COMSOL CONFERENCE BOSTON 2013

VNIVERSIDAD NACIONAL AVTNOMA DE MEXICO

Low Reynolds Number Around a Flying Saucer Micro Air Vehicle

S. Cortés, D. Güemes, R. Ávila

Departamento de Termofluidos, Facultad de Ingeniería, Universidad Nacional Autónoma de México, Ciudad de México, México.

Contents

- Introduction
- Flow around a cylinder
- Flow around a sphere
- Flow around a flying saucer
- Results
- Conclusions

Introduction.

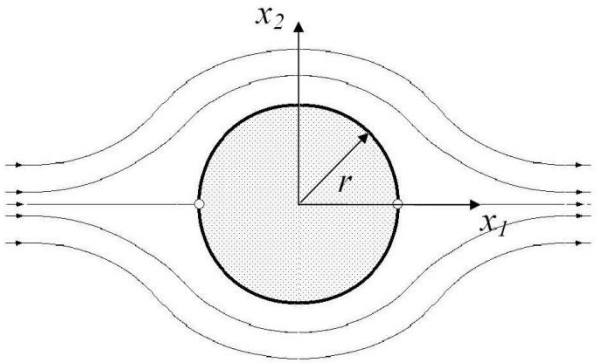
Today UAVs are a reality. The tendency of these devices is to decrease their size. The purpose of this work was to analyze the behavior during flight of a small scale UAV. This device has the shape of a flying saucer with dimensions: 4.2885 mm high and 10 mm wide. In order to achieve our goal, we performed two simpler analyses which consisted on the simulation of a flow around a cylinder in 2D and around a sphere in 3D for different Reynolds number.

Hypothesis.

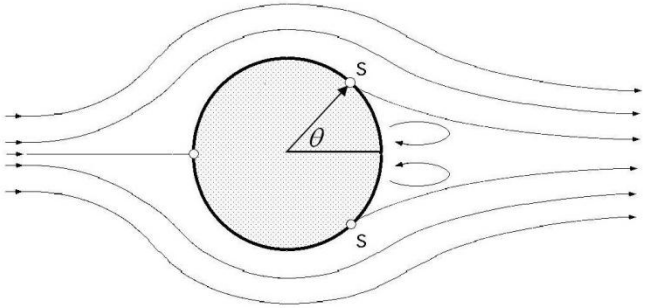
- Our device flies in very large spaces, therefore, for the simulation we considered a large domain.

- The speed developed by the vehicle is very low.

