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PRECISE DETERMINATION OF STATIC MARGINS FOR UNGUIDED SOUNDING ROCKETS

Abstract

This paper presents a novel methodology enabling precise determination of static margins for unguided sounding rockets. Various models described in state-of-the-art literature are compared and it is shown that they give unacceptable differences. Therefore, an investigation of both sub- and supersonic flight aerodynamic regimes was conducted. This research was supported by wind tunnel experimentation data from all over the world, including datasets obtained by the author personally. With ground test results set as the reference, a mathematical model with sufficient accuracy in predicting the static margin's initial value and its changes during flight was constructed. Moreover, CFD simulations were done. In particular, influence of turbulence model selection on the results is investigated. Also the choice of first or second order scheme and obtained y-plus values are analyzed. Combining wind tunnel experimentation results with CFD calculations, analytical methods and test flights of rockets developed during the Polish Small Sounding Rocket Program enabled the establishment of the described methodology. Thus, recommendations for analyzing flight stability of unguided rockets are presented.