

Actuator Disk User's Guide

An actuator disk approach is implemented in ISIS-CFD to take into account the effect of propeller in the computation. The following input record can be used to activate the actuator disk:

```
*  
*** ACTUATOR DISK  
*  
YES
```

The characteristics of the actuator disk are defined in a file named “actuator_disk_definition.dat” located in the folder where the user runs the ISIS-CFD code. Here are the contents of this file:

- | | |
|------------------------------|---------------------------|
| 1. Number_of_Disk | Integer |
| 2. Activate_Tangential_force | Logical (T/F), |
| 3. Auto_Update, Frequency | Logical, Integer |
| 4. Nx, Ny, Nz | Integer, Integer, Integer |
| 5. Research_Coef | Real |

Then, for each actuator disk, repeat the following input:

- | | |
|-----------------------------------|------------------|
| 1. Thrust, Torque | Real, Real |
| 2. X_Center, Y_Center, Z_Center | Real, Real |
| 3. Dx, Inner_Radius, Outer_Radius | Real, Real, Real |
| 4. Anx, Any, Anz | Real, Real, Real |
| 5. Body_Index | Integer |

Here are the comments on different parameters.

Line 1, Number_of_Disk, the total number of actuator disk.

Line 2, Activate_Tangential_force, This is a logical input that takes “T” for True or “F” for false as input. It controls whether the tangential force is activated or not in the computation. It is not necessary to activate the tangential force to obtain a good prediction for the resistance.

Line 3, If Auto_Update is set to True, the thrust of the actuator disk is automatically updated in the computation such that Thrust=Drag. Frequency is the update frequency.

Line 4, Nx, Ny, Nz, The virtual mesh dimensions used to represent the actuator disk. It is recommended that Nz is set to $4*N+1$.

Line 5, Research_Coef, an internal parameter to help the searching algorithm. Set this parameter to about 5.

For each actuator disk, five data lines are used to specify the characteristics of the actuator disk.

Line 1, Thrust, torque, the thrust and the torque of the propeller. Facing the hull, a propeller with a positive torque rotates in counter clockwise direction.

Line 2, X_Center, Y_Center, Z_Center, the centre of the propeller.

Line 3, Dx, Inner_Radius, Outer_Radius, Dx, the thickness of the propeller, Inner_Radius and Outer_Radius, the inner and the outer radius of the propeller, respectively.

Line 4, Anx, Any, Anz, vector aligned with the shaft oriented from the hull to the propeller. It defines the angle of the propeller force. Normalization is not required.

Line 5, Body_Index, the body index to which the propeller is attached

The above 5 input lines are repeated for each propeller.

Here is an example of the “actuator_disk_definition.dat” file:

```
1           Number of actuator disk
F           Not to activate tangential force
T 1000     Auto_update, Update_frequency
25 35 97   Nx, Ny, Nz
5           Research coefficient
5000.  1.   Thrust and torque of disk 1
1.6  0.  1.25 Centre of propeller of disk 1
0.  0.34  1.13 Thickness, inner_Radius, Outer_Radius of disk 1
1.  0.  0.   Propeller is oriented in x direction
1           Propeller is associated with body No. 1
```

Comments can be added after the input data. To avoid additional numerical difficulty, it is recommended to activate the actuator disk not at the very beginning of the computation, but only in a restarted computation.