

Making Waves

Newsletter of Oceanic Consulting Corporation
Winter 2007



BERTHING STUDIES FOR LNG CARRIERS IN THE CALCASIEU RIVER WATERWAY

Oceanic recently teamed up with Infinity Engineering of New Orleans and the Centre for Marine Simulation at Memorial University to perform a comprehensive study of the new Cameron LNG Terminal on the Calcasieu River, Louisiana. The project will see the creation of a large turning basin adjacent to the main river channel, with two berths for LNG carriers of up to 200,000 cubic meters capacity. The study, funded by the Calcasieu River Waterway Harbor Safety Committee, had two main components. The first component was a passing study to determine if the mooring system was adequate when large deep-draft vessels traverse the channel, with wind and current forces also present, and the second was a ship allision study. The first module involved Oceanic constructing a 1:45 scale hydraulic model of a section of the channel,

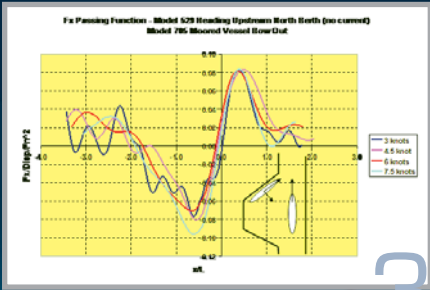
the turning basin and the berths. The Institute for Ocean Technology's Offshore Engineering Basin was used to model the river with current. The passing ship was towed in the channel at fixed speeds ranging from 3 to 7.5 knots past the moored vessels. The passing vessel traversed upstream in a loaded condition, and downstream in a ballast condition. Two different LNG carriers, of 138,000 and 200,000 cubic meters capacity, were instrumented to measure surge, sway, and yaw. Part of the physical model study was to spatially survey the current profile in both the channel and the turning basin. A numerical model of the channel was also created using the Computational Fluid Dynamics (CFD) code FLOW3D, and was correlated with the experimental test results.

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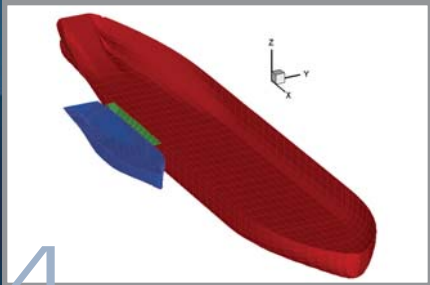
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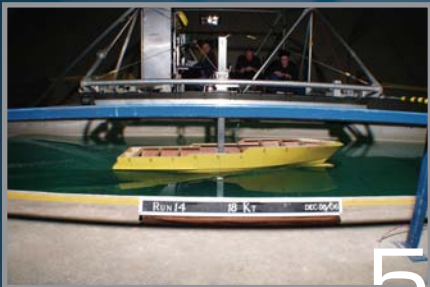
CHARTING THE COURSE



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As you browse the pages of this edition of *Making Waves*, you may notice that many of the articles written deal with tests performed in collaboration with other companies and institutions. Oceanic has decided to make co-operation an underlying theme of this issue as we believe that when we work together, we make a stronger community.



In the pages ahead, we explore partnerships formed with Infinity Engineering Consultants of New Orleans, the Ocean Engineering Centre, and Memorial University among others. In the case of Memorial, the relationship goes beyond simple commercial services and instead extends to focusing on enhancing regional, national, and international cooperation by bringing together people who share common goals: promoting new projects, addressing new challenges, building on research and science, and increasing international awareness of our advances in the field. Oceanic is therefore pleased to announce its support for Memorial's Dr. Qiu and his research team who have been granted a DND/NSERC Research Partnership Grant for a collaborative project that aims to improve numerical simulation of vortex flow computation. Oceanic is supporting this grant through cash and in-kind contributions to Memorial. This is the third such award Oceanic has supported at Memorial, helping the University leverage close to \$1,500,000 in research funding.

