IFAC
INTERNATIONAL FEDERATION OF AUTOMATIC CONTROL

8th IFAC Symposium on
Advances in Automotive Control - AAC 2016
June 20-23, 2016,
Kolmården Wildlife Resort, Sweden
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Modeling and Control of Diesel Aftertreatment Systems

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 tutorial will give an introduction to and fundamentals of modeling, simulation and model-based control design for diesel aftertreatment systems. The aim is to give those who are interested in or work with aftertreatment systems and their simulation and control a common reference frame. The tutorial will mix lectures with practical hands-on computer simulation exercises, and it is arranged with lectures in the morning and simulation exercises in the afternoon. There are two simulation modules; the first is on basic catalyst modeling and the second on model based control design with validation on a complex catalyst system model.

Target Group

This course is intended for automotive engineers that have a basic background in engine modeling and control. Also, PhD students are encouraged to attend. Following this course, the attendants get an introduction into the basics behind state-of-the-art modeling and control simulation tools. A basic Matlab/Simulink modeling experience is strongly advised.

Instructors

Xander Seykens, Eindhoven University of Technology, TNO Automotive
Assistant Professor, Combustion Technology, Department of Mechanical Engineering, TUE
Senior Research Scientist, Powertrains, TNO Automotive

Xander Seykens received his M.Sc in Mechanical engineering in 2003 from Eindhoven University of Technology, The Netherlands. In 2010 he received his Ph.D. in mechanical engineering from the Eindhoven University on the topic of physics-based diesel engine combustion modeling for controls. This project was also run in close cooperation with the Powertrain department of TNO Automotive. He joined TNO in 2010, where he is currently a technical specialist in engine and aftertreatment system modeling for controls. He has been involved in various industrial research projects on clean diesel technologies, especially EGR, DPF and urea SCR-deNOx.

Since January 2016, he is a part-time member of the scientific staff of the Combustion Technology group, Department of Mechanical Engineering, Eindhoven University of Technology. He presently holds a position as part-time assistant professor in this group.

Frank Willems, Eindhoven University of Technology, TNO Automotive
Professor, Control Systems Technology, Department of Mechanical Engineering, TUE
Senior Research Scientist, Powertrains, TNO Automotive

Frank Willems received the M.Sc. and Ph.D. degrees in mechanical engineering from Eindhoven University of Technology, The Netherlands, in 1995 and 2000, respectively. In 2000, he joined the Powertrains Department of TNO Automotive, The Netherlands, where he currently is a technical specialist in diesel emission control. He has been involved in various industrial research projects on clean diesel technologies, especially EGR and urea SCR-deNOx.

Since 2007, he is a part-time member of the scientific staff of the Control System Technology group, Department of Mechanical Engineering, Eindhoven University of Technology. He presently holds a position as part-time professor in this group. His main research interests are modeling of diesel engines and aftertreatment systems, cylinder pressure-based combustion control, and integrated powertrain control.

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Day 1: Heavy-duty Diesel Urea-deNOx System Modeling

Morning Session

- Introduction to diesel aftertreatment
  - Main drivers and trends
  - Overview of diesel aftertreatment technology
  - Diesel: LNT, (c)DPF, SCR
  - Functionality and principle of operation
- Catalytic converter modeling
  - Modeling approach: Map based vs. Physics based
  - Describing balances: Mass, energy, momentum
  - Chemical kinetics modeling: The Arrhenius eq.
  - Example case: SCR catalyst system
- Modeling of diesel urea-deNOx system
  - NH3 availability: The urea decomposition process
  - NH3 slip oxidation in AMOx
  - NO2/NOx variation in DOC

Afternoon Session

- Build your own model: SCR catalystic converter in Matlab®
  - Energy balance
  - Ammonia (NH3) storage
  - NOx conversion - Standard, fast and slow SCR reactions
- SCR simulation case study
  - Sensitivity study - Impact of engine out temperature, flow and concentrations on SCR catalyst performance
  - Example case: SCR catalyst system

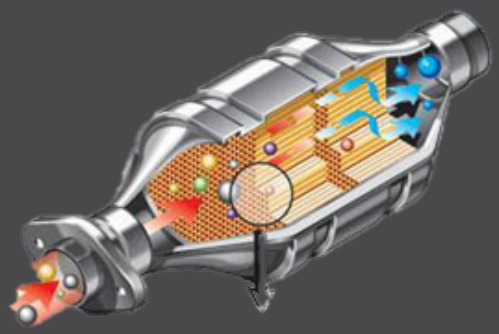
Day 2: Model-based SCR Dosing Controls

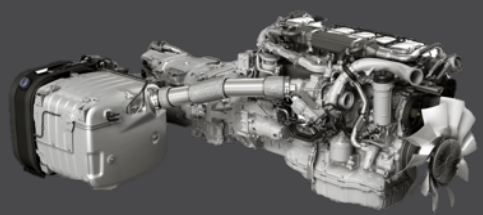
Morning Session

- Introduction SCR dosing control
  - Feedforward and feedback control
  - NH3 storage control: Map-based vs. model-based
  - The control calibration process

Afternoon Session

- Introduction to TNO's control-oriented simulation environment: SIMCAT
- Design and implement your own NH3 storage controller in SIMCAT
- Case: EURO IV SCR dosing controls calibration





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