

# RotorFF

## Syntax

[Vt,wt,Vp,wp,Pt,Tp] = RotorFF(alfa)

## Function description

[Vt,wt,Vp,wp,Pt,Tp] = RotorFF(alfa) returns the characteristic curves for rotor in forward flight for both constant thrust and power and gives in output also the relative x and y values. It requires in input the angle of attack in degrees.

The plot available are:

- For constant Thrust:
  - w versus V
  - P versus V
- For constant Power:
  - w versus V
  - T versus V

where w = induction, V = asymptotic velocity, T = Thrust, P = Power

## Algorithm description

The algorithm implements the following equations:

Constant Thrust

- $(\tilde{V}_\infty^2 \tilde{w} \sin \alpha + \tilde{w}^2)^2 + \tilde{V}_\infty^2 \tilde{w}^2 \cos^2 \alpha = 1$
- $\tilde{P}_t = \tilde{V}_\infty \sin \alpha + \tilde{w}$

Constant Power

- $\left[ (\tilde{V}_\infty^2 \tilde{w} \sin \alpha + \tilde{w}^2)^2 + \tilde{V}_\infty^2 \tilde{w}^2 \cos^2 \alpha \right] (\tilde{V}_\infty \sin \alpha + \tilde{w}) = 1$
- $\tilde{T} = (\tilde{V}_\infty \sin \alpha + \tilde{w})^{-1}$

The code begins at line 51 with the function call.

At line 54 the angle of attack given as input in degrees is converted in radiant.

At lines 58, 72, 86, 100 the functions are defined. The two implicit functions at line 58 and 86 are managed through a function handle and plotted at line 62 and 90 using the fimplicit function.

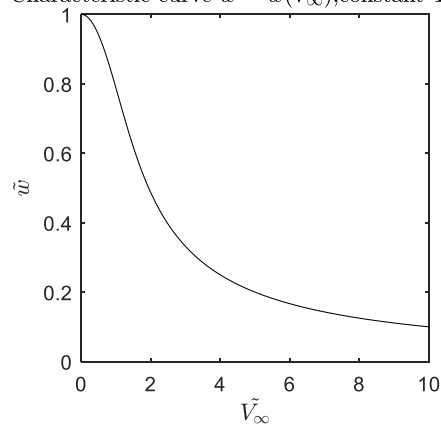
At line 68,69 and 96,97 the values of the axis are extracted and are used to define the functions at lines 72 and 100. These two functions are plotted at lines 75 and 104.

## Examples

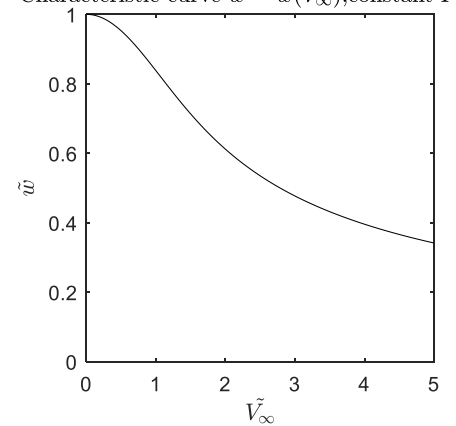
```
alfa=0;
```

```
[Vt,wt,Vp,wp,Pt,Tp] = RotorFF(alfa)
```

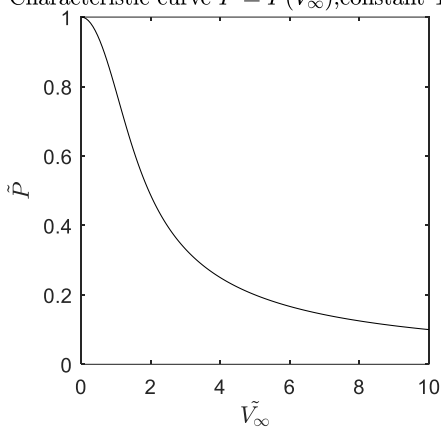
Characteristic curve  $\tilde{w} = \tilde{w}(\tilde{V}_\infty)$ , constant Thrust



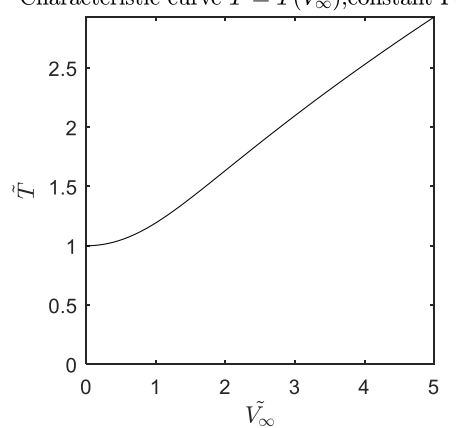
Characteristic curve  $\tilde{w} = \tilde{w}(\tilde{V}_\infty)$ , constant Power



Characteristic curve  $\tilde{P} = \tilde{P}(\tilde{V}_\infty)$ , constant Thrust



Characteristic curve  $\tilde{T} = \tilde{T}(\tilde{V}_\infty)$ , constant Power



## Input Arguments

**Alfa** – angle of attack

## Output Arguments

### Constant Thrust

**Vt** – asymptotic velocity

**wt** – induction

**Pt**– power

### Constant Power

**Vp** – asymptotic velocity

**wp**– induction

**Tt**– power

All the values are non-dimensional in respect to their value in hovering (for V is used induction in hovering).

## Reference

R. Tognaccini. "Lezioni di aerodinamica dell'ala rotante" 2019 pp. 84-85.