Development of Autonomous USVs within an Intelligent Systems Engineering Capstone

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***Abstract*—Student robotics competitions provide a structured way to connect engineering coursework with open-ended, field-tested systems development. This paper presents the integration of the Artificial Intelligence Maritime Maneuver Indiana Collegiate Challenge (AIMM ICC) into Indiana University's Intelligent Systems Engineering capstone sequence. AIMM ICC requires student teams to design, build, integrate, and validate autonomy-enabled unmanned surface vehicles (USVs) under realistic outdoor conditions. The capstone maps these requirements into a two-semester design-build-test process spanning requirements definition, subsystem development, hardware selection, system integration, testing, and on-water validation. Across three cohorts, student designs progressed from an exploratory adaptation of a competition-provided vessel, to a semi-submersible marsupial architecture, to a multi-agent system strategy. Competition performance improved alongside this curricular integration, culminating in an overall championship and sweep of all AIMM ICC categories. Initial student outcomes indicate that participation supported workforce placement, continued graduate study, and returning-student knowledge transfer. These results suggest that AIMM ICC can serve as a repeatable capstone framework for maritime autonomy education and field-tested autonomous systems design.**

I. Introduction

Undergraduate engineering programs increasingly use student competitions to connect disciplinary coursework with open-ended systems engineering practice. Competitions require students to move beyond isolated assignments and instead design, fabricate, integrate, test, document, and demonstrate working systems under external constraints. These experiences are particularly valuable in intelligent and autonomous systems education because successful performance depends on the coordinated use of sensing, perception, planning, controls, embedded computing, mechanical design, communication, and field validation. As a result, competition-based projects provide a natural bridge between classroom learning and the type of iterative, multidisciplinary engineering practice expected in senior design and capstone settings.

A growing body of student robotics and vehicle competitions illustrates this educational model. RoboBoat, for example, is an international student competition in which teams design, build, and operate autonomous surface vessels that complete on-water tasks involving navigation, sensing, object detection, and obstacle avoidance [1], [2]. RoboSub similarly challenges students to develop autonomous underwater vehicles for realistic underwater missions, emphasizing autonomy and systems engineering in a maritime environment [3], [4]. Defend the Republic extends this model to autonomous lighter-than-air vehicles, requiring teams of students and researchers to design vehicles for adversarial, force-on-force autonomy tasks involving coordination, planning, and implementation [5]–[9]. Across these examples, competitions often function in two complementary ways: as research platforms, where faculty-led laboratories use them to advance autonomy, perception, or vehicle design, and as curricular platforms, where student teams use the competition requirements as the basis for capstone or senior design work. For instance, RoboBoat has been implemented as a senior capstone project at institutions such as the United States Coast Guard Academy [10] and Embry-Riddle Aeronautical University [11], demonstrating how a competition vehicle can serve as a year-long design, integration, and testing project.

Similar patterns are well established in aerospace engineering. The AIAA Design/Build/Fly competition was created to give university students real-world aircraft design experience by requiring teams to design, fabricate, and demonstrate an unmanned electric radio-controlled aircraft for an annual mission profile [12], [13]. Many aerospace programs integrate this type of competition directly into senior design: Virginia Tech describes its Design/Build/Fly team as led by undergraduate aerospace engineering seniors and supported by underclassmen [14], while university capstone programs have used AIAA Design/Build/Fly and SAE Aero Design as structured design-build-test experiences. SAE Aero Design similarly emphasizes technical design, written reports, and oral presentations, making it well aligned with capstone outcomes in engineering communication, design justification, and prototype validation [15], [16]. Recent engineering education work has also framed SAE Aero Design as a multidisciplinary capstone experience supporting systems integration, collaboration, and engineering self-efficacy.

