Task 6 - OLVHN

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1 Overview

This report contains the results and summary of the 12 step process described in Dr. Cizmas notes for computing the Operating Line. Also included in this report is the engine performance vartiatio with wheel speed, altitude and aircraft speed.

2 Methodology for Computing the Operating Line

1. Calculate the compressor work w_c, given an angular speed calculated in Task2, as a function of nominal compressor work and nominal angular speed.

$$w_c = w_{c_n} \left(\frac{N}{N_n} \right)^x \tag{1}$$

   Usually $x \in [1.9, 2.1]$, for convience we will use $x = 2$.

2. Estimate the compressor efficiency η_c, given an angular speed calculated in Task2, as a function of nominal compressor efficiency and nominal angular speed. We start by calculated the pressure ratio π_c^*

$$\pi_c^* = \left[\left(\pi_{c_n}^{\frac{\gamma-1}{\gamma}} \right) \frac{\eta_c}{\eta_{c_n}} \left(\frac{N}{N_n} \right)^x + 1 \right]^{\frac{\gamma}{\gamma-1}} \tag{2}$$

3. Calculate the T_3^* from:

$$\pi_c^* = \frac{1+f}{\sigma_{comb}} \left(\frac{p_3^*}{\dot{m}\sqrt{T_3^*}} \right)_n \sqrt{\frac{T_3^*}{T_1^*}} \frac{\dot{m}\sqrt{T_1^*}}{p_1^*} \tag{3}$$

Where:

$$\frac{1+f}{\sigma_{comb}} \left(\frac{p_3^*}{\dot{m}\sqrt{T_3^*}} \right)_n = constant \tag{4}$$

From here, calculate h_3^3, assume $c_p = 1.0045 \frac{kJ}{kgK}$. Check to see if the ratio $\frac{w_c}{h_3^*}$ is equal to the nominal ratio $\frac{w_{cn}}{h_{3_n}^*}$. If not, iterate until it is. Allow a tolerance of 1%.