Oceanic is also pleased to announce a cooperative agreement that has allowed it to assume the operation of the Ocean Engineering Centre (OEC) in Vancouver. This acquisition will allow Oceanic to be closer to its West Coast clients and to gain a better understanding of their needs while also allowing us to fulfill our commitment to outstanding client service by providing faster access to testing facilities and reducing project turnaround times. The facility is also a cost-effective alternative to larger tanks. It features a 67-meter Towing Tank, a 30-meter by 26-meter Wave Basin and a shallow water Towing Tank. Oceanic is happy to add the OEC to its list of facilities and technologies available to clients.

On a much smaller but equally important scale, I am proud to tell you that Oceanic has joined the Canadian Blood Services *Partners for Life* program. As members of this crucial program, Oceanic staff demonstrated their commitment to saving lives by donating blood, platelets, and plasma for use in all manner of medical procedures. This program is a true example of how individual contributions united in a common cause can make a valuable difference.

Allow me to conclude by reaffirming that Oceanic considers cooperation in these fields and other initiatives to be paramount. As always, we are focused on advancing marine and naval architectural engineering, building on research, promoting cooperation, and increasing international awareness of the entire community. Cooperation has the potential to enrich the world in which we live and do business. I invite you to visit our booth at the upcoming Offshore Technology Conference, the Society of Naval Architects and Engineers SMTC&E, and the International Workboat Show to explore how a collaboration with Oceanic can make a difference for you and your clients. ●

For Oceanic Consulting Corporation
and with best regards,

Dan Walker, Ph.D., P.Eng
President

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BERTHING STUDIES FOR LNG CARRIERS IN THE CALCASIEU RIVER

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FLOW3D was then used to predict the flow for a 1 knot current in both ebb and flood directions. The passing loads were found to be a function of the speed through water as well as the relative orientation and displacements of the moored and passing vessels. The study also found that the moorings could be treated independently: a second vessel on the other berth does not affect the results. The normalized passing function curves were used by Infinity Engineering to numerically model the prototype mooring using Tension Technology's OPTIMOOR program. OPTIMOOR solved 3 degree of freedom motions in the time domain, using externally applied wind and current forces as well as the hydrodynamic loads from the passing vessels. This program uses the non-linear characteristics of the mooring hawsers and fenders. The wind force was applied at seven different headings relative to the berth, and the line tensions were monitored as the vessel passed in the channel; the maximum line tension was determined for each scenario. Infinity considered various layouts to optimize the surge and sway restraint. The OPTIMOOR program was then used to provide guidance to the Calcasieu River Waterway Harbor Safety Committee as to the maximum safe transit speed for various vessel sizes, in differing current and wind conditions.

The second part of the study, a ship allision study, was conducted by the Centre for Marine Simulation and two members of the Committee.

Twenty-nine simulations were conducted on the Centre's NMS90 full mission bridge ship simulator. The channel current information was obtained from the physical model tests and the CFD modeling. Two simulated target vessels were moored at the north and south terminal as ships in the main channel made their way past the terminals. At an inopportune moment, the passing ship suffered a loss of steerage, or propulsion, or both. The captain, an experienced river pilot and a member of the Calcasieu River Waterway Harbor Safety Committee, then took several corrective actions to try to avoid the allision with moored LNG carriers. The simulations were conducted with differing directions, wind, and current.



Proposed Cameron LNG Terminal.

