POWERTRAIN OPTIMISATION

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Ford Otosan

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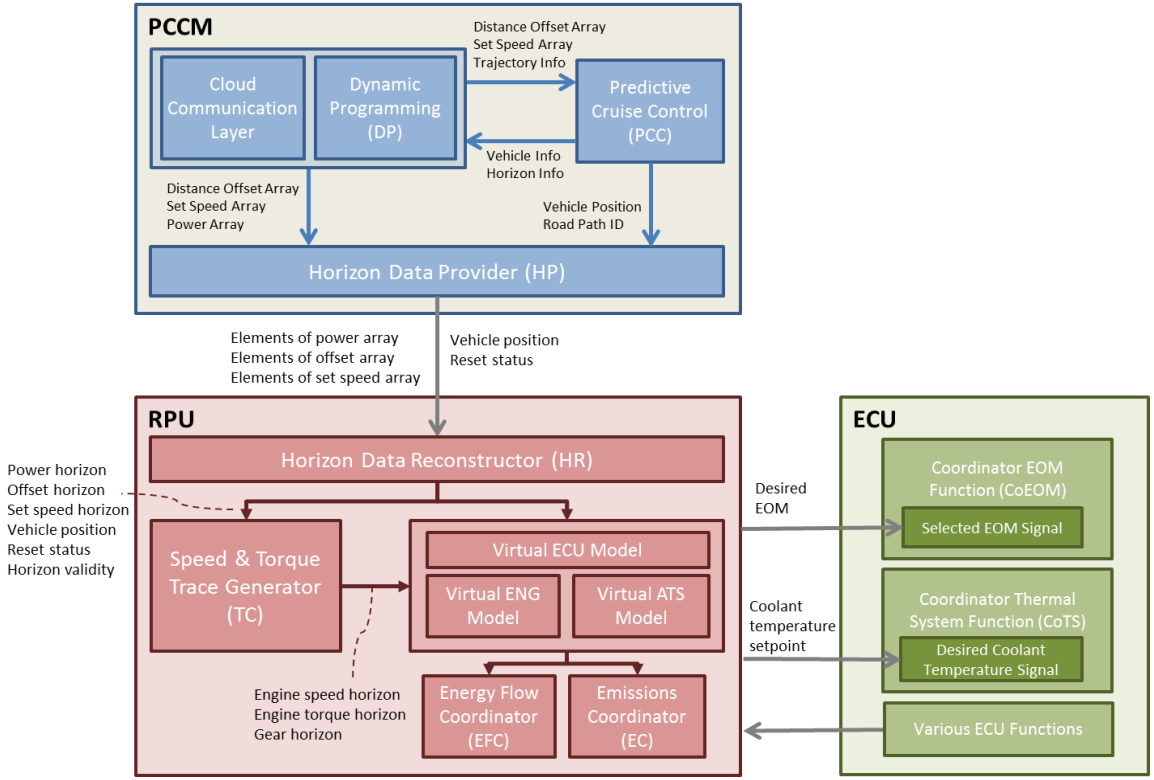
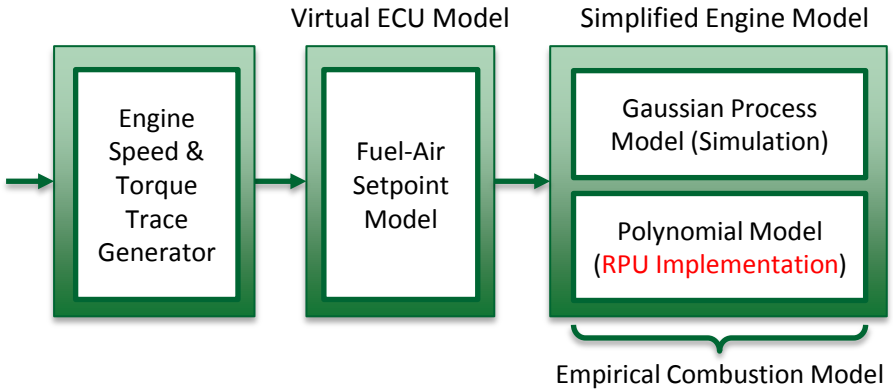
Onboard Control System Architecture

