

Fundamentals of Aerodynamics

Assessment: Report (3000 words)



Introduction:

With the future flight towards the zero-emission, the driver for the sustainable and environmentally friendly aircraft is higher than before. Aerodynamics has been identified as a key technique for the future fuel-efficient aircraft design. The motivation of this project is to design a low speed wing with high lift-to-drag ratio (CC_{LL}/CC_{DD}). Students are encouraged to take the initiative and explore the possible designs (e.g. winglet) as the project is intended to be open-ended.

Tasks:

Task 1: (1000±100 words)

- 1) Provide a concise critical review of aircraft aerodynamics. You are encouraged to take your initiative and explore the state-of-art and future development of aerodynamics. For example, novel aerodynamic design such as morphing wing concept is becoming more feasible with the development of composite material, which enables smoother contour and presents great potential to improve aerodynamic efficiency of future aircraft.

Task 2: Aerodynamic analysis of thin airfoil

- 1) Select a cambered thin airfoil from the database below:
<http://www.airfoiltools.com/search/index>
- 2) Explore the aerodynamic characteristics of airfoil using XFLR5 (such as lift curve, lift-to-drag ratio, Reynolds number effects, ect).
- 3) Validate the thin airfoil theory by comparing your results with XFLR5 (e.g. lift slope, centre of pressure and aerodynamic centre).

Task 3: Low speed wing design

- 1) Design a wing with different shapes (e.g. rectangular, tapered and elliptical, etc) using the selected airfoil and explore how the shapes of the wing and aspect ratio impact the aerodynamic performance (e.g. lift-to-drag ratio); Compare your finding with lifting line theory qualitatively.

Fundamentals of Aerodynamics

- 2) Explore any design features such as winglet to improve the aerodynamic performance.

Submission:

Report presenting details of the analysis, conclusion and scope of the future work. Proper citation is required when necessary, and the word count DOES NOT include the references.

Marking specification:

Task 1: 20%

Task 2: 30%

Task 3: 40%

Presentation and structure of the report: 10%

Note: The chart below is an example to structure a thesis. You could adapt it for your report.

