



Facility Factsheet

Combustion & Laser Diagnostics Research Complex (CLDRC)

Description:

The Combustion and Laser Diagnostics Research Complex (CLDRC) supports the experimental and computational study of fundamental combustion phenomena to expand the scientific knowledge base; validate combustor-design codes; and improve the performance, reduce the pollutant emissions, and enhance the affordability, maintainability, and reliability of current and future generation propulsion systems for military and commercial aviation. This state-of-the-art complex provides unique laboratory tools for the experimental characterization of combustion through the development, demonstration, and application of advanced laser-based/optical diagnostic techniques. These capabilities are complemented by a suite of specialized modeling and simulation methodologies for assessing and predicting the detailed chemistry and physics of combustion processes.

Purpose:

Achieve predictive understanding of combustion chemistry and physics. Provide tools for evaluating advanced combustor concepts. Demonstrate optical platforms for on-board sensing and control.

Products:

The CLDRC features an impressive array of advanced laser technologies, including many one-of-a-kind optical sources and detectors. CLDRC lasers provide broad spectral coverage from the ultraviolet through the visible to the near, mid, and far infrared (terahertz-radiation region) for flow visualization and spectroscopic investigations of complex reacting and non-reacting flowfields. Continuous-wave and pulsed (nano-, pico-, and femtosecond) sources are employed in conjunction with various scientific-grade cameras and ultrafast imaging devices to provide tremendous spatial and temporal resolution and data-acquisition bandwidth for critical Air Force applications. A host of linear and nonlinear optical techniques have been developed and applied, including high-speed digital imaging, emission spectroscopy, planar laser-induced fluorescence (PLIF), laser-induced incandescence (LII), planar Rayleigh scattering (PRS), reactive Mie scattering (RMS), laser Doppler velocimetry (LDV), particle-image velocimetry (PIV), thin-filament pyrometry and velocimetry (TFP, TFV), pressure- and temperature-sensitive paints, spontaneous Raman scattering spectroscopy, coherent anti-Stokes Raman scattering (CARS) spectroscopy, transient-grating spectroscopy (TGS), phase Doppler particle analysis (PDPA), femtosecond ballistic imaging, ultrafast pump-probe spectroscopy, laser-induced polarization spectroscopy (LIPS), tunable diode-laser absorption spectroscopy (TDLAS), time-division-multiplexed (TDM) hyperspectral absorption spectroscopy, terahertz time-domain spectroscopy (THz-TDS), and advanced techniques for tomographic reconstruction. Recent innovations with femtosecond lasers and burst-mode laser technology have enabled kHz-rate 2D-CARS imaging and full 4D (three spatial dimensions and time) volumetric imaging of non-reacting and reacting flowfields. These tools have also been applied to measure species and temperature fields with fully resonant electronically enhanced CARS (FREE-CARS) and velocity fields with selective two-photon absorptive-resonance femtosecond laser electronic-excitation tagging (STARFLEET).

Availability:

Primarily in-house and related DoD contractor research. Other U.S. Government agency, DoD contractor and commercial customer programs upon request. Contact: 937-255-4100.

