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Title: New graphical user interfaces for calculation models IBHVG2 and XNOVAKTC for the simulation of the interior ballistics of guns and closed vessels

Abstract Text: Topic addressed: Modeling and simulation; interior ballistics of guns

Relevance to Conference theme: The use of computer-based simulations is an essential component of the development cycle of guns and ammunition. The simulation consists of three independent processes: data input, calculation, data output. Whereas the quality of the calculation mainly depends on the effectiveness of the modeling, data input and data output play a major role in the handling, use and application of the simulation. The graphical user interfaces shown in the presentation are so effective that even the educated layperson will be able to learn how to work with complex gas-dynamic models and achieve usable results within a short time.

Objective of presentation: One objective of the presentation is to demonstrate new user interfaces for data input and data output for the two frequently used internal ballistic calculation models IBHVG2 and XNOVAKTC. With these new user interfaces, data input will be much more visual and easy. On the one hand, data output is presented in a very clearly arranged and well-explained table. On the other hand, it is displayed in a slightly modifiable graphic. Its visual contents can then be exported immediately to other software packages, such as Office applications. These new user interfaces will make the handling of complicate programs for weapon and ammunition designers much more convenient. This will be explained on the basis of a few examples (automatic gun, tank gun, artillery). Another theme of the discourse is the presentation of first results of the simulation of the internal ballistic combustion in a closed vessel.

Abstract At present, in Germany, simulations of the interior ballistics of guns are mainly based on two calculation models: thermodynamic calculations with IBHVG2 and gas-dynamic calculations with XNOVAKTC. For easier handling of the programs, Graphical User Interfaces (GUI) were developed a few years ago, which carry out the pre- and post-processing. This facilitated the handling of the programs considerably. In 2008, to further optimize the performance of the GUIs, the Ernst-Mach-Institute was commissioned by WTD 91 to develop new versions of the GUI with an enhanced scope of application and which enable a more stable process flow. In addition, Rheinmetall-Defence was contracted to accompany the development of the new programs with extensive tests to detect process
and representation errors. Since September 2008, the two new GUIs are available: IBGRAF V2 for thermodynamic simulations and GASINBAL V2 for one-dimensional gas-dynamic calculations. The operability of both programs was confirmed in extensive tests. In the presentation, the GUIs and possible applications will be shown. On the basis of three examples of the caliber bands 35 mm (machine gun), 105 mm (tank gun) and 155 mm (artillery, modular propellant charges), the simulation’s input and output capacities will be demonstrated. In order to conduct interior ballistic calculations also for closed vessels, special program features which permit very fast data inputs and outputs were integrated in the pre- and post-processing of IBGRAF V2. For example, the calculation of dynamic vivacity as a part of the post-processor has been implemented. With the features of IBHVG2, the reaction of propellants in closed vessels can be simulated extremely well, and also the effect of ignition on pressure build-up can be demonstrated. Using different propellants, possible uses of the program for the calculation and representation of the pressure-time history and dynamic vivacity in tests with closed vessels will be demonstrated. We will also see that the methodology for the calculation of heat losses in IBHVG2 leads to results which must be considered problematic compared to measured values.