ORE since 1966
OCEAN AND RESOURCES ENGINEERING
IN THE SCHOOL OF OCEAN AND EARTH SCIENCE AND TECHNOLOGY AT THE UNIVERSITY OF HAWAI'I AT MĀNOA

HANA O KE KAI "Work of the Ocean"

NEWSLETTER OF THE OCEAN AND RESOURCES ENGINEERING DEPARTMENT, Spring/Summer 2010, Volume 10, Issue 1

Chair's Message

John C. Wiltshire, Chair

Every three years a new chairman of ORE is appointed by the Dean of SOEST following a nomination process by the faculty. It has been my honor to serve the department for the past three years. On July 1, 2010, the Department of Ocean and Resources Engineering will have a new chairman. During the last three years, three new faculty have been hired. The department has added several new technicians. A new deepsea glider lab has been brought on board. The department's role in ocean observation and renewable energy has been strengthened and new courses have been added. The department has gained considerable space for students and technicians albeit in three different buildings of SOEST. The department's research budget has essentially doubled.

Perhaps the most gratifying part of the last three has been ABET. Every six years there is a departmental evaluation and accreditation process administered by the *Accreditation Board for Engineering and Technology*. ABET sends an evaluation team and reviews a very detailed several-hundred page Self-Study Report. On the basis of their findings, they assign deficiencies, weaknesses and concerns. Each and everyone of you, including the faculty, staff, students and supporters of ORE, should be very proud. For the first time in over 10 years, the ORE department received *no* deficiencies or weaknesses and only two very minor concerns. Of the five engineering departments at UH Manoa, the Department of Ocean and Resources Engineering received the best review in terms of both the fewest problems and most positive comments by the ABET reviewer who stated that the department was "poised for greatness".

This semester, the department renewed its outstanding student award. While the award is not designed to necessarily be given every year, it had not, in fact, been awarded for several years. This year, the award will be given to Yoshiki Yamazaki for his innovative tsunami model, the NEOWAVE model. Yoshi is Kwok Fai Cheung's Ph.D. student. The NEOWAVE model won the 2009 Benchmark Challenge at the NSF-sponsored Inundation Science and Engineering Cooperative Workshop in Oregon, correctly reproducing the waves breaking over a complex reef in the Tsunami Wave Basin at OSU and outperforming models from USGS, NOAA-PMEL, USACE and Delft3D. In other words, it's the best of the best. Congratulations Yoshi! Based on this and previous work, Fai's group were invited to Samoa to model the tsunami inundation there and are now being asked to join the Chilean tsunami evaluation team.

Lastly, it is also my honor to announce the next Chairman of the Ocean and Resources Engineering Department. Please join me in congratulating **Dr. Bruce Howe**, who will serve from July 1, 2010, through June 30, 2013. Dr. Howe is a specialist in gliders, ocean observatories and acoustics. He came to the University of Hawaii from the Applied Physics Lab at the University of Washington and brings to the department a wealth of research prowess, which will significantly move us forward on the national stage. It is with true excitement for the future that I welcome Bruce as the next chair of ORE. I have every confidence in his capable leadership, which will carry us ever onward.

Warmest aloha,
John Wiltshire

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Photo of the issue: ***ORE, the top ABET accredited school!***

Students' Voice

Masoud Hayatdavoodi, Student Representative

Student activities at the Ocean and Resources Engineering department have been a success over the past academic years. After establishing a student calendar for the year during the Fall student meeting, the activities began with a wonderful BBQ in September 2009 hosted by one of the Masters students at that time, Inchieh, who is now an alumni of the department. In the Fall semester, this was continued with the ORE men's football team in the UH tournament coordinated by Patrick. The Fall activities were finished by a department BBQ organized by Troy. The Spring semester began with a student meeting in February, a department BBQ in March and a wonderful all-ORE-surfers session at the Tennis Courts break on the south shore of Oahu. A picture of the event is given here. May this become a tradition in the department which studies waves and has many surfers. That, however, was not the end of the academic year activities, since another UH tournament was expecting the ORE team, the UH intramural softball league. This time, the ORE team was much stronger than before and although they did not really win any games, they were not an easy opponents for any of the teams. The ORE team even qualified for the second round, thanks to all players present during the elementary level of the tournament. A photo of the ORE team is published in the last page of this issue. The student activities continued through the end of the Spring semester with the recent wonderful BBQ organized by Jacob Foster. Finally, an upcoming event, the Spring 2010 ORE hike, is organized by Matthew. He picked the Kamanaiki trail as the location for the last student activity of the ORE student calendar 2009-2010.

ORE surfing group. From left: Troy, Volker, Patrick, Prof. Pawlak and Masoud. Jacob, later met the crew in the water. Tennis Courts break, South shore Oahu.

Quantitatively and certainly qualitatively, the ORE student activities have improved compared to past years and this, positively, will be continued in the next years even better than what it is now. Establishing a yearly academic calendar is certainly a key to this success.

