Objectives / Expected Results

WP Leader: Dr. M. Moser, T. Moeller

Cut operating, maintenance and deployment costs

- Develop systems, methods an processes for improved engine lifetime performance

Reduction of emission & increased efficiency at part load

- Cylinder cut-out
- NOx: expanding operation range emission reduction technologies
- Particle: novel lubrication injection system

Enhance dynamic performance

- Model-based control

Partners:

University of Bremen

Vienna University of Technology

Karlsruher Institute of Technology

Linköping University

Aventics GmbH

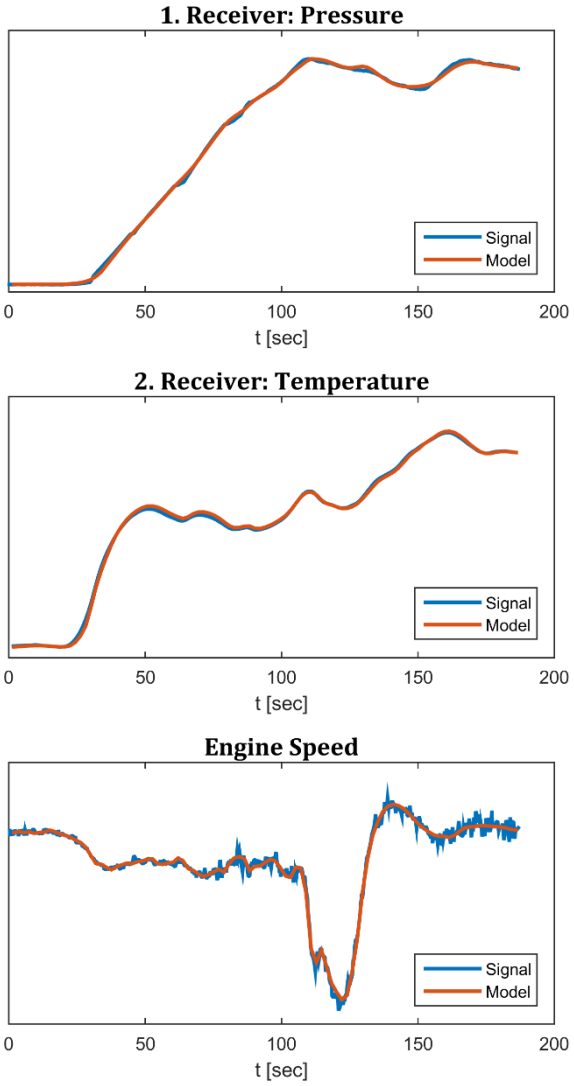
Technical University of Denmark

National Technical University of Athens

Engine control and optimization

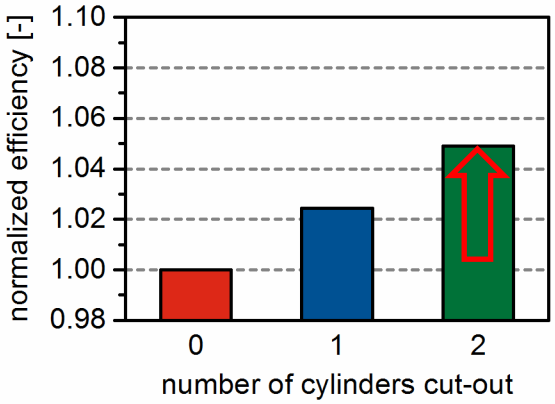
- Development of physical-based models for Model-based engine control
- Numerical problems with TC model solved
- Reduction of free coefficients (~100 -> 10)
- Polynomial approach for combustion model (2nd and 4th Order) including identification done
- Feasibility study concerning optimal control done

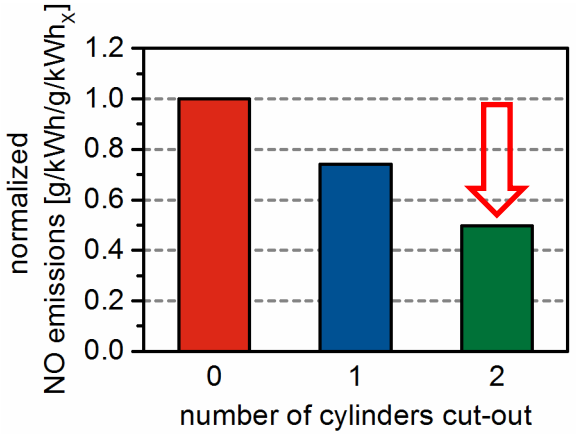
- Parameter identification will be done based on thermodynamic calculation results
- Validation of conventional vs. MPC controller will be done by Simulation



