

LATEEF KAREEM, Dept. Mechanical & Aerospace Engineering, West Virginia University, Morgantown, WV, 26506, and V'YACHESLAV AKKERMAN, Dept. Mechanical & Aerospace Engineering, West Virginia University, Morgantown, WV 26506. A New Approach to Quantify Flame Acceleration due to Wall Friction in a Micro-Slit.

Various analytical models have been developed to describe velocity profile for flame acceleration (FA) and deflagration-to-detonation transition (DDT), but none accounts for observed acceleration to constant velocity seen in case of micro gaps (in which the flow stays laminar even at speed of sound). To fill such a gap, here we propose an alternative model, which is based on the first physical principles and agrees with the experimental finding that FA is subsequently replaced by steady flame propagation. Starting with the Navier-stokes for a radial flow between two flat plates, we set the pressure gradient to be proportional to the vertical component of a velocity function, split the resulting differential equation in velocity into the vertical and temporal component, and then absorbed the driving force into the temporal component equation. The unknown parameters were computed by using nonlinear optimization to fit the model to the experimental measurement showing good agreement between the model and the experiments.