

## Objectives / Expected Results

### Cut operating, maintenance and deployment costs

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

### Reduction of emission

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

### Enhance dynamic performance

- Model-based control

### Increased part load efficiency

- Cylinder cut-out

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



### 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



## WP 6.1: Predictive model-based engine control

### Objectives

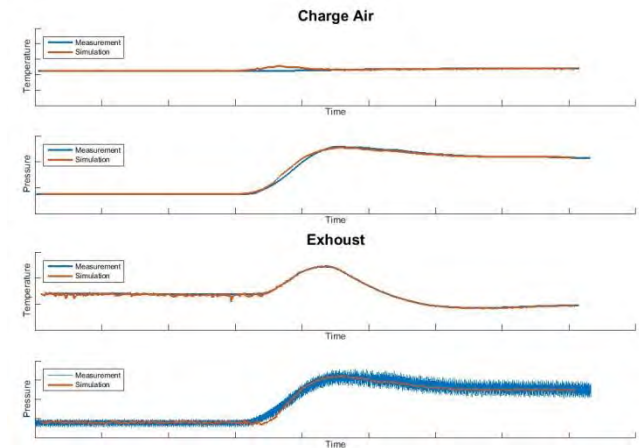
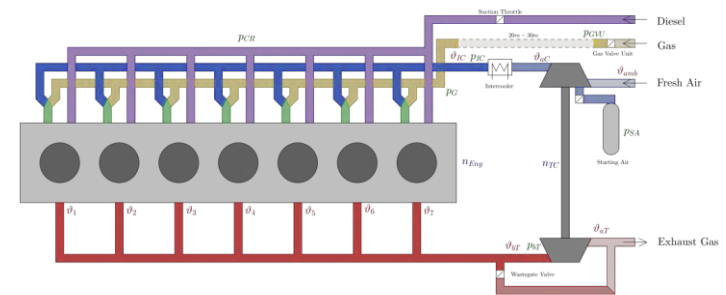
- Enhance dynamic engine performance with the help of multiple-in, multiple-out controllers

### Current Status

- Literature research on **Mean Value Models (MVM)**
- Measurement data analysis
- Development of a mathematical air path model which is based on physical laws
- First implementations of a MVM for the air path in Matlab and OpenModelica

### Next steps

- Extending the MVM with the gas path
- Extending the MVM with the Diesel path
- Optimal parameter identification with WORHP
- Verification of the model



## WP 6.2: Efficiency increase at part load

### Objectives

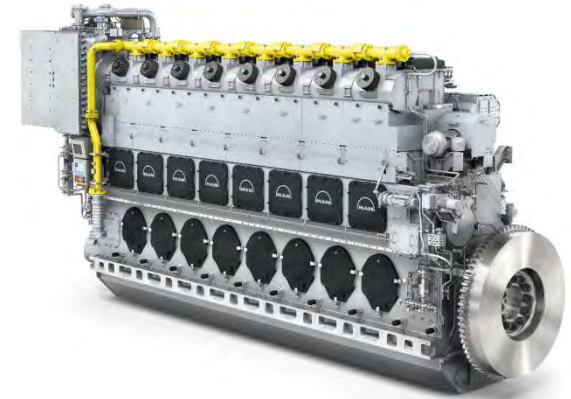
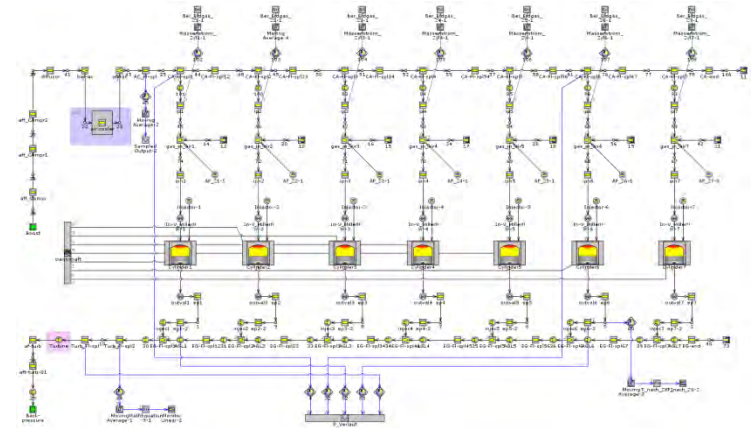
- Reduction of emissions and efficiency increase due cylinder cut-out

### Current Status

- Measurement data collection and preparation
- Thermodynamic and Fluid mechanic modelling of the engine in GT-Power based on measurements

### Next steps

- Implementation of the turbocharger
- Application and evaluation of the predictive combustion model
- Implementation and calibration of the  $\text{NO}_x$ - and knock model
- Investigate different cut-out scenarios



