

Creation of High-Power Airborne Laser Systems Could Destroy Missiles

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ARLINGTON, Va. -- The Air Force Office of Scientific Research is funding research at the University of Notre Dame to advance the knowledge of near-field aero-optic deviations and their effect on directed energy.

Aerodynamic flows around aircraft structures induce density variations in the boundary layer flows and slipstream. The interaction of these density variations with a laser beam (aero-optics) can severely alter the beam characteristics, making it difficult or impossible to focus laser power on distant objects or transmit laser communications signals from a flight vehicle. Successful development of airborne laser weapons or communications systems will entail the development of adaptive optic or aerodynamic solutions to the corrupting effects of aero-optics.

A team led by Professor Eric Jumper is researching the effect of aero-optics and its implication on laser communication applications and other optical research initiatives.

"We hope to provide a path-to-integration from theory to flight tests, following a logical, step-by-step progression from theoretical modeling, through wind tunnel testing to validate aerodynamic and optical quality predictions towards design and fabrication," Mr. Jumper said.

To conduct the computational analysis, the team will use an advanced, large-eddy simulation code that can capture the density fluctuations and thus the changing index of refraction. That is important for accurate predictions of the effect of flow control on aero-optical deviations.

To continue the process by conducting wind tunnel experiments prior to flight tests, a new closed-loop wind tunnel with a 3-foot square test section with high-optical quality access and low turbulence intensity is being built at Notre Dame. The culmination of the process will be to conduct flight tests in two Cessna Citations flying in formation, each capable of obtaining Mach 0.5 ,or 380.7 mph (half the speed of sound) in straight and level flight, and Mach 0.71, or 532.5 mph in a descent.

"This body of work is a culmination of decades of investigation into the relationship between fluid dynamic mechanisms, such as density gradients, existing in the presence of pressure-wells, and index of refraction of fluid media," Mr. Jumper said.

When first introduced over two decades ago, the evaluation of the phenomena was considered trivial, but is now viewed as crucial in assuring the success of directed energy and laser communication technologies used by the Air Force.

By funding research efforts for the Air Force in relevant scientific areas such as advanced adaptive signal processing, AFOSR continues to expand the horizon of scientific knowledge. AFOSR is part of Air Force Materiel Command's Air Force Research Laboratory.

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