COMBUSTION WEBINAR

Modeling and Analysis of Sooting Flames: Turbulence, Pressure, and Chemical Kinetics

Speaker: Prof. Suo Yang, University of Minnesota

Time: *December 5, 2020*

10 am EST; 4 pm Paris; 11 pm Beijing.

Meeting: *Zoom*

Registration (required): Check https://sun.ae.gatech.edu/combustion-webinar/ for details or directly contact wenting.sun@aerospace.gatech.edu.

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Biography: Dr. Suo Yang is a Richard & Barbara Nelson Assistant Professor of Mechanical Engineering at the University of Minnesota – Twin Cities. During 2017-2018, he was a Postdoctoral Research Associate in Mechanical & Aerospace Engineering at Princeton University. He received Ph.D. (2017) and M.S. (2014) degrees in Aerospace Engineering, and another M.S. degree in Computational Science & Engineering (2015), all from Georgia Institute of Technology. He received a B.Sc. degree in Mathematics & Applied Mathematics from Zhejiang University in 2011. His research focuses on the modeling and simulation of laminar and turbulent reacting flows, including combustion, plasma, particulate and multiphase flows. He has authored more than 35 papers in refereed journals and conferences, with a Google H-Index of 15. He is a member of the AIAA Propellants and Combustion Technical Committee. His research has been supported by National Science Foundation and Army Research Laboratory.

Abstract: In turbulent combustion, soot evolution is heavily influenced by soot-turbulence-chemistry interaction. Specifically, soot is formed during combustion of fuel-rich mixtures and is rapidly oxidized before being transported by turbulence into fuel-lean mixtures. A conditional subfilter probability density function (PDF) model is proposed to account for this distribution of soot evolution in mixture fraction space. At the same time, Polycyclic Aromatic Hydrocarbons (PAH) are confined to spatially intermittent regions of low scalar dissipation rates due to their slow formation chemistry. A Strain-Sensitive Transport Approach (SSTA) is developed to model the competition between differential molecular transport and turbulent mixing. These two models are first validated *a priori* against a Direct Numerical Simulation (DNS) database, and then implemented within a Large Eddy Simulation (LES) framework, applied to a series of turbulent sooting jet flames with different pressures, and validated by experimental measurements. Predictions of high-pressure sooting flames are found to have larger uncertainty, mainly because the chemical mechanisms were developed based on low-pressure data. A new soot-based global pathway analysis (SGPA) method is developed to identify the key chemical kinetics for soot evolution processes and point out the directions for high-pressure mechanism development with more practical relevance.