scFLOW

Cradle MSC Software Company

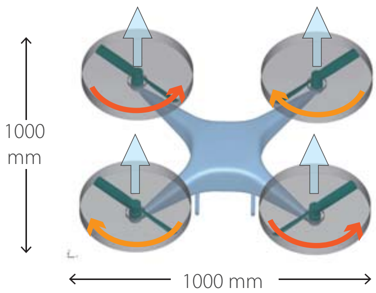
Maximizing Payload Capacity of Unmanned Aerial Vehicles

SC/Tetra used to simulate internal cooling channels embedded in turbine blades

Challenge

Commercial applications for drones are dramatically increasing and engineers are racing to maximize payload capacity. We simulated details of the airflow pattern around a common type of commercial drone in flight to determine the pressure distribution exerted on the aircraft, lift force generated, and the cargo capacity of the drone.

Model of multirotor drone

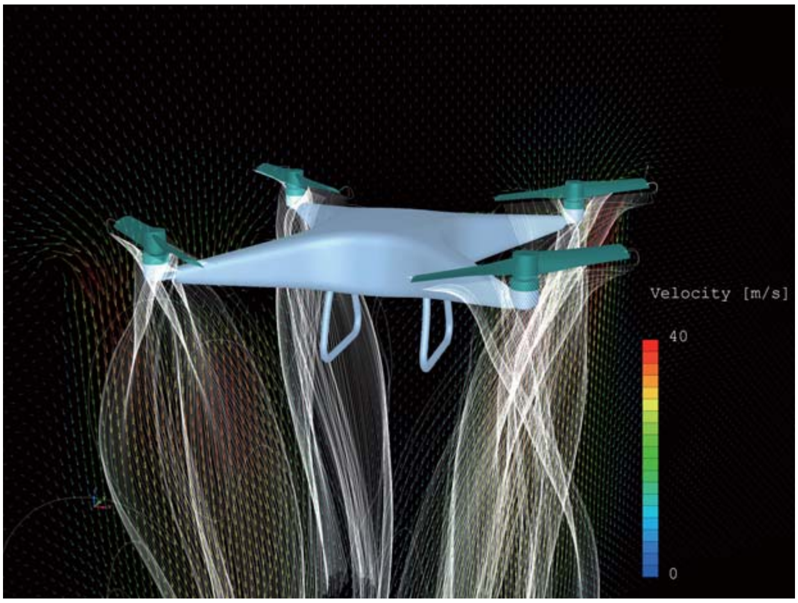


Direction of propeller rotation and lift force

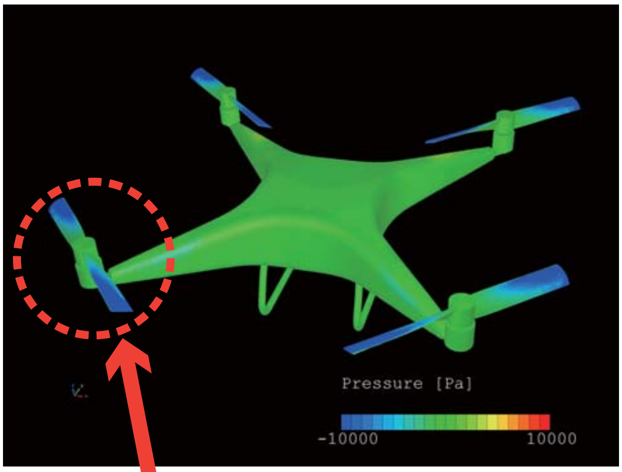
The airflow pattern of a drone taking flight was simulated.

scFLOW's Moving Element function with a discontinuous mesh was used for the propellers, which rotated at 8,000 rpm. The mass of the aircraft was 10 kg.

Simulation results: Flow pattern



Simulation results: Pressure distribution

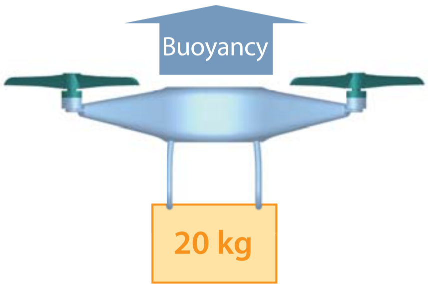


Simulation results confirm that a large negative pressure occurs on the propeller surface, creating lift force on the drone.

Simulation results

Lift Force on the aircraft : 300 N

A lift force to the aircraft results from the propellers rotating at high speed. Accounting for the weight of the aircraft (about 10 kg), this drone can safely carry a cargo payload up to about 20 kg.



Lift force mechanism

Notes

- We used scFLOW and conducted flow analysis during drone flight.
- From the simulation results, we could obtain the lift force acting on the aircraft during flight as well as the flow/pressure distribution.
- In this study, the flow pattern of a drone taking flight vertically was analyzed. We can also simulate the flow pattern of a drone moving horizontally by adjusting the flight attitude and rotation speed of each propeller. scFLOW accurately calculates the variations in flow pattern and lift force caused by a change of flight mode.