Project Scope

1. Project Description

The objective of this project is to design, simulate, and fabricate an underwater glider for Boeing.

2. Key Goals

The first key goal is to optimize the design of the underwater glider for high efficiency. Energy efficiency directly affects power consumption, range, and the duration that the glider can operate without needing to be maintained by humans. Materials selection, weight reduction, and hydrodynamic designs have already been proven to reduce the energy costs associated with operating a glider, allowing gliders to operate for much longer (Zhang 2023). The team will reference these design choices when working to maximize the efficiency of the glider.

The second key goal is to implement some level of autonomous functionality with the underwater glider. Autonomy will allow the glider to react to outside conditions and change its behavior in situations where human input would be difficult to provide, such as being underwater or in bad weather. Examples of external conditions that the glider would need to react to include, but are not limited to depth, temperature, currents, and sea states. These conditions can cause significant damage if the glider is unable to react to them and make corrections to avoid or mitigate risks.

The third key goal is to apply control laws to the glider to control the buoyancy of the glider. Controlling the buoyancy allows the glider to submerge and move. By controlling buoyancy, the glider can move without the need for a traditional propeller, offering an alternative method of underwater propulsion. A combination of controls engineering, systems engineering, and design engineering will be required to ensure that these subsystems can be integrated into the underwater glider.

The final key goal is to develop a fully operational physical model. This can only come after completing all deliverables, generating prototypes, implementing the previously stated key goals, and performing computer simulations to evaluate the performance of the glider. The simulations will demonstrate the performance of the glider when subjected to different environmental conditions. This data will be used to inform the team on what design decisions need to be made to accomplish the feat of building a functioning physical model.

3. Market

The primary market for this project is Boeing, the sponsor that provided the project statement, oversees the project, and will ultimately evaluate and accept the team's deliverables. There are three additional markets that could benefit from team 502’s glider.

The secondary markets include government agencies concerned with weather and protection of the ocean such as the National Weather Service and the National Oceanic and Atmospheric Association (NOAA). Defense contractors like Northrop Grumman and Lockheed Martin are also potential markets due to the military advantages of underwater gliders, such as their stealth and autonomous capabilities. Lastly, universities and companies interested in oceanographic research and further education of the ocean would benefit from the glider due to its energy and cost efficiency.

4. Assumptions

To ensure the project remains focused and manageable, our team has made a few assumptions based on the information available and external factors that are out of our control.

1. Resource Availability
   Our team assumes that we will have access to the necessary resources, including materials for the craft's construction, such as the desired composites and metals. We are also assuming access to testing equipment for things such as pressure and buoyancy.
2. Testing Environment
   It is assumed that testing will be conducted in a controlled environment, specifically with areas that have shallow water access (such as a large pool) rather than an open or deep-sea environment.
3. Power and Data Access
   The testing facility is assumed to have readily available external power sources for charging and running initial tests. Additionally, we assume that the glider will have access to standard data collection and communication, such as GPS, to monitor its location and performance.
4. Temperature Variations
   The project assumes there will be a measurable temperature gradient in the water, which the glider will be designed to go through.
5. No Payload
   We assume that the glider will not be tasked with transporting a payload. This simplifies the design focus to be on navigation and efficiency rather than the ability to carry cargo.
6. Training Requirements
   It is assumed the personnel handling the glider will have the proper training or expertise to deploy and use it, thus minimizing the training required for testing.

5. Stakeholders

This project is authorized by FAMU-FSU College of Engineering. The internal stakeholders include Team 502 and the teaching staff for Senior Design EML 4551C. The teaching staff consists of three teaching assistants Elias Haase, Tripp Lappalainen, and Jacob Schmitt, as well as the senior design professor Dr. McConomy. Dr. McConomy is responsible for overseeing all students working on various projects and their progression throughout the program. Shawn Butler has been designated Team 502's point of contact for the project's sponsor Boeing. Internal stakeholders have direct influence over the direction of the project.

There are several external stakeholders to consider. At the FAMU-FSU College of Engineering three professors were aided as extra resources to help project progression with their input, these professors are: Dr. Shoele, Dr. Clark, Dr. Ordonez. Dr. Shoele is the assigned advisor to the project, Dr. Clark and Dr. Ordonez are controls and robotics professors at FAMU-FSU Collage of Engineering, and Dr. Oates has interest as the Dean of Mechanical Engineering, and a successful project adds to the prestige of the university.

Other external stakeholders include the NOAA, the United States Navy, the United States Coast Guard, commercial fisheries, and environmental groups such as Oceana. These could all have interest in the project as the development of underwater gliders can be used in each of the specialty fields of each organization such as: reconnaissance, fuel efficient motion, and autonomous area coverage.

References

Zhang, J., Li, B., Peng, Y., Zou, D., & Yang, G. (2023). Optimization design of pressure hull for long-range underwater glider based on energy consumption constraints. *Journal of Marine Science and Engineering*, *11*(1), 202. https://doi.org/10.3390/jmse11010202