CCGEx: Ongoing Projects
Research Area: HOTSIDE

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# 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

## Research Area

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<td>Ted Holmberg, PhD student, ICE, 1D/EXP</td>
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<td>Marcus Winroth, PhD student, Mek-CICERO, EXP</td>
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<td>Nicholas Anton, Ind. PhD stud SCANIA, ICE, 2D AeroDesign</td>
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<td>Roberto Mosca, PhD student, Mek, CFD/optimization, Turbine performance optimization with focus on maximizing exergy transfer</td>
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<td>Yushi Murai, PhD student, Mek, EXP, Turbocharger turbine efficiency in steady and pulsating flow: an experimental investigation</td>
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NEW PhD

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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

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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).

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Competence Center for Gas Exchange

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