Four different passing ships were used: a Panamax tanker, a MOSS type LNG carrier, a product tanker, and conventional and azimuth-stern-drive (ASD) tugs. The study concluded with specific recommendations about the number and type of tugs required to safely navigate vessels past the terminal. ●

SUB-CRITICAL VORTEX INDUCED VIBRATION TESTING

The demand for Oceanic Consulting Corporation's (OCC) small-scale vortex induced vibration (VIV) test apparatus has continued since its development. Recently, OCC completed another VIV suppression test program to evaluate fairing designs for potential use on British Petroleum (BP) drill rigs and floating production platforms such as *Thunder Horse*. A comprehensive test program was undertaken to evaluate various contractor-supplied fairings. Several fairing parameters, including chord-to-diameter ratios, were tested, along with several leading and trailing edge variants, to evaluate the sensitivity of each change. Bare pipe tests were also conducted to provide a reference baseline. Based on the test results, a number of fairing configurations were selected for future development.

OCC's small-scale VIV rig offers clients an opportunity to evaluate multiple small-scale VIV suppression devices in an efficient, cost-effective manner. Devices can be tested up

to Reynolds numbers of 300,000 and with reduced velocities of 0 to 25, offering a chance for clients to evaluate preliminary designs before expending significant resources on larger scale testing. The apparatus provides basic free vibration drag and cross flow motion data using a test cylinder measuring 3.4 meters in length by 0.1 meters in diameter.

Continued evaluations of these and other fairings for BP are scheduled using OCC's high Reynolds Number test rig at the Institute for Ocean Technology. As the number of deepwater offshore fields with potentially high currents increases, the need to provide

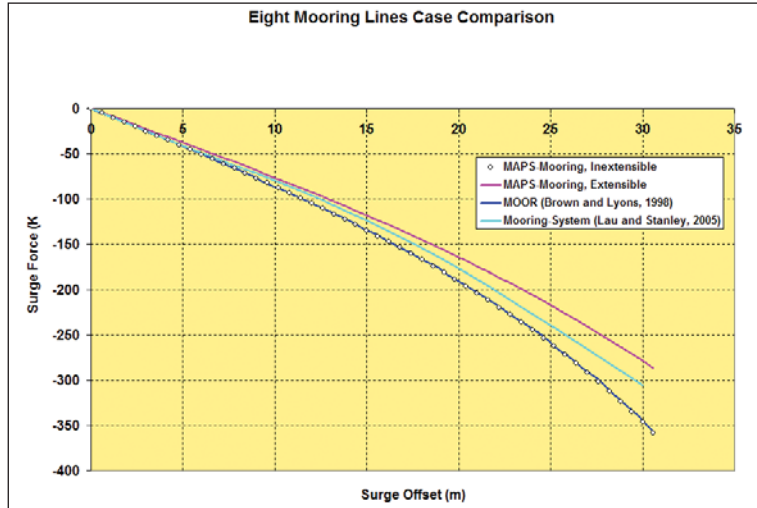


Artistic rendering of the Thunder Horse platform.

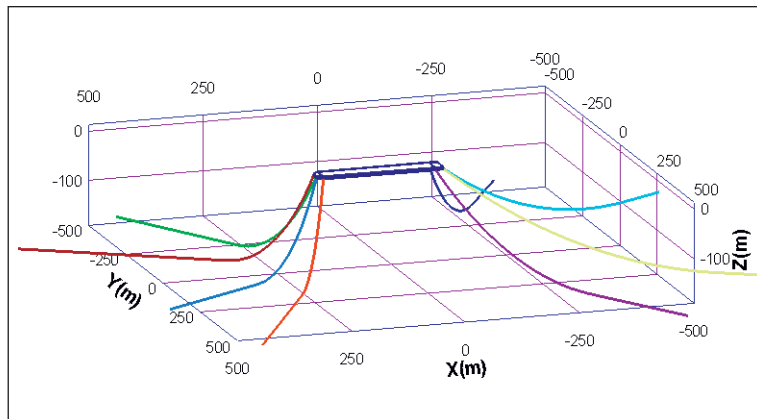
adequate VIV suppression to drilling and production risers is highlighted. ●

