Spring 2019 AAE 251 Design Project

This semester your team will be assigned to either a space- or an aircraft-oriented design project. Each team will choose its name and be assigned to either the aircraft or the space project.

1   Logistics

1.1   Update Email

By every Sunday, each team **must** send an email to the TA mailing list (aae251-tas@lists.purdue.edu). This email will contain three things:

- One or two sentences (no more!) on what the team did this week for the project.
- A sentence that states what the plan is for next week.
- A sentence on any issues encountered.

Remember to CC your teammates when you send your update email.

1.2   Project Reviews

We will have several opportunities for you to get feedback on your progress. Please check the course schedule for exact dates.

- January: Initial instructor review
- February: Second instructor review
- March: Third instructor review
- April: Paired review sessions on your project progress

These reviews are intended to help you continue making good progress on your projects, and deliver quality final reports and videos. You are in charge of earning your grade! If you are not sure about something related to the project, ask!

1.3   Project Report

Your main final deliverable is a report describing your project. Use this google doc as a starting point: https://docs.google.com/document/d/1D9ZoKiOY-3DW0wtZGDRbPPW8Gg4bfugWgDoOJHHij0U/edit?usp=sharing

Please submit your google doc link to BB with each update. Remember to share them with us at aae251purdue@gmail.com with editing allowed, so we can give you feedback.

We will also put a Microsoft Word version of the template on Blackboard. You may want to import your document into this template at the end of the semester, since Word has more advanced formatting options.

The final report is due, in pdf format, on BB by **11:59pm, Thursday of Dead Week**.

1.4 Project Video

We will not have the traditional final project presentations. Rather, each team will prepare a 4–6 minute video documenting their project.

The videos should be uploaded to **YouTube** with **"Unlisted"** privacy setting. After uploading your video to YouTube, you need to **submit a link** to your video via **Blackboard**. The link should be submitted via BB by **11:59pm, Thursday of Dead Week**.

How you choose to present your story is up to you, but your video must contain at least:
- Title, with your team name, member names, the class name, and the date. [~15 seconds]
- A brief review of the project stakeholders and requirements (highlight the important/interesting ones) [~30-60 seconds]
- A brief discussion of risks [~30 seconds]
- A discussion of your design process [~3 minutes]
    - How did you generate concepts?
    - What calculations did you do?
    - How did you choose concepts and design features (e.g., airfoil)
- Your final design [~30 seconds]
- What you learnt [~30 seconds]

I know these times seem really short, but think about how much companies convey in a 30 second advert!

2 Project Description

"We were all warned that it could happen, we just didn't know when. Or how bad it would be."

Survivor of the Zombie Apocalypse of 2019

"Auuuuuh. Auuuuuh."

Victim of the Zombie Apocalypse of 2019

2.1 Background

The event that ended civilization as we knew it was the Zombie Apocalypse of 2019, despite academic studies that said such a thing could never happen [Skokowski, 2002]. It started in the airports. Probably someone got bit, who bit someone else, and then this plague spread throughout the world. Humanity was caught unprepared. The world's military were at a loss. It turns out that USSTRATCOM was hit pretty early, so was Schriever AFB, and NAVSTAR (GPS) was out. Fortunately, the West Lafayette area has been relatively safe from zombies. Some hypothesize that the rot smell near Grissom Hall and the corn processing plant on US52 have kept the ghouls away from the area. Nevertheless, we're safe, but we don't know if we are alone among the undead. We suspect that there are safe havens of other humans, but we don't know where or how many. We need other humans so that we can strike back, because it's only a matter of time before we could be eliminated ourselves [Munz et al., 2009]. We can't communicate with the outside world, but we have a snapshot of the

internet as it was in spring of 2018 and our libraries have lots of resources. Plus, we have our airport and some key manufacturing facilities in the area.

2.2 Design Requirements and Constraints

Here's what we can do at Purdue:

- Figure out where the living people are. Fortunately, before the outbreak we were able to develop cubesats, which are 10 cm on each side and have a mass of 5 kg each, that use thermal imaging to identify human life. Zombies, being undead, have a body temperature similar to their surroundings. We've got lots of cubesats in storage and we have the tools to build a ground control and a launch facility. We just have to get the cubesats into space and in the right orbits to help us find other humans so that we can...
- Send a plane to pick up the survivors. Unfortunately, we don't have planes right now either. But we can design and build something on the scale of a 737 with what we have here at Purdue. Unlike a 737, these jets must be able to land pretty much anywhere. Remember, all public and military airports are off limits—too many zombies! Where else could the airplane land? How could we load passengers quickly? And how do we deliver relief to humans at safe havens where we can't land? We don't know much about zombie behavior. Good guides are Munz et al. (2009), Darabont (2010), Wright (2004), and Brooks (2003). Perhaps we will learn more as the semester goes on. So we'll have to design our plane to be agile, adaptable, and maximize its SAR abilities. But it also has to be realistic.

For both objectives, we have a limited amount of material and fuel. Do what you can to be efficient in your designs and to maximize our survival. Luckily, we have the skills and tools at Purdue to build just about anything anyone else could in 2019.

In the end, one design for the space vehicle and one design for the aircraft will be chosen by the instructors and the TAs. The teams whose designs are not chosen will be sent off to scout for survivors. The people on these teams will probably be eaten.

Fight the good fight.

2.3 Proposal Requirements

Your technical proposal should be specific and complete. While not all of the technical factors can be defined in advance, the following should be included:

- Demonstrate a thorough understanding of the requirements.
- Describe the proposed technical approaches to comply with each of the requirements specified here.
- Make sure you identify the critical, technical problem areas. Your descriptions, sketches, drawings, systems analysis, and method of attack, and discussions of new techniques should be presented in sufficient detail to permit engineering evaluation of the proposal.
- Include the tradeoff studies you performed to arrive at the final design.

Your report must convincingly demonstrate that the design can satisfy the design performance requirements. Your report should satisfy the following tasks to show how the design would be developed:

- Justify the final design, and describe the technologies, engine/fuel selection and technical approach used to meet the mission requirements.
- Include a dimensioned three-view general arrangement drawing.
- Provide performance estimates.
- Describe any advanced technologies or design approaches and their relative benefits as used to obtain performance improvements. Address risk mitigation if these technologies fail to materialize, including cost increase and performance decrements.
- Discuss how you made your design decisions.