Furkan Kodakoglu, V'yacheslav Akkerman, Department of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, WV, 26506. Towards an analytical description of propane-air premixed combustion in gaseous and gaseous-dusty industrial applications.

Emerging usage of propane as an alternative fuel for transportation, cooking, heating and manufacturing, will unavoidably lead to accidental leakage and accumulation of propane occurring in industries dealing with flammable gases and explosive dust. An example is the coalmining industry, which historically has one of the highest fatality and injury rates among the employees. For this reason, here we extend a recent theory of a coalmine fire scenario, accounting for wall obstacles and switching from methane to propane. The new formulation combines the theories of self-accelerating expanding flames, of finger flames and of ultrafast flame acceleration in obstructed conduits. Specifically, the mining configuration is imitated by two-dimensional and cylindrical passages of high aspect ratios, with comb-shaped arrays of obstacles attached to the walls. The passages have one extreme open such that a flame is ignited at a closed end and propagates to an exit. The key stages of the flame evolution such as the velocity of the flame front and the run-up distance are scrutinized for a variety of the flame and mining parameters. Starting with gaseous propane-air flames, the analysis is subsequently extended to gaseous-dusty ones. Specifically, the coal dust (combustible, i.e. facilitating the fire), inert dust (such as sand, moderating the process), and their combinations are considered, with the impact of the size and concentration of the dust particles quantified. Overall, the influence of obstacles on the fire scenario is substantial, with a stronger effect observed in the cylindrical geometry as compared to the two-dimensional passages.

Acknowledgements
This work is supported by the Alpha Foundation for the Improvement of Mine Safety and Health, Inc., through the Award No. ASTI14FO-82 (V.A.), as well as by the National Science Foundation, through the CAREER Award No. 1554254 (V.A.). The views, opinions and recommendations expressed in this work are solely those of the authors and do not imply any endorsement by the Alpha Foundation, its directors and staff.