The Artificial Intelligence Maritime Maneuver Indiana Collegiate Challenge (AIMM ICC) [17] provides a related but regionally focused opportunity for intelligent systems education. Hosted by Trine University in partnership with Naval Surface Warfare Center Crane Division, AIMM ICC

(a) (b)

Fig. 1: Indiana University's 2024-2025 ISE capstone students with their 2,600 lb semi-submersible autonomous boat.

asks Indiana university teams to develop low-profile vessels capable of Autonomy enabled autonomous maritime operation. The competition emphasizes applied autonomy through tasks such as navigation, object detection and identification, obstacle avoidance, sensing, data transmission, and return-to-base operation. These requirements align closely with the learning objectives of Indiana University's Intelligent Systems Engineering curriculum, where students study cyber-physical systems, artificial intelligence, robotics, sensors, controls, and system integration.

This paper examines how AIMM ICC was integrated into Indiana University's Intelligent Systems Engineering capstone sequence, describing the competition context, curricular alignment, three years of student USV designs, competition results, and initial student outcomes.

II. Artificial Intelligence Maritime Maneuver Indiana Collegiate Challenge

The Artificial Intelligence Maritime Maneuver Indiana Collegiate Challenge (AIMM ICC), is an autonomous maritime systems competition in Indiana in which university teams design, build, and demonstrate low-profile vessels capable of autonomous operation. The challenge is hosted through a partnership between Trine University and Naval Surface Warfare Center Crane Division (NSWC Crane), and is structured around practical maritime autonomy tasks such as navigation, object detection, identification, and mission execution using autonomy enabled control systems. Rather than serving only as a robotics contest, AIMM ICC provides an applied engineering environment in which students must integrate perception, autonomy, embedded systems, communications, and mechanical design together, ultimately culminating in a field deployment of their developed systems under realistic environmental conditions.

The competition is designed around a sequence of practical maritime autonomy challenges that require teams to demonstrate reliable system performance in an outdoor water environment. Tasks include launching from the dock, navigating gates and buoy fields, avoiding obstacles, identifying target buoy colors, deploying or recovering objects, transmitting sensor data, and returning the vessel to dock. The scoring structure rewards successful task completion while also encouraging approaches that improve operational effectiveness, such as autonomous execution, reduced dependence on GPS, and use of less commonly used onboard sensing modalities including IR, radar, or LiDAR. Penalties that are given for interventions, buoy contact, or failure to meet vessel requirements further reinforce the importance of robustness, safety, and repeatable performance. In this way, AIMM ICC evaluates not only whether a vessel can complete a mission, but whether it can do so reliably with minimal human assistance in realistic conditions.

Across its first three years, AIMM ICC has involved a broad set of Indiana institutions, including Indiana University Bloomington, the University of Notre Dame, Trine University, Purdue University West Lafayette, Purdue University Fort Wayne, Purdue University Indianapolis, and Rose-Hulman Institute of Technology. This statewide participation gives AIMM ICC value beyond a single-institution capstone activity by creating a shared external benchmark for autonomous maritime system design, student presentation, technical reporting, and field performance.

III. Curriculum Integration

AIMM ICC is well suited for capstone integration because it maps directly onto the design-build-test cycle expected of senior engineering projects. Within Indiana University's Intelligent Systems Engineering curriculum, the competition provides a concrete platform for applying coursework in cyber-physical systems, artificial intelligence, sensing, control, embedded computing, communication, and team-based design to a mission-driven autonomous maritime system. The course functions as a project-based vehicle design challenge, moving students from requirements definition and system architecture to prototyping, hardware integration, validation, and competition-based assessment. Because AIMM ICC requires field deployment, the project also exposes students to practical constraints that are difficult to reproduce in conventional classroom assignments. This allows students to face real-world issues in a safe-to-fail environment and include hardware availability, water-tightness, environmental uncertainty, sensor reliability, interface management, and schedule risk.

The capstone implementation is organized to mirror professional engineering practice. Students work in functional sub-teams focused on vehicle design, sensing, controls, communication, and autonomy, with one student typically serving in a program manager-like role responsible for scheduling, task delegation, and coordination. This structure enables parallel subsystem development while requiring regular coordination across technical interfaces. Students select and requisition hardware, adapt designs based on cost and availability, and integrate independently developed subsystems onto the autonomous maritime vehicle through hardware-in-the-loop testing, on-water validation, and iterative tuning. Regular design reviews and check-ins provide feedback on technical progress, schedule risk, system readiness, and competition preparation.

