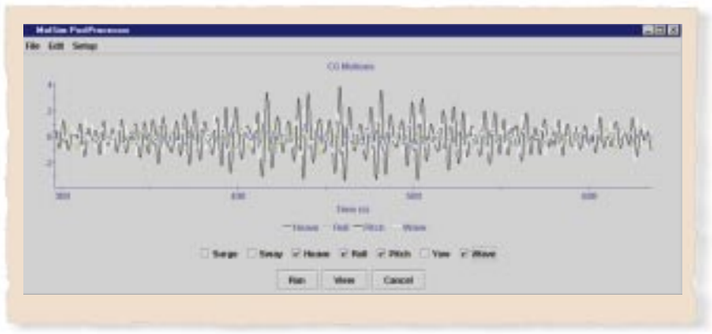
Numerical Simulation

Brad Rixmann

The comfort and safety of the passengers of any ocean-going vessel is primarily a function of how it responds to the wave forces exerted on it. To ensure that a design will behave as desired, accurate assessment of its seakeeping performance is essential prior to construction.

Due to the limitations of most tank facilities, seakeeping performance is often tested in simplified conditions such as head or following seas, or at zero speed. This approach neglects the conditions experienced during the majority of vessel's operation and those in which its motions are likely

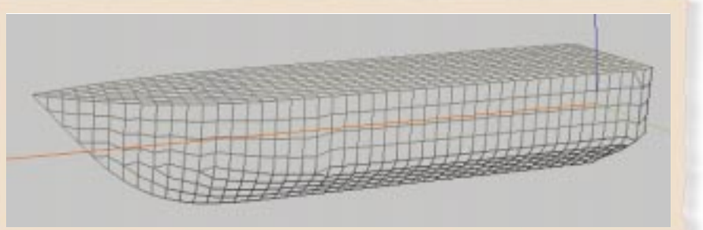


▲MOTSIM's Post Processor

to be most uncomfortable and even potentially dangerous. Oceanic uses both physical and numerical modeling tools to provide a more comprehensive evaluation of seakeeping characteristics.

Oceanic's seakeeping code, MOTSIM, simulates sea conditions including both regular and irregular waves from any heading with or without forward speed. The code uses a non-linear, time-domain solver which allows the simulation of severe seas and transient phenomena such as rudder operation which is not possible in a frequency domain simulation. MOTSIM has proven its accuracy and reliability through extensive validation during its development at NRC and MUN and as part of its ongoing commercial use at Oceanic.

▼MOTSIM Meshed Hull



The output from MOTSIM is analogous to the results of a seakeeping experiment - time-histories of linear and angular position. From this basic output, displacements, velocities and accelerations at any position on the vessel may be quickly computed and analyzed using MOTSIM's post-processor programs.

A substantial development program has been undertaken over the past year to provide tools for mesh development and for results interpretation and visualization. This development is dramatically improving the turnaround time for simulation results as well as reducing the cost to the client. It is now possible to perform basic seakeeping evaluation for most vessels for less than it would cost just to build a model.

Oceanic has used MOTSIM successfully to model the motions of vessels from yachts and cruise ships, to barges and icebreakers. Recent projects include motor yacht simulations in which MOTSIM was used to complement physical model tests. In another project, MOTSIM was used to compare alternate roll stabilization systems for a passenger vessel.

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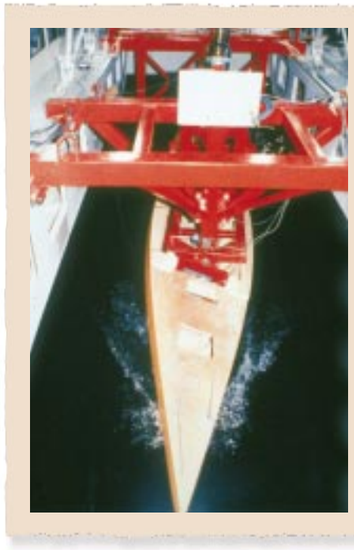
NEWSLETTER OF OCEANIC CONSULTING CORPORATION — WINTER 2000

World-class Yacht Testing

Bruce Parsons



▲12m Sailing Yacht.

In 1993 the National Research Council of Canada (NRC) addressed some of the long-standing problems with lift/drag experiments. Questions concerning the accuracy of model data plagued the tests since the 1930s. NRC's solution was to design new hardware to measure lift and drag more accurately on larger models.

The Institute for Marine Dynamics (IMD) is a state-of-the-art facility capable of testing very large models. Using a yacht dynamometer designed, built and tested in 1994, IMD assisted its first client produce the second-fastest boat in the 1995 America's Cup.

In the past six years, further refinements were used with the then Whitbread 60 design (now the Volvo Ocean 60) for Bruce Farr and Associates. Other projects included an IMS 50 for Canadian John Risley and a Whitbread 30. IMD is currently involved in a parametric series representing modern yacht trends for the US Yacht Racing Union and the Offshore Racing Council to better handicap the designs used in professional yacht racing. Work has also begun with Bruce Farr and Associates for the next Volvo Ocean Race, round the World, 2001 - 2002.

IMD's reputation in the field has grown and it is widely acknowledged that the institute has only one-third of the noise of any other facility in the world in its lift and drag measurements. Comparisons with the full-scale performance of many different types of yachts have given designers confidence that the results produced in the model basin in St. John's represents an accurate picture of how full-scale models will behave, greatly reducing uncertainty in the prediction of racing yacht performance.

