Energy Efficient Safe SHip OPERAtion

TuD Engine Dynamics

WP4 – 4.4

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Content

- The Diesel Engine Model
- Overall System Model
- Diesel Engine Individual Models
- Collaboration with Duisburg University

The Engine Model (1)

Developed by:

- Prof. D. Stapersma
- Dr. H. Grimmelius
- Ir. P. de Vos

- Mean value modeling
- First principle

The Engine Model (2)

- Engine design parameters from Matlab script
- Any number of cylinders
- Any cylinder size
- 4-stroke and 2-stroke
- Engine limitations from operating envelope

Overall System Model

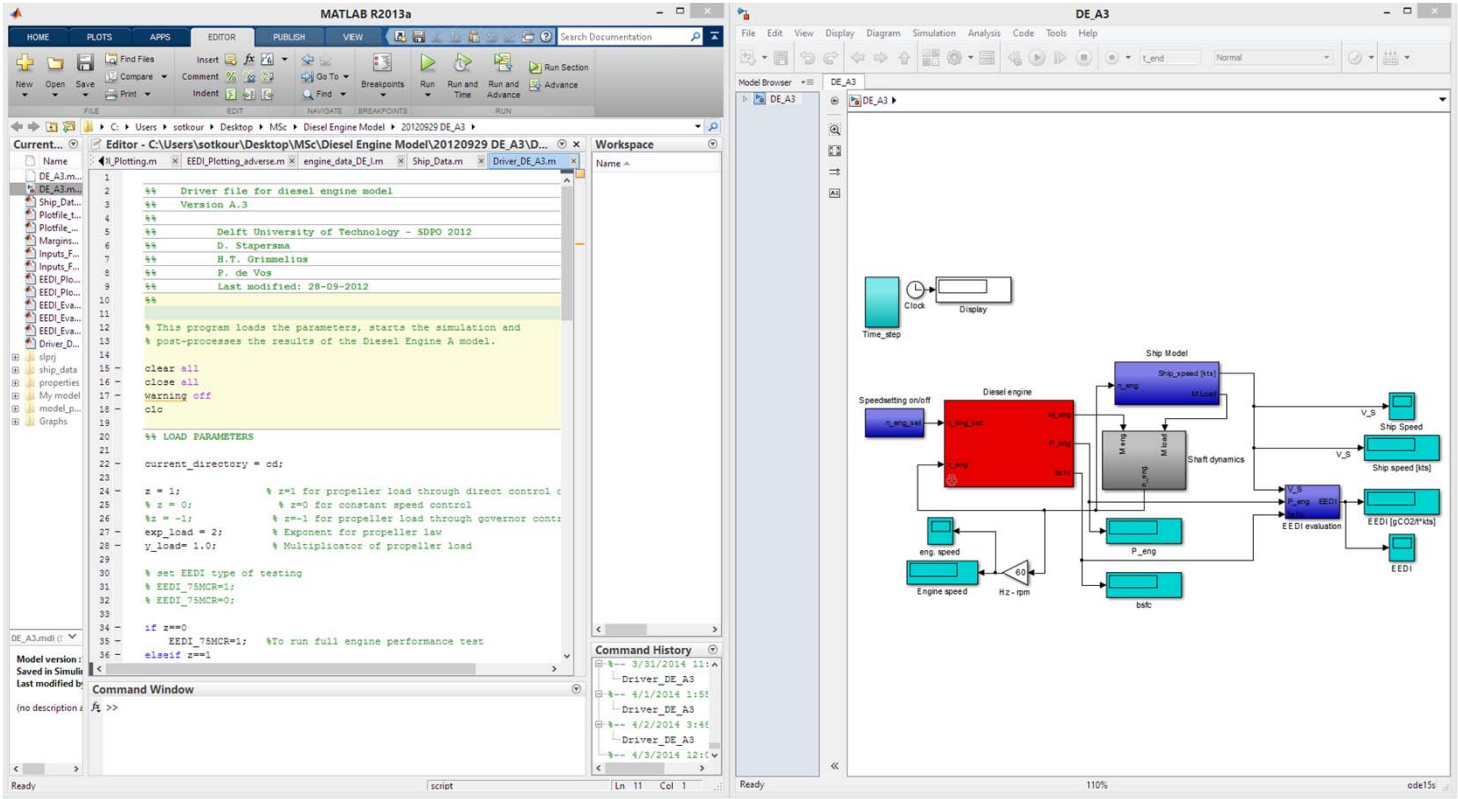
Contains:

- Shaft and transmission dynamics
- Constant propeller characteristics (No 4-quadrant CPP)
- 1D ship motion
- List of added resistances
- EEDI evaluation

- Non- linear simulation
- Variable time steps due to solver

Diesel Engine Individual Models (1)