A. *Intelligent Systems Engineering*

The Department of Intelligent Systems Engineering (ISE) at the Luddy School of Informatics, Computing, and Engineering at Indiana University (IU) is reshaping what engineering education can be. Rather than limiting itself to traditional disciplinary boundaries, ISE integrates computation, artificial intelligence, sensing, embedded systems, and physical system modeling with a rigorous engineering framework. ISE emphasizes a systems-level perspective grounded in mathematics, science, and core engineering principles. Its educational philosophy emphasizes the tight coupling of theory with experimentation and real-world system development, enabling students to design, build, and deploy engineered systems that operate in dynamic, uncertain environments. This systems-oriented approach spans applications including cyber-physical systems, computer engineering, bioengineering, environmental engineering, intelligent systems, molecular and nanoscale engineering, and neuroengineering.

The department offers B.S., M.S., and Ph.D. degrees in Intelligent Systems Engineering, providing vertically integrated training from undergraduate through doctoral levels. The department's engineering portfolio continues to expand with the addition of a B.S. in Computer Engineering beginning in Fall 2026, and a cross-departmental B.S. in Robotics beginning in Fall 2027. Together, these programs reflect IU's commitment to forward-looking engineering education that tightly couples theory, experimentation, and real-world system development, preparing graduates for the challenges of modern, data-driven, autonomous, and intelligent systems.

The AIMM ICC capstone closely aligns with the Luddy School's strategic vision of providing students opportunities to apply their knowledge to real-world challenges through experiential, project-based learning [18]. This "learn-by-doing" approach is increasingly recognized as essential for effective engineering education, particularly in domains where students must integrate computation, hardware, autonomy, and physical system performance. In this context, AIMM ICC provides an especially strong match for ISE because it requires students to connect intelligent algorithms with embedded implementation, sensing, controls, communication, mechanical design, testing, and field deployment.

B. *Engineering Capstone Curriculum*

The ISE capstone sequence consists of ENGR-E 490 Engineering Capstone Design I and ENGR-E 491 Engineering Capstone Design II, which together form a two-semester senior project requirement for Intelligent Systems Engineering students. The sequence is designed to support faculty-guided projects aligned with student concentrations, including advanced research, prototype development, new product design, and redesign of existing products. Major deliverables include oral presentations, project reports, and prototypes, providing a natural structure for AIMM ICC as a year-long autonomous maritime systems project.

Within this structure, AIMM ICC fits as a project-based capstone experience that requires students to move from requirements capture and conceptual design to prototyping, integration, verification, and validation under real-world constraints. The sequence emphasizes the engineering design process, customer requirements, objectives and constraints, conceptual design evaluation, mathematical modeling, engineering economics, sustainability, multidisciplinary teamwork, project management, ethical responsibility, and professional documentation. These elements align closely with the development of an autonomous maritime vehicle, where students must translate competition requirements into system architecture, subsystem responsibilities, hardware choices, test plans, and field-ready prototypes.

The capstone assessment framework also supports AIMM ICC integration through explicit ABET alignment. The strategic checkpoints distributed across both semesters evaluate team and individual contributions against ABET student outcomes, including complex problem solving, constrained engineering design, effective communication, ethical and professional responsibility, teamwork, experimentation, and acquisition of new knowledge. Team-level criteria include technical content, engineering principles, system-level design and integration, professionalism, and coordinated delivery, while individual criteria emphasize technical depth, use of datasheets and specifications, testing or simulation results, reflection, and clarity of presentation. This ABET-aligned structure ensures that AIMM ICC is evaluated not only as a competition activity, but as a rigorous capstone experience grounded in measurable engineering education outcomes.

IV. Student Maritime USV Designs

Across the first three years of Indiana University's AIMM ICC participation, student teams developed a sequence of maritime uncrewed surface vehicle (USV) designs that reflected both changing competition requirements and accumulated institutional knowledge. The students explored the full range of the term USV as this represented platforms that ranged from surface vessels to low-profile and partially submerged designs that traded speed for limited visibility. Each cohort approached the course requirements differently and developed their own strategy that built upon the lessons learned from prior systems developed. They also took advantage of the developed institutional knowledge and prior developments each year to build progressively better systems.