NON-LINEAR ANALYSIS OF MOORING LINES AND MARINE RISERS

MAPS-MOORING, a finite element-based mooring program, has been developed by Dr. Wei Qiu's group at the Advanced Marine Hydrodynamics Laboratory, Memorial University. This program can perform both static and dynamic analysis of moorings and risers. The global coordinate-based finite element method is used to model mooring lines and marine risers. For the static problem, the inertia term is neglected. The non-linear equations are expanded about the estimated solution, or the solution from previous iterations using Taylor series, and are solved using Newton's method. For dynamic problems, the second-order differential equations are substituted by a set of first-order differential equations, and the first-order Adams-Moulton method is used to integrate the equations. The non-penetrating bottom boundary conditions are considered for both static and dynamic problems. The sea bottom is modeled by a spring mat that is assumed to be flat and elastic. Validation studies have been completed for single and multiple mooring line scenarios. Static and dynamic results were compared with experimental data and other published results.



Surge force and surge offset plot.

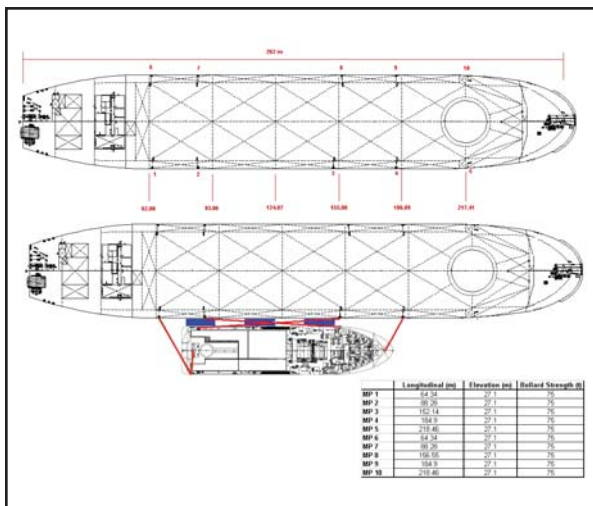


Sample mooring system configuration.

Recently, the program has been extended to address riser vortex induced vibration (VIV). Added mass and lift force data was derived from high Reynolds number forced cylinder experiments conducted by Oceanic Consulting Corporation and this data was used in a time-based solution scheme to provide forcing and damping depending on the current state (i.e., amplitude and reduced velocity) of a riser element. The forcing scheme makes full use of the available forced motion data, and makes no assumptions about damping functions or correlation lengths. It is also general enough to allow for suppression devices, such as strakes and fairings to be incorporated.

This work was funded by Oceanic Consulting Corporation in conjunction with the Mathematics of Information Technology and Complex Systems (MITACS). Presently, work is underway to fully couple the mooring/riser element with other Motion Analysis Program Suite (MAPS) components. ●

NUMERICAL EVALUATION OF SIDE-BY-SIDE MOORING LOADS



Layout illustrating position of OSV moored to FPSO.

Oceanic Consulting Corporation, in conjunction with Memorial University's Dr. Wei Qiu, has completed a study to assess the mooring loads

of an offshore supply vessel (OSV) moored to the *SeaRose* FPSO. The study for Husky Energy was to determine the side-by-side mooring loads that are likely to be experienced while underwater work is conducted on the FPSO.

The study used Dr. Qiu's Motion Analysis Program Suite (MAPS). This code modeled the FPSO, the OSV and the pneumatic fender between the vessels as three separate floating bodies in the frequency domain. Initially, a linearized inter-vessel mooring system was used to derive the relative vessel motions as response amplitude operator (RAO) functions. These motions were then transformed into the time domain using linear wave theory. The resulting motions were then used

to estimate the mooring line tensions and fender loads based upon the actual non-linear characteristics of these elements. Also, since the OSV has a flying bridge which extends beyond the beam of the hull, the study included an examination of the relative distance between the two hulls while in waves. An initial part of the study validated the motions of the *SeaRose* FPSO with respect to the Bureau Veritas HYDROSTAR[®] software and existing model test data. Both the MAPS and HYDROSTAR[®] codes were found to agree well with the experimental data. The test matrix considered six different wave directions and two significant wave heights.

