

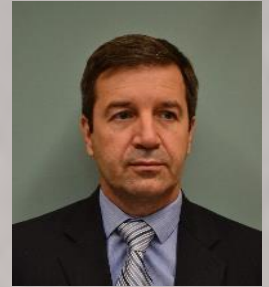
Ultrafast Optical Diagnostics for Aerospace Applications

Friday, October 1st, 2021

12:30 PM

Bowen Hall Room 222

MAE Seminar Series



Arthur Dogariu
Princeton University

Since the first femtosecond laser was fired at MAE more than a decade ago, we leveraged nonlinear optics and ultrafast spectroscopy for the development of advanced optical diagnostics and remote sensing with applications in fields like aerospace, environment, medicine, and national security. In this talk, I will present several innovative solutions we developed and demonstrated for remote species detection and for optical diagnostics of gases and plasmas. A novel hybrid femtosecond/picosecond Coherent Anti-Stokes Raman Scattering (CARS) spectroscopy technique enabled standoff molecular detection and identification of trace species using single shot spectroscopy at kHz rate, as well as non-equilibrium thermometry. Our Femtosecond Laser Electronic Excitation Tagging (FLEET) velocimetry technique relies on femtosecond laser dissociation of nitrogen and subsequent delayed recombination for mapping flows. FLEET, hybrid CARS, and femtosecond Two-Photon Laser Induced Fluorescence (fs-TALIF) allowed first ever remote velocimetry, thermometry, and species measurements at kHz rate in large-scale hypersonics and low temperature plasma facilities. By tailoring the focusing of ultrafast lasers in atmospheric air, we succeeded to obtain backwards air lasing, where multi-photon dissociation and excitation lead to stimulated emission from the constituent atomic species (N, O, Ar, Kr). The strong coherent emission is an example of a mirror-less atomic laser which can aid remote atmospheric trace species detection and can even bend the light around the corner. Finally, I will show how nonlinear optics enables standoff measurement of the electric field, and how slow-light can be used for hyperspectral imaging without the use of a spectrometer.

Arthur Dogariu received his Ph.D. in Optical Physics from CREOL (School of Optics) at the University of Central Florida in 1997. His past appointments include Researcher at the University of California, Santa Barbara, Research Scientist at NEC Research Institute, Assistant Professor at the University of Washington. Since joining Princeton in 2005, he was a Research Scholar in the Department of Chemistry, PRISM, and in the Department of Mechanical and Aerospace Engineering. His research interests include experimental optical physics in the areas of applied optical diagnostics, remote detection techniques, nonlinear and ultrafast optics, biomedical optics and biosensors, plasma dynamics, photo-physics of organic materials and devices, ultrafast spectroscopy, nano-optics, quantum optics, wave propagation in dispersive media. He has authored over 90 publications in refereed journals, more than 150 conference papers, and 6 US and international patents. He is a Fellow of the Optical Society of America, member of the American Institute of Aeronautics and Astronautics, and an Honorary Member of the Academy of Romanian Scientists.

