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Author: Dr. Antonella Ingenito
Sapienza University of Rome, Italy, antonella.ingenito@uniroma1.it

LES OF HTPB/O2 AND HTPB/N2O HYBRID ROCKET ENGINES

Abstract

Last years have seen a substantial growth in space launch market with a continuous increase of the average rate of launches per year. This growing request to access to space should be supported by a cheaper and a environmental friendly access to space: hybrid propulsion may be an answer to these requirements. Nowadays, this technology is still not solid: a comprehensive understanding of the physics of hybrid combustion pointing out on its criticalities such as ignition, pyrolysis, mixing, flame-holding, regression rate, and paying attention on the effect of the geometry and the operative conditions is a must to push ahead this technology. In this context, numerical simulations are a valuable tool to achieve a deeper understanding of the physics and chemical kinetics involved in hybrid combustion. In this work, LES simulations of a HTPB/O2 and a HTPB/N2O hybrid rocket have been performed in order to identify critical issues to be addressed. A kinetic mechanism of 7 species and 6 reactions has been implemented in the numerical code. A user defined function has been implemented in order to simulate the regression of the grain in time as function of the heat flux to the walls. Numerical results have been validated with experimental results obtained by the CISAS group of Padova. The simulations show a good agreement with the experimental results.