Engine control and optimization

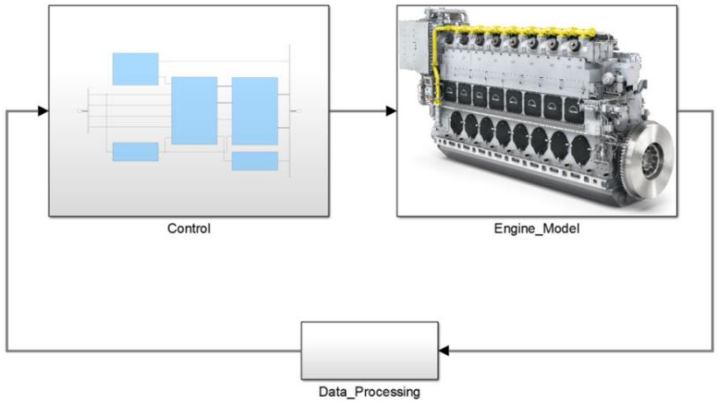
- Low load operation with cylinder cut out (static & dynamic) investigation was finalized
- Dynamic cylinder cut-out sequences are based on torsional vibration calculations
- Furthermore the operating range of different cut-out numbers based on air/fuel ratio has been defined (1,2 or 3 cut-out cylinders)
- Simulation results of cylinder cut out are very promising (at dedicated load points).
  - NOx reduction up to 49%
  - Increase of the brake efficiency about 4%



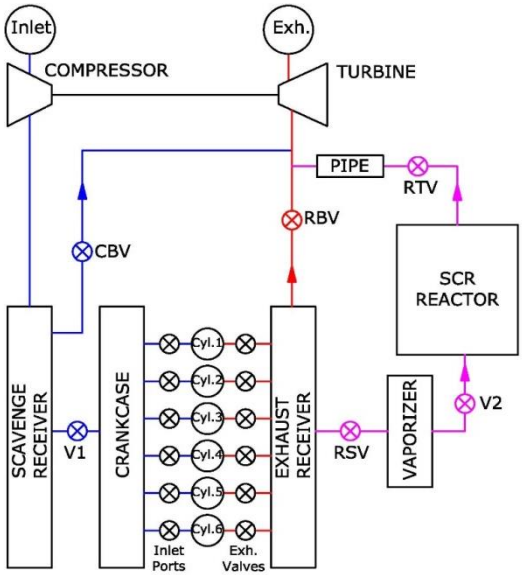


Engine control and optimization

- MiL environment for control development available
- Feasibility study concerning timing behavior and latencies of control system and fuel injection de-/activation has been performed on HiL test bench
- Control implementation for different cut out scenarios (static, dynamic, amount of cylinders, ..) are ongoing



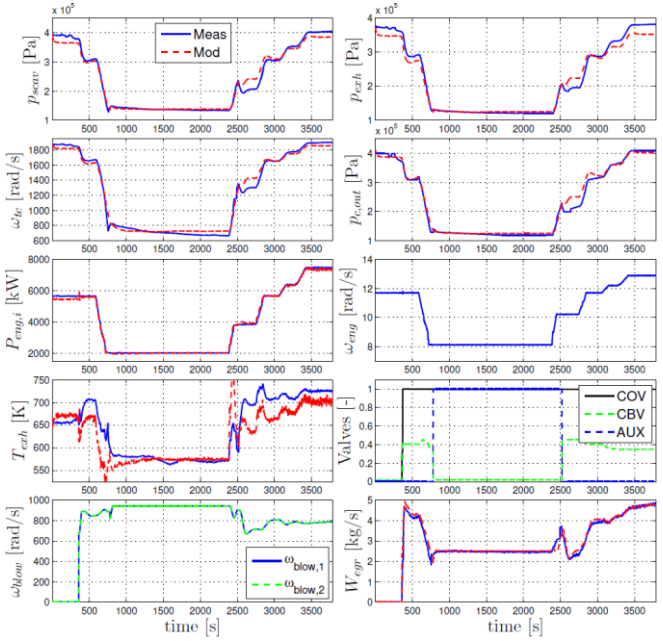
- SCR model (pipe, vaporizer, reactor) developed and validation have been finalized
- Incorporation of different controllable valves of the SCR string (RBV, RTV, CBV) in the engine model
- SCR model integrated in full engine model

