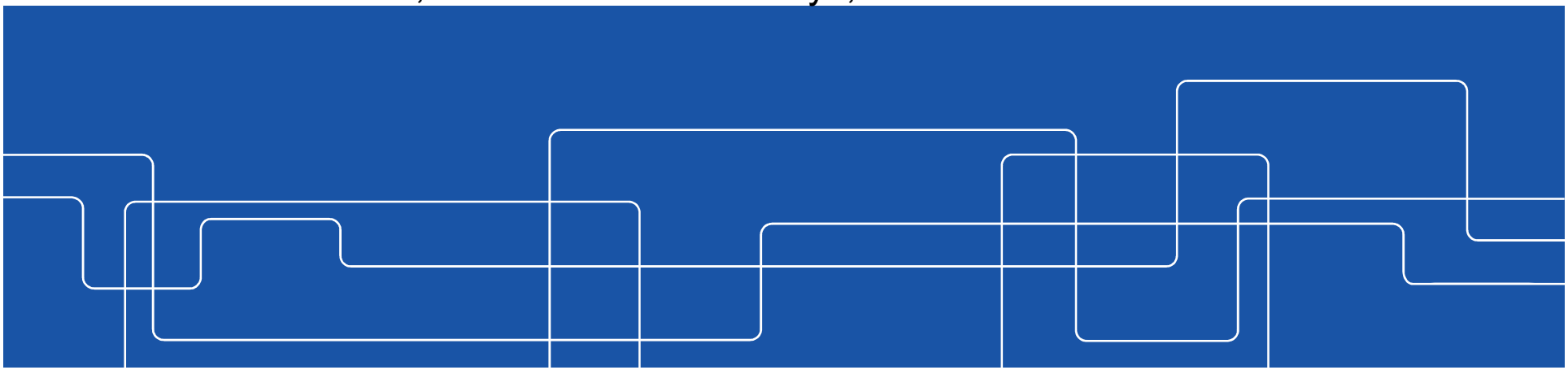
KTH ROYAL INSTITUTE
OF TECHNOLOGY

CCGEx: Ongoing Projects

Research Area: HOTSIDE

Mihai Mihaescu
Associate Professor, KTH-Mechanics

11-12 October 2018, CCGEx Research Days, Stockholm



Research Area: HOTSIDE

GOAL

Maximize heat and pressure recovery from the exhaust gas flow

STRATEGY

From physics-based understanding, build knowledge of the unsteady exhaust flow interaction with the turbine, waste-heat-recovery systems and exhaust

TOOLS

- Integrated high-fidelity simulations with predictive models
- Detailed experiments
- Dynamic system models

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- Flow characterization & heat transfer effects
- System optimization incl. ICE, Turbo, WHR

Research Area	2015				2016				2017				2018				2019				2020				2021				2022			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
i-HOT: Mihai Mihaescu																																
Ted Holmberg, PhD student, ICE, 1D/EXP										Lic							PhD															
Marcus Winroth, PhD student, Mek-CICERO, EXP										Lic								PhD														
Shyang Maw Lim, PhD student, Mek, CFD									Lic							PhD																
Nicholas Anton, **Ind. PhD stud SCANIA**, ICE, 2D AeroDesign													Lic						PhD													
Roberto Mosca, PhD student, Mek, CFD/optimization. Turbine performance optimization with focus on maximizing exergy transfer															NEW															PhD		
Yushi Murai, PhD student, Mek, EXP. Turbocharger turbine efficiency in steady and pulsating flow: an experimental investigation															NEW															PhD		

HOTSIDE: Overall aims

- Improve understanding of the pulsating flows in complex manifolds
  - high-fidelity simulations / experiments
  - intermittent flows effects on heat transfer
- Quantify the characteristics of the pulsating flow and effect on turbocharger's efficiency
  - different exhaust valve strategies (1D/3D/Exp)
  - different turbine designs (1D + 3D aerodesign)
- Improve understanding of heat transfer and heat transfer related losses for unsteady, pulsating, hot flows in complex manifolds
- Develop better calibrated 1D models and reduced order models

