



Making Waves

The 5th Annual Ocean Technology Job Fair and New England SNAME Student Paper Competition

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Thanks to all who made the 5th Annual Ocean Technology Job Fair a success!

Held on February 22, 2002, the Ocean Technology Job Fair is the largest recruiting event in the New England area for ocean engineering, marine technology and naval architecture students and companies. Throughout the day, students had the opportunity to interact with industry representatives from across the country, as well as attend information sessions presented by each of the participating companies. These sessions allowed students to learn more about each company, such as their specific interests and current research.

The career fair also served as a medium for intercollegiate networking by bringing together approximately two hundred students from MIT, the University of Rhode Island, the University of New Hampshire, Boston University and the US Coast Guard Academy.

In addition, the New England SNAME Student Paper competition was held in conjunction with the Job Fair. Students from MIT, UNH, and the Coast Guard Academy presented their research. Representing MIT were: Melissa Harness '02 "Velocity Measurements of a Cavitating Tip Vortex on a 3-D Hydrofoil Using Particle Imaging



CAPT Craig McLean of NOAA, 13SEAs Pres. Katy Croff, VP Anna Michel, Job Fair Chair Jessica Donnelly, and New England SNAME Chair Denny Mahoney

Velocimetry"; Jae Auh (G) "Analysis of Internet-based Business Models in the Container Shipping Industry: A Technology Strategy Perspective with Case Studies"; and Anna Michel (G) "Experimental Flow Characterization of Anguilliform Swimming Motion." We are currently awaiting award announcements.

Keynote CAPT Craig McLean, Director of the NOAA Office of Ocean Exploration, spoke about the future of ocean exploration and need for new technology, methodology and fresh young minds to pave the way for the new generation of groundbreaking research.

13SEAs would like to extend special thanks to our Career Fair Chair, Jessica Donnelly, and Maggie Merrill, Executive

Director of MOTN, whose planning made the day a huge success. We thank the student and faculty of MIT Ocean Engineering for volunteering your time and resources both before and during the event. We are pleased to have hosted the NOAA Corps, US Navy Coastal Systems, Naval Surface Warfare Center, Naval Undersea Warfare Center, Naval Oceanographic Office, Scientific Solutions, Inc., Northrop Grumman, Fiberspar, American Bureau of Shipping, and Science Applications International Corporation. We are grateful for your support and hope to see you again next year!

This event was sponsored by 13SEAs, MOTN, SNAME, MTS, and MIT's Large Event Funding.

OCEANS 2002 Call for Student Posters

OCEANS 2002 MTS/IEEE will sponsor a Student Poster Session. Full-time students in engineering and the sciences are invited to submit an abstract describing their work in the technical topic areas of the conference.

The abstract must be submitted via e-mail (without attachments), fax, or hard copy to the address below. Students selected to present their posters will be notified of their acceptance and provided information on available scholarships.

Abstracts due: April 30, 2002

Contact: Richard L. Crout
OCEANS'02 Student
Program Chair
crout@cnmoc.navy.mil
Fax: (228) 688-5791

<http://www.oceans2002.com/>

Call for Papers

**9TH INTERNATIONAL
CONFERENCE ON MARINE
ENGINEERING SYSTEMS**
May 18-21, 2003

Topics: Marine engineering systems and issues; Owner/operator experience; New technologies, practices, and procedures in design, management, operation, and maintenance

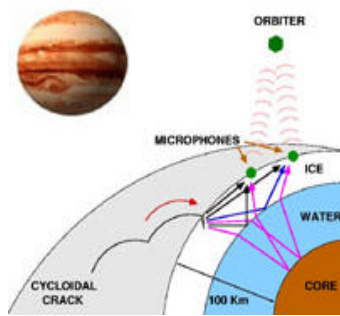
Abstracts due: May 30, 2002:
Notification: Sept. 1, 2002
Papers due: February 1, 2003

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Spotlight on Research: Listening for an Ocean in Space

by Professor Nicholas Makris



Schematic of acoustical sensing methods to determine the depth of the ocean on Jupiter's moon, Europa.