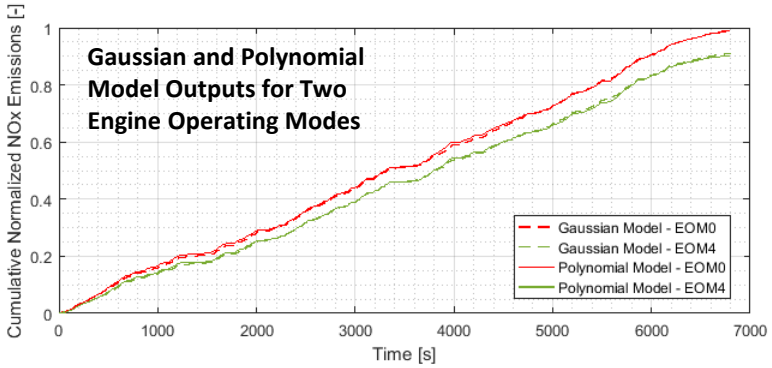
- Vehicle control system architecture (PCCM, RPU, ECU) shows the software functionality developed or modified by FO & IAV for the optiTruck project.
- Main inputs:
  - Distance offset array
  - Predicted vehicle speed array
  - Predicted wheel power array
- Main outputs:
  - Coolant temperature setpoint
  - Engine operating mode



RPU: Virtual ECU & Engine Models

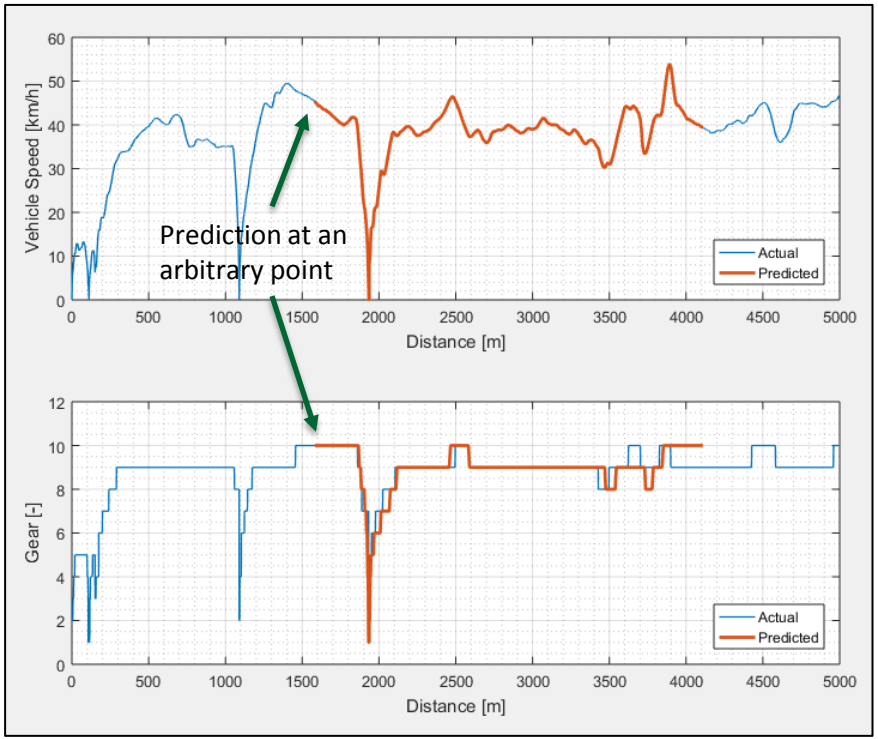
- Real-time capable virtual ECU and engine models developed to run on the RPU.
- Purpose is to compute cumulative engine-out NOx emissions and fuel consumption for the predicted route to support the optimization in energy-flow (EFC) & emissions coordinator (EC) modules.
- Gaussian process model approximated by a global polynomial model for combustion characterization.