All the success over the past academic year, however, should not prevent us from re-evaluating our performance. The Fall 2009 ORE hike as well as magazine-pick-up for both Fall and Spring semesters never happened. Although students are highly anticipated to be involved and coordinate some of the activities, it is also expected to not accept a duty if there is no chance for the nominated coordinator to support it. In fact, the magazine-pick-up has never happened over the past academic year and if none of us takes care of this, the boxes in the ORE corridor will be removed and the "service" will be canceled until a volunteer can be nominated.

Out of many, one of the achievements of the department over the past year was the ABET evaluation of ORE. The outstanding result of the ABET accreditation was obtained through the effort of many, a group of them being the ORE students. After forming a student advisory committee and evaluating the department's performance through a standard SWOT technique, students participated in two meetings with the program evaluator for ABET at the end of the past fall semester. Both meetings went very well, as well as the whole accreditation. Congratulations to everybody and many thanks to all who helped on this.

ORE student meetings, which have been held once a semester on a regular basis over the past years, has changed in their form. One of the major changes, starting from the past meeting, has been the idea of having a guest speaker at the meetings. This guest speaker will cover interesting topics for the ORE students, both academic and non-academic. The first speaker attended the student meeting in February 2010 and was the SOEST Associate Dean for Academic Affairs, Dr. Pat Cooper. She was there to talk to ORE students and, in more detail, give a summary of the ABET accreditation process and the results and necessity of evaluation. According to Dr. Cooper, two "concerns" were reported about ORE's performance: a.) Subjective outcomes of fulfilling student learning process, and b.) Some of the MS theses could be longer. Notice that receiving "concerns" does not give a negative impression about the department's performance, but rather are ideas to improve what it is believed to be good already. Another new section of the ORE meetings is the 'Life outside of ORE', which is dedicated to the involvement of the ORE students in non-ORE activities. The first speaker was Jacob Tyler and he talked about 'Engineers Without Borders', their goals, activities and plans.

One of the issues that the department is suffering from, and was discussed and approved by Dr. Cooper, is the lack of space in the department, specifically a socializing space for ORE students. A room where ORE students can socialize and have meals, instead of eating at their working desks, would dramatically change the quality of student life in the department. Although the space issue has been an ongoing one in the department and good improvement has been made over the past years, this needs to be addressed as one of the top concerns of the department, at least in students' point of view. This, unfortunately, happens while most of the ORE friends in the other departments under SOEST are perceived to have a much better situation. It is believed that aside from adding comfort to the student life, a student social-room would help in building a stronger student body in the department.

Congratulations to Inchieh, Viki, Troy and Nick for finishing their Master theses since the last issue of the newsletter. In this issue, we will hear from Inchieh. The rest will be covered in the next issue. Ann, Jennie, Ghizlane and Simone are new members of the department and we will hear more about them in the next few pages. Very welcome to the great ORE and best of luck for your life here and after.

Last but not least, this is the third issue of the ORE newsletter, Hana O Ke Kai, being published once per semester on a regular basis. This, indeed, is another success of the department and would only happen if all the ORE members participate. We all hope to see the newsletter next semester too.

The Summer is coming, a change in nature that reminds us of the natural possibility of good changes in our life. Experience, learn and enjoy a wonderful 2010 summer and hope to talk to you soon.

Live Happily!

Remembering Dr. Bretschneider

Dr. Frans Gerritsen, ORE Professor Emeritus

It was a sad moment to hear about Dr. Bretschneider's passing away. He represents so much in our memories of 25 years in Hawaii.

I was working in Holland on the closing of the Haringvliet Estuary (part of the Delta Project) when I read a small announcement in Civil Engineering magazine that "Dr. Charlie Bretscheider had been appointed by the University of Hawaii to start a new graduate program in Ocean Engineering". This was one of the first ocean engineering programs in the nation (1966).

Many years earlier, when I was associated with the Coastal Engineering Department of the University of Florida, I had met Charlie when he worked with the Beach Erosion Board, where he developed his famous wave prediction models. I wrote to Charlie, congratulating him with his new position, and suggesting that I would be interested in a position at the university in my field of expertise.

Charlie replied that coastal engineering would be an important component of the new program, and he invited me to come to Hawaii to give a series of lectures on the Dutch Delta Project, where I worked at that time (1967). Charlie had organized a lecture series for his first group of graduate students, by internationally known scientists and engineers from different parts of the world. Naturally my wife, Levina, was invited to come to Hawaii too, because she also had to decide whether or not living in Hawaii would be to her liking.

We came to Hawaii for two whole weeks, for me to lecture on fundamentals and execution of the Delta Project and for her to get acquainted with the Hawaiian culture and meet future friends.

What a time that was!!

