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GM Powertrain, SCANIA CV

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.
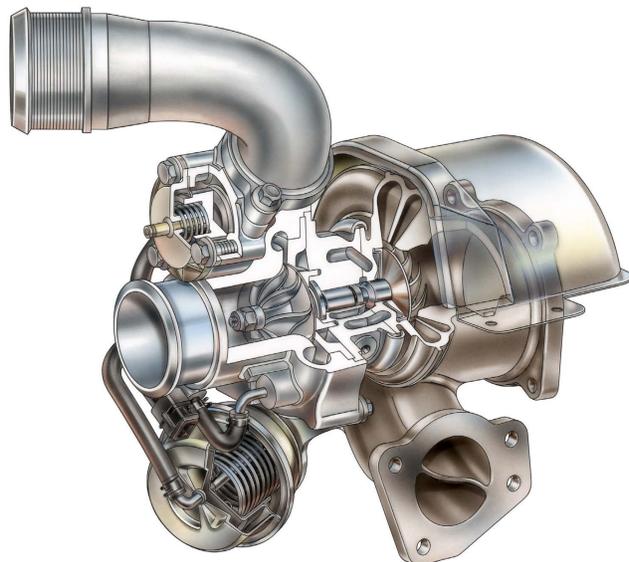
Furthermore, the emission legislations are successively made stricter which reduces the margins and increases the demands on the control systems. Today the entire powertrain management is central when it comes to achieving the desired performance in terms of emissions, efficiency, and drivability. The 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 GM Powertrain are the main industrial partners and collaboration is planned around the following general 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)

The first area is done in collaboration with GM Powertrain and focuses on engines and advanced turbocharging systems. A common platform for the collaboration is being built and dual stage turbocharging systems are studied. Scania is involved in the second area, that is centered around the driveline, and the project on slipping clutch is being started. Other subprojects will be started successively in a dialog with the partners in the LINK-SIC center.

Establishing a Collaboration Platform

As a first step a hardware and software platform is developed. The goal is to have a common platform for rapid algorithm prototyping, enabling fast technology and algorithm transfer. With this platform it is possible to directly transfer algorithms that have been tested and validated in the project directly to the industry, and also the converse. The platform is built around RapidPro in Matlab/Simulink with MicroAutoBox hardware from dSPACE. That hardware is already used by GM Powertrain in their advanced engineering projects and their knowledge is valuable in the startup. The hardware is powerful enough for regular engine control tasks and also capable of simultaneous signal processing for advanced prototype testing and demonstrator development. In-kind support is provided by GM Powertrain and a direct contribution by code and delivery covering the basic engine control functionality.

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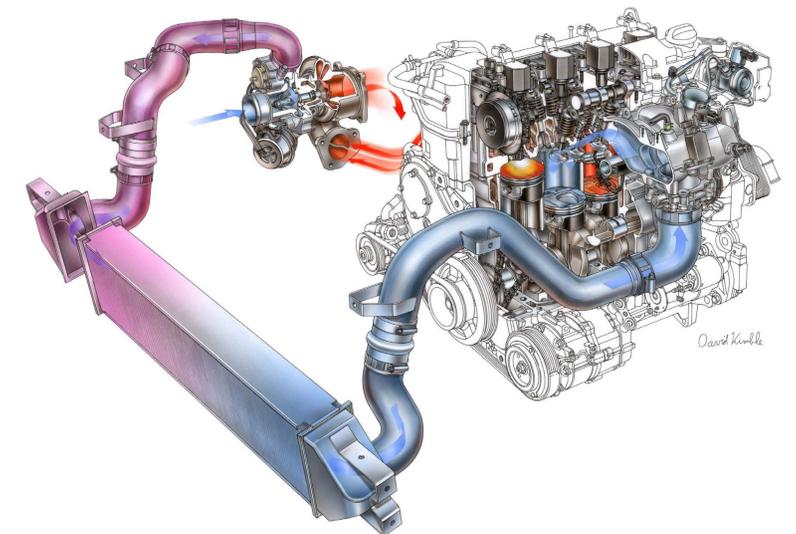
An upcoming area that is very promising is dual turbo charging where it is interesting to study the control of both serial and parallel configurations. There are many open issues in this field for example when the design is made to tune the system towards optimal performance.