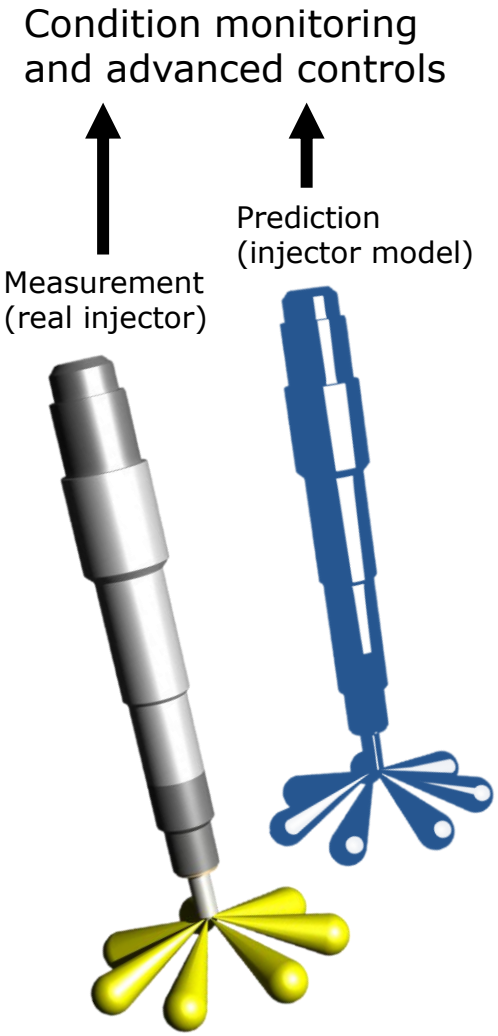
Development of a Data-driven Injector Model for Condition Monitoring and Advanced Control Concepts



- **Target:**

  Diesel fuel injectors play a central role in the performance and robustness of large diesel engines. By instrumenting these injectors and using an appropriate condition monitoring system, it is possible to detect signs of wear and damage to the injectors and to counteract these through interventions in the engine operating strategy, thereby maintaining the highest level engine performance.

  The target of this thesis is to develop a data-driven and real-time capable injector model that predicts key injection parameters as a function of other engine parameters for an unworn and fully functional injector. Condition monitoring is implemented by comparing predicted to measured parameter values. To generate a measurement database for modeling, diesel engine tests that involved a specially instrumented prototype fuel injector were carried out on a single-cylinder research engine at the Large Engines Competence Center (LEC).

- **Tasks:**
  - Familiarization with engine and injection technology and corresponding measurement technology and measurement parameters
  - Preprocessing of relevant engine and injection system measurement data
  - Investigation of the interrelationship between engine performance and injection system behavior through an explorative data analysis
  - Development of a data-driven "Injector Model" for condition monitoring
  - Composition of the master's thesis
- **Prerequisites:** Programming skills in Python and/or R; experience in data analysis
- **Earliest possible start date:** Immediately
- **Duration:** Approximately 6 months
- **Contact details:**

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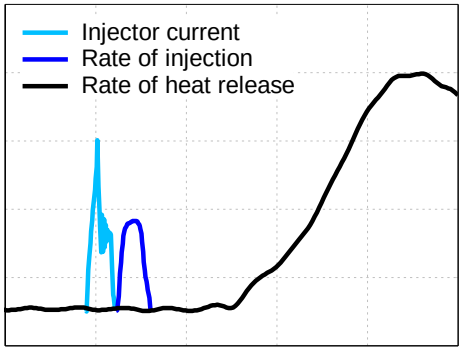
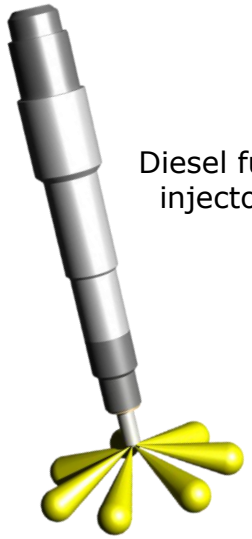
Development of a Data-Driven Injection Rate Model Based on Measurements With an Instrumented Diesel Fuel Injector





- **Target:**

  Diesel fuel injectors play a central role in the performance and robustness of large diesel and dual fuel engines. Instrumentation of such injectors has the potential to reveal detailed insights into the fuel injection process and related combustion phenomena inside the engine. A valuable parameter for analyzing the injection and the combustion process is the fuel injection rate (i.e., the actual nozzle fuel mass flow rate during the injection process). This parameter can be measured when the injection system is set up on a hydraulic test rig but not when it is part of an engine.

