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Michigan Institute for Plasma Science and Engineering

Wednesday
December 11, 2013
4:00 pm
Room 1200
EECS Building

Prof. Thomas Corke

University of Notre Dame

Plasma Lens for Active Optical Path Difference Control

The presentation will focus on recent investigations of the feasibility of a “plasma lens” for adaptive wavefront control of coherent light sources. The approach is based on the relation between plasma electron density and its index of refraction. A driving application is wave-front correction for airborne laser applications that rely on adaptive optics to provide optical path corrections that account for the local compressible flow field. In an early demonstration, plasma was encapsulated in a hollow glass cylinder with flat optical glass at its ends. Air in the glass cylinder was ionized using a dielectric barrier discharge (DBD). The wavefront distortion produced by the ionized air was characterized by placing the “plasma lens” in one arm of a Michelson interferometer setup. The effects of gas pressure and plasma power were investigated. The results were compared to a derived analytic model that related the electron density and optical path difference (OPD) to the plasma power. The agreement between the experiment and analytic model was very good, especially at the higher plasma power levels. A theoretical model is developed to identify the geometric considerations that lead to the two plasma regimes observed in the experiments. The excellent agreement between the theory and experiment provides a scaling relation that can be used to miniaturize of plasma optical elements for use in an adaptable array.

About the Speaker: Dr. Thomas C. Corke is the Clark Chair Professor in the Aerospace & Mechanical Engineering Dept. at the Univ. of Notre Dame. Prof. Corke is a Fellow of the American Association of Aeronautics and Astronautics (AIAA), a Fellow of American Association of Mechanical Engineers (ASME), and Fellow of the American Physical Society. Prof. Corke was the recipient of the Univ. of Notre Dame's 2007 "President's Research Achievement Award", and the 2009 "R.T. Davis Memorial Lecture Award" from the Univ. of Cincinnati. He has received two NASA Achievement Awards. The first in 1982 recognized his Ph.D. research "for outstanding...contributions in the area of turbulence control and viscous drag reduction." The second was in 1995 "for the development of important insights into basic fluid mechanics phenomena and theoretical analysis tools which have contributed to major advances in flow prediction and control including laminar flow control." In 2010 he received the AIAA Aeronautics Award. His citation read "For his strong commitment to academic and research achievement, consistent record of superior technical accomplishment and numerous experimental and computational contributions to aerodynamics."