The resulting designs illustrate an iterative educational progression rather than a single fixed vehicle architecture. Early work emphasized understanding the competition environment, establishing basic vessel functionality, and identifying integration challenges. Later designs increasingly focused on subsystem reliability, autonomy implementation, sensing strategy, communication robustness, and field-test readiness. The following subsections summarize the student-developed maritime USV designs across the first three AIMM ICC cohorts, highlighting how each year's platform contributed to the evolving capstone model.

A. Year 1: 2023-2024

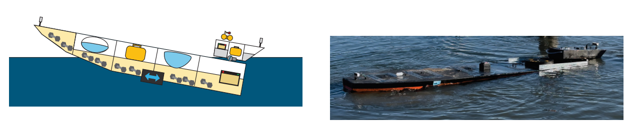
The first year of Indiana University's AIMM ICC participation was primarily exploratory. The team focused on understanding the competition format, the provided maritime platform, and the practical challenges of autonomous operation on water. The effort began with the 14-ft low-profile boat supplied by the competition, which arrived as a "boat kit" with the sensing, computing, and propulsion hardware provided. The students' primary task was therefore not to design a vessel from a blank slate, but to determine how these components could be integrated into a working autonomy system. This first platform, shown in Figure 2, served as both a vehicle and a learning testbed. Students addressed core maritime integration issues, including leakage prevention, ballast and waterline management, propulsion and steering validation, and software integration. The team also developed computer vision capabilities for buoy and object detection, which provided an early foundation for later autonomy. Although the first-year system utilized the competition-provided hardware, the experience revealed the complexity of fielding an autonomous maritime vehicle in an outdoor environment, where perception, control, mechanical design, and environmental effects must operate together. These lessons informed later cohorts, particularly in waterproofing, sensor placement, testing logistics, and the need for early system-level integration.

Fig. 2: Year 1 students with the competition-provided 14-ft low-profile vessel, used for initial autonomy integration.

B. Year 2: 2024-2025

In the second year, the design strategy shifted from adapting the provided platform to developing a semi-submersible marsupial vehicle architecture. The team reused the original full-scale vessel as a mothership, but substantially modified it to operate as a low-profile platform with submersion capability. Major modifications included fiberglass sealing, differential thrusters, submersion pumps, internal ballast, and a waterproof electronics enclosure. These changes allowed the vehicle to lower its profile in the water while preserving enough internal volume for power, computation, sensing, communication, and mission hardware. The year-two system also introduced a smaller, 3 ft long, 150 lb sub-scale boat that could operate with or alongside the mothership. Figure 3 shows the two vehicles near the beginning of the AIMM ICC course. This dual-vehicle strategy allowed students to utilize the advantages of a large mothership with those of a smaller, more maneuverable platform. The full-scale boat provided payload capacity and enabled the semi-submersible concept, while the sub-scale boat offered a more agile vehicle for tasks that did not require the larger platform. The submersion concept is shown in Figure 4. Ballast tanks, internal ballast, and pumping were used to adjust buoyancy and reduce the visible profile of the vehicle. The design also allowed differential ballast adjustment, enabling the mothership to tilt for deployment and recovery of the sub-scale boat and competition task objects. Figure 5 shows the system-level architecture of the full-scale platform, specifically power, sensing, onboard processing, control, communication, and actuation. The sub-scale boat used a similar autonomy and control approach, but without the submersion pump system. Together, these designs marked a transition from first-year exploration to a more deliberate systems-engineering approach, while also exposing students to the logistical constraints of operating a 14-ft, 2,600-lb vehicle, including transportation, launch, recovery, testing, and on-water troubleshooting.

Fig. 3: Year 2 marsupial strategy, utilizing a submersible mothership with a smaller boat.



(a)

(b)

Fig. 4: Year 2 submersible mothership concept where ballast, pumps, and differential buoyancy control the waterline and tilt for deployment or recovery of the sub-scale boat.

