

Progetto Aerodinamica dell'Ala Rotante

- FUNZIONE ELICA INTUBATA - SPINTA TOTALE

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1 Algorithm

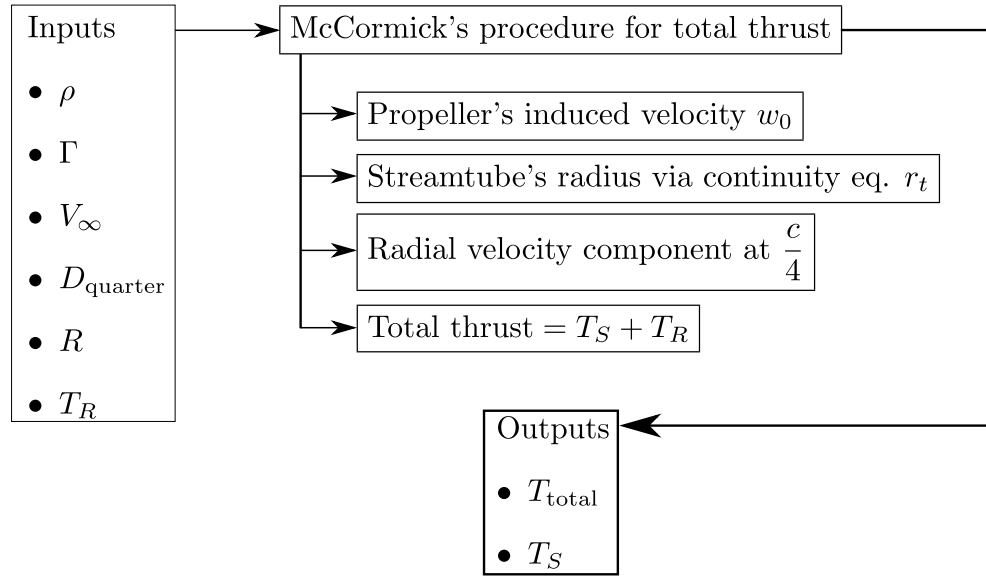


Figure 1 - 1: Flow diagram of the function `elica_intubata.m` with inputs and outputs.

In this brief document, we will describe the algorithm of the function `elica_intubata.m` based on the semi - empirical method proposed by McCormick. A simplified flow diagram for the code is shown in 1 - 1.

1.1 Inputs

The function accepts the following inputs:

- flow density ρ ;
- ring vortex circulation Γ ;
- stream velocity V_∞ ;
- quarter diameter D_{quarter} ;
- duct's radius R ;
- free rotor's thrust T_R .

1.2 Outputs

The function generates the following outputs:

- total thrust T_{total} ;
- shroud thrust T_S .

1.3 Use of the function

This function must be used in conjunction with another program that provides ring vortex circulation and, thus, the isolated rotor's thrust.

2 Code listing

```

1 %% \elica_intubata.m
2 % \brief: A function that calculates total thrust of a ducted propeller.
3 % It generates a vector with total thrust and shroud thrust as output.
4 % \author: Claudio Mirabella, Christian Salzano
5 % \version: 1.04
6 %
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23 %
24 % =====
25 % |Name      : elica_intubata.m |
26 % |Author    : Claudio Mirabella, Christian Salzano |
27 % |          : University of Naples Federico II. |
28 % |Version   : 1.04 |
29 % |Date      : 25/11/2020 |
30 % |Modified  : 11/01/2021 |
31 % |Description : A function that calculates total thrust of a ducted propeller. |
32 % |          : It generates a vector with total thrust and shroud thrust as output. |
33 % |Reference  : Lezioni di Aerodinamica dell'Ala Rotante |
34 % |Input     : |
35 % |          : (rho) = Density |
36 % |          : (Gamma) = Ring vortex circulation associated with the shroud |
37 % |          : (Vinf) = Stream velocity |
38 % |          : (Dquarter) = Shroud diameter at c/4 |
39 % |          : (R) = Shroud radius |
40 % |          : (TR) = Isolated rotor thrust |
41 % |Output    : (T) = Total thrust generated |
42 % |          : (TS) = Thrust generated by the shroud |
43 % |Note      : |
44 % =====
45
46 function [T, TS] = elica_intubata(rho, Gamma, Vinf, Dquarter, R, TR)
47 % -----
48 % Propeller's induced velocity calculations
49 % eq 4.24
50 w0 = .5*(-Vinf + sqrt(Vinf^2 + 2*TR/(rho*pi*R^2)));

```

```
51 % -----  
52 % Streamtube's radius rt calculated via the continuity  
53 % eq 4.20  
54 A = pi*R^2;  
55 const=0;  
56 const = (Vinf + w0)*A;  
57 rt = sqrt(const/(Vinf*pi));  
58 % -----  
59 % Radial velocity component induced by the rotor at c/4  
60 % eq 4.23  
61 cquarter=1/4;  
62 viRquarter = -.5*rt*w0*R^2/((R^2+cquarter^2)^1.5);  
63 % -----  
64 % Thrust component due to the shroud  
65 TS = -rho*viRquarter*Gamma*pi*Dquarter;  
66 % -----  
67 % Total thrust  
68 T = TR + TS;  
69 % -----  
70 end
```

Listing 1: Function elica_intubata.m

Listings

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