Aerospace and Mechanical Engineering Seminar

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Improving Combustion Design: Challenges and the Future

It is expected that in the next forty years, global energy consumption in both the transportation and power generations sectors will remain heavily reliant on the combustion of fossil fuel resources. However, due to the environmental detriment that these systems impose, the feasibility of these existing combustion systems are in jeopardy. In order to meet our future energy demands, while satisfying stringent emission regulations, our best strategy is to improve the operability of such systems, in terms of their energy efficiency, fuel consumption, fuel flexibility, and lean-burn combustion strategies. But to achieve these technical challenges we are going to need both renewed and new fundamental understanding of combustion such that we can design next generation engines and fuels that are both cleaner and more efficient. In this talk, I will discuss the broad scientific methodology that is undertaken to study combustion as a complex chemically reactive system, which can then be applied to better understand the combustion process in their respective technologies.

Specifically, I will discuss two such examples. 1) Plasma-assisted combustion, or PAC, a novel technique whereby non-equilibrium plasmas can enhance the reactivity of a given combustion reaction to facilitate the process beyond the limits of normal operability, often at higher pressures and lower temperatures. The potential advantages of incorporating PAC into practical applications are numerous, ranging from more fuel-efficient engines to potentially realizing hypersonic propulsion systems. 2) As modern SI engine design trends seek to improve efficiency, an abnormal combustion phenomena known as “knock” becomes more likely. The propensity of knock is highly coupled to the properties of the employed real fuels, and a fundamental understanding of its occurrence is critical to the development of future engines. Lastly, I will conclude with future research directions, specifically highlighting areas that are currently lacking in our understanding of combustion, which is ultimately limiting our progress towards designing improved combustion systems.

Bio

Nicholas Tsolas is currently a postdoctoral associate in the Sloan Automotive Laboratory at the Massachusetts Institute of Technology. He received both his BASc and MASc degrees in mechanical engineering from the University of Toronto (Canada) in 2008 and 2010, respectively. He then obtained his PhD from the Center for Combustion, Power and Propulsion at the Pennsylvania State University in 2015. His research interest is in developing sustainable energy technologies with decreased net environmental impact. He studies conventional and alternative fuels and their application to practical combustion devices to mitigate their environmental impact and to improve their performance capabilities.

AME Lecture Hall, Room S212
Tuesday, April 11, 2017
4 p.m.
Refreshments and socializing 3:45 p.m. at the east end of the AME Courtyard