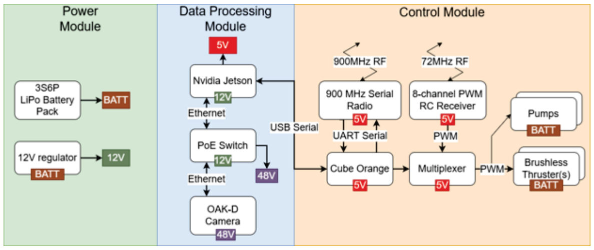


Fig. 5: The high-level system architecture of the Year 2 full-scale vehicle.

C. Year 3: 2025-2026

The third-year design built directly on lessons from the full-scale semi-submersible platform and the sub-scale boat. Rather than continuing to rely on the unwieldy 2,600-lb vessel, the team developed a new 700-lb mid-scale boat sized around the payload, power, sensing, and reliability requirements of the AIMM ICC course. This platform retained the capacity needed for autonomy and mission hardware while reducing the logistical burden associated with the larger mothership. The resulting strategy was a multi-agent system, where the new mid-scale boat completed most course tasks, while the sub-scale boat from the previous year was retained for selected tasks. Figure 6 shows both vehicles staged near the beginning of the course. The year-three system emphasized reliability, autonomy, and field readiness. The mid-scale boat integrated sensing, onboard computation, propulsion, control, communication, and mission hardware into a platform that could be deployed and tested more efficiently than the previous full-scale vessel. This emphasis on robustness was important because the scoring trials occurred under grueling environmental conditions, including rain, wind with gusts up to 25 mph, and temperatures in the high 40s °F. Figure 7 shows two capstone students in the water, preparing the vehicle in these conditions, with other team members staged on the dock for operation and support. The design demonstrated its ability to remain watertight, reliable, and operational despite the weather, while the multi-agent architecture enabled competition tasks to be distributed across two vehicles. As will be discussed in the competition results section, this design progression demonstrated how lessons from the first two years translated into a more robust and competition-ready autonomous maritime system.

Fig. 6: Year 3 multi-agent vehicle configuration at the start of the AIMM ICC course.

Fig. 7: Year 3 capstone students preparing their USVs under grueling rainy, windy (gusts up to 25 mph), and cold (highs in the 40s) conditions.

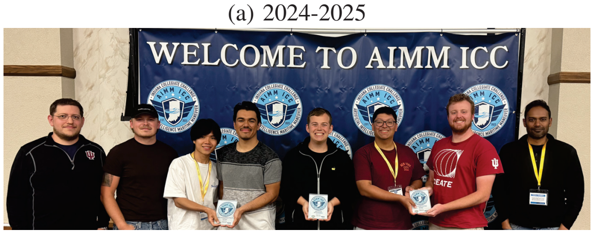
V. Competition Results

Indiana University's AIMM ICC participation progressed from an exploratory student effort into a structured model for integrating competition-based autonomy projects into the curriculum. In the first year, the team was assembled from students across the Luddy School, and the experience primarily served as a learning opportunity for understanding the competition format, maritime hardware constraints, field testing demands, and autonomy integration on a waterborne platform [19]. Because team composition changes each year, with new students joining and some returning from prior years, knowledge transfer became an important part of the program's development.

In the second year, the effort was more directly connected to the Intelligent Systems Engineering capstone sequence, with an ISE capstone team supported by students from Computer Science and Data Science. This structure gave the new cohort a defined framework for design, implementation, testing, and competition preparation while preserving lessons from the prior year. Performance improved accordingly, including first place in the project presentation section of the competition, fourth place in the autonomous course challenge, and successful completion of all nine course challenges in a single run [20].

By the third year, continued participation and accumulated institutional knowledge contributed to a comprehensive success. The third year's cohort team won the overall grand championship and swept the technical design report, project presentation, and course challenge categories [21]. This resulted in IU being the first team to win every category in the competition simultaneously. The team was also the only one to complete every course challenge during this year, doing so mostly autonomously under difficult weather conditions. These early results suggest that AIMM ICC can serve not only as a competition venue, but also as a repeatable educational platform in which successive student cohorts build on prior work to improve autonomous-system design and field performance.