We were overwhelmed with the beauty of the islands, with the university and its faculty, and were particularly impressed with the great hospitality of faculty (future colleagues) and administration. It was one of those periods of the university history that funds were available for faculty and administration to expand and improve the university.

Dr. Bretschneider played a very important role in this. He was able to assemble a great faculty for the department he was charged to lead.

The lovely Mrs. Evelyn Bretschneider played an important role in this process.

They often had parties at their house where people met and present and future faculty enjoyed the mild Hawaiian evenings and the Hawaiian hospitality.

With minor interruptions Charley continued to serve as Chairman of the department, and contributed to the further growth and solid reputation of the group, until his retirement in 1995.

During his tenure with the University of Hawaii Charlie continued to serve as consultant to a number of organizations in his field of expertise.

He spent his last quiet years in the country on Oahu, leaving his former colleagues and associates with a successful department with a vibrant beginning.

Charlie and Evelyn had two children, Ann and Eric.

He may rest in peace.

Upcoming Meetings and Conferences

29th International Conference on Ocean, Offshore and Arctic Engineering (OMAE 2010), Shanghai, China, June 6-11, 2010
http://www.asmeconferences.org/OMAE2010/

The 20th International Offshore (Ocean) and Polar Engineering Conference (ISOPE-2010), Beijing, China, June 20-26, 2010
http://www.isope2010.org/

3rd International Conference Coastlab, Barcelona, Spain, September 28 – October 1, 2010
http://www.coastlab10.com

The 20th International Congress on Acoustics, Sydney, Australia, August 23-27 , 2010
http://www.ica2010sydney.org/Home.htm

OCEANS 2010 MTS/IEEE Seattle, Seattle, Washington, USA, September 20-23, 2010
http://www.oceans10mtsieeeseattle.org/index.cfm

Storm Surges Congress, Hamburg, Germany, September 13-17 , 2010
http://www.loicz.org/calender/Congress/index.html

2011 IEEE/OES 10th Current, Waves and Turbulence Measurements (CWTM), Monterey, CA, USA, March 20-24 , 2011
http://www.ieee.org/conferences_events/conferences/conferencedetails/index.html?Conf_ID=16314

Coasts and Ports 2011, Perth, Western Australia, September 28-30, 2011
http://www.coastsandports2011.com.au

Inside ORE

Passive acoustic monitoring

Eva-Marie Nosal

In 1490, Leonardo DaVinci observed that "if you cause your ship to stop and place the head of a long tube in the water and place the outer extremity to your ear, you will hear ships at a great distance from you" [Urick 1983, Principles of Underwater Sound]. Even though the oceans were a much quieter place in his day, this is still a remarkable observation when you realize that DaVinci was referring to sailing ships!

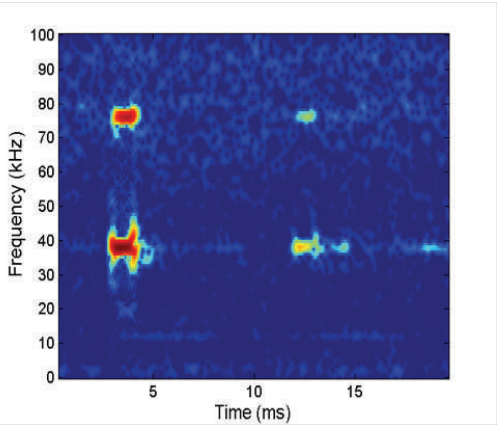
Ongoing research in the ORE Department aims not only to hear sources of underwater sound, but also to extract information about the sources themselves. Many natural and anthropogenic phenomena generate sound that travel long distances in the ocean. Using a hydrophone to passively record sound in a marine environment yields acoustic data that can be inverted for the characteristics and position of the sound sources. For example:

- low frequency sounds from earthquakes and volcanoes can be heard across ocean basins and be used to study source mechanisms
- ambient noise fields are sensitive to wind and rain rates, which can consequently be studied by quantifying noise
- fish and marine mammals use sound to communicate, find prey and navigate, so recordings of their vocalizations can be used to study their movement and behavior
- boats and ships generate characteristic noise which can be used to help monitor marine sanctuaries

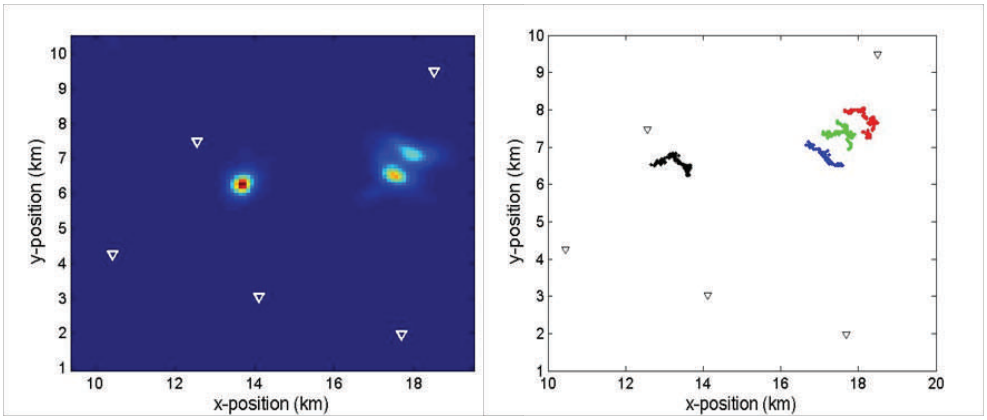
The ORE Department has several ongoing projects that aim to improve and implement methods for passive acoustic monitoring.