Dr. Qiu's group is currently working at the Advanced Marine Hydrodynamics Laboratory of Memorial University to expand the capability of the MAPS suite by extending the code to computation of second-order wave forces. This work is being funded by Oceanic Consulting Corporation and MITACS. The development of MAPS was funded by NSERC. ●

RESISTANCE AND DIRECTIONAL STABILITY EVALUATION FOR BC FERRIES' *MV KUPER*

The latest edition to the BC Ferries fleet, the *MV Kuper*, is a 32-vehicle ferry that will provide service in the Southern Gulf Islands of British Columbia. The hull of the new vessel is comprised of the original structure of the *MV John Atlantic Burr*, which BC Ferries purchased last year from the State of Utah Transportation Department. That ship was cut into sections and trucked to Tacoma, Washington. The sections were then sent via barge to Allied Shipbuilders in North Vancouver where the company then built a virtually new ship.

During construction, a new 11 foot wide longitudinal section was inserted into the hull to provide an additional lane on the vehicle deck. Passenger and crew spaces were totally rebuilt, including washroom facilities for customers with disabilities, and new lifesaving equipment was installed. The wheelhouse, navigational equipment, piping, and electrical systems are entirely new and the main propulsion is provided by two 354 kW Detroit Diesel Allison engines which drive two HRP right-angle-drive propulsion units.

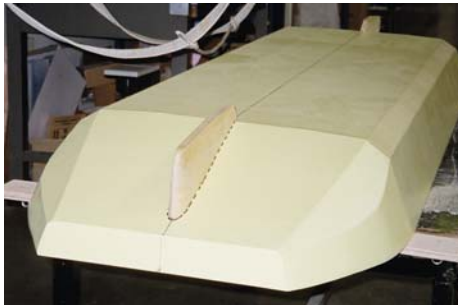
The vessel is a double-ended ferry and has a large skeg located at each end to provide directional stability. The size and location of these skegs is critical in terms of the vessel's running efficiency and ease of handling. Oceanic Consulting Corporation was commissioned to perform model tests to determine the optimal size and placement of these skegs. A 1:20 scale model was constructed and resistance and directional stability tests were performed at Oceanic's Ocean Engineering Centre in Vancouver, B.C.

A skeg configuration which provided the best directional stability and best running efficiency was identified. These modifications were adopted on the as-built vessel.

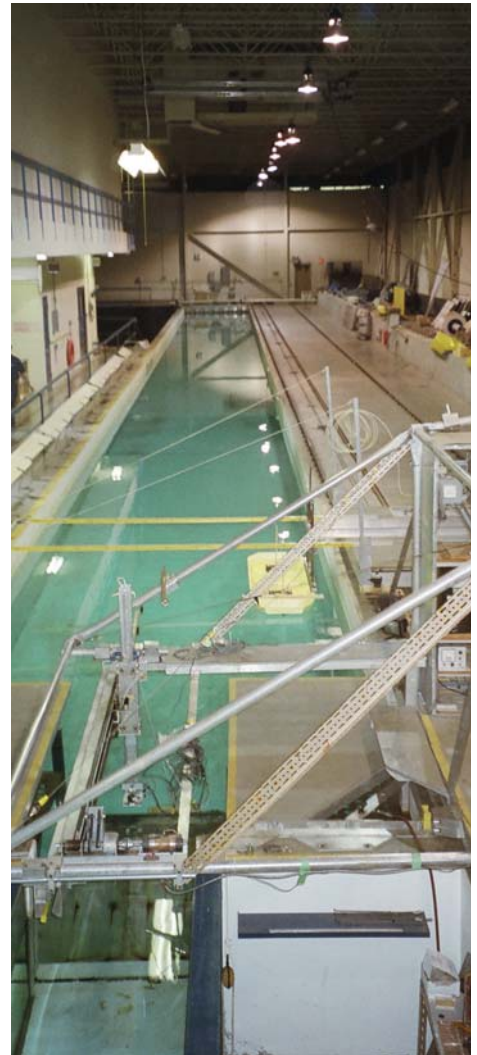
Following the vessel's launch at the Allied Shipbuilders yard, Oceanic also supervised sea trials which confirmed the findings of the model test program. The vessel was found to have excellent handling characteristics and met all expectations for running performance. It is the first of several ferries to be commissioned by BC Ferries in its current commitment to renew its fleet. ●