(a) 2024-2025



(b) 2025-2026

Fig. 8: Indiana University students winning various parts of AIMM ICC.

VI. Student Outcomes

Figure 9 summarizes outcomes for 24 students involved in Indiana University's AIMM ICC effort across the first three years (2023-2026). Students are assigned a primary outcome category, with hatch markings used to indicate additional status when applicable. Primary outcomes include full-time employment, continued undergraduate enrollment (STEM B.S.), continued or completed STEM M.S. study, continued STEM Ph.D. study, and unknown outcomes. Full-time employment primarily refers to industry positions, but also includes placements in research laboratories and civilian defense/military laboratories. Additional markings indicate students who participated again in the following year or who continued to a STEM M.S. and then entered full-time employment.

Overall, the outcomes show that AIMM ICC participation supported both workforce placement and continued STEM education. Across the unique student set represented in Fig. 9, 13 students entered full-time employment directly; these positions were primarily in industry, but also included placements in research laboratories and civilian defense laboratories. An additional 5 students pursued STEM M.S. pathways: 4 continued to or completed a STEM M.S. and then entered full-time employment, while one was continuing in a STEM M.S. program at the time of tabulation. 4 students continued in STEM Ph.D. programs, and 2 students had unknown outcomes at the time of tabulation. Students shown in the STEM B.S. category were still completing their undergraduate degree after their initial AIMM ICC participation and also participated in the following year; they subsequently entered full-time employment directly and have already been counted above.

The hatched segments provide longitudinal context by identifying students who returned in the following year as participants or student advisors, as well as those who followed a STEM M.S.-to-employment pathway. These outcomes suggest that AIMM ICC supported multiple post-participation trajectories, including sustained engagement

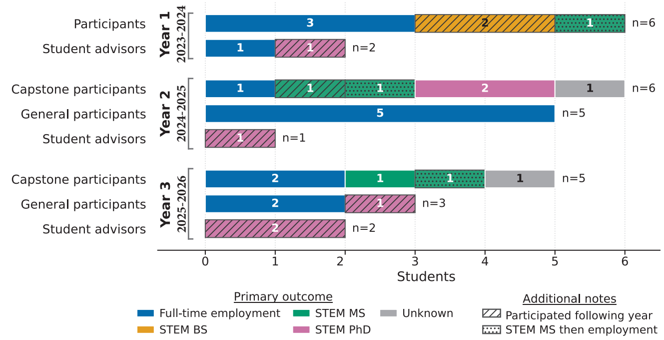


Fig. 9: Indiana University student outcomes by AIMM ICC cohort and role.

with the program. The returning-student and advisor pathways were especially important for knowledge transfer across cohorts, helping preserve technical lessons, design artifacts, and testing experience as new students entered the capstone sequence.

These results suggest that AIMM ICC served multiple educational pathways, including immediate transition to engineering employment, continued graduate study, and sustained engagement through returning participation and advising. In this way, the project complemented the capstone model by providing not only a design-build-test experience, but also a mechanism for knowledge transfer across cohorts and preparation for professional and research-oriented careers in intelligent autonomous systems.

VII. Conclusions

This paper presented the integration of AIMM ICC into Indiana University's Intelligent Systems Engineering capstone sequence as a repeatable framework for maritime autonomy education. Across three years, the effort evolved from exploratory use of a competition-provided vessel to increasingly deliberate student-developed USV architectures, including a semi-submersible marsupial system and a multi-agent system vehicle strategy. The capstone structure supported requirements definition, subsystem development, hardware integration, testing, and on-water validation, while also enabling knowledge transfer across cohorts through returning participants and student advisors. Competition results and initial student outcomes show that participation in AIMM ICC can support both student-led USV development and educational pathways into graduate study, industry, research, and defense.

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REFERENCES

[1] I. RoboNation, "Roboboat," https://roboboat.org/.

[2] C. August and D. Beach, "Roboboat 2020 rules and task descriptions," 2020.

