

AFRL Completes Flight Tests for HARDROC Laser Beam Director

By Richard Scott

The US Air Force Research Laboratory (AFRL) has completed a flight test campaign for a new beam director concept that can be used with directed energy laser systems integrated into aircraft.



A test aircraft carries the sub-scale HARDROC beam director illuminated by a low-power scoring laser during an experimentation flight August 12, 2022. The HARDROC program evaluated in flight the ability of various aerodynamic flow control techniques to mitigate optical and mechanical distortions imparted on a laser beam leaving an airborne platform travelling at high speeds. (Courtesy photo)

The Hybrid Aero-Effect Reducing Design with Realistic Optical Components (HARDROC) team – bringing together personnel from AFRL's Aerospace Systems (Wright-Patterson AFB, OH) and

Directed Energy (Kirtland AFB, NM) directorates, and prime contractor MZA Associates (Albuquerque, NM) – has developed and tested a low-power, sub-scale beam director to evaluate the ability of various aerodynamic flow control techniques to mitigate optical and mechanical distortions imparted on a laser beam leaving an airborne platform travelling at high speeds.

The flow control at the core of HARDROC has been in development for several years by researchers at AFRL. Research initially used advanced computational fluid dynamic simulations to model different flow control techniques. This work, supported by wind tunnel tests, predicted a significant reduction in aero-effects across a wide range of speeds and look angles.

However, while the CFD modeling gave confidence in the flow-control techniques, there were still questions as to whether these could be used with the sensitive optical components required for an advanced directed energy system. To find out, AFRL contracted with MZA Associates for the design of a sub-scale system, incorporating realistic optical components, which could be either utilized in a wind-tunnel or on board an aircraft.

The resulting design was ground-tested in an environmental chamber as well as a wind-tunnel to ensure functionality and performance under load before commencing a series of flight trials in mid-2022 on a Dassault Falcon 10 business jet. During the flight test program, the aircraft cruised at high speed and a variety of sensors were used to measure aerodynamic disturbances.

According to the AFRL, the results “demonstrated that the HARDROC beam director enlarges the envelop that airborne directed energy systems can operate in, providing 360-degree field of regard across extended speed regimes with reduced size, weight and power compared to other turrets”. It adds

that the successful flight demonstration of the HARDROC turret “clears one of the key remaining technological hurdles for operation of high-power lasers on high-speed aircraft for a variety of missions.”