MV Kuper.



Hull model illustrating skeg size and placement.



Ocean Engineering Centre Tow Tank.

BRAY 135 EXPLORER

Bray Yacht Design and Research Ltd. of White Rock, B.C., has recently returned to the test tank at Oceanic's Ocean Engineering Centre in Vancouver, B.C., to continue their award-winning work with super-fuel-efficiency technology, which incorporates their unique hull form with resistance-reducing appendages. This time, the focus was on a design for a 135 foot long-range motor yacht capable of 18 knots with a 3,000 mile range. This performance hull is fitted with a bulbous bow and a bi-foil on each shaft skeg.

Both resistance and seakeeping test results show this boat to be a real performer and typical of this super-fuel-efficiency technology. At 18 knots, the trim angle is just 1.64 degrees and the required effective power is 1673 hp. The bi-foil reduced the running trim by 1/4 of a degree and helped dampen out pitch motions.



Profile of the 135 foot long-range motor yacht.

Seakeeping in both Sea State 3 and 5 showed virtually no change in pitch accelerations measured at bow, amidships, and stern from 12 to 18 knots.

The vessel will be used as a personal yacht with diving as an integral part of its mission profile. It will be built in Louisiana and generally operate in the Caribbean and down to Belize. ●

OIL SPILL REMEDIATION CONCEPT EVALUATED IN ICE TANK



Illustration of the exposed channel created behind the barge in the 90-meter Ice Tank.

Plans are underway to perform exploratory drilling in the Beaufort Sea and with this there are risks of an accidental spillage of oil. If a spill occurs, the presence of moving pack ice may hinder any oil spill clean-up and remediation activities. One potential method to improve the effectiveness of these operations is to provide a deployable barrier, such as a barge, to prevent ice from encroaching on the spill site while the control and remediation operations are underway. Shell Exploration and Production contracted Oceanic Consulting Corporation to undertake a model test program that examined the feasibility of such a concept. The basic

questions that had to be answered were whether the barge would prevent ice from interfering with the downstream spill remediation operation, and whether the ice loads were manageable with typical offshore support vessels. Four ice sheets were produced in the 90-meter Ice Tank at the Institute for Ocean Technology in St. John's, Newfoundland. For the first time, wind shear was modeled using the wind fans normally used for offshore structure testing. The barge was towed at several orientations into the pack ice which had various ice concentrations, floe sizes, and thicknesses. Primary measurements included hawser loads and barge motions.

As the ice piled up against the barge, an ice prow, or virtual bow, formed with its apex at two to three barge lengths away from the hull. As ice entered the prow, it formed rubble, but this eventually stabilized and some ice would periodically shear from the prow and pass by the ends of the barge. The model test program demonstrated that the barge was capable of maintaining a relatively ice-free zone behind it and that the resulting loads were within expectations. The test results also indicated that current speed, barge orientation, and pack ice concentration were the most significant parameters affecting the loading. ●

OCEANIC'S PRESIDENT APPOINTED AS SNAME'S VICE PRESIDENT, ATLANTIC NORTH REGION

Oceanic Consulting Corporation is pleased to announce the appointment of its president, Dr. Dan Walker, as the Vice President, Atlantic North Region, of the Society of Naval Architects and Marine Engineers (SNAME).