[3] I. RoboNation, "Robosub," https://robosub.org/.

[4] A. Goel, C. Szeto, M. Szeto, R. Veerepalli, and E. Vij, "Leveraging competitive robotics experience to spread marine education," in *OCEANS 2021: San Diego – Porto*, 2021, pp. 1–9.

[5] George Mason University, Patriot Pilots, "Defend The Republic Spring 2025," https://gmublimpsquad.github.io/index.html.

[6] Indiana University, Aerospace Systems Lab, "Defend The Republic Fall 2024," https://www.iu-dtr.com/.

[7] W. Duffie, "Battle blimps: Onr-sponsored stem contest shows creativity of student engineers," https://www.onr.navy.mil/media-center/news-releases/battle-blimps-onr-sponsored-stem-contest-shows-creativity-student, 2024.

[8] O. D. Dantsker, "Integrating unmanned aerial systems into the intelligent systems engineering curriculum," Paper 2024-1185, Congress of the International Council of the Aeronautical Sciences, Florence, Italy. 2024.

[9] J. Simmons, A. Lovelace, D. Tucker, A. Mendoza, A. Coates, J. Alonzo, D. Li, X. Yi, S. Potter, I. Mouritzen, M. Smith, C. Banta, R. Hodge, A. Spence, and S. Koziol, "Design and construction of a lighter than air robot blimp," in *2023 ASEE GSW*, no. 10.18260/1-2-1139-46327. Denton, TX: ASEE Conferences, June 2024, https://peer.asee.org/46327.

[10] United States Coast Guard Academy, "Senior projects - electrical engineering," https://uscga.edu/academics/majors/electrical-engineering/ee-senior-projects/, 2026.

[11] A. Lachguar, G. Ucles, S. Sarkar, D. Lane, E. Liebergall, S. Aggarwal, M. Thomson, W. Proper, D. Dcruz, B. Jagwani *et al.*, "Robotx team minion takes on roboboat 2025."

[12] A. I. of Aeronautics and Astronautics, "Aiaa design/build/fly competition," https://aiaa.org/dbf/.

[13] C. Bovais, D. Levy, G. Page, S. Powell, M. Selig, and T. Zickuhr, "Writing the rules: An inside look at the aiaa student design/build/fly competition," in *6th AIAA Aviation Technology, Integration and Operations Conference (ATIO)*, 2006, p. 7832.

[14] Kevin T. Crofton Department of Aerospace and Ocean Engineering, "Virginia tech's design, build, fly team snags fourth place at aiaa competition," Virginia Tech News, April 2024. [Online]. Available: https://www.aoe.vt.edu/about-us/news/articles/2024/design-build-fly-fourth-place-2024.html

[15] S. International, "Sae aero design," https://www.saeaerodesign.com/.

[16] I. I. Basith, S. H. A. Faruqui, A. Dinc, J. Hill, E. E. Robles, A. P. Jackson, and F. Coker, "Design of a micro class airplane for sae 2024 competition: Fostering engineering self-efficacy and collaboration in capstone education," in *2025 ASEE Annual Conference & Exposition*, 2025.

[17] Trine University, "AIMM ICC - Artificial Intelligence Maritime Maneuver Indiana Collegiate Challenge," 2026. [Online]. Available: https://www.trine.edu/innovation-one/aimm/index.aspx

[18] I. University, "Luddy strategic plan," https://luddy.iu.edu/strategic-plan/index.html.

[19] K. Fryling, "Ai-powered-boat competition immerses luddy students in hands-on learning exercise," https://news.iu.edu/live/news/37212-ai-powered-boat-competition-immerses-luddy, 2024.

[20] P. DiPrimio, "Luddy school displays phenomenal performance in competitions," https://news.iu.edu/luddy/live/news/45638-luddy-school-displays-phenomenal-performance-in, 2025.

[21] ——, "Remarkable – luddy school dominates ai maritime maneuver challenge," https://news.iu.edu/luddy/live/news/50408-remarkable-luddy-school-dominates-ai-maritime-maneuver, 2026.