Progetto Aerodinamica dell'Ala Rotante

- FUNZIONE ELICA INTUBATA - SPINTA TOTALE

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Indice

1 Algorithm

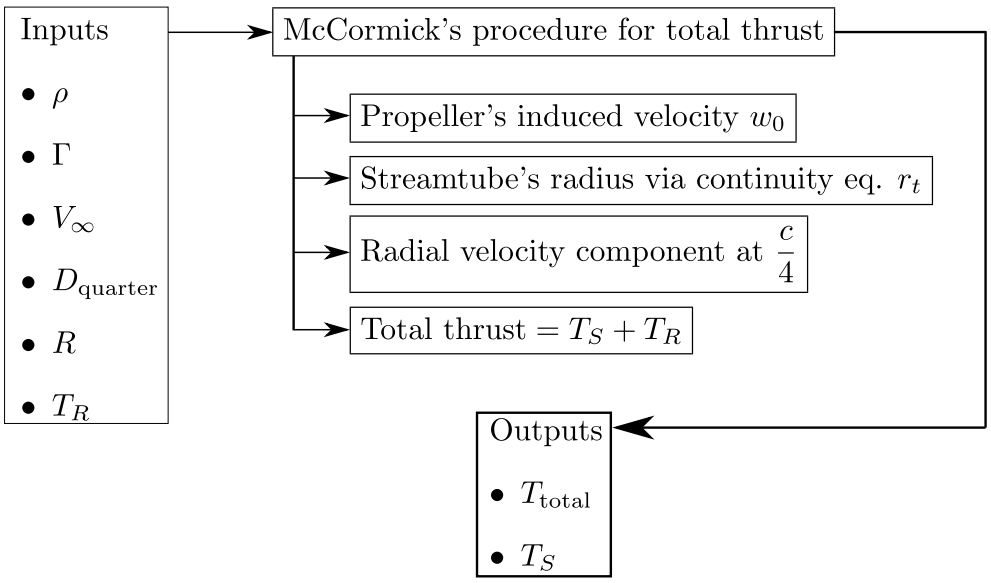

Figura 1 - 1: Flow diagram of the function `elica_intubata.m` with inputs and outputs.

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

```
% ------------------------------------------------------------------------
% FUNCTION NAME: elica_intubata
%   A function that calculates total thrust of a ducted propeller.
%   It generates a vector with total thrust and shroud thrust as output.
%   INPUT
%   1 ---> rho      : Density
%          Type     : Float
%   2 ---> Gamma    : Ring vortex circulation associated with the shroud
%          Type     : Float
%   3 ---> Vinf     : Stream velocity
%          Type     : Float
%   4 ---> Dquarter : Shroud diameter at c/4
%          Type     : Float
%   5 ---> R        : Shroud radius
%          Type     : Float
%   6 ---> TR       : Isolated rotor thrust
%          Type     : Float
%   OUTPUT
%   1 ---> T        : Total thrust generated
%          Type     : Float
%   2 ---> TS       : Thrust generated by the shroud
%          Type     : Float
% ------------------------------------------------------------------------
function [T, TS] = elica_intubata(rho, Gamma, Vinf, Dquarter, R, TR)
% ------------------------------------------------------------------------
% Propeller's induced velocity calculations
%  eq 4.24
w0 = .5*(-Vinf + sqrt(Vinf^2 + 2*TR/(rho*pi*R^2)));
% ------------------------------------------------------------------------
% Streamtube's radius rt calculated via the continuity
%  eq 4.20
A = pi*R^2;
const=0;
const = (Vinf + w0)*A;
rt = sqrt(const/(Vinf*pi));
% ------------------------------------------------------------------------
% Radial velocity component induced by the rotor at c/4
%  eq 4.23
cquarter=1/4;
viRquarter = -.5*rt*w0*R^2/((R^2+cquarter^2)^1.5);
% ------------------------------------------------------------------------
% Thrust component due to the shroud
TS = -rho*viRquarter*Gamma*pi*Dquarter;
% ------------------------------------------------------------------------
% Total thrust
T = TR + TS;
% ------------------------------------------------------------------------
end
```

Listing 1: Function `elica_intubata.m`

Listings