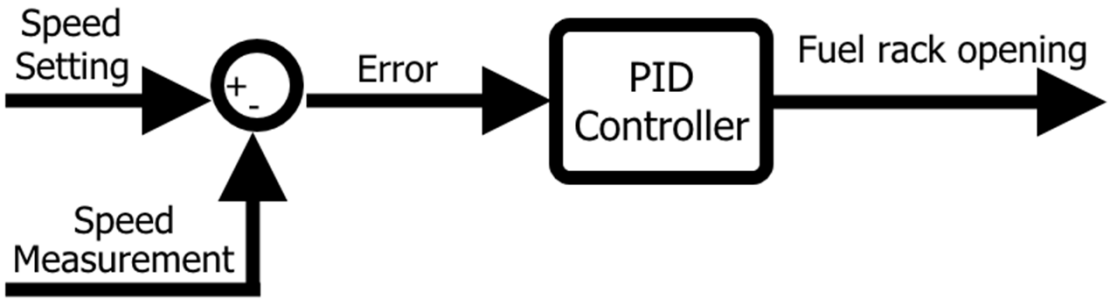
- Data loaded from Matlab code
- Simulation in Simulink environment



Diesel Engine Individual Models (2)

Governor

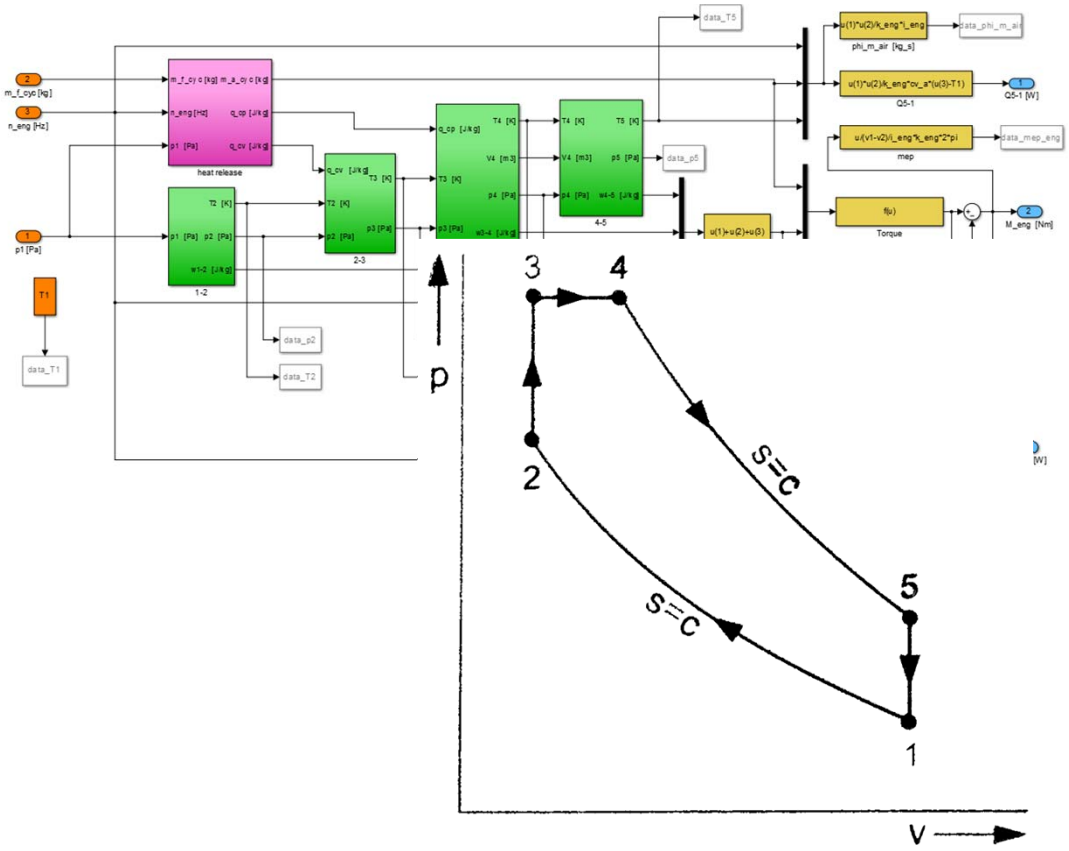
- Observes speed change and regulates fuel added
- PID Control



Diesel Engine Individual Models (3)

5-Point Cycle

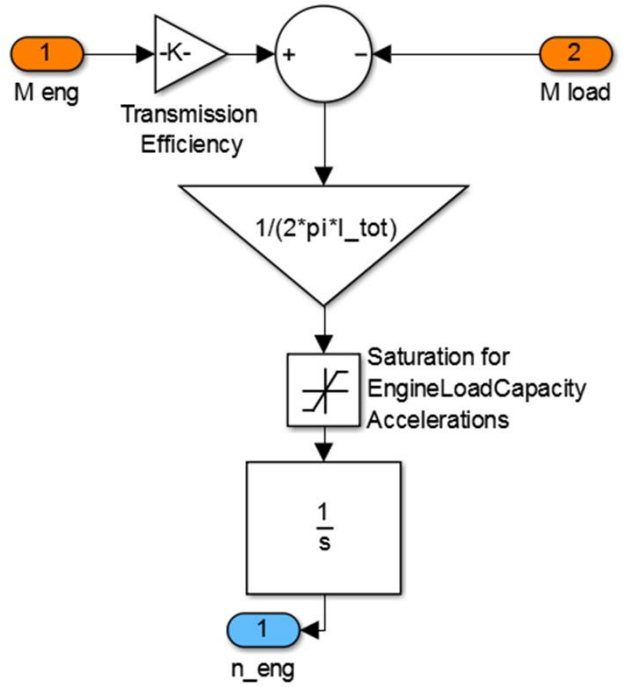
- 5-point Seiliger cycle
- First, isochoric heat addition
- Then, isobaric heat addition