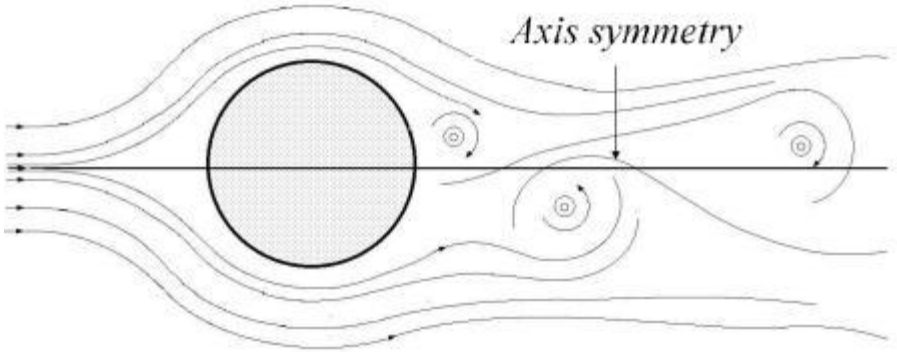
Flow around a cylinder



$1 < Re_D < 20$

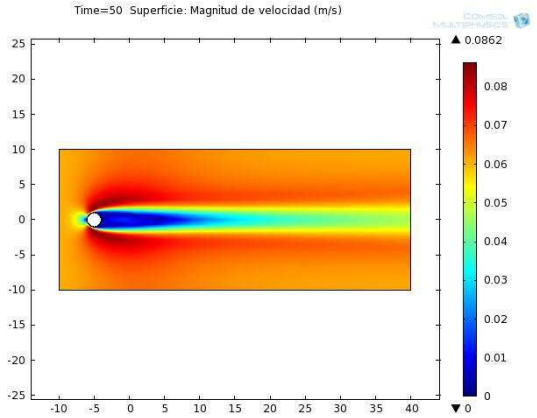


$20 < Re_D < 100$

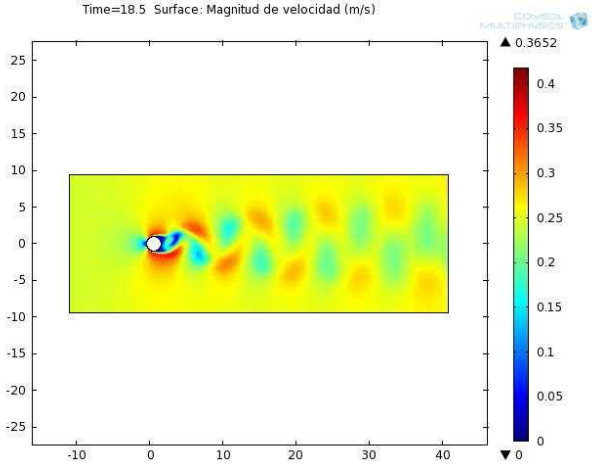


$Re_D < 100$

Results



$20 < Re_D < 100$

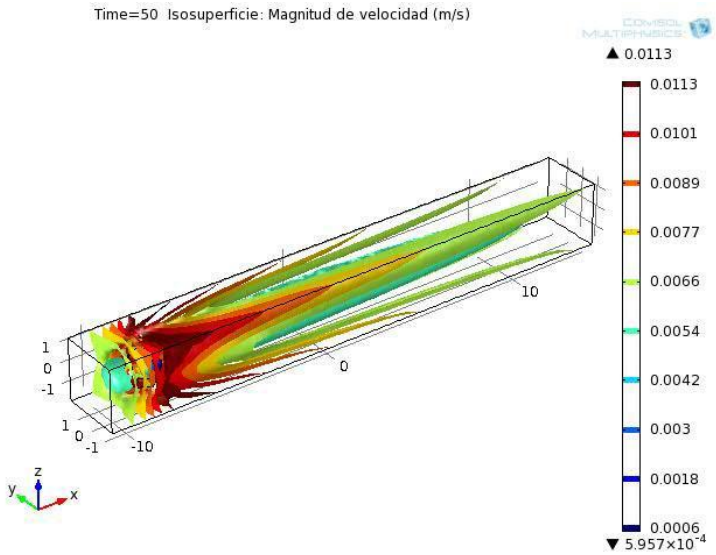


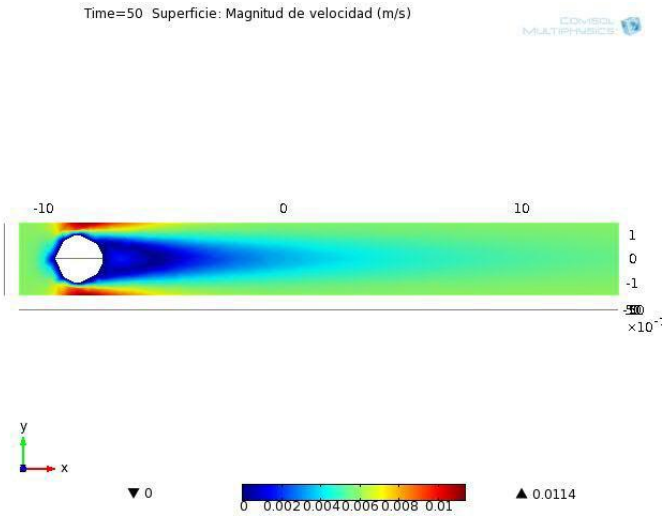
$Re_D < 100$

Reynolds	C_D measured in the simulations	C_D shown in literature	Percentage error
31.25	2.937875	2.903	1.2
59.375	2.252767	2.258	0.232
78.125	1.609433	1.6129	0.215
90.6	1.551598	1.5564	0.308
100	1.501333	1.5	0.089
312.5	1.4225	1.3225	7.561

Comparison of the drag coefficient obtained by COMSOL and the ones obtained from the literature.

Flow around a sphere. Results.

