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MODEL ANALYSIS OF COANDA DRONE

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Abstract

This report focuses on the use of a semi spherical hollow bowl shaped model and its so called effect called "COANDA EFFECT" in a drone. The three dimensional design of the drone was done using CATIA whereas the CFD analysis was done using ANSYS FLUENT. The propeller is meshed along the enclosure surrounding. The input flow was kept in transient state condition with input velocity and allowed to run at one thousand rpm. So based on the output results, we observed that the effect of the airflow at above condition with and without the coanda model in order to track the efficacy of the model. The output results of pressure and velocity output are monitored and studied. By all the observations it was found out that the Coanda model with precise dimensions shows promising results

Key Words: coanda effect, propeller , transient condition, design, CFD, coanda model

1.INTRODUCTION

There is a renewed interest in recent times in use of the Coanda effect for vertical/short takeoff and landing aircraft as it cuts the need for long runways and reduces the time to achieve useful flight. This is particularly true for UAV's/Drones, where less expensive prototypes encourage experimenting with novel concepts. Our approach relies on CFD as a tool for fast and efficient case study under variation of multiple dimensional parameter in order to find out the best efficient dimension ratio for propeller and coanda model by studying the results of velocity and pressure magnitudes.

The **Coandă effect** is the tendency of a fluid jet to stay attached to a convex surface. It is named after Roman inventor Henri coanda. Who described it as "the tendency of a jet of fluid emerging from an orifice to follow an adjacent flat or curved surface and to entrain fluid from the surroundings so that a region of lower pressure develops.This approach enables greater flexibility in evaluating many different aircraft geometries and flow configurations hardly accessible with real model. Also coupling with optimization algorithms is available, that could generate optimized UAV/Drone shapes.

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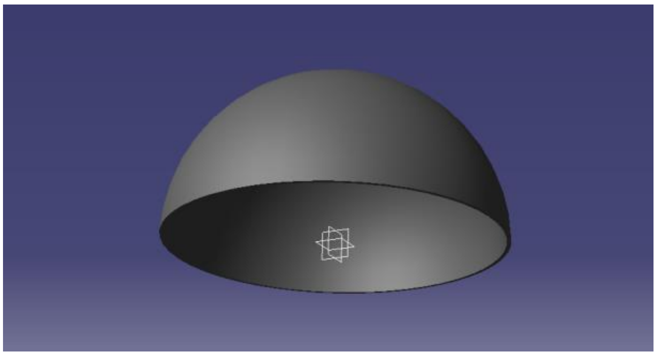
2. OBSERVATION

2.1. DESIGN

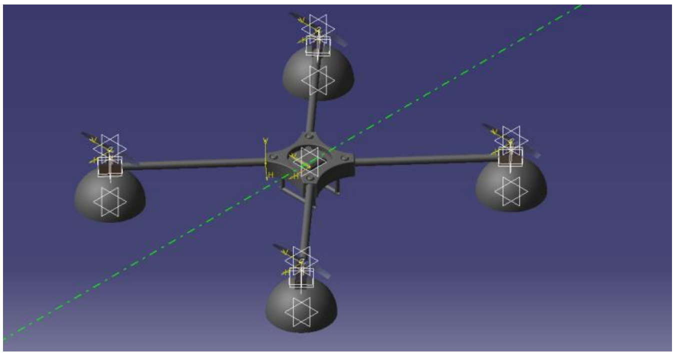
The parts and components of drone and the Coanda model was designed and assembled using CATIA V5.



(Fig 2.1.1)

3D Design of the COANDA MODEL with radius of 8cm

The radius of the model was made in such a way that the efficacy of drone must be uplifted.



(Fig 2.1.2)

Isometric View of Coanda Drone

The design of the coanda model was done with minimal thickness in order to support the drone weight to thrust ratio.

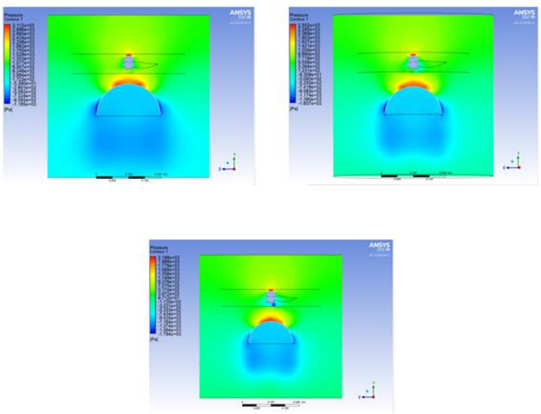
DESIGN DIMENSIONS:

DRONE FRAME: 400x400mm
PROPELLER SPAN: 300mm
COANDA MODEL: i) 200mm ii)190mm iii)180mm

2.2. ANALYSIS

Here in this analysis the pressure, velocity and turbulence of the coanda model along the propeller with varying dimensions
(i.e. 200mm, 190mm, 180mm) was analyzed and studied

5.3.PRESSURE CONTOUR OF COANDA MODEL WITH SIMULATED PROPELLER.
(100mm VS 90mm VS 80mm)

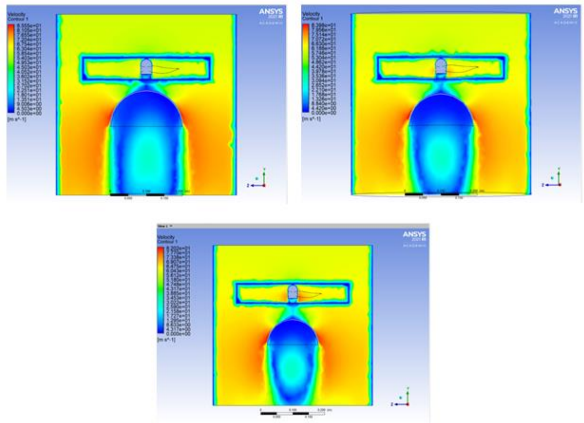


PRESSURE PLOT	R=100mm	R=90mm	R=80mm
Inlet pressure (pa)	2670	2285	1988
Outlet pressure(pa)	-1000	-950	-950

(Fig 2.2.1 PRESSURE CONTOURS)

The pressure contours shows that the model with larger dimension provides more low pressure than the smaller model.
This clearly can state that the more precise to the span of propeller the model is lesser the pressure can be.

