Instructor: Prof. J. Nedic (jovan.nedic@mcgill.ca)
Office: Room 155, Macdonald Engineering Building
Tel: +1 (514) 398-4858
Last Updated: January 31, 2020

MECH 532: Term Project

Objective:

The conceptual design of a remotely-piloted powerless **glider** through the application of theory learned in class, in combination with software analysis tools, to analyze and evaluate the performance and stability characteristics of the aircraft.

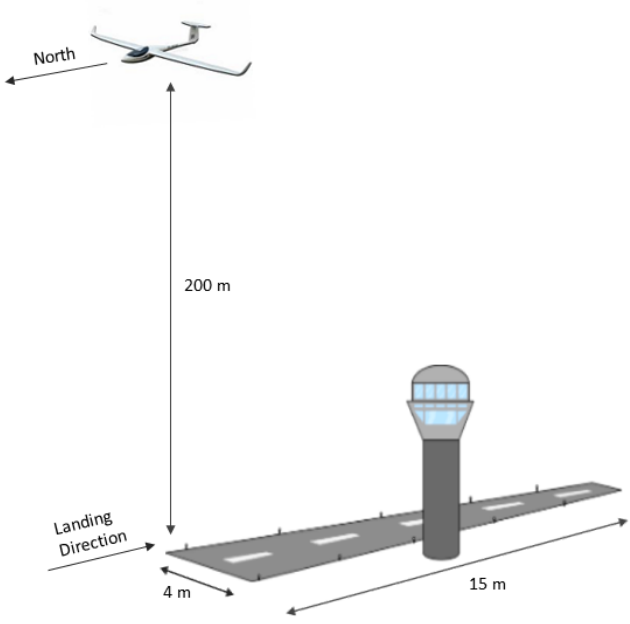
Project Requirements:

- Groups of 5 students.
- Establish and present detailed analysis of performance (steady and turning flight) and stability.
- Must use **XFLR5** throughout the design process to analyze the performance and stability of the glider (This includes airfoil analysis, wing and tail design, trim conditions, static and dynamic analysis, and control surface design and analysis).
- A **CAD** software must be used to determine geometric characteristics of the glider.
- Structural analysis must be performed (ex: during turning maneuvers).
- Other software (such as MATLAB) can be utilized as well.

Design Targets:

Glider is launched north at an altitude of 200 m, at the end of a runway. Assume still air throughout. The mission requirements are as follows:

- Maximize **Endurance**.
- Able to recover when disturbed from steady conditions.
- Must allow for adequate range of maneuvers without stalling.
- Must land on runway below launching point, in the opposing direction to launch (South), as indicated (refer to figure).
- Must perform a loiter at a high bank angle (~40°) to demonstrate maneuverability and structural integrity.



Geometric and Structural Constraints:

- Must fit inside a 2x2x0.5 m box.
- Must carry three 0.5 kg, 5x5x5 cm cubes.
- Tail airfoils must be symmetric.
- Wing and tail components must not be hollow surfaces.
- Minimum wall thickness of 8 mm for fuselage sections.
- Built using **EPP** foam (ρ = 30 kg/m^3).
- Any component that constitutes less than 20% of the total weight can be approximated as a point mass.

Deliverables:

- A detailed report, max 50 pages, outlining the design methodology and analysis of the performance, stability and control of the aircraft.
- CAD model and simplified drawings of the aircraft.
- Program files used for XFLR 5 analysis (for verification purposes).
- 10 minute video presentation on the project. All team members must participate in the video. **Video format must be .mp4**
- If any additional software is used, provide the files.

Due Date: Last day of class at 11:59 pm.

Grading:

25% Explanation of the design methodology and literature review.

30% Ability to meet design targets, geometric and structural constraints, and overall stability and performance of the glider.

30% Performance and stability analysis.

10% Video presentation of project and results.

5% Overview of final design and concluding remarks.

Notes:

• This is a combination design/research project.

• MUST show a design iteration i.e., do one full design, analyze and then improve design to optimize performance.

• Use the below references for guidelines. They are by no means complete, there is plenty of information one can find on the internet and in the library.

• **THERE WILL BE NO ADDITIONAL INPUT FROM THE COURSE INSTRUCTOR FOR THIS PROJECT.** The idea here is that you go out and research the additional information that is required to solve the problem.

• Take full advantage of the below references and additional online material.

• If there appears that some information is missing, then it is up to you to decide what the best path forward is i.e. make a design choice and justify it.

References:

• D. P. Raymer, “Aircraft Design: A conceptual approach”, AIAA

• B. N. Ramadi, “Performance, stability dynamics and control of airplanes”, AIAA

• J. B. Russell, “Performance & Stability of Aircraft”, John Wiley & Sons,

• J. Roskam, “Methods for estimating stability and control derivatives of conventional subsonic airplanes”

• M. H. Sadraey, “Aircraft design: a systems engineering approach.” Hoboken, NJ: Wiley.

• XFLR5 - http://www.xflr5.com/xflr5.htm