Simutech Winter Project

Modelling Of IC Engine Using MATLAB

Week-2 Assignment
(Deadline 27th Dec)

1. Naive Problem

An ideal Otto cycle operates with a compression ratio of 8. At the start of the compression process conditions are:

- Initial pressure $P_1 = 100$ kPa
- Initial temperature $T_1 = 30$°C
- Initial volume $V_1 = 0.0038\ m^3$

The peak temperature in the cycle is 1200°C.
Tasks:

1. Write a **MATLAB** and/or **OCTAVE** code to calculate the following for one cycle:
    - Heat Rejection (Q_{out}) in kj
    - Net work output (W_{net}) in kj
    - Thermal efficiency of the cycle (η)
    - Mean Effective Pressure (MEP) in kPa
2. Plot the P-V diagram of the cycle using **MATLAB**:
    - Assume the compression and expansion processes are adiabatic.
    - Generate intermediate pressure and volume values during compression and expansion using the adiabatic conditions.

Submissions:

1. A script file (**.m**) containing:
    - All calculation done.
    - The P-V plot and processes clearly labeled.
2. Numerical results of Q_{out}, W_{net}, η and MEP

2. Otto Cycle Simulation & Code Implementation

Write a **MATLAB** and/or **OCTAVE** script to simulate the pressure-volume (P-V) diagram of an ideal Otto cycle based on the given data below. Additionally, compare the results with and without considering pistion kinematics.

Input Parameter:

1. Specific heat ratio (γ) = 1.35
2. Initial pressure (P_1) = 110 kPa
3. Initial temperature (T_1) = 400 K
4. Max. temperature (T_3) = 2800 K
5. Bore = 0.09m, Stroke = 0.1m, Connecting rod length = 0.14m
6. Compression Ratio (CR) = 8.5

Engine Geometry and Volumes:

1. Swept volume V_{swept} and clearance volume $V_{clearance}$:

$$V_{swept} = \frac{3.14}{4} * bore^2 * stroke$$

$$V_{clearance} = \frac{V_{swept}}{CR - 1}$$

Tasks:

Write code to compute:

1. Compute volume, pressure and temperature at each state.
2. Compute the thermal efficiency of the otto cycle
3. Plot P-V diagram each processes for:
   - Without considering piston kinematics (use a linear volume change between V_1 and V_2 for compression, and V_3 and V_4 for expansion).
   - With considering pistion kinematics (use the **pison kinematics** function discussed in the class to compute volumes during compression and expansion).

Another Task:

Write a function to analyze the impact of changing compression ratios (CR= 7,9,and 11) on the thermal efficiency. Plot the results using **MATLAB** and/or **Octave** and write your inferences from the plots.

Submissions:

1. Submit a script file (**.m**) implementing the above tasks.
2. Include your inferences comparing the P-V diagrams with and without considering piston kinematics. Write your results and findings.

ALL THE BEST!