

# A Computational Approach for Optimizing the First Flyer Using COMSOL Multiphysics

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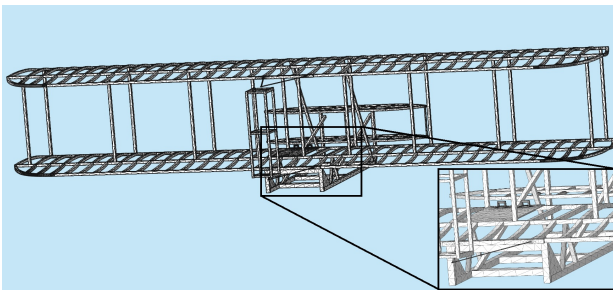
## Abstract

The Wright brothers achieved controlled, powered, heavier-than-air flight, on December 17, 1903 at Kitty Hawk in North Carolina. The longest flight achieved on that day covered nearly half a mile in TWELVE seconds as shown in figure 1. The main objective of this project is to increase the duration of this historic flight to THIRTY seconds using COMSOL Multiphysics. The complete flyer was drawn in details using SolidWorks® and exported as parasolid to COMSOL. This Parasolid® file was imported and meshed using COMSOL Multiphysics 4.3 and its LiveLink™ for SolidWorks® software as shown in figure 2. Aerodynamics analyses are performed using the COMSOL Single Phase Flow physics to increase the propeller thrust. Structural analyses using the COMSOL Solid Mechanics physics to decrease a minimum weight are performed. The above two analyses are repeated when the twist angle of the propeller blades is changed and the vertical bars are modified. The preliminary analysis shows that changing the twist angle of the propeller blade yield improvement in the efficiency of the propeller and hence the thrust is increased. Reducing the gross weight yields an increase in the flight duration as shown in figure 3. The preliminary and expected results show that the duration of flight is increased by increasing the propeller efficiency and reducing the weight of the airplane. The two physics, Single Phase Flow and Solid Mechanics, are used for conducting flow and structural computations on the flyer. The link from SolidWorks to COMSOL was also beneficial and acquiring the COMSOL LiveLink™ for SolidWorks® will even add more flexibility to the model. Future investigation of this model will address the interaction of the aerodynamic and structural model. The use of the Fluid Structure Interaction physics and COMSOL LiveLink™ for MATLAB® will be used.

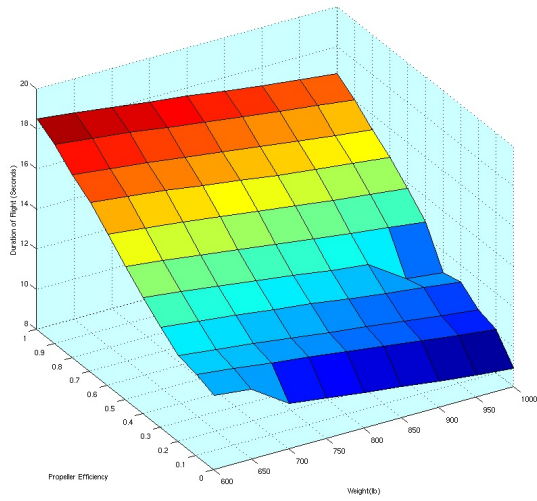
## Figures used in the abstract



**Figure 1:** The first TWELVE seconds of the age of powered flight, Kitty Hawk, N.C., December 17, 1903. National Air and Space Museum, Smithsonian Institution (SI 2002- 16646).



**Figure 2:** Meshed structural model of the flyer using COMSOL 4.3 (more than one million elements).



**Figure 3:** Variation of duration of flight with airplane weight and propeller efficiency.