The New Jersey-based Society is an internationally recognized non-profit, technical, professional guild of individual members serving the maritime and offshore industries and their suppliers. SNAME is

dedicated to advancing the art, science, and practice of naval architecture, shipbuilding and marine engineering.

A prominent voice in the national and international marine engineering community, Dr. Walker also sits on SNAME's Technical and Research Program Steering Committee. He is a past member of the Shipbuilding and Industrial Marine Advisory Committee to the Canadian Minister of Industry

and sat for four years on the Atlantic Innovation Fund Advisory Board to the Minister responsible for the Atlantic Canada Opportunities Agency. He also served as a member of the Board of Governors of the Canadian Unity Council.

Dr. Walker is a Professional Engineer and holds a Ph.D. in Ocean Engineering and a Bachelor's Degree in Naval Architectural Engineering from Memorial University of Newfoundland. ●

PROFILE: SHUHONG CHAI, PH.D.



Oceanic Consulting Corporation wishes to congratulate Dr. Shuhong Chai on being awarded her Ph.D. from the Department of Naval Architecture & Marine Engineering at the Universities of Glasgow and Strathclyde in Glasgow, UK. Dr. Chai successfully defended her dissertation entitled *Experimental and Theoretical Investigation on the Hydrodynamic Properties of Damaged Ships* in November 2005.

Dr. Chai joined Oceanic Consulting Corporation in late 2003 as a Project Engineer. Since 2004, she has worked as an Experimental Hydrodynamicist with the firm and focused on resistance, self-propulsion, seakeeping, and survivability assessments for ships and offshore structures. She has also developed numerical model icebreaking algorithms for the Centre for Marine Simulation (CMS) at Memorial University of Newfoundland's Marine Institute.

Dr. Chai has several years experience in specialized hydrodynamics and ship performance evaluation by means of model testing and numerical prediction. Prior to her work with Oceanic, Dr. Chai was employed at the Ship Stability Research Centre, University of Strathclyde in Glasgow where she focused on the development of model tests of Ro-Ro ferries for intact stability, damaged stability, and survivability, as well as experiments and investigations relating to her thesis. At Strathclyde, she also worked on the EU projects *Time-Based Survival Criteria for Ro-Ro Vessels*

and *First Principles Design for Damage Resistance Against Capsize*.

Dr. Chai earned her Masters degree from Dalian University of Technology in China in 1992, specializing in the interaction between ship hull and propellers. She then taught Ship Hydrodynamics in the Department of Naval Architecture and Ocean Engineering at Dalian University of Technology. During this time, she participated in several physical model-testing projects and worked on the theoretical application of generic algorithms in the design of propeller blade sections. She also managed the Ship Model Towing Tank at Dalian University of Technology.

Dr. Chai's work has been disseminated throughout various industry publications and conferences including the Sixth International Ship Stability Workshop, the International Conference on Propeller Cavitation, the *Journal of Hydrodynamics* (China), and the *Journal of Dalian University of Technology* (China). ●

SUPPORTING THE COMMUNITY

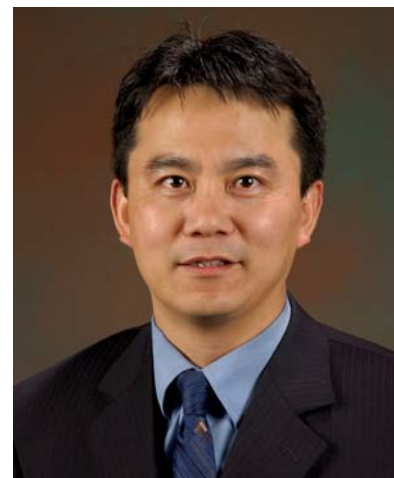
OCEANIC CONSULTING CORPORATION SUPPORTS A DND/NSERC RESEARCH PARTNERSHIP GRANT AT MEMORIAL UNIVERSITY

