Small-Engine Research Laboratory (SERL)



Description:

The Small-Engine Research Laboratory (SERL) is a facility designed to conduct experimental small-scale propulsion and power generation systems research. The SERL has a collection of unique capabilities to support execute related research efforts. These research capabilities include: eight internal combustion (IC) engine test stands ranging from 0.1 kW to 200 kW, three mobile-IC engine research stands (< 7.5 kW), a direct-injection combustion testbed, a liquid spray characterization bench, a small Unmanned Aerial System (UAS) propeller thrust/torque stand, a 445 N thrust-stand for small-turbine and alternative cycle research, a small-IC engine altitude simulation chamber (< 9 kW). A wide variety of instrumentation is available to measure pressures, temperatures, fuel flow, air flow, IC engine power and torque, exhaust gas species, fuel injection spray characteristics, real-time in-cylinder pressure measurements. Laser-based diagnostics and multiple 1+ MHz framing rate digital cameras are also part of the available instrumentation to enable non-intrusive measurement of these combustion parameters. All experiments are operated remotely using in-house-developed data acquisition solutions, engine controls, and a multi-camera high-resolution digital video monitoring system. In-house-developed engine controls and electronics offer accurate, real-time control of combustion parameters (initiation timing, fuel injection timing, fuel flow, air flow, fuel blending, and knock evaluation/feedback) for all experiments. In addition to C-Rio data acquisition and control systems for all experiments, the facility is equipped with up to 16 channels of high-frequency data acquisition at up to 5 MHz.

Purpose:

The overall SERL objective is to develop an understanding of the combustion physics, chemical kinetics, and scientific principles required to enable heavy/multi-fuel (H/MF) operations of small-scale propulsion and power generation, storage, and distribution systems. Specific objectives of the proposed program that are key to enabling H/MF operation of these systems are: 1) Establish combustion initiation strategies to optimize heat release in highly convective, pressure-coupled small-scale internal combustion (IC) engine environments 2) Develop the understanding of governing thermodynamic and fluidic principles unique to heavy-fuel small-scale propulsion along with the control methodologies to enable fuel control and H/MF operations in small-scale propulsion and power generation systems 3) Investigate the use of alternative hybrid (combination of IC, battery, and/or fuel cell) and alternative-cycle propulsion and power generation systems, requiring development of power density improvements, operation of fuel cells on heavy fuels, and hybrid system energy management.

Products:

Small Heavy/Multi-Fuel Engine Enabling Technologies
Alternative and Bio-derivative Fuels Combustion and Emissions Characterization
Small-scale Thermo-chemical Hybrid Propulsion System Technology
Efficient UAS Propulsion and Power Systems Technology

Availability:

Primarily in-house and related DoD contractor research. Other U.S. Government agency, DoD contractor and commercial customer programs upon request. Contact: 937-656-7280.