Diesel Engine Individual Models (4)

The Shaft Dynamics

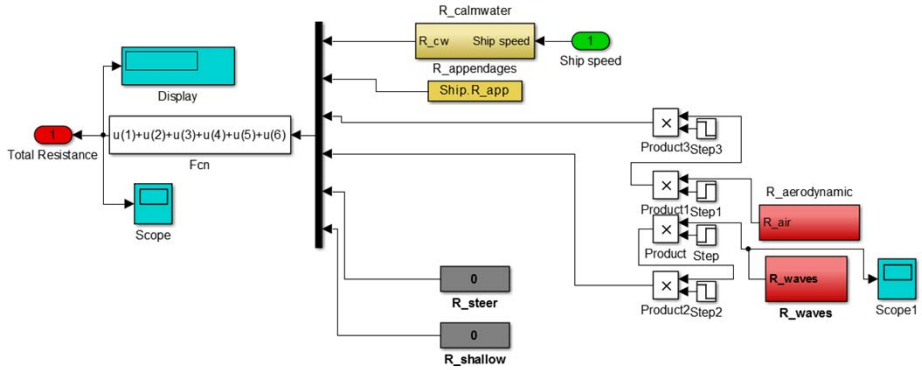
- Speed and torque-related losses
- The load torque input can also be the outputs of the CFD simulations



Diesel Engine Individual Models (5)

The Resistances

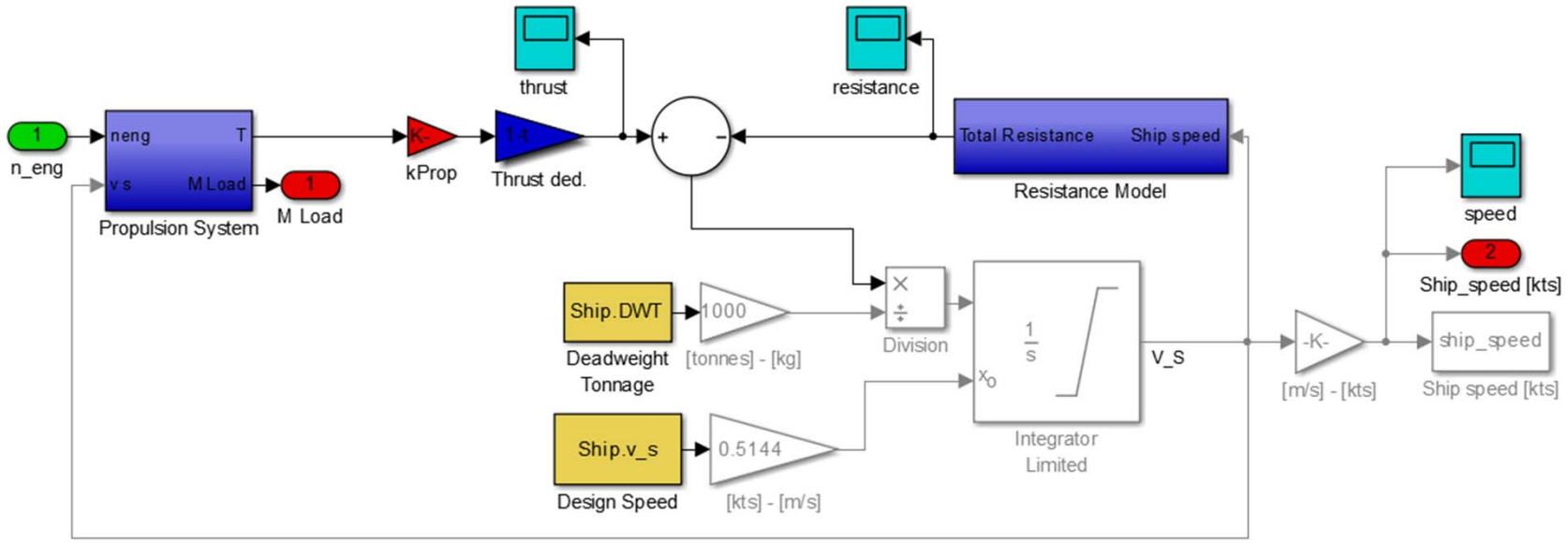
- Speed dependent calm water resistance
- Constant appendages resistance
- Sinusoidal added wave and wind resistances



Diesel Engine Individual Models (6)

The Ship Motion Dynamics

- 1D motion
- No turning, rolling or pitching



Collaboration with Duisburg University

- Create simplified engine dynamics in the form of a function
- Implement variable shaft speed in CFD models
- The output of CFD simulations to be used for condition evaluation of the engine by Delft (thermal overloading, increased wear, shutdowns)