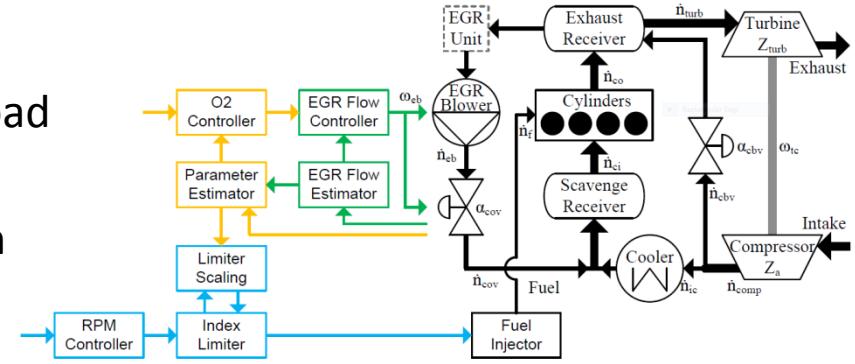


Engine control and optimization

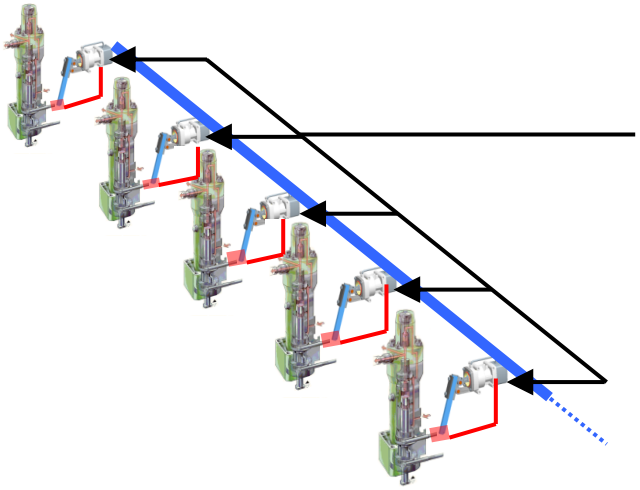
- Validation of full engine model ongoing
- Propeller load estimation in order to simulate complex vessel acceleration or deceleration scenarios (i.e. crash stop) was done
- Standard maneuvering loading cycle was defined

- EGR model was designed to simulate low load operation
- Validation and improvement of the model with real life data finished
- Low load operation → investigation of vessel load profiles (e.g. approaching the harbor)
- Developement of the control has been done on the model and will be tested on the vessel
- EGR control implementation in the production SW already started





Engine control and optimization



- Development of a retrofit solution for continuous engine performance optimization for mechanical controlled engines
- Electronically controlled actuator for fuel injection
- Prototype sample designed, produced and available
- Validation of prototype actuator on test rig and a vessel have been done
- Concept study of integration into PMI-System has been performed

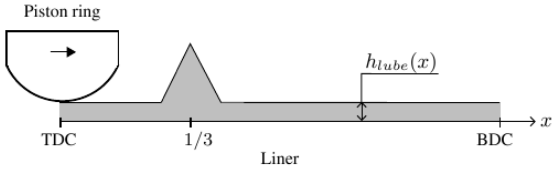
WP 6.5 *no vessel for integrated system available*

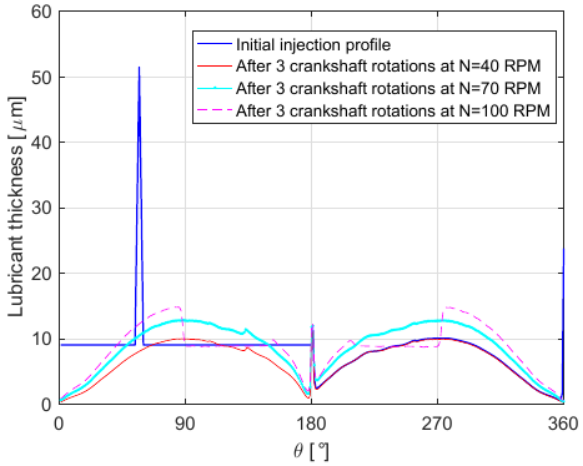
➢ Upgrading of actuator for fuel injection not sufficient due to significant drop in fuel oil price