  The target of this thesis is to develop a data-driven model that predicts the fuel injection rate curve as a function of other signals obtained from an instrumented prototype injector. Injection rate measurements were carried out on a hydraulic test rig to generate a measurement database for modeling.

- **Tasks:**
  - Familiarization with injection and related measurement technology
  - Preprocessing of hydraulic test rig and injection system measurement data
  - Development of a data-driven model for fuel injection rate prediction
  - Composition of the master's thesis
- **Prerequisites:** Programming skills in Python and/or R; experience in data analysis
- **Earliest possible start date:** Immediately
- **Duration:** Approximately 6 months
- **Contact details:**

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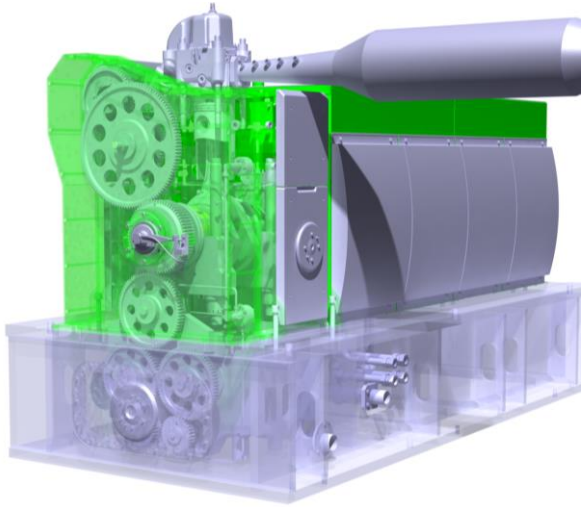
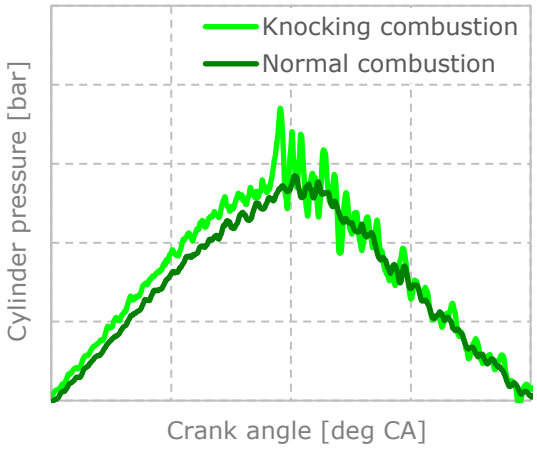
Development of a Data-driven Damage Model for Large Engine On-board In-cylinder Pressure Transducers





- **Target:**

  The service life of on-board cylinder pressure sensors in large engines is determined not only by loads at nominal operating conditions but to a large extent by irregular events such as knocking combustion. In addition to high thermal loads, extreme rates of pressure rise have an impact since they excite sensor natural frequencies and can thus lead to strong vibrations and deformation of the sensor.

  The target of this thesis is to develop a data-driven damage model for a specific in-cylinder pressure transducer based on measurement data from dedicated durability tests that were carried out on a large high-speed single-cylinder research engine (SCE) at the Large Engines Competence Center (LEC). With such a model, the aim is to obtain a detailed understanding of the impact of specific engine operating conditions on pressure transducer degradation.

- **Tasks:**
  - Familiarization with the engine test setup and corresponding measurement technology and measurement parameters
  - Preprocessing of engine measurement data
  - Generation of value-added data
    - Establishment of correlations between different measurement techniques (engine indication system vs. high-speed oscilloscope measurements)
    - Detailed investigation of potential sensor damage indicators
  - Development of a data-driven damage model for a specific in-cylinder pressure transducer
  - Composition of the master's thesis
- **Prerequisites:** Programming skills in Python and/or R; experience in data analysis
- **Earliest possible start date:** Immediately
- **Duration:** Approximately 6 months
- **Contact details:**

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