AMANDA CATHRENO, ABDULAFEEZ ADEBIYI and V'YACHESLAV AKKERMAN, Dept. of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV, 26506. Premixed Flame Pulsations in Obstructed Channels with both Ends Open.

Prior research indicated extremely fast acceleration, with potential detonation triggering, of premixed flames propagating in semi-open obstructed pipes (a pipe filled with a combustible premixture is open at one end; ignition occurs at the closed end such that a flame spreads towards the opening). However, industrial applications oftentimes have both ends open, with ignition occurring at one of them. The latter configuration constitutes the focus of our work. Specifically, flame propagation through a comb-shaped array of obstacles in a pipe with both ends open is studied by solving two-dimensional fully-compressible hydrodynamic and combustion equations with Arrhenius chemical kinetics. The blockage ratios BR=1/3, 1/2, 2/3 (with respect to the pipe radius) are considered, with oscillations of the burning rate observed in all cases. The oscillations are nonlinear but periodic; being steady for BR=2/3, 1/2, they slightly damp for BR=1/3. Increase in the BR facilitates nonlinearity and promotes the oscillation period but reduces the average burning rate. These oscillations can be treated as fluctuations around a quasi-steady solution, being thereby in agreement with recent experiments and modelling of flames in open obstructed pipes that yielded steady flame propagation prior to an onset of flame acceleration. Overall, a conceptual difference between open (oscillations) and semi-open (acceleration) obstructed pipes is identified. It is presumably attributed to the fact that, in a semi-open pipe, the entire fame-generated jet flow is pushed towards a single opening, whereas with both ends open this jet flow is distributed between two flows, towards both openings, thereby weakening flame spreading.

Acknowledgements: This work is supported by the National Science Foundation (NSF) through the CAREER Award #1554254 (V.A.)