

5.5 turbojet with after burner

$$\frac{F}{\dot{m}} = a_0 \left\{ \left[ \frac{2}{\gamma-1} \frac{\gamma_{\text{AAB}}}{\tau_r \tau_c \tau_e} (\tau_r \tau_c \tau_e - 1) \right]^{\frac{1}{2}} - M_0 \right\}$$

$$\tau_e = 1 - \frac{\tau_r}{\tau_c} (\tau_c - 1)$$

vary  $\tau_c$  to maximize thrust

$$\frac{\partial (F/\dot{m})}{\partial \tau_c} = \frac{a_0}{2} \left[ \frac{2}{\gamma-1} \frac{\gamma_{\text{AAB}}}{\tau_r \tau_c \tau_e} (\tau_r \tau_c \tau_e - 1) \right]^{\frac{1}{2}}$$

$$\times \left\{ \frac{-2}{\gamma-1} \frac{\gamma_{\text{AAB}}}{\tau_r \tau_c^2 \tau_e} (\tau_r \tau_c \tau_e - 1) - \frac{2}{\gamma-1} \frac{\gamma_{\text{AAB}}}{\tau_r \tau_c \tau_e^2} \frac{\partial \tau_e}{\partial \tau_c} \right\}$$

$$\times (\tau_r \tau_c \tau_e - 1) + \frac{2}{\gamma-1} \frac{\gamma_{\text{AAB}}}{\tau_r \tau_c \tau_e} \left( \tau_r \tau_e + \tau_r \tau_c \frac{\partial \tau_e}{\partial \tau_c} \right)$$

$$= 0$$

$\Rightarrow$

$$- \left( \frac{\tau_{\text{AAB}}}{\tau_c \tau_c^2 \tau_e} + \frac{\tau_{\text{AAB}}}{\tau_r \tau_c \tau_e^2} \frac{\partial \tau_e}{\partial \tau_c} \right) (\tau_r \tau_c \tau_e - 1)$$

$$+ \frac{\tau_{\text{AAB}}}{\tau_r \tau_c \tau_e} \left( \tau_r \tau_e + \tau_r \tau_c \frac{\partial \tau_e}{\partial \tau_c} \right) = 0$$

$$- \left( \frac{1}{\tau_c} + \frac{1}{\tau_e} \frac{\partial \tau_e}{\partial \tau_c} \right) (\tau_r \tau_c \tau_e - 1) + \tau_r \left( \tau_e \right.$$

$$\left. + \tau_c \frac{\partial \tau_e}{\partial \tau_c} \right) = 0$$