In one project funded by the Office of Naval Research, algorithms are sought to detect, classify, and track marine mammals. Such methods are useful for monitoring and studying marine mammal bioacoustics and behavior in the wild as well as for efforts aimed at mitigating human impact on marine mammals. This project uses recordings made at the Navy's hydrophone ranges at AUTEC (Atlantic Test and Evaluation Center) in the Bahamas and PMRF (Pacific Missile Range Facility) in Hawaii. The AUTEC and PMRF ranges cover hundreds of square kilometers of deep-ocean with bottom-mounted hydrophones. The specific problems being addressed are (1) multiple animals whose calls cannot be easily separated or associated and (2) insufficient receiver coverage for which standard tracking methods fail. Species of particular interest to this project are sperm and beaked whales at AUTEC and minke and humpback whales at PMRF. While they are useful in their own right, our passive acoustics methods are also being used to complement efforts by collaborators that use visual monitoring and tagging techniques.

A second passive acoustic monitoring project is funded by the Department of Homeland Security as part of the newly established Center for Island, Maritime, and Extreme Environment Security (CIMES; http://cimes.hawaii.edu/). This project focuses on detection and tracking of boats, divers, and AUVs in near-shore environments. Breaking waves, internal waves, currents, suspended sediment, snapping shrimp, vessel traffic, and seafloor/surface reflections (among other things) make this a dynamic and noisy environment that presents significant challenges for passive acoustic monitoring. Moreover, while deep water sound propagation is relatively well understood, sound propagation in shallow water and along the interface between deep and shallow water is a relatively new and rich area for underwater acoustics research. A goal for the coming years is to establish a state-of-the-art underwater observatory that will be used to experimentally test and apply passive acoustic algorithms and to study noise and acoustic propagation in near-shore environments. The acoustic observatory will build on Oahu's south shore using the backbone of ORE's Kilo Nalu Reef Observatory (see ORE Newsletter Volume 8 Issue 1).



Spectrogram of a typical echosounder pulse with peak frequency at 38 kHz, the first overtone at 76 kHz, and a seafloor reflection about 10 ms after the direct arrival. If treated correctly, reflections can provide extra information about the location of a source. In fact, with azimuth-dependent bathymetry and enough reflections, a source can be tracked in 3D using only a single hydrophone!



Tracking multiple sperm whales at AUTEC with 5hydrophones (triangles). The figure on the left shows a map-view of a likelihood surface at a single depth where red/blue indicate high/low probability of an animal present. Such surfaces are computed over a list of depths and times. The figure on the right shows the results: four sperm whale tracks from 20 minutes of data.

ORE news and publications

Congratulations to ORE masters student, Ryan Braman and his wonderful wife, Kyleanne, on becoming a dad and mom since January 2010!

His name is **Jude Kia`ikolani Braman**, born Jan 23 at 6lb 9oz via Cesarean section. Happy to report that Ky has completely recovered from the surgery. Jude is growing fast, and was 11 lbs by 7 weeks!

Some Recent ORE Publications

Lay, G.F.T., M.C. Rockwell and **J.C. Wiltshire**. 2009. Investigation of the properties of a borosilicate glass from recycled manganese crust tailings, *Journal of Characterization and Development of Novel Materials* 1(3): 225-240.

Nihous, G.C. 2009. A generalization of the Monty Hall Problem, *The Mathematical Scientist* 34: 94-98.

Nihous, G.C., K. Kuroda, J.R. Lobos-González, R.J. Kurasaki, and S.M. Masutani. 2010. An analysis of gas hydrate dissociation in the presence of thermodynamic inhibitors, *Chemical Engineering Science* 65, : 1748-1761.

Roeber, V., **Cheung, K.F.**, and Kobayashi, M.H. 2010. Shock-capturing Boussinesq-type model for nearhsore wave processes. *Coastal Engineering*, 57(4): 407-423.

Wu, Y.Y. and **Cheung, K.F.** 2010. Two-parameter homotopy method for nonlinear equations. *Numerical Algorithms*, 53(4): 555-572.

McCormick, M.E. and **Ertekin, R.C.** 2009a. Renewable Sea Power: Waves, Tides, and Thermals-new research funding seeks to put them to work for us, *Mechanical Engineering*, American Society of Mechanical Engineers International, May, 36-39 (http://memagazine.asme.org/Articles/2009/May/Renewable_Sea_Power.cfm).