IMD is now equipped to investigate all aspects of sailing yacht hydrodynamics and appendage performance. While the advanced techniques developed at IMD have been used on seven meter, one-tonne models, they are also applicable to less expensive models, making this technology more affordable to a design office. With its partners, Oceanic is equipped to meet the demands of sailing yacht designers for many years to come.

World's Largest Cruise Ship

Oceanic Consulting Corporation has recently signed a contract with America World City to begin performance evaluation tests on its 25,000 tonne passenger ship.

In Phase I of the model test program Oceanic will be responsible for the construction of a 1:40 scale model of the 378m passenger vessel. The model will be over 9.5 meters long. Testing will include flow visualization, resistance and self propulsion experiments. From these tests the owner's Naval Architects will be able to determine the final shape of the hull, where appendages such as the huge podded propellers will be located. They will also be able to determine the required power to obtain the vessel's desired operating speed.

Phase II model tests are planned for a later date and are comprised of sea keeping and maneuvering tests and analysis.

Power Yacht Testing

Carl Harris

Predicting the final performance of a power-yacht design is an interactive process between the designer/owner and a performance evaluation team. From basic resistance and powering, through motion prediction and control, to air-quality and comfort analysis, the development of a successful design is a dynamic process. A timely flow of information is crucial to ensure that the both the designers and the evaluators are working with the most current state of the design.

Oceanic Consulting Corporation works closely with the designers of custom power yachts to help them tune their designs and deliver a superior product. Oceanic and its partners have worked with firms such as Derecktor-Gunnel , Sharp Design and Sparkman and Stephens. The challenges have ranged from straight-forward evaluations of appendages to comprehensive system evaluations of complete designs.

The issue of ride control on the larger (35m +) yachts is an issue for many owners. The different types of devices and techniques commonly used (bilge keels, fin stabilizers, and anti-rolling tanks) are not always suitable for every vessel and not all combinations of such devices will necessarily improve the vessel's ride. For example, in a recent project the designer of a 40m yacht was considering the inclusion of a passive anti-roll tank in way of the engine room. Oceanic was retained to determine whether or not such a tank would appreciably affect the motion. Starting with the lines of the hull, we created a model of the vessel within MOTSIM (our motion simulation code) and examined the motions of the vessel in simulated beam seas. Then, working with the designer to establish the exact geometric constraints of the projected anti-roll tank, a series of numerical tests were conducted to determine what level of roll-damping this tank would likely provide. This approach allowed the designer to cost-effectively evaluate both the cost and space implications of an anti-roll tank. Oceanic is committed to providing designers and owners with the best possible means of predicting their yacht's performance.

▲U-Tube Anti-Roll Tank

OCEANIC CONSULTING CORPORATION

Focus on Expertise

Rob Pallard

Rob Pallard has been working with one of Oceanic's partners, the Institute for Marine Dynamics at the Canadian National Research Council, since 1986. Since 1993 he has been the Technical Manager of the Model Yacht Dynamometer project.

From 1970 to1980 he was a sail designer with Miller Sails in Vancouver and then with Tom Schnackenberg at North Sails. From 1993 to 1995 he was in charge of the series of model yacht evaluations for the Australian America's Cup syndicate. This was followed by work on a Mount Gay Rum 30, a number of power yacht designs from Sparkman and Stephens and Sharp Design, and a series of experiments for Bruce Farr and Associates on their Whitbread 60 designs. In 1997 he was recruited by the New York Yacht Club to conduct their tow tank testing of model IACC designs in the US Navy test basin in Carderock. For the past three years, using the techniques and instrumentation developed at IMD, Rob evaluated hulls and foils for the PACT syndicate. He was sought out by PACT because of his reputation as one of the best experimental naval architects in the world.

Rob has continued to develop this unique capability at IMD. He has collaborated with US Sailing and the Offshore Racing Council to update the current yacht handicapping methodology (the International Measurement System) by adding more representative hull types to the database and by doing fundamental research on the characteristics of keel and rudders. Other fundamental work has included studies on turbulence stimulation, measuring and controlling persistent currents in tow tanks, and tow tank to tow tank reliability.

Rob Pallard has been profiled in Scientific American and is recognized by the international yacht design community for his expertise. He has risen to the top of his field and his expertise is in constant demand.

Dynamic Positioning

Jim Millan

The Institute for Marine Dynamics has developed a dynamic positioning (DP) system for use with model vessel test programs. A need was identified early in 1997 for such piece of equipment as an important component in the Offshore Engineering research program in addition to enhancing the commercial viability of the Offshore Engineering Basin (OEB) Facility. Following the results of a pilot DP project carried out in 1997 with the assistance of the Flight Research Laboratory of NRC's Institute for Aerospace Research, a final system was developed and commissioned in February of 1998.

Since that time, additional software and hardware have been added to the system to incorporate many new features. The latest model DP system has the following features:

- Kalman filtering for removal of 1st-order wave effects
- Fully azimuthing thrusters with integrated thrust and torque measurement
- Windows NT-based GUI
- Real-time stripcharting
- Adjustment of controller gains in real-time
- Choice of PID or multivariable controller algorithms

IMD's DP system has been used with great success on commercial testing of a moored FPSO and a free-floating semisubmersible. The system has also been used extensively for internally sponsored research work. Feedback from our clients has been very positive because of ease-of-use, quick setup and overall performance. Oceanic recently used the DP system during the design evaluation of the Millennium Class semisubmersible for Freide and Goldman Ltd. of New Orleans.

▼Trust Transducer Measures Actual Propeller Thrust.

▼FPSO DP Tests.