SSA 1

Kick-off experiment 2

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Goal

- The goal of this assignment is to start with the second experiment and get as far as possible in the current state. Whilst doing so, it is necessary to document everything I have done to be able to explain it to the rest of the group

Conclusion

- The provided MATLAB files have been documented and a bare-bone analysis script has been created and documented.

Problems

- It was hard to determine where to start with this assignment, because we only know the end goal and not how to get there.

Follow up Steps

Q_{LVH} to finish the computations for the thermodynamic aspects of the analysis;Finding the unknown variables within the SecondExperiment.m file and run the analysis; Report the findings of said analysis.

Work Division

- Alexandra and I have both been tasked with starting on the second experiment. Because working together on one piece of code with two people at the same time is rather difficult, I decided to do the first part and hand it over to Alexandra for her to follow up on it.

Time Division

- Exploring and documenting the provided files: 30 minutes;
- Making the SecondExperiment.m file: roughly 3 hours;
- Documenting the SecondExperiment.m file: roughly 45 minutes.

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1 Explanation Matlab components

The university has provided us with several tools and scripts to work with. However, the scripts for the analyses and the second experiment need to be made from scratch.

1.1 ConvertFiles.m

Turns data sheet that use commas to denote decimals number into periods. In order to make it work, the DataDir variable needs to be changed to the path of the file that needs to be converted. Then the entire script needs to be run. It is advice to make a backup before running this script

```
1 -   clear all;close all;clc
2     %% add general to matlab path
3 -   addpath('General');
4     %%
5 -   DataDir='../Data/Training Set';  % The directory with the
6     % DataDir='../Data/Gasoline';  % The directory with the fi
7     %%
8 -   Files=dir(fullfile(DataDir,'*.txt'));nFiles=length(Files);
9 -   h=waitbar(0,'Converting');
10 -  for i=1:nFiles
11 -      waitbar(i/nFiles,h);
12 -      fname       = Files(i).name;
13 -      curfilename = fullfile(DataDir,fname);
14 -      comma2point_overwrite( curfilename);    % Convert comm
15 -  end
16 -  delete(h)
17
```

Figure 1: The DataDir variable is highlighted in yellow

1.2 NasaUseExample.m

Shows the features of the "NASA" thermodynamic tables using several examples. The "myfind(E1.name,elements)"-function finds all gasses and fuels that have these elements and returns the index numbers in the Sp table of these fuels. The other functions find the respective variables (i.e. CpNasa(T, Sp) finds the isobaric heat capacity) for a given temperature and fluid composition.

1.3 ReadCaseDataExample.m

This script:

- Line 3-10 reads a measurement data text file (if we perform measurements, it is important that we store it in the same format as they store it. Example data has been provided to see how). It can read multiple files
- Line 11-24: stores the data in easy-to-use arrays, structs and variables
- Line 25-32: plots the encoder signal (voltage, time).
- Line 33-39: plots the pressure-time relationship.

1.4 SecondExperiment.m

This document functions as the working script for the second experiment. I have structured it as a fill-in format in which only the variables still need to be found in order to perform the analytical calculations. The calculations that are already implemented are the ones needed to compute the dimensions and the thermodynamic model. This document can be found on GitHub and Canvas. Here follows a line-by-line description of what each section of the code does.

- 3-14: Importing Nasa tables in the same manner as in the example file.

- 15-41: Importing the collected data. This data is then structured in the same style and setup as in the ReadCaseDataExample.m file. For now, it collects the example data as a placeholder. As such, most of the code is copied directly from ReadCaseDataExample.m.
- 42-66: In lines 46 through 51, one specifies the dimensions after which (54-66) the program computes the other dimensions.
- 67-136: Thermodynamic model, the central equation at work is the equation specified in the first presentation: $0 = \dot{Q} - \dot{W} + Q_{LHV} * \dot{m}_{fuel} - c_{p,exh} * (T_{exh} - T_{amb}) * \dot{m}_{exh}$. $\dot{Q}$ is zero, because of the assumption that this process is adiabatic. This assumption may lead to results that are inconsistent with reality.
- 79-83: Insert the air density, molar mass of the fuel and the atom numbers in the fuel
- 86-95: Computes the fuel mass flow and the air to fuel ratio.
- 97-101: The calculation for Q_{LHV} is yet to be completed. I do not understand every variable shown on slide 43 of the first presentation. The chemical bond energy is, then, computed on line 104.
- 117-122: Fill in the exhaust temperature, ambient temperature and the isobaric specific heat of the exhaust gas (combustion products and non-reactive air components).
- 124-125: The sensible heat loss is then computed using the aforementioned variables.
- 127-136: The thermodynamic equation is then solved for $\dot{W}$ and the Carnot efficiency and brake specific fuel consumption are computed.