McCormick, M.E. and **Ertekin, R.C.** 2009b. To harness the Seas, *Mechanical Engineering*, Web Exclusive, American Society of Mechanical Engineers International, May (http://memagazine.asme.org/Web/Harness_Seas.cfm).

Davis, E.P., **Ertekin, R.C.**, and Riggs, H.R. 2009. A Buoy-based WEC Device to Provide Low Power to Sensors, *Proc. 28th Int. Conf. on Ocean, Offshore and Arctic Engineering*, OMAE '09, ASME, May 31-June5, 2009, Honolulu, OMAE09-80091.

Kim, J.W., **Ertekin, R.C.** and Bai, K.J. 2010. Linear and Nonlinear Wave Models based on Hamilton's Principle and Stream Function Theory: CMSE and IGN, *J. Offshore Mechanics and Arctic Engineering*, Trans. Of ASME, Vol. 132, May, pp. 021102-1 - 021102-6, SOEST No. 7478.

Symonds, D., **Ertekin, R.C.**, Davis, E.P. and Riggs, H.R. 2010. Low-Power Autonomous Wave Energy Harvesting Device for Remote Sensing and Communications Applications, ECCE-2010, *IEEE Energy Conversion Congress and Exposition*, September 12-16, 2010, Atlanta, Georgia, USA.

Padmanabhan, B. and **Ertekin, R.C.** 2010. Interaction of Waves with a Steady Intake/Discharge Flow Emanating from a 3-D Body, *J. Offshore Mechanics and Arctic Engineering*, (In print) Trans. of ASME.

Burrows, R. and **Ertekin, R.C.** (2010). Renewable Energy: Leveraging Oceans Towards Energy Sustainability – a Role for Marine Renewables, *Applied Ocean Research* (In print)

Canals, M, **Pawlak, G.** and MacCready, P. 2009. Tilted Baroclinic Tidal Vortices, *J. of Phys. Oceanogr.* 39: 333-350.

Sevadjian, JC, McManus, M.A., **Pawlak, G.** Effects of physical structure and processes on thin zooplankton layers in Mamala Bay, Hawai'i. *Marine Ecology Progress Series*, in press

ORE Student Research

Beginning from this issue of Hana O Ke Kai, there will be a column called 'ORE Student Research' in every issue of the newsletter. The column is allocated to hear about the progress of the research going on by the ORE students. The column of this issue is allocated to Masoud, one of our PhD students, who joined the program in Fall 2007. Professor Ertekin is Masoud's advisor.

On Solitary Waves

Masoud Hayatdavoodi

Those of you who are interested in naval architecture may know the famous Scottish engineer named John Scott Russell (1808-1882) for his substantial contributions to the field. Naval architecture, however, was only one of several fields in which Russell became a master. The phenomenon of solitary wave was first observed and explained by Russell while he was conducting a boat experiment in the Union Canal in Scotland over 170 years ago in August 1834. He saw a wave, being generated by the moving boat, loosen itself from the stern and move forward after the boat was suddenly stopped. He then explains ([1]) :

... assuming the form of a large solitary elevation, a rounded, smooth and well-defined heap of water, which continued its course along the channel apparently without change of form or diminution of speed.

Russell calls the phenomenon "*Wave of Translation*". In 1995, the famous 1834 solitary wave on the Union Canal near Edinburgh was recreated during an international conference on nonlinear waves in physics and biology. This wave is shown in Fig. 1.

Figure 1: Recreation of a solitary wave on the Union Canal near Edinburgh, same place that the "first" solitary wave was observed by J.S. Russell in 1834. Copyright Heriot-Watt University, printed with permission.

The idea of solitary wave was not accepted at the time. It did not follow the rules of water wave theories of the time, mostly due to the fact that the wave keeps a constant form and velocity while propagating.

But, what is a solitary wave and why is (or at least, was) it difficult to believe such a phenomenon?

Physical definition

Unlike linear waves, a solitary wave does not have a trough, it forms entirely above the still water level with a very long wave length. While propagating, it keeps its shape and velocity with almost no deformation. Due to lack of oscillation, water particles are translated a distance in the propagation direction and thus the wave generates a net displacement of water particles. The name "Wave of Translation" is possibly given because of this characteristic. Although these are interesting features about solitary waves, there are other reasons for the idea not to be welcomed by the scientific community at the time.

A solitary wave is a result of a delicate balance between dispersion and nonlinearity. Nonlinearity tends to make the wave front steeper by increasing the wave amplitude and thus wave speed. On the other hand, dispersion fights against this by forcing the wave front to spread. The balance between these two effects is the key feature of the existence of a solitary wave and the wave becomes unstable if this balance vanishes. Due to these characteristics, later in 1953, the dimensionless Ursell number as the ratio between nonlinearity and dispersion was defined, and is usually used as an indicator of the wave class (linear or nonlinear wave theory). Dispersion was not considered during Russell's time and therefore, the theory of solitary wave could not be well understood.

