

# COMBUSTION WEBINAR

## New Advances in Ultrashort Pulse Laser Diagnostics for Combustion Imaging

**Speaker:** Prof. Waruna Kulatilaka, TAMU

**Time:** May 7<sup>th</sup> 2022

*10:00 NYC; 16:00 Paris; 22:00 Beijing.*

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**Biography:** Waruna Kulatilaka is a Professor and Morris E. Foster Faculty Fellow I in the J. Mike Walker '66 Department of Mechanical Engineering with a joint courtesy appointment in the Department of Aerospace Engineering at Texas A&M University (TAMU). He is a pioneer in advanced optical and laser-based imaging diagnostics for fundamental and applied combustion research, as well as for propulsion, energetics, and hypersonics. In recent years, he, together with associated teams, has spearheaded the development of ultrashort-pulse (i.e., femtosecond-duration) multi-photon fluorescence imaging methods for flames and plasmas. Dr. Kulatilaka obtained his Ph.D. in Mechanical Engineering from Purdue University, completed a postdoctoral fellowship at Sandia CRF, then worked as a Senior Research Scientist/On-Site Contractor at the Air Force Research Laboratory at WPAFB, OH before joining Texas A&M in 2014. He is active in multiple professional organizations, including ASME (Fellow), AIAA (Associate Fellow), Optica (Senior Member & Associate Editor of *Applied Optics*), and The Combustion Institute (Chair-Elect of US Central States Section).

**Abstract:** Advances in ultrashort pulse laser diagnostics have enabled non-intrusive, high-speed, multi-dimensional imaging of chemical species in reacting flow applications ranging from fundamental flame studies to gas turbine combustors and hypersonic propulsion systems. Following the original demonstration of femtosecond two-photon laser-induced fluorescence (fs-TPLIF) of H atoms a decade ago, our group and partners have made significant advances in this area. In particular, ultrashort, fs-duration laser methods have enabled interference-free, kHz-rate imaging schemes for highly reactive atomic species such as H, O, and N, and molecules such as OH, NO, CO, and O<sub>2</sub> in combustion and plasma environments. Similar fluorescence methods for flow tracers such as Kr and Xe have also been demonstrated. This seminar will highlight several major milestones in ultrashort pulse laser imaging in the last decade, namely, broadband excitation of multiple narrowband molecular transitions avoiding the need for spectral overlap corrections at elevated pressures, selected set of high-pressure applications of fs-TPLIF, and novel developments in simultaneous multi-species imaging using a single fs laser source. Also discussed are the challenges and opportunities in the widespread application of these diagnostic tools for generating model-validation data sets and implementations in practical high-pressure turbulent combustion environments.

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