



Making Waves

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Summer 2007

Special points of interest:

- Summer BBQ at Dr. Burke's house!
- MIT Museum Exhibit on ROVs this summer!

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RoBoat: An Ocean Engineering Capstone Design Project

Evan Karlik ('07), James Sannino ('07), Christina Gomez ('07)

The industry standard today for deploying all robotic ocean-going vehicles whether manned, remotely operated, or autonomous, is to use a manned research vessel to deploy it, wait for it to run its mission, and then retrieve the vehicle. However, by implementing smarter autonomy and longer battery life, autonomous robots can spend days underwater surveying and running missions without the need of constant watch from above. The current necessity of the manned vessel places a huge cost on ocean surveying projects. This project originally intended to create a robotic monitor for such projects by developing an ocean kayak that autonomously controls itself and can relay signals to and from the subsurface vehicle.

The project first started in the Spring 2005 term, a capstone design class for the Ocean Engineering class of '06. Those



The RoBoat built by seniors Evan Karlik, James Sannino, and Christina Gomez.

students laid the groundwork – installing a trolling motor and servo motor in the kayak hull, placing two emergency stop buttons on the kayak exterior, and other tasks. The '07 Ocean Engineering class was given a similar project statement for 2.017 (Spring 2006) and 2.019 (Fall 2006) capstone design courses. At the conclusion of

our work, the kayak could be driven remotely via wireless modem and could also run pre-programmed courses on the Charles River. Our acoustics system could successfully track a subsurface transponder, as well. Three students are continuing with the development of the kayak and systems for

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Spotlight on: Claudio Cairoli

Interviewed by Rachel Price ('10)

Claudio Cairoli was born in Como, Italy. He finished four years in the Aerospace Engineering Department at the Polytechnic of Milan in Italy, holds an MS in Mechanical and Aerospace Engineering from the University of Virginia, an MS in Naval Architecture and Marine Engineering from MIT and defended his Ph.D thesis, which was a free-surface flow simulation

program to calculate the total hydrodynamic forces for sailing yachts, in December and graduated in February. He is currently co-teaching with Professor Milgram in the Sailing Yacht Design class.

What sparked your interest in OE?

Well, the area that I am interested in is very specific, I am

really interested mostly in yacht design. I started sailing when I was 11 or 12 and loved it from the beginning, so when it was time to choose a college major I realized it would have been great to do something that would let me be around sailboats all the time. Since I always wanted to

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RoBoat: An Ocean Engineering Capstone Design Project

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their senior theses.

Evan Karlik installed a depth sounder in the kayak hull, and intends to take it for a spin on the Charles in remote control mode. With depth data and corresponding GPS locations, he'll be able to use GIS software to plot the bottom topography of the river. He also attached two Mistral windsurfer fins to the stern of the kayak for added directional

stability because the motor is located in the bow of the boat and without resistance from the stern, the kayak is difficult to steer.

James Sannino extended the work on the acoustic system to find the optimum configurations for tracking and positioning as well as the resolution capabilities of a low-cost system. His goal is to upgrade this system to enhance its autonomy for further implementation.

Christina Gomez is developing the software required to enable the acoustic tracking system to autonomously control the kayak. To properly follow an acoustic source with the system mounted on the kayak, specific algorithms would be necessary to position the craft properly in relation to the source.

If all goes well, these prototypes could easily be developed into a marketable product.

“The current necessity of the manned vessel places a huge cost on ocean surveying projects.”

Spotlight: on Claudio Cairoli

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be an engineer, yacht design seemed the way to go. There was no specific program in Italy, so I started by doing aerodynamics. A chance of studying abroad brought me to the University of Virginia. I then started looking around for a Naval Architecture program and eventually found Professor Milgram. I came up to MIT and we talked; I then applied, got in, and I've been here for six and a half years.

What are you working on right now?

I defended in December and graduated in February, so I've been looking around for jobs a lot. Professor Milgram was asked to teach a yacht design class one more time before he leaves, and since I was his TA the last time he taught it, he asked me if I wanted to teach it with him, and I did. Also up until the first half of April I was working with Professor Milgram and some other designers on the upgrade of a racing sailboat. It involved design, computational and experimental work and I enjoyed it a lot. I'd been working on it for roughly a



Claudio Cairoli in his natural habitat.

year and a half just for fun in between thesis work, but then over the last four months I've had a little bit more time and I've been doing it as a job.

What changes did you make to the boat?

It's an International 12 Meter, a design from the 1987 America's Cup, now they're mostly used to race against each other. The owner wanted an upgrade, so

we fitted it with a new keel and rudder, cut out the bow and put a new one in. We kept the mid body that has an aluminum structure that holds the mast, rigging, and the keel.

How does it feel to be past your thesis?

These last couple months have been a lot of fun, I've enjoyed the project and the class a lot. (Continued on Page 3)

“I always wanted to be an engineer, yacht design seemed the way to go.”

Spotlight on Claudio Cairoli

(Continued from Page 2)

I've enjoyed the class a lot more than the last time because I didn't have the ghost of my thesis hanging over my shoulder, it's been much less stressful. Although now I'm stressing out about finding a job...

Are you looking for jobs in the US or are you trying to go back to Italy?

I have a slight preference for staying in the US, but I think

I've sent resumes to three different continents. I'm not really looking specifically to go back to Italy quite yet. It's a very niche job market, you have to be pretty open as far as location is concerned. If you think about it, you can't really end up in a bad place: San Diego, Newport, Annapolis, Valencia, Australia, none of them are bad.