Soliton

After establishing the initial mathematical basis for the solitary wave theory during the late nineteenth century, it was not until the second half of the twentieth century when solitary waves again became an interesting topic of study. This happened when applicability of solitary waves were seen in many different fields. A very interesting characteristic was the interaction between two solitary waves, where waves would split into two individual waves without losing their initial identity. The term "soliton" is coined by [2] as an alternative for 'solitary-wave pulse' as a result of this characteristic. This name was chosen to emphasize the particle-like properties of the wave. It is discussed that:

... solitons "pass through" one another without losing their identity. Here we have a nonlinear physical process in which interacting localized pulses do not scatter irreversibly.

[I remember in, at least, a couple of the meetings with Professor Ertekin, the term *soliton* was explained as the combination of the words **solit**ary and collisi**on**.]

Although an exact definition is difficult to be given, one may list the following properties for a soliton:

- Soliton is a stable wave. It keeps its shape and velocity with no major change when traveling over a flat bottom and can travel a long distance.
- The speed of a soliton depends on the wave amplitude and water depth.
- During interaction with other solitons (collision or overtaking), waves will pass through each other without any change in their identity. They merge into a single wave for a portion of time and then soon split into two solitons with the same shape and velocity as prior to interaction. In this sense, solitons behave like moving particles, they are localized and preserved during collision.

Continued on page 7

ORE Student Research

Continued from page 6

Mathematical definition

Solitons can be produced as the solution of a number of nonlinear equations. Korteweg-de Vries (KdV hereafter) equation, for instance, is one of those. KdV equation is an example of the propagation of weakly dispersive and weakly nonlinear waves, used widely to model shallow water waves. The nonlinear Korteweg-de Vries PDE is given as

$$u_t + u_{xxx} - 6uu_x = 0,$$

where x and t stand for space and time and u, which is given as a function of space and time, is the surface elevation function. The above equation is a nondimensionalized form of

$$\frac{\partial \eta}{\partial t} = \frac{3}{2}\sqrt{\frac{g}{h}}\left(\eta\frac{\partial \eta}{\partial x} + \frac{2}{3}\frac{\partial \eta}{\partial x} + \frac{1}{3}\sigma\frac{\partial^3 \eta}{\partial x^3}\right),$$

where h is the channel depth, g is the gravitational acceleration, ρ is the mass density and $\sigma = h^3/3 - Th/(g\rho)$

where T is the surface tension and η is the surface elevation measured from the still-water level.

Notice the presence of the nonlinear term $\eta\frac{\partial \eta}{\partial x}$ and the dispersion term $\frac{h^3}{9}\frac{\partial^3 \eta}{\partial x^3}$ in the same equation which, as discussed above, is the reason for the stability of the solution.

The solution of this PDE can be one-soliton answer which is a localized disturbance, which means far away from the peak the solution gives the same answer as u=0. A stationary solution of the KdV equation has the following form

$$\eta = a\,sech^2 x\sqrt{\frac{a}{4\sigma}},$$

where a is the amplitude of the wave.

A test study

Let us look into a test case of two colliding solitons, as a result of solving the shallow water, dispersive and nonlinear Green-Naghdi (G-N hereafter) equations which are derived using Cosserat surfaces. This test case is replotted from the original paper of [3]. For more details about the test case, as well as several other test cases and also the theory of G-N equations, refer to that paper. Here, there are two solitons moving toward one another, their amplitudes are

$\overline{A}_L = 0.6$ and $\overline{A}_R = 0.3$.

Notice that these are dimensionless amplitudes with regard to the water depth. The seafloor is flat. This plot is given in Fig. 2

At the moment when the soliton peaks meet at the same location, the height of the resultant wave is *not* equal to the sum of the two solitons heights, unlike what would happen if two linear wave interact. After passing each other, however, one may notice the phase shift in each of the solitons. The dimensionless velocity of these solitons is given by

$$\overline{U} = \sqrt{\overline{A}+1},$$

where $\overline{A}$ is the soliton amplitude being nondimensionalized by water depth. Notice solitons are always supercritical, means $Fr > 1$ where Fr is the Froude number defined by the dimensionless number as

$$Fr = \frac{U}{\sqrt{gh_0}}$$

or by the dimensionless parameters as $Fr = \sqrt{\overline{A}+1}$ which proves that solitons are always supercritical. Also one may notice, even only based on this last definition of the Froude number, that the soliton becomes steeper as the Froude number increases.

Soliton is very sensitive to the seafloor slope and depth changes. The amplitude and all characteristics of the wave can be changed in such a condition. Fission is a known phenomenon in this regard. It is shown, numerically and experimentally, that a soliton may split into two or even more waves once it propagates over a submerged shelf or shallower depths.

