

Raising Awareness for Robotics-Aided Ocean Conservation

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Earth is 71% water, and the health and vigor of oceans and their endangered marine ecosystems have emerged as a pressing issue. The biggest challenges for ocean conservation are the enormous size and inaccessibility of these ecosystems: it is difficult to determine cause-and-effect relationships between small daily events (e.g., discarding plastic items) and global challenges (such as ocean pollution).

Experimentation, data collection, preservation, and surveying come at great costs—with numerous dull, dangerous, and dirty tasks—making them prime candidates for robotics-based automated solutions. The IEEE Robotics and Automation Society (RAS) Chapter at the Clemson University International Center for Automotive Research (CUICAR) sought to use this opportunity to shift more attention to this issue, generate innovative solutions, and enable and motivate the engineers of today and tomorrow.

Founded in 2007, CUICAR is an advanced-technology research campus in Greenville, South Carolina, focused on next-generation automotive systems. In recent years, that focus has evolved to include vehicle automation and autonomous operations for land, sea, and air. Robotics laboratories at CUICAR—such as the Automation, Robotics, and Mechatronics Lab and Collaborative Robotics, headed by Dr. Venkat Krovi,

and the Collaborative Robotics Automation Lab, headed by Dr. Yunyi Jia—have deployed innovative ways to train incoming graduates from diverse engineering backgrounds and provide them with the necessary electromechanical and software skills needed to realize autonomous systems. Courses such as Autonomy: Science and Systems,

Autonomous Vehicle Technologies, and others seek to empower students with exposure to the theories and technologies necessary for the autonomy paradigm (see [1] for further details).

Hand-in-glove with pedagogical and research efforts, the IEEE RAS Clemson Chapter has participated in various outreach efforts to promote



Figure 1. The graduate student competition of 2017. (Photo courtesy of Dr. Yunyi Jia.)



Figure 2. One of the summer camp's student-made boats. (Photo courtesy of Aditya Yerra.)



Figure 3. The various boats constructed by the summer camp students. Pictured in the lower center photo are students from the graduate student competition. (Photos courtesy of Adhiti Raman.)



Figure 4. Students compete in the final showdown. (Photo courtesy of Aditya Yerra.)



Figure 5. (From left) Dr. Srikanth Pilla, Dr. Yunyi Jia, and Dr. Uwe Neumann (vice president of Bosch Rexroth) listen to a student poster presentation. (Photo courtesy of Aditya Yerra.)

robotics among graduate, undergraduate, high school, and middle school students. In 2017, the Bosch Community Fund supported an autonomous boat competition among Clemson's graduate-level students at CUICAR. In that competition, led by Dr. Jia, 71 students were divided into 18 groups, each of which built an autonomous boat equipped with cruise control, boundary tracking, and collision avoidance using the sensing, signal-processing, and filtering techniques and advanced control methods taught by Dr. Jia in his automotive electronics course (Figure 1).

The success of this event led to the Ocean Conservation Summer Camp, focused on autonomous boat building

and aimed at local middle and high school students during the summer of 2018 (Figures 2–4). Dr. Jia, the advisor of Clemson University's IEEE RAS Student Branch Chapter, teamed up with Dr. Srikanth Pilla, advisor of the local Clemson Society of Plastics Engineers (SPE), to organize this event.

Supported by the Bosch Community Fund, this collaborative, month-long camp included lectures on boat-building materials and sustainability, hands-on tutorials about electronics system integration, Arduino programming, and boat controls (Figure 5). Students 11–17 years old created 13 different autonomous boat designs and competed in scenarios to

clean up plastic debris floating in the oceans. Encouraged by the success of this event, Clemson University's IEEE RAS and SPE Chapters hope to make this an ongoing summer activity, improved and enhanced in future editions. For more information, visit <http://newsstand.clemson.edu/mediarelations/youngsters-learn-value-of-preserving-earth-while-building-autonomous-boats-at-cu-icar/>.

Reference

- [1] A. Raman. (2018). Enabling graduate engineering students with proficiency in mobile robotics. engrXiv. [Online]. Available: <https://engrxiv.org/fsqcz/>. doi: 10.31224/osf.io/fsqcz