## WP 6.3: Development of intelligent algorithms for failure detection and plant analysis

### Objectives

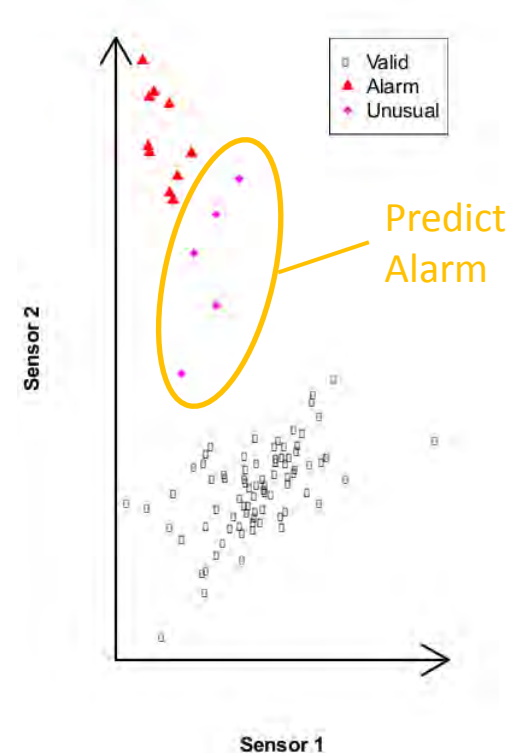
- New outlier-detection and subspace search methods for improve engine lifetime performance

### Current Status

- Data collection, cleaning and preparation
- Additional feature generation (mean values, min/max deviations)
- Evaluation of different approaches to predict the alarm based on state of the art subspace search

### Next steps

- Enhance prediction through development and evaluation of novel alternatives
- Investigation of the data quality in terms of prediction quality



## WP 6.4: Methods for evaluating engine performance via modeling and simulation

### Objectives

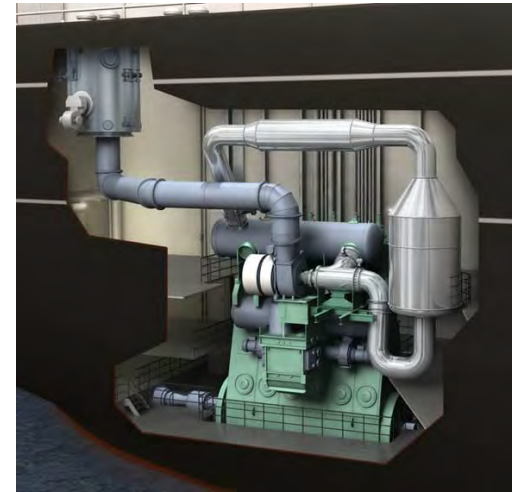
- Improve  $\text{NO}_x$  reduction in non normative engine operation by expanding the operation range of  $\text{NO}_x$  reduction technologies

### Current Status

- Data collection for modelling SCR and EGR
- Modelling of low load operation on components
- Detailed modelling of SCR

### Next steps

- Establish a test cycle for comparison of solutions
- Build full engine + SCR/EGR models and validate data
- Design controllers and strategies



## WP 6.5: Continuous combustion control & monitoring of mechanically controlled engines

### Objectives

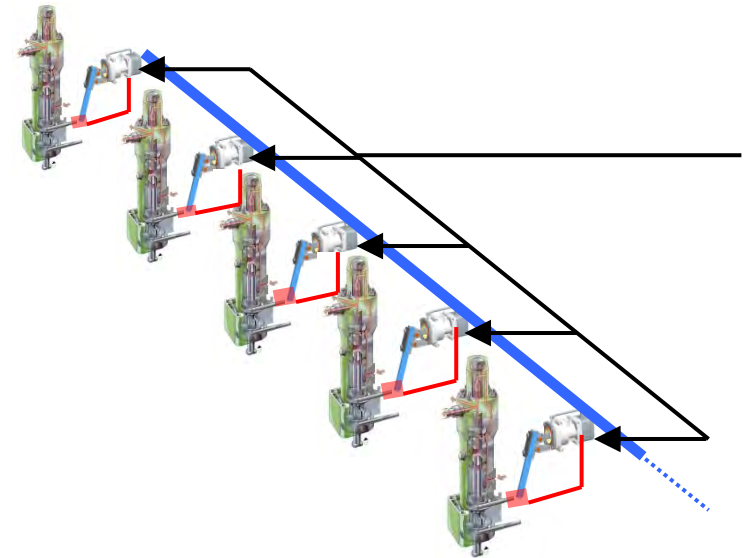
- Develop retrofit solution, incl. full scale demonstrator, for continuous engine performance optimization

### Current Status

- Development of fuel pump VIT actuator prototype
- System outline for continuous cylinder pressure integration

### Next steps

- Adapt prototype actuator and control network for communication & integration into existing online cylinder pressure measuring system
- Build-up test-rig in laboratory



## WP 6.6: Lifetime managed engine software deployment

### Objectives

- Develop fleet solution for un-attended & secure engine software management

### Current Status

- Develop a hardened engine software management platform
- Outline solution for secure centrally managed engine software configurations

### Next steps

- Develop and introduce security scheme to all levels of production, installation and maintenance in service of engine network components, based on “CIA” principles -**C**onfidentiality, **I**ntegrity & **A**vailability





## WP 6.7: Lifetime performance improvement by reduction of lubrication rate

### Objectives

- Develop novel lube oil injection strategy in order to improve engine lifetime performance and cost

### Current Status

- Initiation of a mathematical model of a lube oil injection system
- Basic investigation of the flow of lubricant injected based on test rigs generated during HERCULES-B & -C
- Development of lube oil distribution (LOD) test rig

### Next steps

- Experimental investigation of lube oil distribution
- Modelling of free/forced surface flows