Will the acoustic techniques we use to probe our own oceans on earth one day be used to probe oceans on another world? I sometimes wondered this, but never thought I would live to see the day that it may happen. Well, I still may not live to see that day, but the odds are very high that my students will! All bets are on that these techniques will be used on Jupiter's moon Europa in the next couple of decades. It is equally fantastic that work done in a particularly specialized and environmentally extreme area of acoustics, known as arctic acoustics, now provides a vital link to the search for extraterrestrial life.

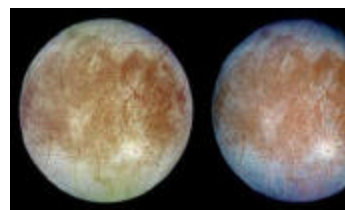
Europa is one of four Jovian moons. Discovered by Galileo in 1610, Europa is roughly the size of earth's moon but is covered with a layer of ice and possibly liquid water that is roughly 100-200 km thick above a silicate and iron core. Its radius is roughly 1500 km, about 1/4 that of the Earth. What is remarkable about Europa is that below this ice sheet may lie a dark ocean of salty water that exceeds the volume of all terrestrial oceans combined. This makes Europa probably the world outside of our own for life to exist, as we know it.

Most planetary scientists agree that the outermost surface of Europa is a brittle ice sheet that is roughly 5 km thick. What stimulates most debate is what

lies beneath this layer. At one extreme is a thin-shelled model and at the other is a soft convective ice model.

Proponents of the former argue that a liquid ocean at least 100 km deep lies directly below the brittle ice. Those in favor of the latter argue that there is no liquid ocean below but only mushy ice that extends to the moon's core. The middle ground, which seems to be most popular, is taken by those who believe that about 40 km of soft convective ice lies below the brittle surface and beneath this is an ocean of liquid water that extends for 5 to 100 km to the planet's core [1].

Perhaps the strongest evidence for a liquid ocean on Europa stems from magnetometer data collected during Galileo's orbit [2]. Europa's magnetic pole flips direction like a big compass as it orbits around Jupiter's immense magnetic field. The magnitude of this field change indicates that the surface of Europa has a conducting layer that is at least 6 km thick. Thus, favoring the existence of a salty ocean.



Picture from Galileo probe revealing intricate network cracks present on the surface of Europa.

Other evidence comes from optical images of Europa from the orbiting Voyager probe of the early 1970s and the Galileo probe of the mid 1990s. These revealed a large number of surface cracks and craters on Europa's surface--some extending for thousands of kilometers -- that have been healed by liquid water or soft ice oozing up from below.

How do acoustics come into the

picture? Electromagnetic waves are quickly attenuated in water, so the primary tool for probing the depth and structure of our terrestrial oceans is with sound. At low frequency, sound waves can propagate thousands of kilometers across the ocean. For example, humpback whales vocalizing as far away as Greenland have been readily tracked using acoustic listening stations in Bermuda.

We plan to use both acoustic echo-sounding and tomographic techniques to probe Europa's interior. Echo-sounding reveals the depth and composition of the seafloor and sub-bottom layers by analysis of the arrival time and amplitude of acoustic reflections from these interfaces. Tomography reveals the temperature structure of the ocean by the way sound waves are perturbed along forward propagation paths. Multiple sources and receivers are typically required to probe a large volume of ocean by tomography. On Europa, our goal is to use echo sounding to determine the thickness of the ice layer and the depth of the potential ocean. We also hope to use tomography to invert for the temperature structure of Europa's ice or water layers since this temperature information holds vital clues for the existence of life.

According to current plans at NASA, the first Europa landing mission is probably two decades away and will likely only carry a single acoustic sensing device. Many valuable measurements can be made with a single sensor. For example, the first task should be to determine the level of acoustic activity on Europa by time series and spectral analysis. Correlations should be made of ambient noise level versus tidal stress to determine whether noise levels respond directly to orbital eccentricities.

(Continued on page 4)

Celebrating a Century at MIT: The XIII-A Program *by John Hootman*

It's not what you get when you ask a Canadian "What Scares a Tridecaphobic?" ("13, eh")

"13A"...many of us have heard of it and seen its students around, but it's more than another one of those mysterious MIT acronyms; it represents a large and important portion of the OE department.