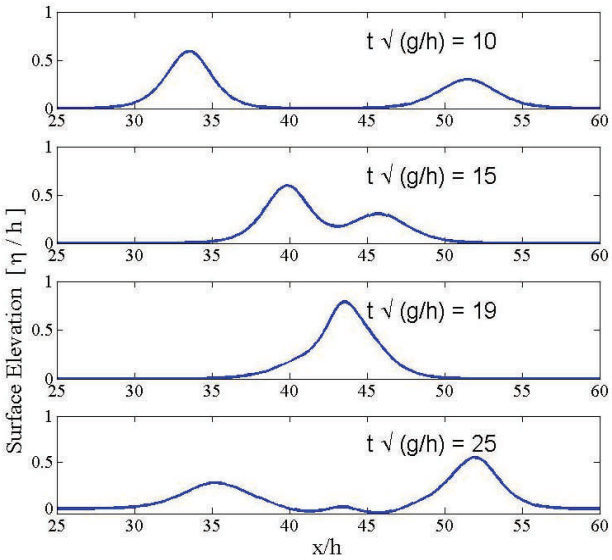


Figure 2: Two colliding solitons modeled by solving 2-D Level I G-N equations. $\overline{A}_L = 0.6$ and $\overline{A}_R = 0.3$ and seabed is flat.
Two solitons travel toward one another, "collision" happens and then they continue to propagate by recovering their identity almost as prior to collision.

Applicability of solitary wave theory

As discussed above, the existence of a solitary wave is based on the balance between nonlinearities with the dispersion effects. This balance may be achieved even away from the free surface through stratification, shear, compressibility and even rotation, any or all of these may led to generation of a solitary wave in nature. See [4] for more details. In ocean engineering, solitary wave is usually used to model long waves and tsunamis. When oscillatory waves arrive in shallow waters, they also show solitary behavior and might be studied through this theory. Internal ocean waves and tidal bores are other examples of possible solitary waves. In general, many phenomena in physics, biology, electronics and mathematics may be described by the theory of a solitary wave. From nonlinear shallow water waves to modeling high temperature super conductors and even energy transport in DNA. The fact that solitary wave can travel a long distance without significant loss, deformation or break, makes it an ideal tool for fiber-optic communication networks where solitary waves are used to carry data through the fiber circuits used in cable TV, telephone and computers, for instance.

Despite the substantial studies and contributions on solitary waves, the experimental studies of solitary wave passing over submerged obstacles is missing, as well as colliding and overtaking solitons. In fact, if you happen to see a paper on this topic, I would be very thankful to be informed about it.

References

[1] Russell, J. S. *Report on Waves*. Rep. Meet. Brit. Assoc. Adv. Sci., 14th, York, 1844, London: John Murray, 1845.

[2] Zabusky, N. J. and Kruskal, M. D. Interaction of Solitons in a Collisionless Plasma and the Recurrence of Initial States. *Physical Review Letters*, 15(6):240-243, 1965.

[3] Ertekin, R. C. and Wehausen, J. V. Some Soliton Calculations. *Proc. 16th Symp. on Naval Hydrodynamics, Berkeley,*. July, pp. 167-184, Disc. p. 185 (Ed. by W.C. Webster, National Academy Press, Washington, D.C., 1987)., 1986.

[4] Miles, J. W. Solitary Waves. *Annual Review of Fluid Mechanics*, 12(1):11--43, 1980.

ORE Members & Graduates

Jazlyn Wandasan

Jazlyn Wandasan has been a part of the Department of Ocean and Resources Engineering as a student assistant since September 2007. She is currently a senior double-majoring in Graphic Design and English with a certificate in Women Studies.

As a Waianae High School Valedictorian (2006), Jazlyn holds two national awards for her skills in media writing from the Student Television Network (2006) and the Journalism Education Association (2004). Rather than pursuing a degree with the Academy of Creative Media or in Communications, she chose to broaden her interests in Women Studies, Psychology, and History before deciding on Graphic Design and Women Studies as her focus. However, her passion for creative writing and literature had her adding another major in English in 2009.

In order to accomplish all her goals in life, she believes she must be a well-rounded individual. For this personal development she has educated herself in various disciplines. She finds many of her interests cross multiple fields and knows that with her love of learning, they will be useful for her future.

In addition to school and work, she splits her time between various community service projects throughout the year. These range from working in public libraries, beach and community clean ups, and money collections and fundraisers for homeless children. The knowledge and experience she has gained in these projects have strengthened her resolve in giving back to her community. It is for this reason she plans to pursue an MSW/PhD in Social Work. She also has plans to pursue a graduate degree in English.

Currently, Jazlyn's art projects include her display of mixed media focusing on State issues regarding homelessness, dislocation and poverty. She is also working on three short stories and finishing part of her autobiography for her Anthology class.