5.4.VELOCITY CONTOUR OF COANDA MODEL WITH SIMULATED PROPELLER.
(100mm VS 90mm VS 80mm)

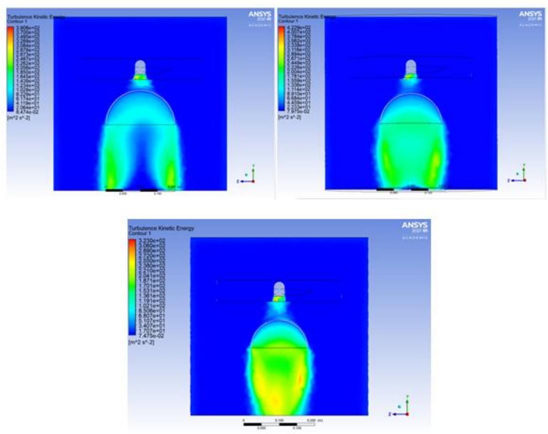


VELOCITY	R=100mm	R=90mm	R=80mm
Inlet Velocity (m/s)	0 at origin	0 at origin	70 at origin
Outlet Velocity(m/s)	85.5	79.56	70

(FIG 2.2.2 VELOCITY CONTOURS)

The velocity contours show that the velocity at the origin tip of the coanda model remains zero dure to the high pressure face. The outlet velocity of the models produces high velocity out than the normal propeller alone drone which increases the velocity 16% increase than the inlet velocity.
From the comparisons, the 200mm dimension model only produces more velocity than the other model. So it shows that the 200mm model has more efficacy.

5.5.TURBULENCE K.ECONTOUR OF COANDA MODEL WITH SIMULATED PROPELLER.
(100mm VS 90mm VS 80mm)

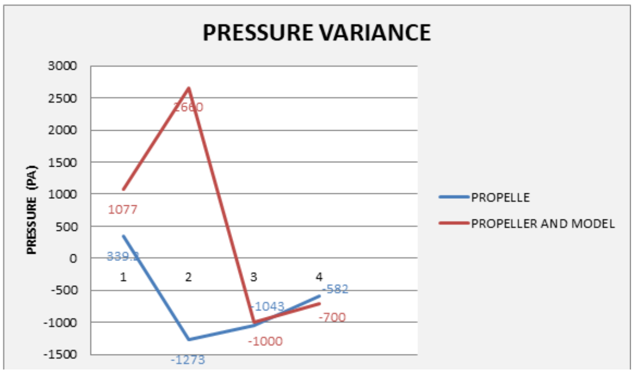


TURBULENT K.E	RADIUS=100mm	RADIUS=90mm	RADIUS=80mm
MODEL BASE(M^2/S^2)	123	155	170

(Fig 2.2.3 TURBULENCE CONTOURS)

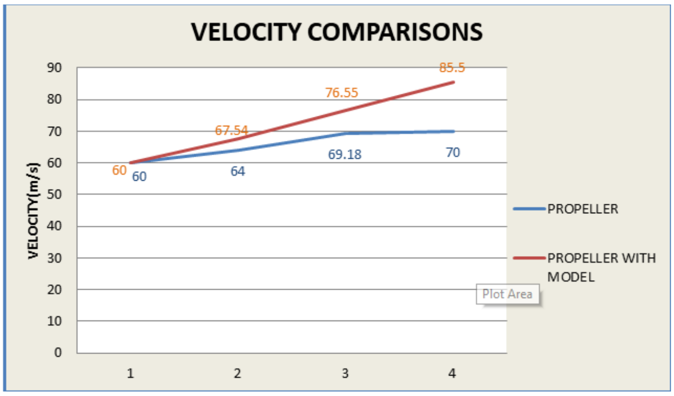
From the turbulence contours, it show that the bigger model has decreasing turbulence K.E so that it can be said that the bigger model houses more steady and stealthy drone.

3. RESULTS



(FIG 3.1 PRESSURE RESULTS)

From the selected efficient model comparisons was done between the propeller alone CFD and propeller along the 200mm diameter model and the pressure variance shows that the without the model the pressure is lower from the drone downstream.



(FIG 3.2 VELOCITY RESULTS)

Apart from the pressure results, though the pressure is lower for propeller alone results than the model, the so called "**COANDA EFFECT**" helps the air velocity to accelerate higher than the normal drone and achieves more exit velocity.

4. CONCLUSION

After studying all the analysis it has been seen that the coanda model is efficient in increasing the lift of the model and also makes airborne drone stealthy due to reduced turbulence. Where the model helps in increasing the exit velocity of the propulsive efficacy up to **42.5%**

After comparing with different contours of pressure, velocity, turbulence it has been clearly found that the coanda model of radius=100mm is efficient to work with the propeller to provide extra thrust .The coanda model not only increases the lift value it creates the downstream environment with many different streamlines with different velocity magnitude. so according to newton's third law we can say that the coanda model is useful in producing EXTRA LIFT to the drone.

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