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Impact of atmospheric turbulence on the flight path of a guided bomb

Abstract.

This doctoral dissertation presents a quantitative and qualitative analysis of the impact of turbulence on the flight of a guided bomb. A 15.5 kg guided bomb constituted the study subject matter. It was created at the Air Force Institute of Technology, as a result of modifying a LBCw-10 air bomb. The paper reviews a standard method of modelling the spatial motion of the bomb, based on Euler's equations, where the bomb is treated as a rigid body with six degrees of freedom. It discusses the wind field model applied in the simulations, which was developed based on the Shinozuki's earthquake model. The dissertation shows the coefficient waveforms aerodynamic forces and moments acting on the studied object. They were determined using the PRODAS computation software and based on the results obtained in the course of the bomb model tests conducted in an aerodynamic tunnel. The doctoral dissertation also includes results of a numerical simulation of the bomb's flight in a calm atmosphere, used as a base to determine the impact of initial release parameters, such as velocity, altitude and release angle, on the parameters describing the bomb impact moment. The further part of the dissertation analyses the impact of the aforementioned bomb release conditions and a turbulent atmosphere described by the scale of the turbulence and wind standard deviation, on the spread of bomb impact points and its accuracy. It shows the bombardment error change trends, average hit circular error and deviations determined for bomb impact points. The parameters describing the impact moment for a bomb dropped in turbulent conditions, such as impact velocity, impact angle, bomb range and flight time were also presented. The paper contains a short analysis of bomb flight dynamics in a turbulent atmosphere and conclusions drawn on the basis of the conducted tests. The appendices added to the doctoral dissertation present a brief description of the study subject matter and results obtained in the course of simulations conducted for a bomb dropped in a turbulent, and calm atmosphere, which were not discussed in the essential section of the dissertation.