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The Effects of Time-Periodic Shear on a Diffusion Flame Anchored to a Model Propellant AMIR H.G. ISFAHANI, Department of Mechanical Science and Engineering, University of Illinois at Urbana-Champaign, JU ZHANG, THOMAS L. JACKSON, Computational Science and Engineering, University of Illinois at Urbana-Champaign — Propellants of solid rocket motors are subject to intense time-dependent shear flows and the response of the combustion field to these flows is of fundamental interest. Erosive burning (EB), the enhanced regression rate that can arise due to these flows, affects the performance of the solid rocket motor: the specific-impulse history. It is generally agreed that EB results from an increased heat transfer to the surface. The geometry is that of two quarter-planes of ammonium perchlorate (AP) and binder (or a blend of AP/binder). Three step kinetics is considered: AP decomposition and two diffusion flames, one between the virgin AP gases and binder and one between AP decomposed gases and binder. Gas and solid phases are coupled and temperature along the surface as well as the burn rate is solved for. We present an estimation of the shear parameters as a function of the motor size using a 2D planar periodic rocket (PPR) analysis without resorting to fully time-dependent three-dimensional turbulent simulations. These parameters are then used to study the change in the heat flux to the surface and the burn rate. It is shown that the burn rate is increased by more than two folds for larger amplitudes and frequencies.

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