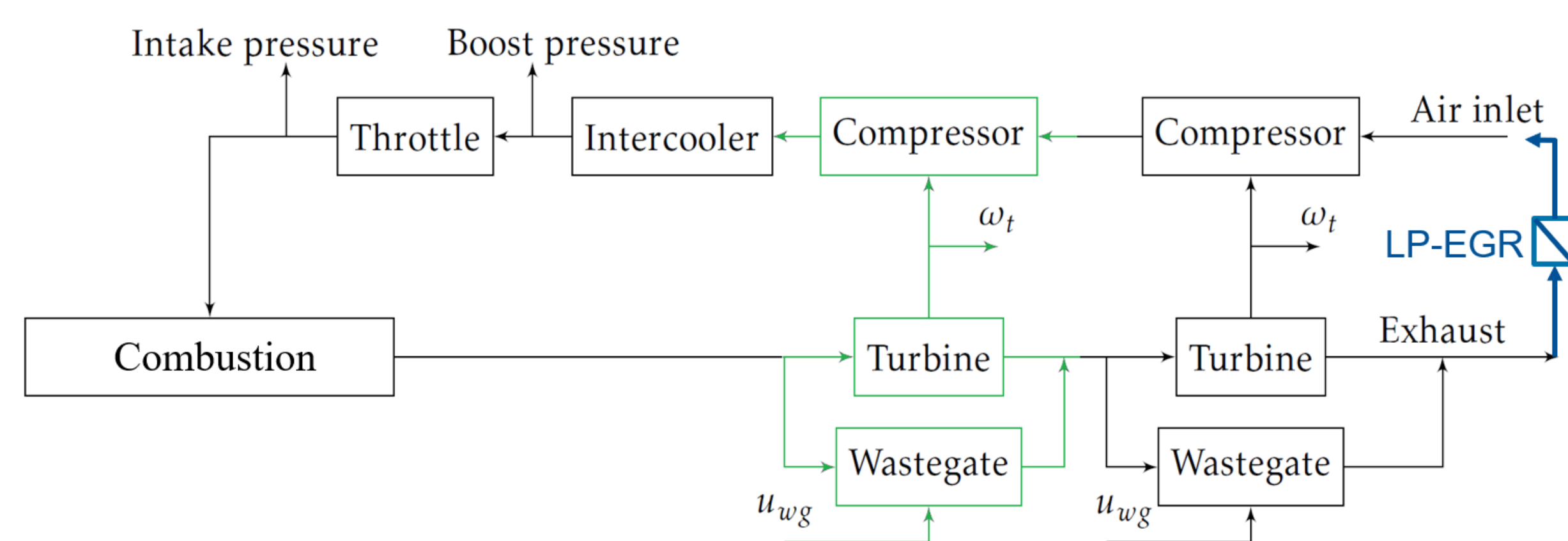


Model-Based Engine Control

Robin Holmbom

Presentation

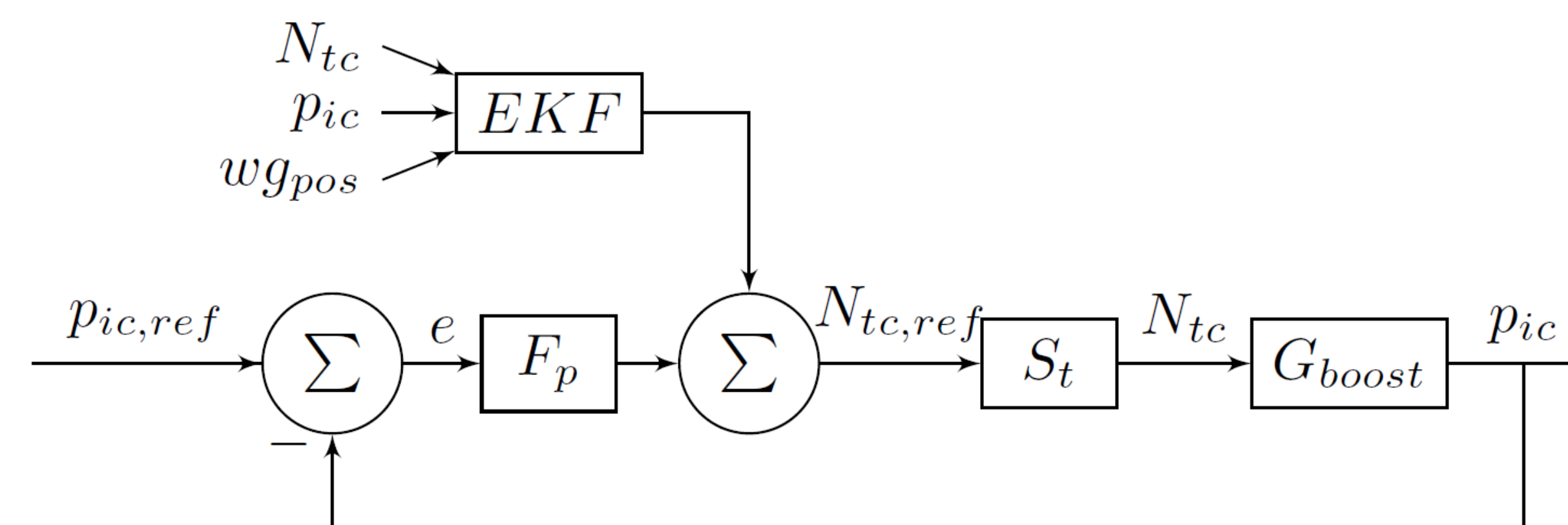
Ph.D Student supervised by Lars Eriksson at Linköping University since 2016. Joined LINK-SIC in 2019 after the Vinnova research project AVATAR ended in December 2018. The goal with the project was to look into model-based control of new engine concepts to meet the increasing legislative demands on lower exhaust-emissions. The work within AVATAR involved Ph.D Studies, Master's Thesis, Research, and Student Projects. Topologies involved were: Low-Pressure EGR, Water Injection, Two-Stage Serial Turbocharging, Servo-Actuated Wastegate, etc. Modelling was also a part of the AVATAR project where it looked into modelling of temperatures in the exhaust and during pressure transients, EGR/Throttle-flow, etc.



