Competence Center for Gas Exchange

CCGEx

”Charging for the future”

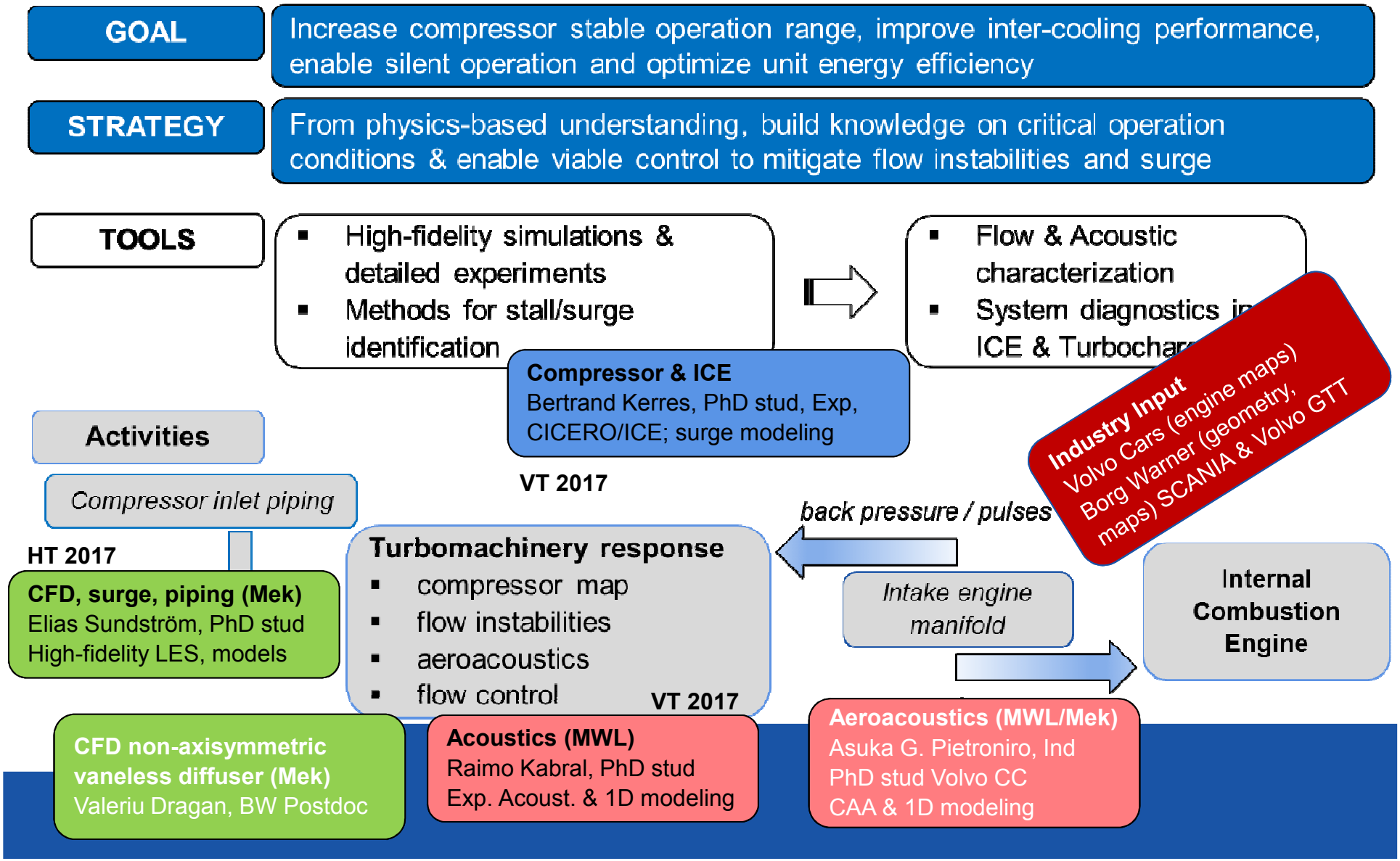
Energimyndigheten SCANIA VOLVO VOLVO BorgWarner

KTH ROYAL INSTITUTE
OF TECHNOLOGY

Research Area:
Compressor off-Design Operation

Coordinator: Mihai Mihaescu

Overview: Compressor off-Design (CoD)



CoD: Overall aims

- Improve understanding of the compressor flow at off-design conditions
  - high-fidelity simulations and experiments
  - quantify the flow instabilities with advanced mode decomposition techniques
- Quantify the geometry installation effects on the on-set of flow instabilities and surge
  - effect on compressor performance
- Aeroacoustics characterization of compressor surge
- Develop and /or adopt methods for stall/surge identification
- Surge inception scenario definition

