Engine Research Laboratory

Indian Institute of Technology Kanpur

Single Cylinder Optical Research Engine with Transient Dynamometer

Two Cylinder Engine with Eddy Current Dynamometer

Single Cylinder Optical GDI Engine with Transient Dynamometer

Hydrogen Fuelled Single Cylinder Engine with DC Dynamometer

Engine Research Laboratory (ERL) was established in the Department of Mechanical Engineering of IIT Kanpur on October 16th, 2005. The aim of this laboratory is to carry out world class research in the area of internal combustion engines with an objective of increasing fuel efficiency, emission control and engine durability and new technology development. ERL is dedicated to introducing new technologies in IC engines in the country and it is the first laboratory in India to apply laser diagnostics and micro-sensors to the IC engines. Several unique experimental facilities have been established to meet these objectives.

http://www.iitk.ac.in/erl

Major Research Areas

- Engine combustion
- Alternative fuels
  - Biodiesel and other biofuels
  - Primary alcohols and bio-butanol
  - Direct injection of natural gas
  - Laser ignition of Hydrogen/ CNG
  - Hythane
  - HCCI of gasoline and diesel like fuels
- Exhaust gas after-treatment
  - Particulate characterization
  - Particulate control
  - Regulated and unregulated emissions
- Optical diagnostic techniques
  - Time resolved 2D and 3D PIV for in cylinder flow visualization
  - 2D and 3D PDI for spray investigations
  - Laser Induced Fluorescence
- Lubricating oil tribology
  - Development of micro-sensors
  - Capacitance sensors and fiber optic probes
- Large-bore engine research
- Field trials of alternative fuel vehicles
- Engine endurance and long-term durability studies
- Prototype development

Achievements

- Developed Electronic Fuel Injection System for ALCO-DLW Locomotives of Indian Railways, which was designed, developed and prototyped in just 4 months. This development made India 4th region in the world to have this technology.
- Converted mechanical fuel injection system to electronic fuel injection system leading to 4% fuel saving and 70% carbon reduction with faster locomotive engine acceleration under the Indian Railways duty cycle.

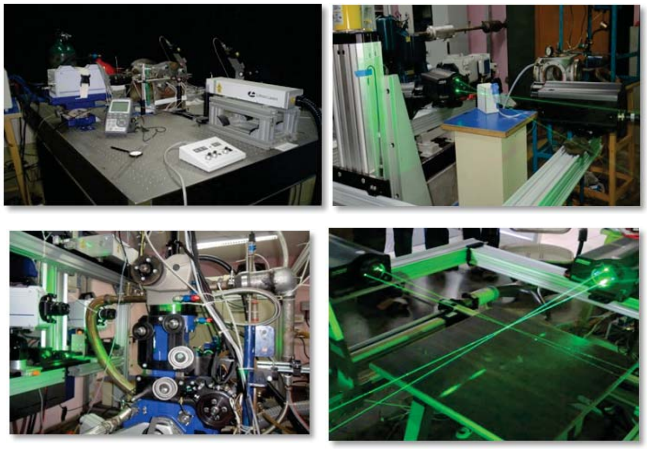
Major Facilities

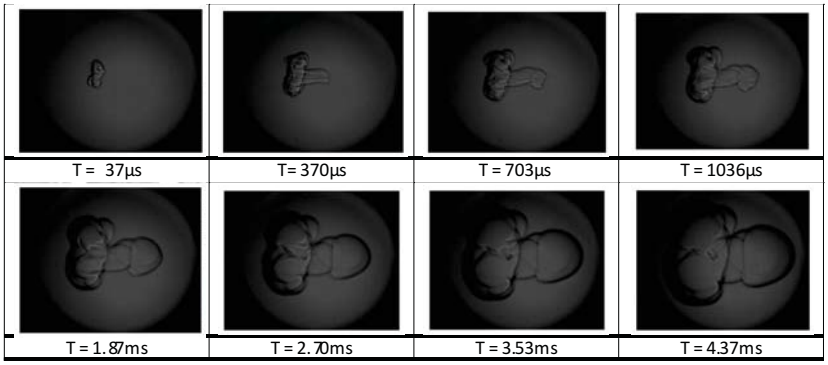
Single Cylinder Optical Research Engine (SCORE)