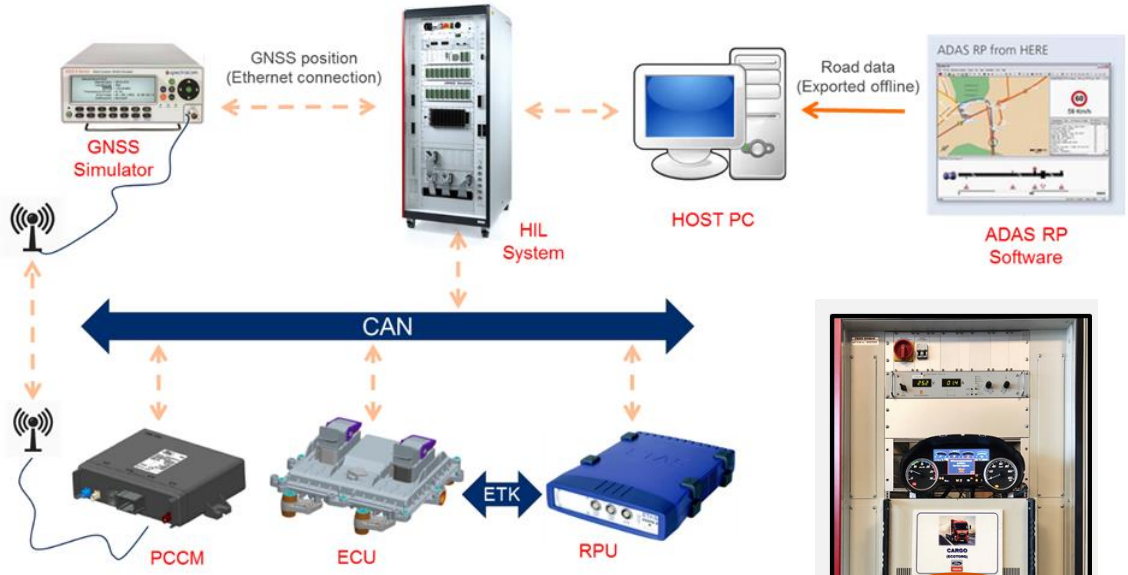
PCCM & RPU: Horizon Data Processing

- The Horizon Data Provider packs prediction arrays from the cloud into CAN messages and transmits them to the RPU.
- The Horizon Data Reconstructor unpacks the CAN messages and reconstructs the predicted vehicle speed and wheel power arrays on the RPU.
- The Speed and Torque Trace Generator transforms the prediction arrays into engine speed and torque traces using a simplified transmission model.



OptiTruck Hardware-In-The-Loop System Setup

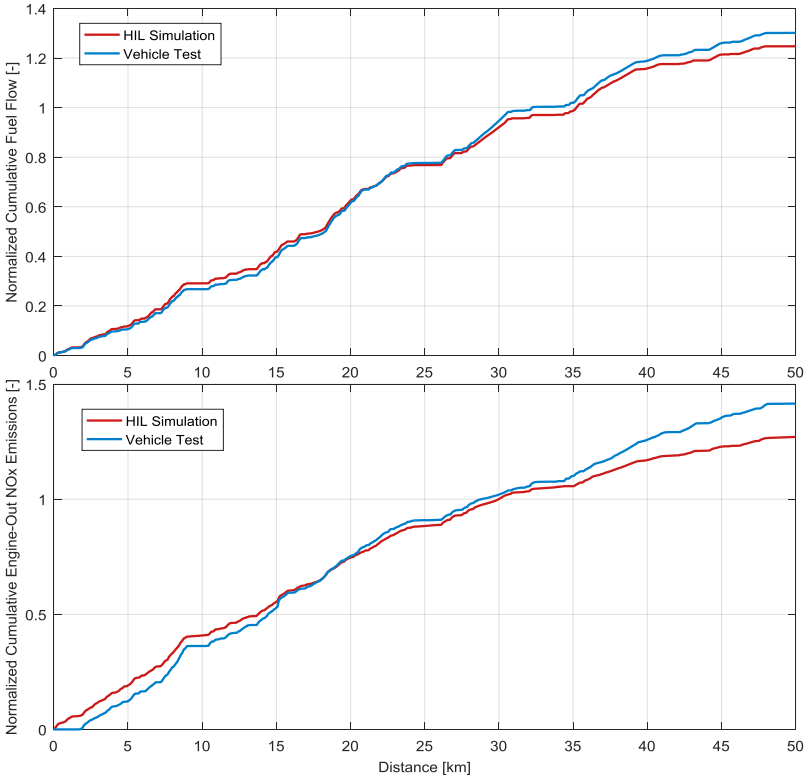
- optiTruck HIL setup includes a GNSS simulator.
- Allows closed-loop testing of any real-world driving scenario using realistic map data.
- All three control modules are represented as actual hardware.
- ETK interface between ECU & RPU for external bypass implementation.



optiTruck HIL Loadtray in Ford Otosan premises

Comparison of HIL Simulation and Vehicle Test

- Complete OptiTruck vehicle simulation model adapted for HIL environment.
- Back-to-back comparison of vehicle test and HIL simulation shown for a 50 km real-world road segment.
- HIL simulation results are satisfactory for control system testing purposes.



Example HIL Test Result: Cloud-PCCM Interface

- Cloud to PCCM software interface validated over the national route using the HIL system.
- Repeatable real-time testing in the HIL environment enabled troubleshooting of issues difficult to detect in vehicle.