Contributions

- ✘ Control Synthesis for Servo Controlled Wastegate [1].
- ✘ Using Turbocharger Speed Sensor for Boost Pressure Control [2].
- ✘ Compact Models for Mass Flows through Butterfly Throttle Valves [3].

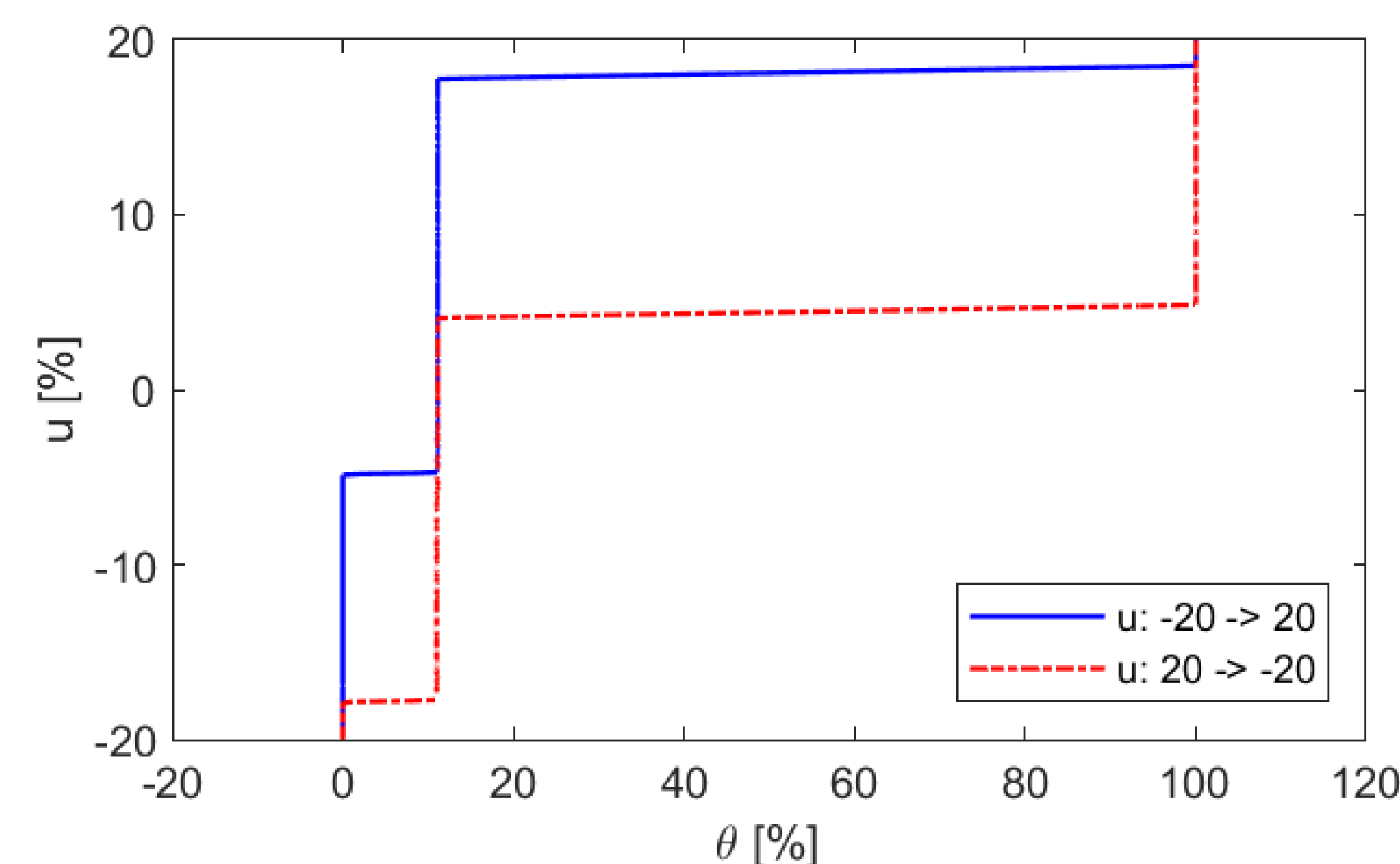
An illustration of the cascade structure for the boost control with turbo speed sensor.