The Naval Construction and Engineering Program (Course 13A) "prepares Navy, Coast Guard, foreign naval officers, and other graduate students for careers in ship design and construction." The program's website

(<http://web.mit.edu/13a/www/>) states that a primary goal of the program is to prepare its students for their future roles as

advocates in ship design and acquisition and that it does. Graduates have gone on to become four-star admirals, corporate executives, and leading researchers in naval engineering fields.

Two active duty naval officers (who are also MIT professors and 13A graduates) lead the program, Captain R. S. McCord, USN, and Commander J.V. Amy Jr., USN. Thirty 13A students currently represent the United States, Greece, Canada, Chile, Turkey, and Israel and are working towards Masters, Engineers, or Doctoral degrees in the OE department, as well as degrees in other departments throughout MIT.

One important aspect of the 13A

program is its emphasis on the design of a ship as a total ship system. 13A students have recently completed design projects investigating the conversion of a fleet supply ship to a range instrumentation ship, a submarine to an undersea survey platform, and a commercial catamaran ferry to numerous military roles. Another team of 13A students has undertaken a yearlong project to perform a concept design of the next generation Amphibious Helicopter Assault ship. Each of these projects is sponsored by and is of timely interest to the US Navy.

The 13A program is also sponsoring the 2002 Ship Design and Shipbuilding Technology Symposium on May

8th and 9th. This symposium "establishes and maintains positive communications among industry, Navy labs, and Navy programs on research and education issues relevant to the Naval Construction and Engineering curriculum and MIT in general." This year's theme is "Designing the Navy for a New Type of War" and will feature Vice Admiral George "Pete" Nanos, Commander, Naval Sea Systems Command as the keynote speaker.

Last May, the 13A program celebrated its 100th anniversary here at M.I.T. Let's hope that they'll be around for another 100 years.

Exxon-Mobil Offshore Research Scholarship

by Katie Wasserman



ExxonMobil Offshore Research Scholar Matt Greytak '04.

Four students vied for the \$1500 scholarship and opportunity to attend the Offshore Technology Conference in Houston, Texas, May 6-9, 2002. Senior Lecturer Dave Burke, Professor Paul Sclavounos, and Professor Michael Triantafyllou judged the competition. The winner was selected based on the following criteria: the research merit, its applicability to the offshore community, knowledge and understanding of the subject,

and ability to relate said knowledge to others.

Matt presented his research on the forces and drag on an underwater cylinder in driven oscillation. When vortex-induced vibration from ocean currents causes an underwater cable or riser to oscillate, these oscillations are transmitted down the cable into a region of slower or unmoving fluid. In this region, the cylinder causes the water to oscillate, instead of the other way around (as is the case near the surface). For the design process of these cables and risers, it is therefore necessary to understand what forces a cylinder in driven oscillation.

Turgut Sarpkaya's papers of 1976 and 1985 offer a wealth of data on this phenomenon. Matt's goal is to verify Sarpkaya's results in MIT's larger towing tank. So far, Matt has worked with a cylinder mounted between two endplates, which are driven in vertical oscillations. The next

phase of Matt's research will be to design a two-axis, spring-suspended system, in which the cylinder would be allowed to oscillate in two axes.

Other students in the running, and their entries: Karl McLetchie '02 "Drag Reduction of an Elastic Fish Model", Saul Rosser (G) "Underwater Optics and LED Technology", and Katie Wasserman '04 "Drag on Multiple, Flexible Cables."

References:

Greytak, M. *Summary of Current and Future Research*, Massachusetts Institute of Technology, Cambridge, MA, 2002.

Sarpkaya, Turgut, *In-Line and Transverse Forces on Smooth and Sand-Roughened Cylinders in Oscillatory Flow at High Reynolds Numbers*. Naval Postgraduate School, Monterey, CA, 1976.

Sarpkaya, Turgut, "Force on a Circular Cylinder in Viscous Oscillatory Flow at Low Keulegan-Carpenter Numbers." *J. Fluid Mech.* Vol. 165 pp. 61-71, 1986.