Doctoral students:
Marcus Winroth, (Exp), Mek-CICERO
Ted Holmberg (GT-Power, Exp), ICE
Shyang Maw Lim, (CFD), Mek
Nicholas Anton (Turbo design), Scania
Roberto Mosca, New PhD Stud., CFD
Yushi Murai, New PhD Stud., Exp

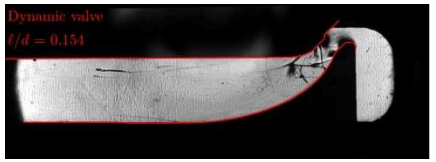
CCGEx Coordinator: Mihai Mihaescu

Reference group:
Arvin Aghaali, Volvo Cars
Mattias Ljungqvist, Volvo Cars
Martin Bauer, Volvo GTT
Fredrik Rahm, Volvo GTT
Per-Inge Larsson, Scania
Marc Gugau, Borg Warner TS
Thomas Biesinger, Borg Warner TS

HOTSIDE: Individual projects

Gas Dynamics at the Exhaust Valves and Ports
Doctoral student:
Marcus Winroth (Exp), Mek-CICERO

Supervisors:
Henrik Alfredsson, Ramis Örlü

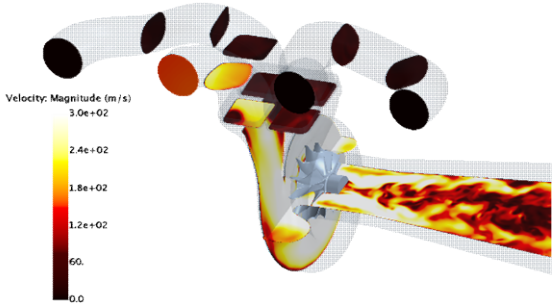


Valve Strategies and Exhaust Pulse Utilization
Doctoral student:
Ted Holmberg (1D modeling, Exp), ICE

Supervisors:
Andreas Cronhjort, Ola Stenlåås (KTH/Scania)

Flow and Heat-transfer in a Turbocharger Radial Turbine
Doctoral student:
Shyang Maw Lim (CFD), Mek

Supervisors:
Mihai Mihaescu, Anders Dahlkild, Christophe Duwig



Engine Optimized Turbine Design
Ind. Doctoral student:
Nicholas Anton (Aero-design, Exp), SCANIA

Supervisors:
Anders Christiansen Erlandsson, Magnus Genrup, Per-Inge Larsson

HOTSIDE: Individual projects

Turbine performance optimization with focus on maximising exergy transfer from hot-side to cold-side

Proposed PhD student (HT2018):
Roberto Mosca (CFD & reduced order modelling), Mek

Supervisors:
Mihai Mihaescu, Anders C. Erlandsson, Anders Dahlkild

Turbocharger turbine efficiency in steady and pulsating inlet flow

Proposed PhD student (HT2018):
Yushi Murai (Experiments CICERO Lab), Mek

Supervisors:
Jens Fransson, Mihai Mihaescu, Anders C. Erlandsson

HOTSIDE: Highlights

- Discharge coefficient has a strong dependency on both valve opening speed & pressure ratio; quasi-steady assumption used for modeling exhaust flow in the port is incorrect
- Surface flow visualizations indicate shock patterns in the exhaust port; the shock pattern is altered when using a static geometry
- Evaluation of the adiabatic & diabatic turbine performance under continuous flow conditions and some pulsating flow conditions
- Developed an exergy-based method to evaluate exhaust gas utilisation in turbine by means of 3D and 1D simulations
- Assessed performance for two axial turbine designs and Twin-scroll turbines at SCANIA (CFD and Gas stand data comparisons)

Competence Center for Gas Exchange

CC GEx

”Charging for the future”

Energimyndigheten SCANIA VOLVO VOLVO BorgWarner