MECH4450 Aerospace Propulsion

# Major Assignment - Part 1

Muirhead, Alex
s4435062

Watt, Robert
s4431151

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The following finite rate chemistry mechanisms provide an accurate model of fuel combustion within a scramjet engine.

$$C_2H_4 + 2\,O_2 \longrightarrow 2\,CO + 2\,H_2O \tag{1}$$

$$CO + \frac{1}{2}\,O_2 \longleftrightarrow CO_2 \tag{2}$$

The rates of formations for the individual species are given as:

$$\frac{\mathrm{d}[C_2H_4]}{\mathrm{d}t} = -k_1[C_2H_4]^{0.5}[O_2]^{0.65} \tag{3a}$$

$$\frac{\mathrm{d}[O_2]}{\mathrm{d}t} = -2k_1[C_2H_4]^{0.5}[O_2]^{0.65} - \frac{1}{2}k_{2f}[CO][O_2]^{0.5} + \frac{1}{2}k_{2r}[CO_2] \tag{3b}$$

$$\frac{\mathrm{d}[CO]}{\mathrm{d}t} = 2k_1[C_2H_4]^{0.5}[O_2]^{0.65} - k_{2f}[CO][O_2]^{0.5} + k_{2r}[CO_2] \tag{3c}$$

$$\frac{\mathrm{d}[H_2O]}{\mathrm{d}t} = 2k_1[C_2H_4]^{0.5}[O_2]^{0.65} \tag{3d}$$

$$\frac{\mathrm{d}[CO_2]}{\mathrm{d}t} = k_{2f}[CO][O_2]^{0.5} - k_{2r}[CO_2] \tag{3e}$$

where $k_1$ is the rate of reaction for Eq. 1, and $k_{2f}$ and $k_{2r}$ are the forward and backward reaction rates for Eq. 2 respectively.