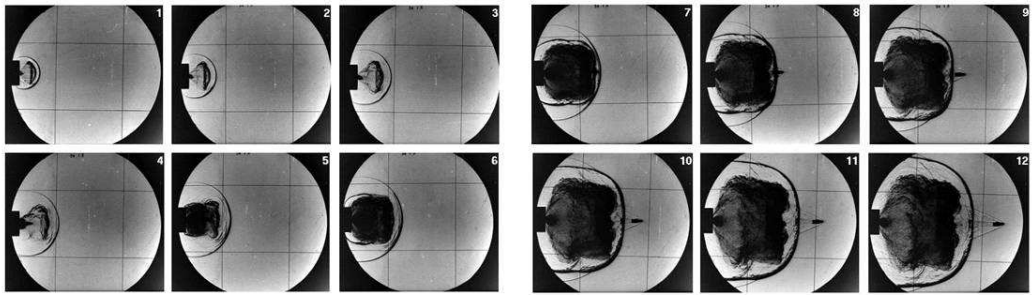

Fig. 1 Example of unsteady intermediate flow visualizations using a schlieren method

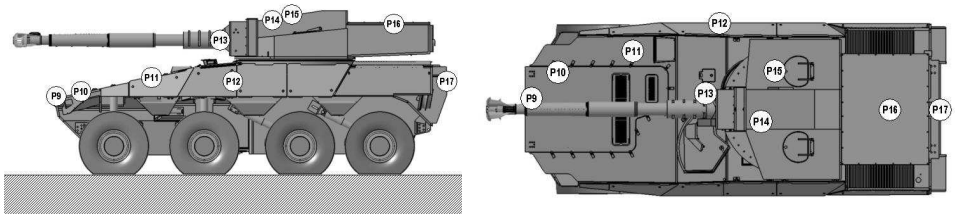

Fig. 2 Example of validation experiments
Pressure measurement locations on a tank demonstrator

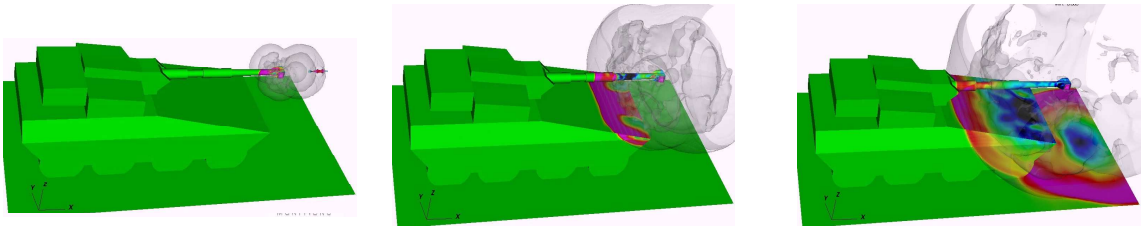

Fig. 3 Example of the numerical prediction of the blast wave behavior's
Pressure contours on a tank demonstrator at different time levels

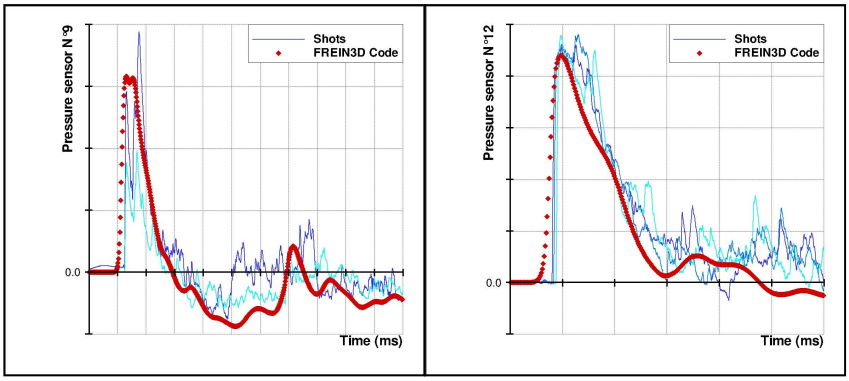

Fig. 4 Example of validation results
Pressure versus time for measurement points N° 9, and 12

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