



Modeling and Control of Turbocharged Engines

Announcing a two day tutorial that will be held 18-19 June 2016 at Linköping University, Sweden. This is a pre-symposium tutorial at the 8th IFAC Symposium on Advances in Automotive Control (AAC2016).

Tutorial Outline

This two day interactive tutorial will give you an introduction to modeling and control of turbocharged combustion engines. You will learn about mean value engine modeling (MVEM), parameter estimation, model validation, downsizing, turbocharging, powertrain control systems, implementation issues and more. The emphasis will be on turbocharging. You will build and validate your own turbocharger model, if you have your own turbocharger data you can use that to build your model. You will also get to build a boost pressure controller for your turbocharger in a MVEM framework using Matlab®/Simulink®. This is a chance to meet and learn from some of the very best in the field of turbocharging and you can expect a great learning experience and lots of fun.

Target Group

This course is intended for engineers, Ph.D students and master's students that have a basic background in modeling and control. Basic experience using Matlab®/Simulink® is advised.

Instructors



Lars Eriksson, Linköping University

Professor, Vehicular Systems, Department of Electrical Engineering

Professor Eriksson is currently managing the engine laboratory at vehicular systems. His research interests are modeling, simulation, and control of internal combustion engines for vehicle propulsion in general, but with a focus on downsizing and supercharging concepts for improved fuel economy. His contributions are foremost on engine control and control oriented modeling of combustion engines. He has published one book, three book chapters, and 132 international peer reviewed conference and journal papers. As the manager of the engine laboratory he has developed a well established network of contacts with research groups both in academia and in industry.



Andreas Thomasson, Linköping University

Postdoc, Vehicular Systems, Department of Electrical Engineering

His research interest lies in modeling and control of engine actuators and air flow, with emphasis on turbocharging and air control. His main project during his Ph.D studies was modeling and control of parallel turbocharged engines, with emphasis on co-surge phenomena. I have previously worked with electronic throttle control and modeling of pressure actuators. Current research focuses on how cyclic variations in intake and exhaust effect balance in parallel turbocharged engines.



Xavier Llamas Comellas, Linköping University

Ph.D. Student, Vehicular Systems, Department of Electrical Engineering

His research interests are modeling, control and simulation of vehicle powertrains, with focus in combustion engines and turbomachinery. During the first two years of his PhD studies, his research was more focused in optimal control for fuel economy. Currently he is involved in a research project of marine low speed two-stroke engines together with industry. The main goal of the project is to use modeling and control to reduce harmful emissions.

Day 1: Mean Value Engine Model for a Turbocharged Engine

Morning Session

- The engine from a system perspective
 - Components and equations
 - Mean value engine modeling
- Parameter estimation
 - Least squares, total least squares, etc.
- Turbochargers
 - Basic principles and performance
 - Turbochargers in mean value engine models
 - Model structure with corrected quantities
 - Compressor and turbine performance maps
 - Turbocharger models and parametrization
 - Transient behavior

Afternoon Session

- Model validation
- Implement and validate your own turbocharger model
 - Use your own turbo data or use data provided at the tutorial.

Day 2: Control of Turbocharged Engines

Morning Session

- Torque-based Powertrain Control
 - Propagation of torque demands and torque commands: Driver interpretation, vehicle demands, driveline management and engine integration.
- Boost pressure control
 - Fuel optimal vs. time optimal control
 - Anti-surge control
- Controller implementation
 - Integrator windup and how to handle it
 - Bumpless transfer
 - Bumpless parameter change

Afternoon Session

- Time to have fun! Implement your own boost pressure controller for the turbo model you worked on day 1 and simulate the complete mean value engine model

For more information about AAC 2016 please visit aac2016.isy.liu.se

For more information about the vehicular division at Linköping University please visit vehicular.isy.liu.se