Ongoing work

✘ Adaptive Friction Estimation of Throttle Servo

The Figure below is illustrating the hysteresis behaviour in the throttle due to friction. In this work the research question is if it is possible to estimate the friction model during normal driving.

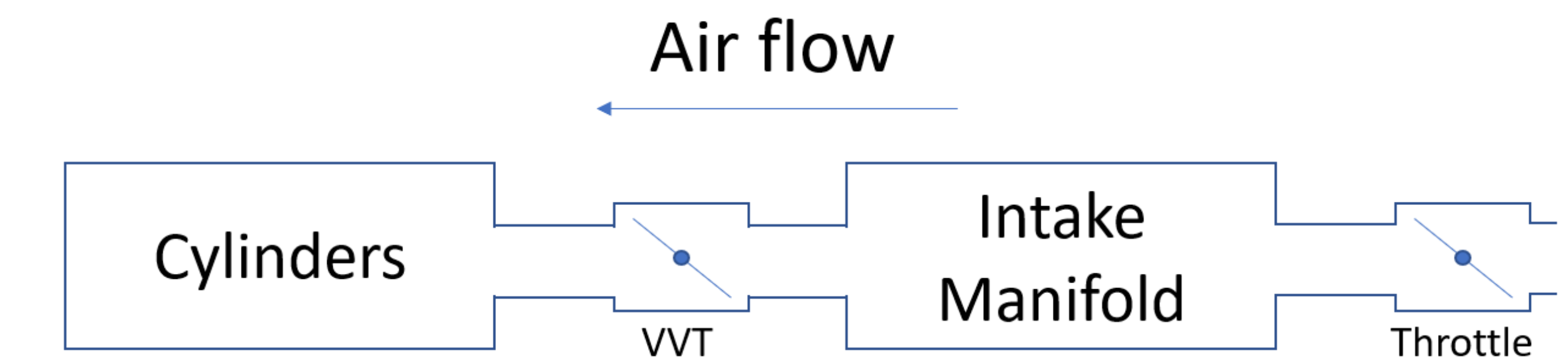


✘ Model Predictive Control of Air Intake System

This work is to implement the control of the air intake using intake valve actuation and throttle position as control signals. A student project in the course TSRT10 at Linköping University is working with this.

Future

In the Figure below an overview of the control problem is illustrated. Variable Valve Timing (VVT) and Throttle position are the actuators.



✘ Mass Flow Modelling of Variable Valve Timing

Modelling of the VVT-actuation's effect on the mass flow through the intake valves.

✘ Aim

The aim is to combine the previous models into the model predictive controller and control the air mass flow into the cylinders and demonstrate this in the engine test cell at Linköping University.

Publications

- [1] *Investigation of Performance Differences and Control Synthesis for Servo Controlled and Vacuum Actuated Wastegates.* Robin Holmbom, Bohan Liang, Lars Eriksson. SAE 2017 WCX Technical Paper 2017-01-0592.
- [2] *Implications of Using Turbocharger Speed Sensor for Boost Pressure Control.* Robin Holmbom, Bohan Liang, Lars Eriksson. IFAC World Congress 2017.
- [3] *Analysis and Development of Compact Models for Mass Flows through Butterfly Throttle Valves.* Robin Holmbom, Lars Eriksson. SAE 2018 WCX Technical Paper 2018-01-0876.