Weekly CEAFM Seminar: Fall 2016

JOHNS HOPKINS
Center for Environmental
& Applied Fluid Mechanics

Date: **Friday, September 23, 2016**

Time: 11:00 AM

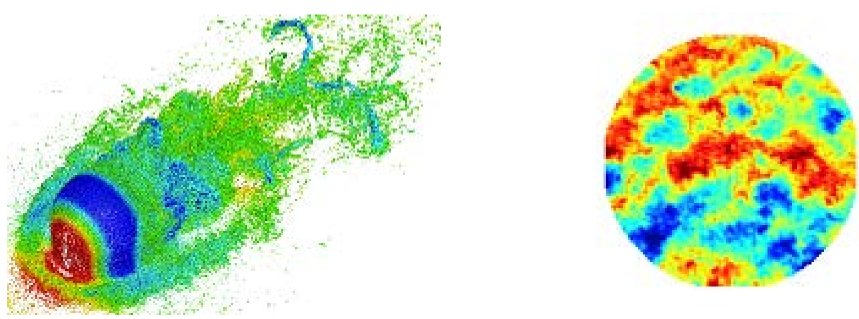
Location: Gilman Hall # 50

Speaker: **Prof. Meng Wang** (University of Notre Dame)

Title: ***"Physics and Computation of Aero-Optics"***

Abstract

Distortions of optical signals by turbulent air flow are detrimental to the performance of airborne optical projection, imaging and communication systems. Because of the extremely short optical wavelengths, even small variations in the speed of light due to air density fluctuations can produce large phase distortions and consequently poor beam/image quality. This talk will discuss recent numerical investigations of several important aero-optical flows including turbulent boundary layers, separated shear layers and flow over a 3-D turret using highly-resolved LES or wall-modeled LES at realistic experimental Reynolds numbers. The objectives of these studies are to predict the statistical properties of optical distortions and relate them to the underlying flow physics and structures. Among the findings to be presented, it will be shown that temperature fluctuations are primarily responsible for optical distortions in turbulent boundary layers whereas pressure fluctuations are the dominant distortion source in separated shear layers, the aero-optical properties of shear layers formed by turbulent separation are insensitive to the Reynolds number, and the directionality of optical distortions is strongly correlated with the orientation of the coherent turbulence structures. Validated numerical databases are employed to evaluate statistical models, measurement techniques and mitigation strategies for aero-optical effects, and the results will also be discussed.



Aero-optics of flow over a hemisphere-on-cylinder turret at Mach 0.4 and $Re_D = 2.3 \times 10^6$. Left: vortical structures visualized by iso-surfaces of λ_2 colored by density; right: wavefront distortions for an optical beam propagating through a wake region.