- SCORE is a flexible engine system with provision to vary fuel injection strategies, injection timing, boost pressure, and compression ratio.
- SCORE has provision for control and measurement of fuel injection pressure, injection pattern (two pilot, one main and one post injection).
- For combustion visualization, it has transparent quartz liner and quartz window in the piston crown.

Laser Related Investigations

- ERL is one of the major engine research centers carrying out laser related investigations.
- Major research areas include development of laser ignition system, 2D, 3D and tomographic time resolved particle imaging velocimetry (PIV) and phase doppler interferometry (PID).
- PIV is a non intrusive technique, which measures whole velocity field by taking two images shortly one after the other and can be employed in an optical engine.
- PDI technique allows simultaneous measurement of droplet size distribution and the three components of velocity by measuring the phase difference and frequency of the light scattered by droplets in a fuel spray.





Shadowgraph images of flame kernel development for laser ignited methane-air mixture

Data Acquisition System

High Speed Combustion Data Acquisition (DAQ) systems are very important for engine combustion and performance investigations. ERL has a custom built data acquisition system, which is capable of measuring all combustion parameters, in addition to dozens of state-of-the-art systems from reputed manufacturers for raw combustion data acquisition and analysis.

Major Facilities

Emission Measurement Equipment

ERL has world class emission characterization systems for regulated and unregulated gaseous emission species. These equipment are capable of measuring regulated pollutant species like NOx, CO, CO_2, HC and smoke opacity in addition to 31 unregulated species, using FTIR emission analysers.

EC/OC Analyser

HFID

Online PAH Analyser

FTIR

Raw Emission Analyser

ERL has specialized facilities capable of measuring particulate number-size distribution along with particulate mass, EC/OC, PAH content etc. using advanced equipment such as engine exhaust particle sizer (EEPS), smart particle sampler, EC/OC Analyser, Photo-Acoustic Sensors etc.

SPC

EEPS

Oil Testing Facility

ERL has advanaced oil testing facilities, which are capable of measuring various properties of lubricating oils and fuels. Using these facilities, physical, chemical and other important properties of fuels and lubricating oils can be accurately measured for comparative analysis.

Biodiesel Pilot Plant

- ERL has designed and developed a low cost biodiesel pilot plant .
- The cost of the plant is less than Rs. 10 lakhs.
- ERL has also developed a biodiesel operated car, which can operate on 100% biodiesel as well as its blends with mineral diesel.

Current Research

- Experimental investigations of HCCI/ PCCI combustion in a single cylinder research engine using convention fuels and biofuels.
- Laser ignition of Natural Gas fuelled single cylinder engine.
- Experimental investigations of combustion characteristics and emissions of a laser fired hydrogen fuelled engine.
- Experimental investigations of fuel sprays of biodiesel, straight vegetable oils and their blends with mineral diesel.
- Fuel spray and combustion visualization endoscopy of biodiesel fuelled direct injection engine.
- Development of a common rail injection system for a constant speed compression ignition engine.
- Combustion, material compatibility and engine tribology investigations in biodiesel fuelled turbo-charged transportation engine.

TATA Dicor 3L Engine

TATA Dicor 2.2L Engine

Maruti Zen Engine

TATA Indica Engine

Laser Ignited CNG Engine

Gasoline HCCI Engine

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Shell · Hanyang University · TATA · Argonne National Laboratory · NEERI · Indian Railways · RDSO · RITES

Flagging of ERL Developed First Rebuilt Loco Based on Electronic Fuel Injection System for Indian Railways by Director General, RDSO

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