**Congratulations to
Melissa Harness,
winner of the SNAME
William M. Kennedy
Graduate
Scholarship**

**Congratulations
to our new
Ph.D. Candidates!!!**

George Dikos
Jay Dryer
Konstantinos Galani
Qiao Hu
Sunwoong Lee
Young-Woong Lee
Anna Michel
Travis Poole
Jeff Stettler
Xiaqing Teng
Ding Wang
Jon Withee
Liang Xue
Li Zheng

National Engineers Week at the MIT Museum

One of our primary goals is to participate in community programs and activities to introduce engineering concepts to students of all ages in hopes of sparking an interest in marine science and related fields.

13SEAs president Katy Croff and treasurer Karl McLetchie helped to celebrate National Engineers Week and share their passion for OE at the MIT Museum with a group of children ages 7-12. Together they and built sailboats to introduce the concepts of buoyancy and stability, and to demonstrate a simplified mode of fluid flow around a moving vessel.



Junk Food & Junk Yard Wars

Come see Sea Grant's Justin Manley '96 leads his team to victory...or defeat?
May 6th, 2pm, Rm 5-314

Conference on Technology, Archaeology and the Deep Sea

April 26-28, 2002



<http://web.mit.edu/sts/deeparch>

MIT DeepWater Archaeology Research Group

13SEAs Internship Program

STUDENTS: Are you having trouble finding a summer internship that's tailored to your field of interest? Are you looking for a meaningful summer experience that can bridge the gap between problem sets and practical application? Perhaps we can help...

13SEAs is launching a pilot program to match ocean engineering students with internships at participating companies. If you are an undergraduate seeking a summer internship:

Send your resume in pdf or MS Word format along with a short statement of interest (1 page maximum). Please indicate location, if necessary.

EMPLOYERS: If you would like to host an undergraduate intern for the summer, please write a 1-page summary that includes the kind of position you are seeking to fill, potential projects, start and finish dates, and salary.

As positions arise, we will match students up with companies based on their statement of interest. To accomplish this remarkable feat by the end of April, we require all applicants to submit their resumes and statements of interest **no later than 5PM on April 5th, 2002**. Employers are encouraged to submit positions as soon as possible.

To submit your application, or for more information, please contact John Hootman at jhootman@mit.edu.

Research Spotlight (continued from page 2)

Estimates can be made of Europa's ice and ocean depths with a single acoustic sensor. This can be done by first finding the range to an isolated cracking event by comparing compressional and shear wave arrivals and then exploiting subsequent echoes to determine ice and ocean thicknesses. With later NASA missions, more sensors will inevitably be available and more robust inversions involving triangulation, matched field processing and tomography can be employed.

We are investigating the robustness of these various acoustic sensing techniques with fully elastic 3-D models developed for arctic acoustic propagation and scattering. One of the primary issues is that of signal-to-noise ratio. To determine conditions in which ambient noise from the sum of a large number of cracking events distributed over a wide area may overwhelm signal echoes from a distant ice-ocean or ocean-core interface, we have developed a European waveguide noise model that is based on classical ocean acoustic noise models. Our present simulations indicate that

signal echoes from an ice-ocean interface and ocean-core interface can stand robustly above European ambient noise if the spatial distribution of active surface cracks is on the order of a typical cycloidal crack length.

I am often asked how an ocean acoustician became involved in an extraterrestrial problem. It began when NASA's Scientist in charge of the Europa program gave a talk at my weekly freshmen seminar entitled Acoustical Oceanography. Plans for the current NASA landing craft included a device to melt through a very thick ice sheet. I mentioned the idea of using remote acoustic sensing techniques and natural sound sources as a possible alternative. We were invited to give a talk at NASA and have been working with the planetary science community ever since.

The MIT graduate students who are working on this project are Sunwoong Lee, Purnima Ratilal, Josh Wilson, Yisan Lai and Post-Docs Aaron Thode and Michele Zanolin. We have more recently been collaborating with planetary scientist Prof. Robert Pappalardo of the University of Colorado. The work is partially funded by ONR under

my Secretary of the Navy/Chief of Naval Operation Scholar of Oceanographic Sciences award.

