geometry.py

Inducer

$c_{m1i} = arange(lower, higher, step)$

$c_{\theta 1i} = c_{m1i} \tan(\alpha_1)$

$T_{1i} = T_{00} - \frac{c_{1i}^2}{2C_p}$

$M_{1i} = \frac{c_{1i}}{\sqrt{\gamma RT}}$

$P_{1i} = P_{00} \left(\frac{T_{1i}}{T_{00}}\right)^{\frac{\gamma}{\gamma-1}}$

$\rho_{1i} = \frac{P_{1i}}{RT_{1i}}$

$A_{1i} = \frac{\dot{m}}{\rho c_1 (1-B_1)}$

$U_{t1i} = \frac{2\pi r}{60} N$

$w_{1i} = \sqrt{c_{\theta 1i}^2 + c_{m1i}^2}$

$dh_{0s} = \frac{\gamma RT_{00}}{\gamma-1} (\mathrm{Pr}^{\left(\frac{\gamma-1}{\gamma}\right)} - 1)$

$U_{crit} = \sqrt{\frac{2\sigma_{max}}{\rho_{material}}}$

$U_2 = U_{crit}$

Evaluating for given rotational speed N:

$U_{t1i} = \frac{2\pi r}{60} N$

$w_{1i} = \sqrt{c_{\theta 1i}^2 + c_{m1i}^2}$

w_{1i} is minimized. All arrays are evaluated at index of smallest w_1 in w_{1i}. This index is called w1ti_index_min:

$c_{m1} = c_{m1i}[w1ti\_index\_min]$

$c_{\theta 1} = c_{\theta 1i}[w1ti\_index\_min]$

$\vdots$

$w_1 = w_{1i}[w1ti\_index\_min]$

$U_2 = U_1 \frac{r_1}{r_2}$

If $U_2 > U_{crit}$ rotational speed is adjusted

Impeller, diffuser

For all β:

For all Z_B:

σ = checkSlipFactorSigma(...)

$\psi, c_{\theta 2}, c_{m2}, c_2$ = impellerOutletVelocities(...)

while Pressure ratio not converging:

$w_x = \frac{dh_{0s}}{\eta}$

$T_{02} = T_{00} + w_x \frac{1}{C_p}$

$P_{02} = P_{00} \left(\eta\, w_x \frac{\gamma-1}{\gamma RT_{00}} + 1\right)^{\frac{\gamma}{\gamma-1}}$

$T_2 = T_{02} - \frac{\gamma-1}{2\gamma R} c_2^2$

$P_2 = P_{02} \left(\frac{T_2}{T_{02}}\right)^{\frac{\gamma}{\gamma-1}}$

ρ_2, A_2, b_2, M_2 ...

P_3, P_{03}, C_3 = diffuserFlow(...)

$\eta_{isen}, PressureEstimate$ = systemTotalPerformance(...)

if pressure ratio not converging

Plotting