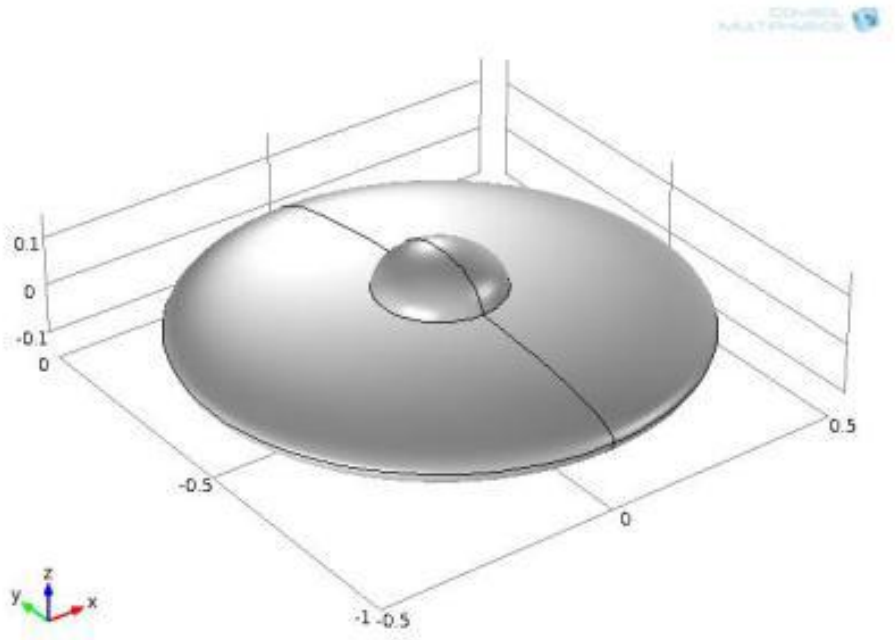




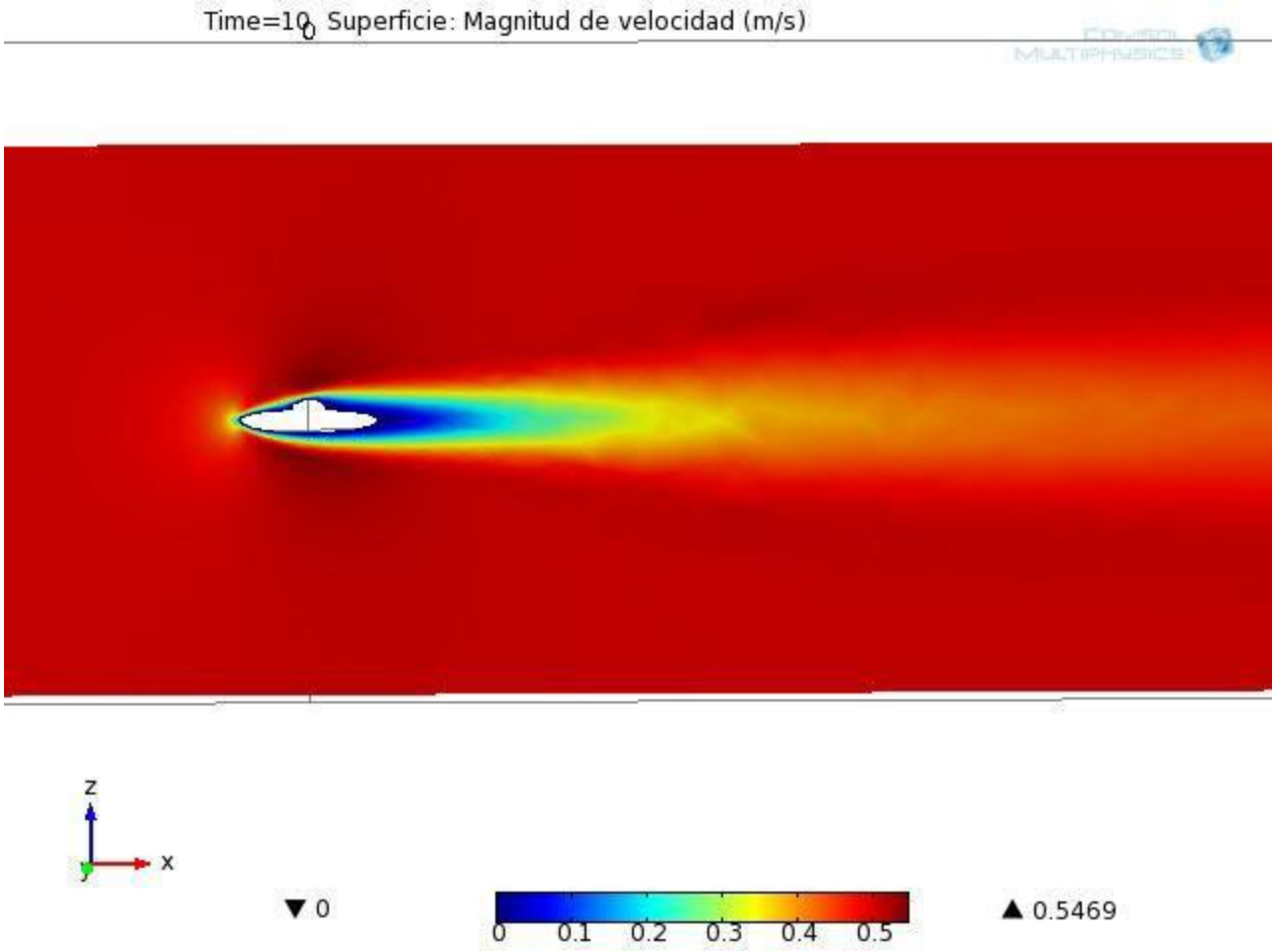
Reynolds	C_D obtained from the simulation	C_D found in the literature	Percentage error
32.25	2.44299	2.445	0.082
59.375	1.62162	1.623	0.085
78.125	1.47706	1.48	0.199
90.625	1.37277	1.3728	0.002
206.5	1.36427	1.3649	0.005

Comparison of the drag coefficient obtained by COMSOL and the ones obtained from the literature.

Flow around a flying saucer



Results


Time=10 Superficie: Magnitud de velocidad (m/s)
z
x
y
▼ 0
0
0.1
0.2
0.3
0.4
0.5
▲ 0.5469

Conclusions

- The results obtained for the analyses of the flow around a cylinder and a sphere are within the range of those found in the literature, this is because the percentage error obtained for the drag coefficient is less than 8%.

- Because the geometry of NAV is not a simple one, there are no references of the drag and lift coefficients; therefore, the results obtained for the simulation of the NAV with COMSOL can be considered adequate.

Thanks you for your attention!