[1] Pappalardo, Robert T., Belton, M. J. S., Breneman, H. H., Carr, M. H., Chapman, C. R., Col - Does Europa have a subsurface ocean?; evaluation of the geological evidence, Journal of Geophysical Research, E, Planets (October 25, 1999) 104 (10), p. 24,015-24,055, illus. incl. 1 table, 120 refs, 1999.

[2] Margaret G. Kilvelson, Krishan K. Khurana, Christopher T. Russel, Martin Volwerek, Raymond J. Walker, Christophe Zimmer - Galileo Magnetometer Measurements: A stronger Case for a Subsurface Ocean at Europa. SCIENCE VOL 289, pages 1340-43, 25 August 2000.

[3] Gregory V. Hoppa, Randall Tufts, Richard Greenberg, Paul E. Geissler - Formation of Cycloidal features on Europa SCIENCE, vol. 285, pages 1899-1902, 17 September 1999



Dr. Nicholas C. Makris is the MIT Doherty Professor of Ocean Utilization.

Spotlight on Alumni: Archie Todd Morrison III



Todd Morrison trapped by a roving band of profilers.

After spending the 80s at Harvard, Raytheon, Yale, and Cornell studying and working in everything from missile control radar to marine archaeology to operating a soup kitchen and maintaining a secure mailing address for 3500 homeless residents of the city of Atlanta, Archie Todd Morrison III found himself in the MIT/WHOI Joint Program in Oceanographic Engineering in 1989.

At MIT and WHOI, says Todd,

"somehow, while I was too busy with classes and research to notice, I learned how to think and solve problems."

"During my first year in grad school another first year student was struggling with an unfathomable (to us) problem. The student asked a third year grad student for help. The third year student, who had never seen the problem before, immediately and absolutely systematically, on the fly, tackled the problem, took it apart, laid it out so we could see and understand her approach, and arrived at an answer. I was both impressed and overwhelmed. I knew with terrible certainty that I was never going to be able to measure up to that performance. Several years later a first year student came to me with an unfathomable problem that I had never seen before. I took it apart on the fly without a second thought, laid it out for him, and arrived at an answer."

Todd is now applying his life experiences and newfound problem-solving abilities to create new observational capabilities that lead us to an improved understanding of the natural world. He is the Senior Engineer for Electronic Systems at the McLane Research Laboratories and the Senior Engineer at Nobska Development, as well as a Visiting Investigator at WHOI.

McLane designs and manufactures time-series sampling instruments and instrument systems for oceanographic research and environmental monitoring, which are used by ocean biologists, chemists, and geologists in a wide variety of research programs. Nobska designs and manufactures MAVS, an acoustic current sensor. MAVS is used for general physical oceanography, but is particularly well suited to marine boundary layer studies and measurements of turbulence.

In addition to his ocean engineering career, Todd is involved with IEEE Oceanic Engineering Society and with educational outreach to primary and secondary school students.

Todd is married to Hilary Ann Gonzalez, a scientist at the Marine Biological Laboratories at Woods Hole. They live in Falmouth, MA with their two children, Abigail, 10, and Daniel, 5.

For more information on Todd's work at McLane Labs and Nobska, check out: <http://www.mclanelabs.com/>. <http://www.nobska.net/>.

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In each newsletter, we would like to spotlight an OE alumnus to give students some insight into career opportunities for Ocean Engineers. If you are interested, please contact the 13SEAs news group at [13seas-news@mit.edu](mailto:13seas-news@mit.edu).

## Aprilfest !!!

Hart Nautical Gallery  
Friday, April 19th  
4:00-7:30

Join us for a bigger, better Novemberfest. More time, more people, more food, more refreshments, more selection, more mascots, and more fun with a 21+ ID. Bring friends and family. Email [knwm@mit.edu](mailto:knwm@mit.edu) with any questions. Sponsored by 13Seas and GSC



Event sponsored by  
Graduate Student Council  
all graduate students welcome

The Students and Faculty of MIT Ocean Engineering are invited to the first annual  
**Ocean Divas Dinner**  
And 13SEAs Award Ceremony

30 April 2002  
6pm, MIT Faculty Club

Featuring a discussion panel of leading women in ocean science and engineering.  
13SEAs Outstanding Faculty and Spirit of Ocean Engineering Student Awards will be presented.

