

Project report
Project 1A – TSFS09

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Chapter 1

Introduction

This document contains information about the project assignments that you need to address in all your submissions. You're welcome to utilize the provided template here. It's a good idea to go through the Project Compendium before each assignment, as it includes general details about the projects and background information that could be useful for understanding the project tasks. The Project Compendium also offers suggested models. For completing the project assignments, you should consider referring to lecture notes, course books, and the Project Compendium.

All hand-ins are to be sent in through Lisam. For each Project hand-in the full Project document has to be attached. If you have to make a supplementary submission the whole project document is to be handed in again that addresses the comments received.

An overview of all input signals to the actuators and output signals from the sensors which should be included in Project 1 is shown in Figure 1.1 where the red signals and components will be used in Project 2 for a turbocharged engine. The notation seen in Figure 1.1 is to be used in hand-ins for the models.

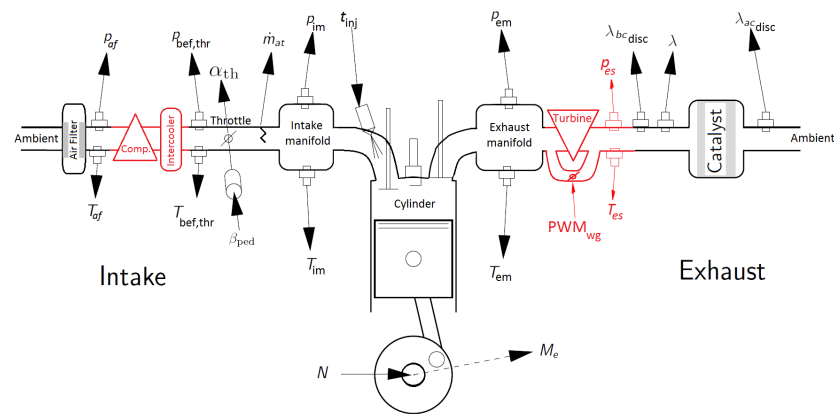


Figure 1.1: An overview of the air path with signals and components to be modeled in Project 1 (shown in black) and Project 2 (shown in red+black)

Project 1A Assignments

To pass Project 1A, all questions in this chapter must be answered as well as having an active presence in the measurement session in the engine lab.

1. **Considering Figure 1.1, the fact that the Enginemap data is obtained from a turbocharged engine and that a naturally aspirated engine is going to be modeled, which one of p_{em} or p_{es} signals in the Enginemap should be used in the task to parameterize the exhaust system component model previously mentioned? Why?**
2. **In the context of Project 1A, what is meant by an engine map?**
3. **Finish all the component model descriptions below.**

1.1 Accelerator pedal

A model describing the dynamics from β_{ped} to α_{th} .

Model:

$$\dot{\alpha}_{th} = \frac{1}{\tau_{th}}(\beta_{ped} - \alpha_{th}) \quad (1.1)$$

Known model parameters: -

Unknown model parameters: τ_{th}

Measurement signals: β_{ped} , α_{th}

Measurement type: Dynamic

1.2 Throttle

A model for the air mass flow through the throttle, \dot{m}_{at} .

Model:

$$\dot{m}_{at} = \frac{p_{bef,thr}}{\sqrt{RT_{bef,thr}}} A_{eff}(\alpha_{th}) \Psi(\Pi), \quad \Pi = \frac{p_{im}}{p_{bef,thr}} \quad (1.2)$$

$$A_{eff}(\alpha_{th}) = a_0 + a_1 \alpha_{thr} + a_2 \alpha_{thr}^2 \quad (1.3)$$

$$\Psi = \sqrt{\frac{2\gamma_{air}}{\gamma_{air} - 1} \left(\Pi_{lim}^{\frac{2}{\gamma_{air}}} - \Pi_{lim}^{\frac{\gamma_{air}+1}{\gamma_{air}}} \right)}, \quad \Pi_{lim} = \max \left(\Pi, \left(\frac{2}{\gamma_{air} + 1} \right)^{\frac{\gamma_{air}}{\gamma_{air}-1}} \right) \quad (1.4)$$

Known model parameters: γ_{air} , R

Unknown model parameters: a_0 , a_1 , a_2

Measurement signals: p_{im} , $p_{bef,thr}$, α_{th} , $T_{bef,thr}$, \dot{m}_{at}

Measurement type: Stationary (Engine Map)

1.3 Intake manifold

Describe the model for the dynamics of the intake manifold pressure p_{im} .

Model:

Known model parameters:

Unknown model parameters:

Measurement signals:

Measurement type:

1.4 Fuel injector

Describe the model from the injection time, t_{inj} , to the fuel mass flow from the fuel injectors, \dot{m}_{fi} .

Model:

Known model parameters:

Unknown model parameters:

Measurement signals:

Measurement type:

1.5 Cylinder

Describe the models for:

- Model 1: Generated engine torque (M_e).
- Model 2: Cylinder temperature (T_{cyl}).
- Model 3: Air mass flow into the cylinders (\dot{m}_{ac}).
- Model 4: Air/fuel ratio inside the cylinders (λ_{cyl})

Model 1:

Model 2:

Model 3:

Model 4:

Known model parameters:

Model 1:

Model 2:

Model 3:

Model 4:

Unknown model parameters:

Model 1:

Model 2:

Model 3:

Model 4:

Measurement signals:

Model 1:

Model 2:

Model 3:

Model 4:

Measurement type:

1.6 Exhaust manifold

Describe the model for the dynamics of the exhaust manifold pressure p_{em} .

Model:

Known model parameters:

Unknown model parameters:

Measurement signals:

Measurement type:

1.7 Exhaust flow

Describe the model for the air mass flow through the exhaust system including the catalyst (\dot{m}_{es}).

Model:

Known model parameters:

Unknown model parameters:

Measurement signals:

Measurement type:

1.8 Lambda sensor

Describe models for:

- Model 1: Continuous lambda sensor before the catalyst λ_s .
- Model 2: Discrete lambda sensor after the catalyst $\lambda_{bc, disc}$

Model 1:

Model 2:

Known model parameters:

Model 1:

Model 2:

Unknown model parameters:

Model 1:

Model 2:

Measurement signals:

Model 1:

Model 2:

Measurement type: