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My interest in ships started eleven years ago when I came across several interesting maritime stories while watching historical documentaries on the History channel. These stories included the voyage of the Titanic, the last stand of the Yamato, and the luck of the Enterprise. A few years later, when I participated in a STEM program at school, I learned that a career as a naval architect would allow me to combine my love of ships, maritime history, and science, and I have been determined to become a naval architect ever since. One way I have pursued my interest in naval architecture and marine engineering is by conducting research. During the 8th grade, I conducted my first research project by studying the effect of drag on different ship hulls and bow types using computational fluid dynamics (CFD) technique to perform this investigation. During the 10th and 11th grades, I conducted research on vortex-induced vibrations and their potential use as a form of maritime propulsions by investigating the feasibility of a direct drive engine and a piezoelectric generator. So, when I found out about Naval Horizons, I became fascinated with the research topics presented in the videos. Of all the topics, artificial intelligence (AI) in ships inspired me the most to propose a possible solution to today's problems.

As AI improves in its sophistication and capability, demand throughout all parts of society has increased for such a versatile tool. One such entity with a high interest in AI is the United States Navy, as seen by its development of unmanned surface vehicles (USV). Such vehicles have the capability of risker missions without dangers being presented to personnel, as well as increasing flexibility of design without the restriction of crew accommodations, as stated by Dr. Bob Brizzolara (2020) in an interview for Naval Horizons. However, such vessels are not without issues. Some issues are with the current nature of AI itself, such as the problem of USV interpreting cameras and radar as mentioned by Dr. Brizzolara (2020). Another issue is with hull design, where Dr. Leigh McCue (2020) states in her interview that current designs for USV use existing hull designs, as opposed to having optimized structures seen in unmanned submersibles and drones. Researchers like Dr. McCue are currently investigating hull designs that allow a vessel to move forwards, backwards, and sideways without respect to the orientation of the vessel. In this essay, potential designs will be proposed and explored, followed by a plan for implementation as inspired by Dr. McCue's research.

Regarding a ship that can move without respect to which way is up or down, there are a few possible implementations. One would be to design a ship with a high buoyancy and stability so that the risk of capsizing is minimal. Another option would be to design a self-righting ship. The final option would be to design a ship that can continue moving after capsizing. The first design is the simplest design that can be achieved using traditional methods. However, once the ship does capsize, it is difficult to return it to an upright orientation. The second option allows for a design that does not need to factor orientation as much as the other options as the ship will return to an upright position regardless of situation. However, such a ship must have a superstructure that is watertight, buoyant and can withstand forces from rolling, which results in an unoptimized ship (Akyıldız & Şimşek, 2016). The final option allows a ship to operate at multiple orientations, thus negating the need for high stability or self-righting. However, this design results in a higher drag than the other designs, which do resemble traditional ships. Furthermore, all designs are most efficient moving forwards and backwards, with these designs experiencing high drag relative to movement forwards and backwards when moving sideways. Some ships today have the capability to moving sideways due to propellers placed perpendicular to the ship's length. However, these are mainly designed for slow maneuvering into ports, not as a means of primary movement. Therefore, a hull design must be hydrodynamic along all axes in order to allow for constant motion along a two-dimensional plane. A possible solution could be a circular hull.

The idea of a circular hull is an infamous one among naval architects and marine engineers, which can be attributed to the Imperial Russian Navy in the 1870s. The popovas were unique circular warships designed with the intention of having high displacement and less surface area needed for armor, thus allowing for larger guns with a 360-degree gun arc (Hay, 2014). However, according to Hay (2014), the design proved to be problematic as the ships had poor maneuverability and ignored crew accommodations. The ships have been regarded as a failure, although they could see better use in modern times. A circular ship has the same beam regardless of its direction, so the hull maintains high and constant stability regardless of its direction. Also, a circular hull almost experiences the same drag regardless of what part of it is facing forwards, so the flow is constant and predictable. The design's disregard for crew accommodations would also be useful to USV. As for issues with propulsion and other aspects of design, CFD software and other simulations can help optimize the hull. Although the design is not the best for offensive operations, it could be applied for defensive actions, like how the popovas were effective coastal defense ships. If a purely circular hull does not work as intended, then the hull can be modified through elongation like the Livadia, which solved every issue with the popovas (Hay, 2014).

However, future experimentation must occur in order to determine the feasibility of the proposed design. The way this experimentation will be conducted is through the use of CFD technique and experimental testing using a tow tank. Research conducted within a university with a tow tank is most optimal. This research seeks to determine the best hull form for USV by comparing the performance of each hull in a variety of environments to be encountered by such vessels, such as incorporating waves from various sea states. By exposing each hull design previously mentioned to such environments, the hull that suits the needs of USV will be determined. That hull design will then be optimized by modifying its design as well as incorporating additional components of a ship until a final design is achieved. Such experimentation can be done in a university setting, where students participate in research programs to conduct research on similar topics. This research carries on beyond the moment the students become professors. Furthermore, experimentation at a university lab produces data that can be taken up by Navy researchers to continue investigating the established work. Therefore, experimentation by students and professors at a university can result in further research being done by the Navy, possibly with collaboration with said students and professors.

I am inspired by Naval Horizons to take up this work. I have wanted to have a PhD in naval architecture ever since I was young, and after watching the videos provided by Naval Horizons, I believe that working as a researcher for the United States Navy is a possible option. By participating in such projects, not only would I prepare myself for a career in naval architecture in general, but I would also build up the connections and experience needed to work for the Navy. Eventually, in twenty years, the most optimal hull design and software system will be developed for USV, resulting in novel hull designs not typically seen in ships today, perhaps including a circular hull. At the current rate of research, smaller coastal craft will have achieved full autonomy, while larger vessels such as destroyers will be able to conduct some activities without human assistance. In the future, the Navy will cement itself as the world's most effective fighting force, capable of ensuring global peace and a low risk to servicemen due to autonomous vessels. As the Navy develops vessels for its own goals, such technological advances will be introduced to civilians, allowing for autonomous vessels similar in sophistication to warships to be used for recreational and commercial purposes. Concepts already exist for such vessels, but still utilize traditional hull designs and have yet to incorporate technology developed by the Navy. In twenty years, autonomous ships will be common throughout the world, rendering most manned ships outdated. This future will see efficiency, safety, and cost reduction improve throughout the seas, and I hope to play a part in that future.

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