LINK-SIC — Automotive Applications

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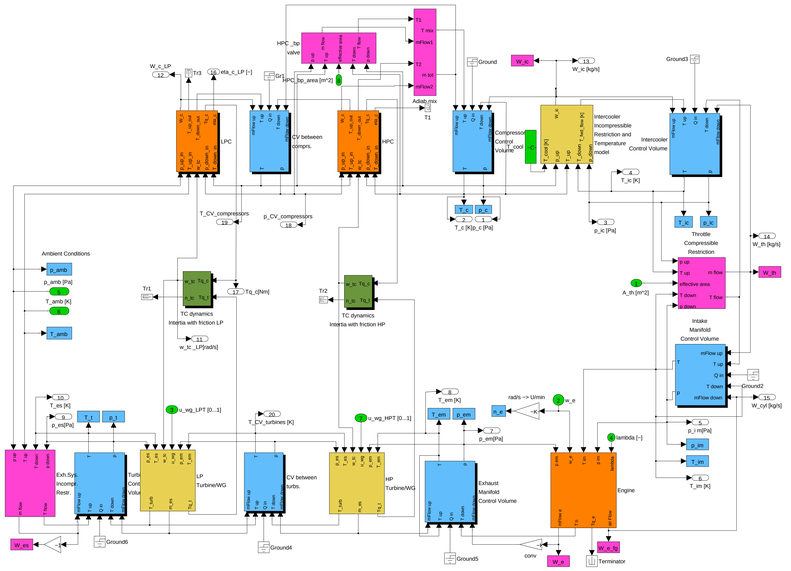
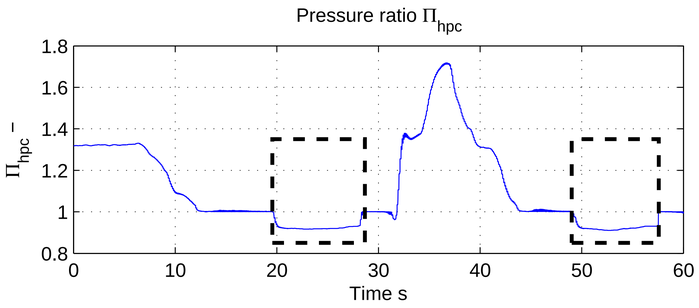
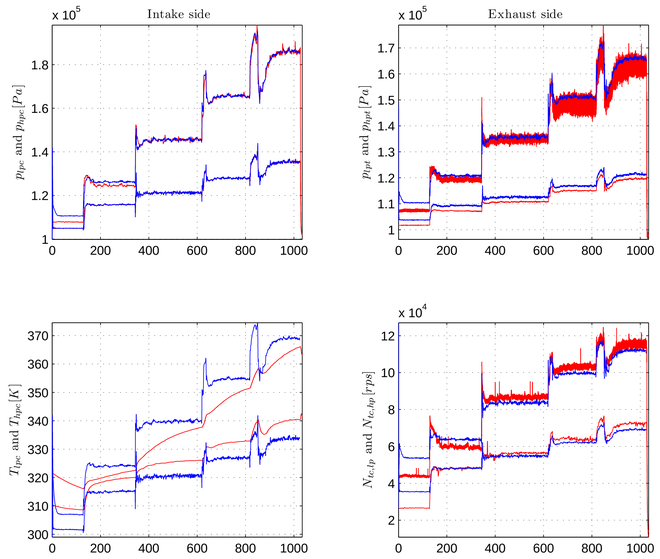
Modeling of Advanced Turbo Engines

A first step in the project has been the delivery of a prototype engine to LiTH with variable cam timing, where scavenging is possible. This engine will be fitted with a dual stage turbocharger. In parallel to the laboratory buildup a theoretical study is planned to be performed, seeking fundamental knowledge about the instabilities that can occur in dual stage parallel turbocharged engines. The motive comes from the fact that dual parallel systems have potential to give good response over the full engine operating region, but problems with instability phenomena that can occur between the compressors.



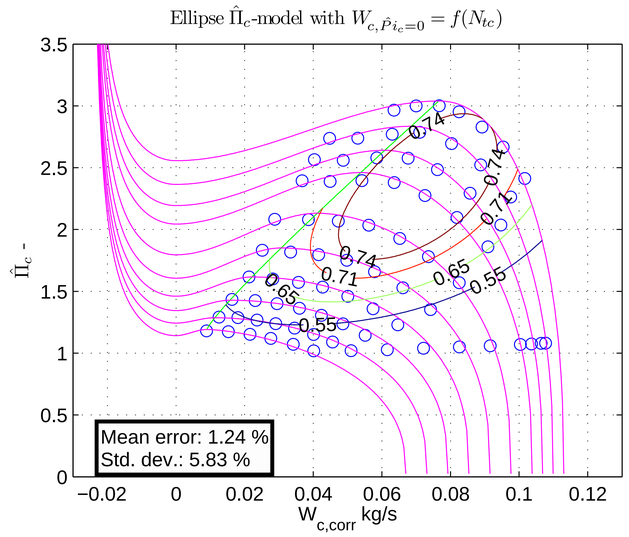
This analysis will use the knowledge and models that have been developed by the LiTH group as foundation and then refine these such that they are suitable for the investigation of both instability issues and control principles for dual stage turbocharging configurations.





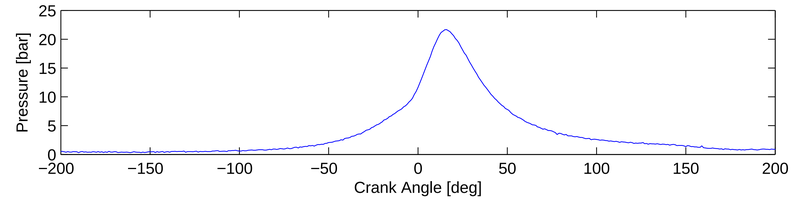
Compressor Performance Modeling

Measurements made recently in this project has exposed an interesting fact; the high pressure compressor in a dual stage system can be forced to operate in a region that is not covered by conventional compressor models. In particular it can operate in a region where the pressure ratio is less than one. This has driven the development of new compressor models that are able to describe the compressor operation in this region.



In-Cylinder Informatics

In today's engines many of the important outputs from an engine are not available as sensor outputs, for example the delivered torque, the emissions. 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. Along these lines it is therefore interesting to investigate the information contents and what other sensors can be replaced when the cylinder pressure is available.



Of the other possible sensors, the engine speed variation is an available free signal since it is required by the control system. This sensor has been shown to contain a lot of information and many schemes for information extraction have been proposed, investigated, and proven to work in laboratory installations. However the systems have failed to reach production which indicates that there is a gap in knowledge. In preliminary investigations it has been shown that the step from an engine on a dynamometer to an engine installed in a car is non-trivial. In particular, it seems to be important to study systems aspects for example how the engine interacts with the driveline: clutch, transmission, and backlashes in the complete driveline. This is an area open for research and it is very valuable to build up knowledge about how the information attained from the engine speed at the crank shaft can be used in an actual engine installation in a vehicle.