To nominate a student or professor, please email [mailto:13awards@mit.edu](mailto:mailto:13awards@mit.edu) by April 17, 2002.

RSVP for the event to [13divas@mit.edu](mailto:13divas@mit.edu) by April 25, 2002.

13SEAs Newsletter

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*Making Waves is a quarterly publication of the 13SEAs written by the students of the MIT Department of Ocean Engineering.*

We're on the Web!

<http://web.mit.edu/13seas/www/>

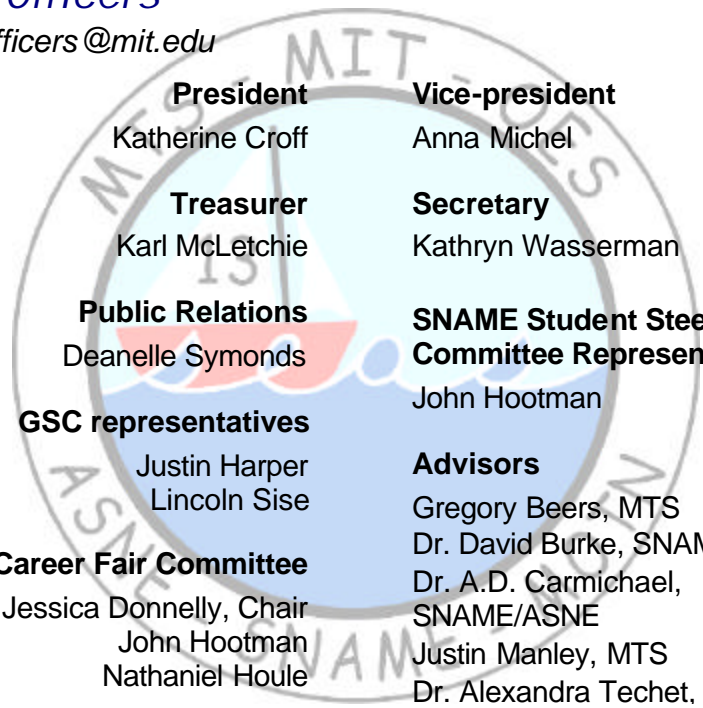
Submit your interesting news, notes and OE anecdotes to:

[13SEAs-news@mit.edu](mailto:13SEAs-news@mit.edu)



13SEAs Officers

13seas-officers@mit.edu



|                                                                                            |                                                                                                                                                               |
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Upcoming Events and Deadlines:

- April**
- 4<sup>th</sup> Glenn Ashe, American Bureau of Shipping Room 5-314, 11:30am
- 5<sup>th</sup> Resumes & Summary of Interests due for Internship Program
- 5<sup>th</sup>-6<sup>th</sup> Campus Pre-view Weekend for incoming freshman, OE lab tours
- 8<sup>th</sup> Ocean Engineering Open House Room 5-314, 3-5 PM
- 13-14<sup>th</sup> SCUBA Class & Pool Session
- 15<sup>th</sup> 16<sup>th</sup> Holiday, No Classes
- 19<sup>th</sup> APRILFEST: Hart Nautical Gallery, 4-7:30pm
- 25<sup>th</sup> Drop Date deadline
- 26<sup>th</sup> OE Undergraduate BBQ  
MIT Sailing Pavillion, 4:30-6:00 PM
- 26-28<sup>th</sup> Conference on Technology & Archaeology in the Deep Sea. Info: <http://web.mit.edu/sts/deeparch>
- 30<sup>th</sup> Ocean Divas Dinner
- May**
- 6<sup>th</sup> Junk Food & Junk Yard Wars  
2pm, Room 5-314
- 6-9<sup>th</sup> Offshore Technology Conference  
Houston, TX
- 8-9<sup>th</sup> 2002 Ship Design and Shipbuilding Technology Symposium sponsored by the XIII-A Program
- 16<sup>th</sup> Last Day of Classes
- 20-24<sup>th</sup> Finals Week Period
- 25-26<sup>th</sup> SCUBA Open Water Dives
- 27<sup>th</sup> Memorial Day
- June**
- 7<sup>th</sup> MIT Commencement