What is your favorite MIT memory?

In a certain way, academically, I

would have to say my thesis defense, just because it meant that I was done. Otherwise there are so many, it's hard to pick just one specific event. Classes kind of feel like a distant memory, as I had just been doing research for the two years prior to my graduation. I think the last time I was involved with a class was the last time I TA'd for yacht design. I have a lot of great memories of people I've met, friends I've made, and projects I've worked on.

Look out for this summer's events including a BBQ at Dr. Burke's house. See you in the Fall!

The Ocean Engineering Department would like to express their deepest sympathies to the friends and families of the victims of the recent tragedy at Virginia Tech.

Don't forget! Sometime this summer the MIT Museum will have an exhibit on ROVs!

Spotlight on the Graduating Seniors

(In their own words)

Name: Seth E. Clark

Plans: Next year I will be attending the University of Southampton to get a Master of Science degree in Maritime Engineering Science. I will live there with my wife Sarah and go to school with my best friend Tim Pennington ('06).

Senior Project: I worked on the design and construction of a two meter long autonomously controlled model sailboat.

Favorite OE Memory: Sophomore year I took a class called Mechanical Systems Signal Processing and Stochastics, which was unbelievably difficult. The night before the test Nina Young and I stayed up all night to cram. After getting no sleep and doing hundreds of Fourier Transforms, we both ended up passing and even got A's on the test.

Name: Evan Karlik

Plans: I will commission into the US Navy on June 8, then head out to Stanford for a bit over a year to earn a M.S. in Aero/Astro, then start at Navy flight school in Pensacola, Florida.

Senior Project: For my senior thesis, I outfitted the 2.019 "RoBoat" remote-control kayak with a depth sounder and conducted a depth survey of the Charles River Basin.

Favorite OE Memory: I still fondly remember building my Sea Perch and deploying it in the Z-center pool as a freshman in DOE, and this spring I enjoyed chasing RoBoat around the river in a Sailing Pavilion motorboat.

Name: James Sannino

Plans: Next year I hope to be working in the field, possibly at an oceanographic institution.

Senior Project: My senior project involves designing and building an autonomous acoustic tracking system. Given enough time it could be implemented to an autonomous surface vehicle which is also being constructed.

Favorite OE Memory: My favorite part about OE is the closeness of the department. With so few undergrads, once you meet the people in your classes, you know everybody! Getting to know them really made me feel at home here.

Name: Nina Young

Plans: I was accepted as a fully-funded masters student at the MIT Media Lab in Tod Machover's "Opera of the Future/Hyperinstruments" group.

Senior Project: I analyzed the possibility of placing dual-fuel diesel electric motors on the newly developed LNGRV's (LNG Regasification Vessels). With the changes in

gas prices the idea of using diesel motors in LNG ships has become popular (before the ships were powered from the boil of natural gas in the vessel)- currently 50% of new LNGs in the order books are being outfitted with Dual-Fuel Diesel Electric Motors. This idea is also being considered for future orders of LNG Regas Vessels- making offshore terminals going straight into the pipeline feasible. Because of onboard regasification, the power consumption is quite different for an LNGRV vs. a typical LNG vessel. I analyzed this option from economic, engineering, and environmental points of view.

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We're on the Web !

web.mit.edu/13seas



Sailing Vessel Design
Julie Arsenault ('08)

This semester, due to popular demand, a course on Sailing Vessel Design was offered. Professor Jerry Milgram, one of the foremost experts in the field of yacht design, agreed to teach the class one last time before retiring. Students gained the theoretical knowledge necessary to design hulls, sails, and appendages. The final project was to design a yacht—all aspects of a yacht. Students began by designing the hull, the keel and rudder were next, followed by the sailplan and rig. Loads on the rigging were calculated and components were chosen accordingly. Finally, students concluded the project by designing the structural supports, calculating skin thickness and weight, and laying out the deck and interior of the yacht. The project was an extensive foray into designing an entire system. Here are impressions from some

of the students:

“It was nice to be able to learn from the best before he retired.” –Jordan Stanway, Graduate student in Ocean Engineering.

“It is rare at MIT that a student gets to design an entire system. This class gave us a really great opportunity to see every aspect of sailing vessel design by requiring each student to design their own boat from top to bottom.” –Morgan Laidlaw, '08 Ocean Engineering.

“Designing a Sailing Vessel is one of the most interesting courses I have taken at MIT. This course had an excellent mix between theory, laboratory, and sharing of experience with experts in naval architecture.” –Patrick Martel, MIT Sloan Fellow.

“Sailing Vessel Design has taught me a lot about sailboats; what we know about them and how they work. However, I've noticed that there is a lot about sailing that we don't understand. Yacht design is as much art as it is science and this class has shown me some of the magic behind it all” –Seth Clark, '07 Ocean Engineering.

“I truly enjoyed teaching the class and seeing the progress all of the students made during the term. I learned a lot from them too.” Claudio Carioli, co-instructor

And lastly, Adam Guttenplan (G) quotes Jim Taylor, a local yacht designer from Marblehead, Massachusetts:

“Nobody NEEDS a sailboat...”

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13Seas is the ocean engineering student organization. We are a group of students, faculty, and alumni who work to build and maintain the vitality of the ocean engineering community at MIT.

Check us out on the web at: web.mit.edu/13seas

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