Automotive Systems

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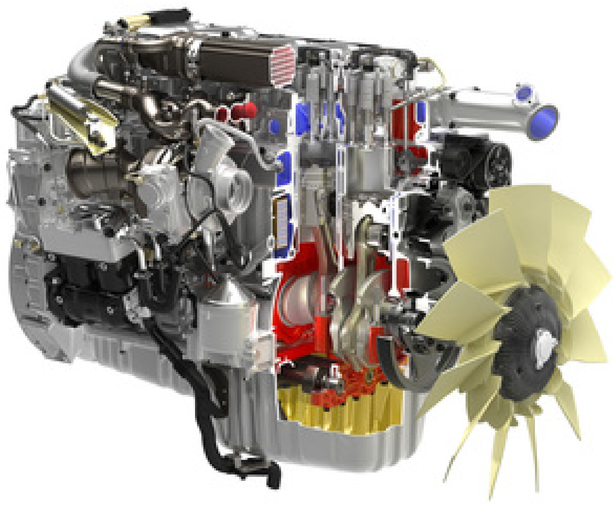
Background

Automotive industry faces challenging tasks. Customers have an increasing demand for transport missions and there is also a demand for performance. At the same time the crude oil resources are being depleted. For passenger cars the European Community has proposed a CO_2 limit of 120g/km, this will lead to even more focus on downsizing, which will be implemented by turbocharging small engines. For heavy trucks the fuel consumption is not legislated but the drive comes from the customers where it is one of the key figures when investments are being planned, and it is also an area of competition in marketing. Also for diesel engines the use of turbochargers are important for fuel efficient engines with high power/density ratios.



Furthermore, the emission legislations are successively made stricter which reduces the margins and increases the demands on the control systems. Today the entire powertrain management is central when it comes to achieving the desired performance in terms of emissions, efficiency, and drivability. The demands on the control systems and on their interaction drive the technical development in a direction where previous design compromises are removed giving a more flexible system but also a system that is more complex. Modeling and simulation have evolved to standard engineering tools for analyzing and designing these complex systems, analogously to these developments model-based design methods are promising for giving a path toward efficient parameterization and calibration of future control systems.

LINK-SIC Projects

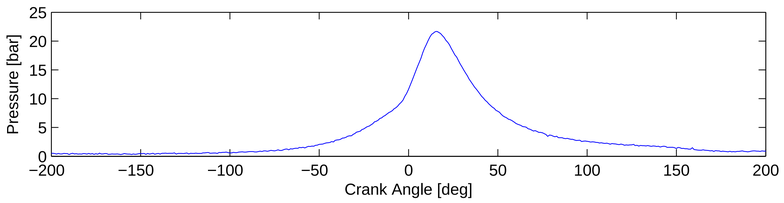
Scania CV and Saab Powertrain are industrial partners and collaboration is planned around the following areas.

- Engine Informatics and Control
  - Establishing a Common Collaboration Platform
  - Modeling and Control of Advanced Turbocharged Engines
  - In-Cylinder Sensor Informatics

- Integrated Powertrain Control
  - Efficient Engines
  - Exhaust After Treatment
  - Control of a Driveline with a Slipping Clutch
  - Gear Selection Control in AMTs (Automated Manual Transmissions)

Engine Informatics and Control

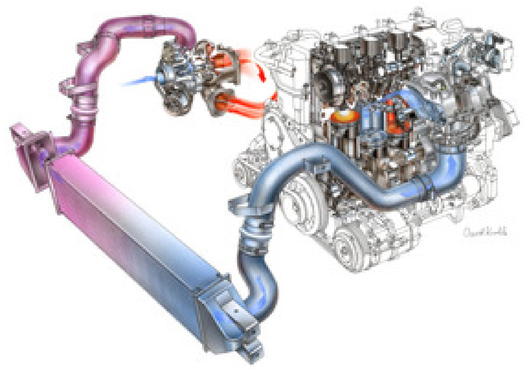
In today's engines many of the important outputs from an engine are not available as sensor outputs, for example emissions and delivered torque. One possible path to attain this information is via cylinder pressure sensors from which many of these quantities can be calculated. It is not only the cylinder pressure sensor that is the sole information carrier but there are many more options that are interesting to investigate. For example, all sensors related to in-cylinder quantities (like torque sensor, cylinder pressure, engine speed variations, ion current measurement) contribute with information concerning torque production and emission generation. When the sensors are available it is not far fetched to start using these sensors for other purposes too. Along these lines it is therefore interesting to investigate the information contents of sensors and how this can be complemented with models for the purpose of improving the control performance.



Advanced Turbocharged Engines

This is a wide and strategically important area. The area encapsulates turbo control for both gasoline and diesel engines and a multitude of supercharger and subsystem arrangements are envisioned, examples are dual stage turbo charging both serial and parallel arrangements, turbo and compressor, compressor with a clutch, long-route EGR, VNT for gasoline engines, direct injected gasoline engines with scavenging, coordinated control of turbo by-pass and throttle.

An upcoming area that is very promising is dual turbo charging where it is interesting to study the control of both serial and parallel configurations. There are many open issues in this field for example when the design is made to tune the system towards optimal performance.



Integrated Powertrain Control

The goal of this part of the project is to study modeling of and control principles for integrated control of efficient engines, exhaust after treatment, and driveline control of clutch and AMT (automated manual transmission). The specific selection of problems will be done together with Scania. The main guideline is that models should aim at control and that control principles studied should aim at the next step to be used in actual control systems.