Oceanic Consulting Corporation congratulates Memorial University's Dr. Wei Qiu and his research team on being awarded a Department of National Defence (DND) and Natural Sciences and Engineering Research Council of Canada (NSERC) DND/NSERC Research Partnership Grant. Supported by Oceanic and Defence Research and Development Canada (DRDC) Atlantic, Dr. Qiu has received \$245,000 in cash and \$25,000 in in-kind contributions for the three-year \$270,000 collaborative research project entitled *Development of Numerical Tools for Propeller Tip Vortex Flow Computation* which began in October 2006. This project is the third such award that Oceanic has supported at Memorial University. To date, Oceanic has helped Memorial obtain nearly \$1,500,000 cash in research funding.

This research, which is one of the priority research areas noted by DND and NSERC in their creation of the DND/NSERC Research Partnership program, addresses the development of numerical tools to improve the safe and effective operation of surface ships and underwater vehicles.

The first objective of Dr. Qiu's research is to develop numerical methods to compute the turbulent vortex flow from propeller blade tips; the second is to accurately predict the viscous flow field around a ship, including the effects of free surface and propeller inflow conditions. Propeller cavitation is of major concern for naval warships, research ships, ferries, and cruise ships since it is the predominant source of propeller-generated noise and vibration. Cavitation not only influences low frequency propeller-induced pressure fluctuations on the ship hull, but it also increases high frequency noise levels in ships. For naval ships, these aspects are particularly challenging.

The DND/NSERC Research Partnership Program aims to capitalize on the complementary R&D capacity existing in Canadian universities to generate knowledge and to support the development of technical capabilities relevant to the development and application of dual-use technologies in selected areas of interest to both DND and NSERC. The program accomplishes this by building strong two- and three-way linkages and creates synergy between researchers in



Dr. Wei Qiu

universities and the private sector. This achieves the efficient and effective transfer of research results and technology to identified receptors in the public and private sectors. The program also trains and develops highly qualified personnel to meet the future human resource requirements in the public and private sectors. ●

Offshore Engineering Basin - Facility Specifications:

Length	75m
Width	32m
Max. Water Depth	3.2m
Wave Making System (Power)	1800kW
Max. Wave Height (Regular Waves)	1m
Sig. Wave Height (Irregular Waves)	0.5m
Wave Lengths	0.5m to 20m
Articulation of Waves (Modes)	Flapper, Piston, Combination
Wave Spectra	Regular, Irregular, Bi-Modal, Multi-directional
Current Speed	Water-depth Dependent (0.5m/sec at 1m depth; 0.25m/sec at 2m depth; 0.2m/sec at 2.8m depth)
Average Wind Velocity	11m/sec at 1m from Fan, 5m/sec at 5m from Fan
Turbulent Wind Spectrum Mean Speed	12m/sec
Wind Spectra	American Petroleum Institute Standard, Norwegian Petroleum Directorate Standard, Other Industry Standards
Optical Tracking System Accuracy	±1mm Moored Models, ±5mm Free-running Models

Applications

- Testing of Moored Floating Systems or Gravity Base Structures in Wind, Waves and Current
- Testing of Free-running and Self-propelled Ship Models

Tests Performed

- Seakeeping
- Maneuvering
- Wave Energy Conversion
- Wave Impact Loads on Ships or Offshore Structures
- Tow out, Set Down, and Operation of Offshore Structures
- Mooring/riser evaluations

Specification Sheets are Available for All Major Facilities, Including:

- Offshore Engineering Basin • 200-meter Wave/Towing Tank
 - 58-meter Wave/Towing Tank • 90-meter Ice/Towing Tank • Cavitation Tunnel
 - 22-meter Flume Tank • Centre for Marine Simulation • MOTSIM
- Specification sheets can be obtained from the Oceanic website or by contacting our office.



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Meet us at:



April 30 - May 3
Houston, TX



November 13-16
Fort Lauderdale, FL



November 28-30
New Orleans, LA