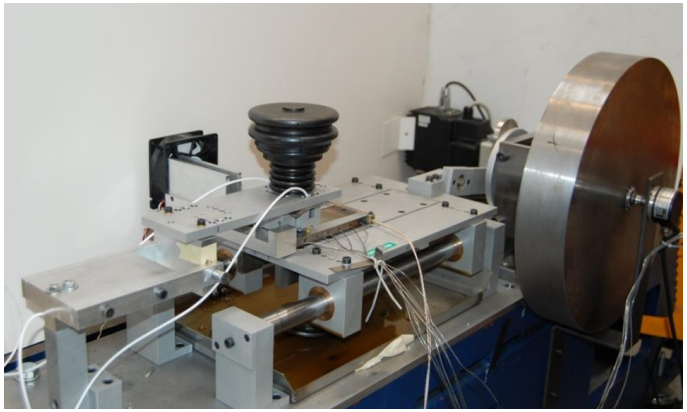
Engine control and optimization

- Simulation tool for investigation of different injection positions was built up
- Investigation of lube oil distribution and consumption at different speeds have been carried out

- Next step will be to validate the simulation results by test bed measurements
- Reciprocating test rig which was built up in HERCULES A/B projects will be used for measuring the oil film build-up in the piston ring / cylinder liner contact. The distance measurement will be carried out utilizing LIF-technique.

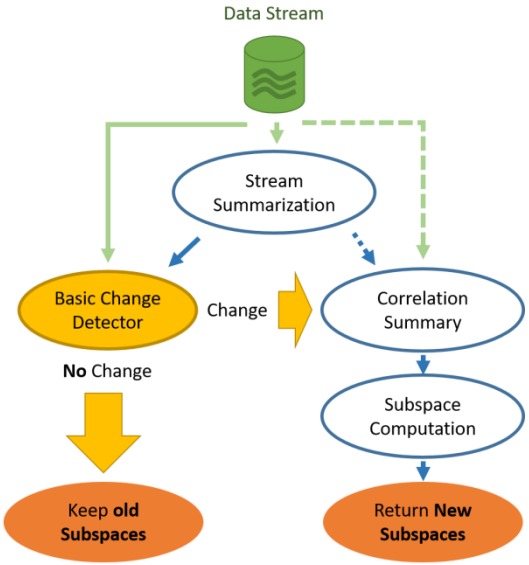


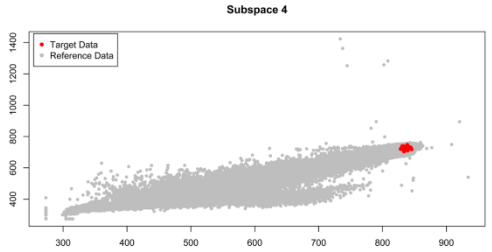


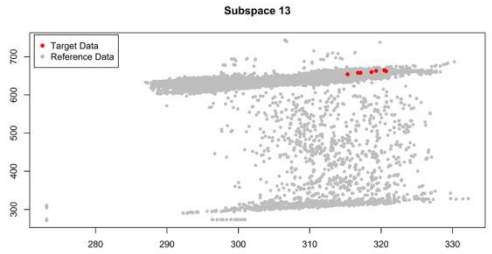


Remote monitoring & software distribution

- Development of tailored subspace-search method finished
- Quality of subspace search was analyzed
- Investigation of data compression technique with the help of the tailored subspace-search method by generate synthetic Gaussian data (=control defined subspaces).
- Definition of different engine states for improved subspace-search results
- Investigations in a change-detection method are started.







$$AMSS = \frac{\sum_{S_i \in FoundSubspaces} \max_{Sj \in Target\ Subspaces} StructuralSimilarity(S_i, S_j)}{|\ FoundSubspaces\ |}$$