Assuming thrust (T) equals weight (W), momentum theory assumes that half the velocity change of the induced flow occurs above the disk and the other half below. This gives us the basic principle of momentum theory:

$$P=\sqrt{\frac{W}{2ρA\_{d}}}$$

Accounting for various losses and inefficiencies of a monocopter the power required for the drone to hover is shown here:

$$η\_{h}P=\frac{W^{\frac{3}{2}}}{\sqrt{2ρA\_{d}}}$$

where ηh accounts for swirl and non-uniform flow losses. The thrust and power can be non-dimensionalized:

$$T=\frac{1}{2}ρ\left(ΩR\right)^{2}\*A\_{d}C\_{T}$$

$$P=\frac{1}{2}ρ\left(ΩR\right)^{3}•A\_{d}C\_{P}$$

$$C\_{P}=\frac{C\_{T}^{\frac{3}{2}}}{2η\_{h}}+C\_{P\_{ν}}$$

where CPv is a viscous power coefficient that accounts for wing profile drag.

### Wing Design Variables

We begin with design variables R (wingspan), σ (solidity), and λ (taper ratio) related to the wing root chord cr and tip chord ct by:

$$λ=1-\frac{c\_{t}}{c\_{r}}$$

Equation 1 Taper ratio

$$σ=\frac{c\_{r}R\left(2-λr\right)}{2•A\_{d}}$$

Equation 2 Solidity