PhD Students / Postdoc:
Elias Sundström, (CFD), Mek
Bertrand Kerres (Exp), ICE
Raimo Kabral, (Acoustics), MWL
Asuka Pietroniro, (Aeroacoustics), MWL/Mek
Valeriu Dragan (CFD), Mek

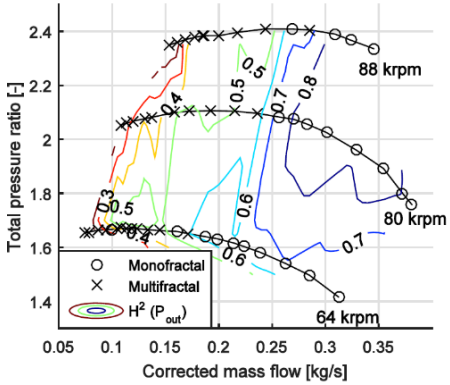
Reference group:
Habib Aghaali, Volvo Cars
Magnus Knutsson, Volvo Cars
Magnus Ising, Volvo GTT
Per-Inge Larsson, Scania
Tom Heuer, Borg Warner

CoD: Individual projects

Experimental and modelling efforts towards assessing compressor surge and performance

Doctoral student:
Bertrand Kerres (Exp, 1D), ICE

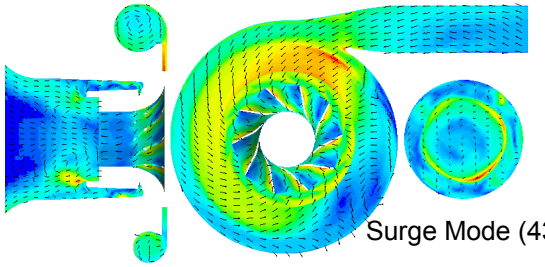
Supervisors:
Andreas Cronhjort, Mihai Mihaescu



LES of Centrifugal Compressor Flows at Low Mass Flow Rate

Doctoral student:
Elias Sundström (CFD), Mek

Supervisors:
Mihai Mihaescu, Laszlo Fuchs

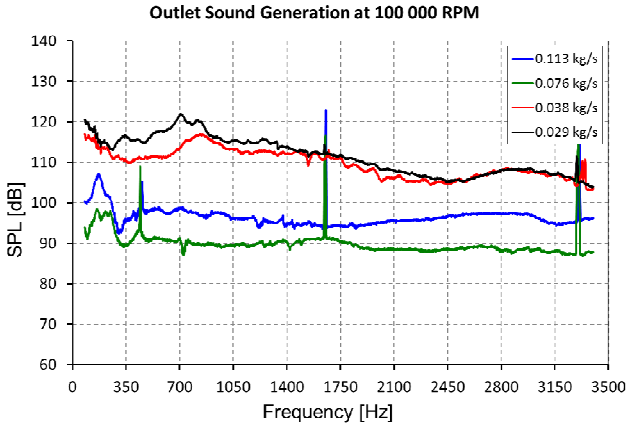


Surge Mode (43Hz)

Experimental Aeroacoustics of Rotating Machines and Innovative Noise Control

Doctoral student:
Raimo Kabral (Exp/Sim), MWL

Supervisors:
Mats Åbom, Hans Boden



CoD: Highlights

- Demonstrated capability for extracting acoustics from the LES data
- Upstream installation effects on surge line quantified
- Determination of aeroacoustic coupling and system's characteristics (compressor-piping arrangement) @ design and off-design
- An efficient and compact noise control solution, based on the optimal flow channel wall impedance was developed and proposed
- Validity range established for RANS & theoretical models for predicting compressor maps; comparisons with gas-stand experimental data (Mek-MWL-ICE)
- A surge criterion based on the fractal properties of time-resolved pressure signals was developed

CoD: Near-future Plans

- Asuka G. Pietroniro, Ind. PhD stud. Volvo Cars - CAA (to start 05/12)
- Valeriu Dragan, Postdoc BorgWarner - CFD of compressor flows with non-axisymmetric diffusers (to start 14/11)
- PhD defenses: Raimo Kabral (Mar 2017); Bertrand Kerres (Jun 2017)
- Experimental & computational efforts on the BorgWarner geometries (flow & acoustics)
- Noise generation mechanisms; quantification of the acoustic noise sources at off-design; develop noise supression technologies
- Evaluation / calibration /development of improved compressor surge models & assess the mechanisms for losses in centrifugal compressors
- New programm period & funding opportunities, e.g. Marie Sklodowska-Curie actions, Innovative Training Networks (ITN/ETN); H2020-MSCA-ITN-2017; focuss on **FUTURE** power train systems

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