In this issue of the newsletter, we are featuring In Chieh, one of the ORE students who just finished her thesis defense. Others who have recently defended will be covered in the next issue.

1. *Name:* **In Chieh Chen**

2. *Admission Date:* Fall 2007

3. *Graduation Date:* December 2009

4. *Graduation level:* MS

5. *Advisor:* Brian Glazer (Oceanography)

6. *Thesis title:* In-Situ Voltammetry at the Kilo Nalu Nearshore Cabled Observatory: Techniques for Studying Redox Cycling in Permeable Sediments

7. *City and Country that you live in now:* Kailua - same place!

8. *One thing that you liked the most about ORE:* Great small, personal department. People are always interested in and excited about what they are working on!

9. *One thing you would change in ORE.*

10. *A short description about your current professional life.*

I'm working on an OTEC project with Makai right now. I get to go to NELHA once a week, but just for work - no Kona adventures yet!

11. *Something about your current personal life that you would like to share with others.* We're expecting our puppy to arrive from Sydney in a couple of weeks - I can't wait!

12. *A message to the current ORE students, faculty and staff.*

Hope everyone is well and hope to at least see those of us still on Oahu around sometime =)

New in ORE

Welcome to ORE! Since the last issue of the newsletter, four new members joined the department, two masters students, a post MS and a technician. We are going to hear from three of them here. Everybody is asked the following standard questions and below are their answers.
Once again, welcome to the ORE department and all the best for you.

Questions:
1. Name
2. Level of study
3. Your academic background
4. Your research topic in the department
5. Your advisor
6. Where is your office?
7. Only after being here for a short time, what has attracted your attention about the program and the department the most?
8. Anything else you would like to share with others?

1. My name is **Ghizlane Ahrouch**, I am from Morocco.
2. I am currently getting a M.S in Ocean and Resources Engineering (First semester, so far).
3. I went to the University of Hawaii at Manoa for my undergraduate studies and obtained a B.S in Global Environmental Science with an emphasis and research project in Physical Oceanography entitled: "A study on wave-reef interaction" particularly focusing on the phenomenon of fringing reef resonance.
4. I am currently a Research Assistant at the UH marine center helping with the Hawaii Undersea Research Laboratory's Remotely Operated Vehicle RCV 150.
5. My advisor is Dr. Bernard Dan Greeson.
6. I have some office space in MSB 318.
7. I have only been in this department for a short time, but have lived in Hawaii for 7 years and enjoy the active ongoing research at the Hawaii Undersea Research Laboratory. I am glad to be studying ORE because of today's issues relating to finite resources and enjoy the hands on type of work which is related to engineering.
8. I would like to meet most of the staff, professors and students in this department!

1. Jennie Mowatt
2. Staff
3. BS from University of Washington in Geological Oceanography
4. Keeping my armada of Seagliders running.
5.
6. HIG 155
7.
8.

1. Simone Meme'
2. Post MS with grant from University of Rome La Sapienza
3. MS and BS Environmental Engineering from University of Rome La Sapienza
4. Renewable energy and sustainable development for coastal communities
5. Prof. Nihous
6. Holmes Hall 407
7. Well-organized department in comparison with the chaotic Italian jam.
8. If I become a pro-surfer I'll give money to the department to buy an Italian coffee machine!!!

Final Page

Your Gift to the ORE Enrichment Fund

THE ORE ENRICHMENT FUND
(The University of Hawaii Foundation
Account # 123-7310-4)

Yes, I'll support

My gift is:

□ $10,000 □ $5,000 □ $3,000

□ $1,000 □ $500 □ $300

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□ A matching gift program is offered through my (or my spouse's) employer, _____(form enclosed)

□ The gift is in memory/honor of _____

Name(s): _____

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□ Please do not include my name in the ORE Enrichment Fund Donor Report (I would like to be an anonymous donor).

Please mail your check and this form to: c/o ORE Enrichment Fund Administrator, Department of Ocean and Resources Engineering, University of Hawaii at Manoa, 2540 Dole Street, Holmes Hall 402, Honolulu, HI 96822, USA
Eml: adminore@hawaii.edu, Tel: +1 (808) 956-7572, Fax: +1 (808) 956-3498

ORE COED softball team.
Recently, the ORE department has been very active in participating in the UH sport tournaments.
Standing from left are: Patrik, Blue, Aimee, Kai, Jacob, Masoud, Jacob and Troy. Missing in the photo are: Anne, Pablo, Simone and Vanna.

ORE since 1966
OCEAN AND RESOURCES ENGINEERING
IN THE SCHOOL OF OCEAN AND EARTH SCIENCE AND TECHNOLOGY AT THE UNIVERSITY OF HAWAI'I AT MANOA

Hana O Ke Kai
Newsletter of the
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University if Hawaii at Manoa

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ENGINEERING THE OCEANS SINCE 1966!