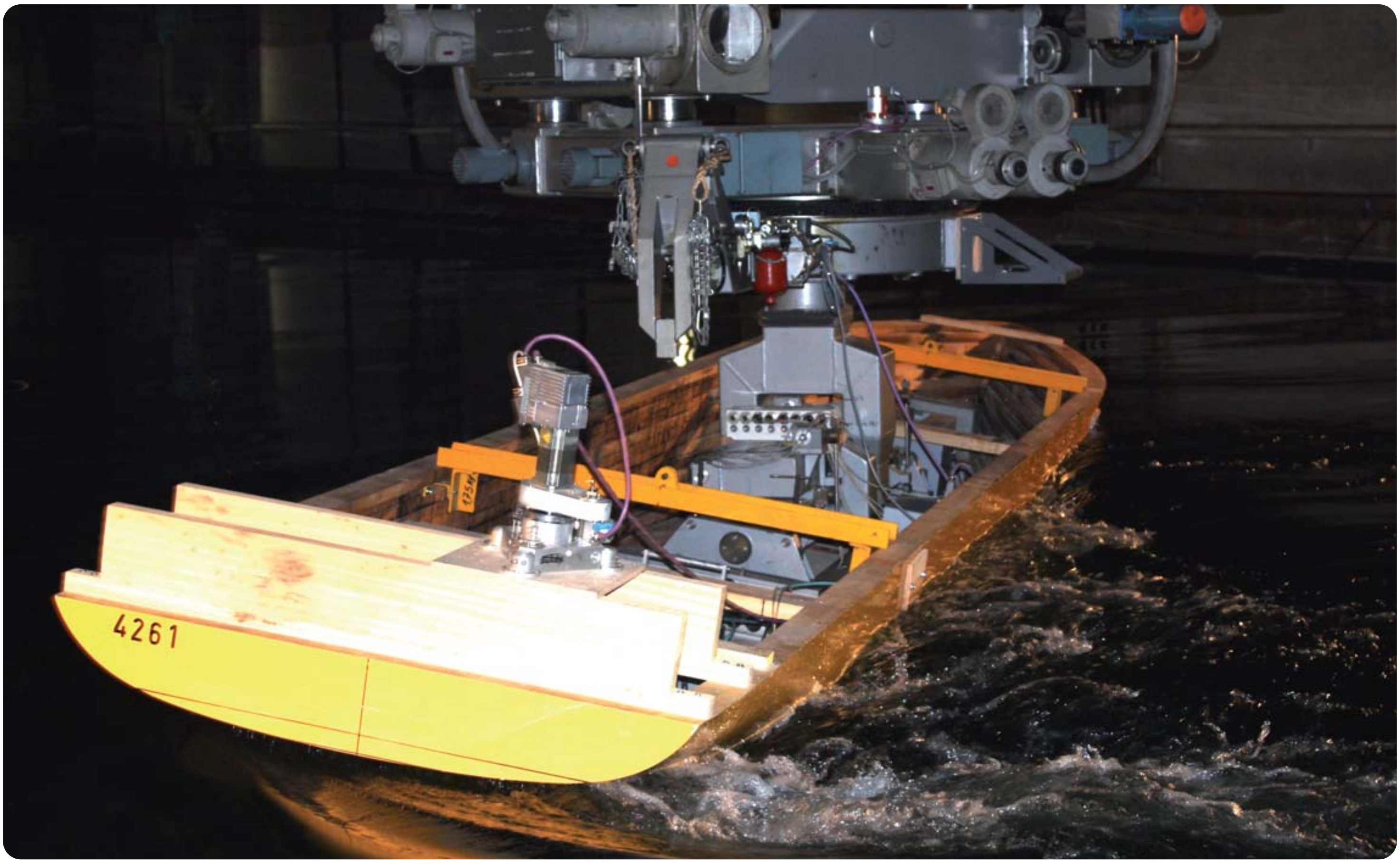
HSVA Newswave 2009/1

THE HAMBURG SHIP MODEL BASIN NEWSLETTER




## IN THIS ISSUE:



**Dear Reader,**

welcome to the first Newswave 2009. Looking back, 2008 again was a busy and very successful year. Besides interesting projects for our clients, much research was performed, some results are presented inside this issue. Our new RANS-Code *FreSCo* made a real step towards daily work applications and we made some really interesting investigations on different full scale submarine components in our large towing tank. The general public is more and more aware that noise from shipping affects marine organisms. Not only at IMO this is currently being discussed, HSVA takes part in this discussion.

What is ahead for us?

We all are aware of the challenges ahead, the financial crisis, all the economical problems we hear day by day and finally the over capacities in ships and in ship yards. Will all this influence the work at the model basin? I am sure it will, but it will also give us the chance to take a real step forward. Transportation will still play an important role in the future and the globalization will not stop. It will go slower and hopefully more realistically, but ships are always needed and many of the existing designs do not fulfill the environmental issues of the future: less fuel consumption, CO2, NoX, noise emission, etc. This means the key is still designing, building and operating ships more efficiently. Design speeds will certainly become lower in the future. This automatically leads to fuller ship lines revealing special challenges to avoid bad wake fields and related problems. All this needs sophisticated CFD calculations, model tests and the combined effort of all parties engaged in the design process. Still much work needs to be done, and HSVA is ready to help all our clients. We will be even more flexible than in the past in order to accommodate your expectations within short times.

I hope you enjoy reading this issue of Newswave!

We are underway, steady on course!

**Juergen Friesch**
Managing Director

# Slow Manoeuvring and Dynamic Positioning

*by Henning Weede and Peter Soukup*

HSVA's R&D project SLOWMAN is going ahead successfully. It will result in means for simulating slow manoeuvring and dynamic positioning scenarios, which are characterized by very large drift angles, turning on the spot, crabbing in wind, waves and current not only in deep, but also in shallow water. The project is being sponsored by the German Ministry of Economy and performed together with SVA, the Potsdam Model Basin. In 2008, by means of captive model tests in deep and shallow water as well as RANS calculations, HSVA completed a data base of stationary hydrodynamic hull forces and moments for three reference ships: a tanker, a container vessel and a twin-screw cruise liner. The numerical and experimental results included a comprehensive set of combinations of drift angle (full 360°), yaw rate/speed ratio (from turning on the spot up to straightforward sailing), depth/draught ratio in shallow water up to 1.2 and heeling angle. This allows to interpolate any imaginable situation. A multi-purpose simulation algorithm is still being developed, but some components are available already: For the case of zero yaw rate which is of special interest in dynamic positioning as well as harbour approach of wind-sensitive vessels, means to interpolate accurately among all these model test results have been programmed. This function can now be called from any custom-made program to serve individual customers' projects, e.g. to simulate crabbing against a current in a DP situation or sailing slowly in strong lateral wind. Thus, HSVA is in the position to respond to corresponding inquiries either by theoretical estimations based on the reference vessels or by combining their data with individual model tests for the project in question.

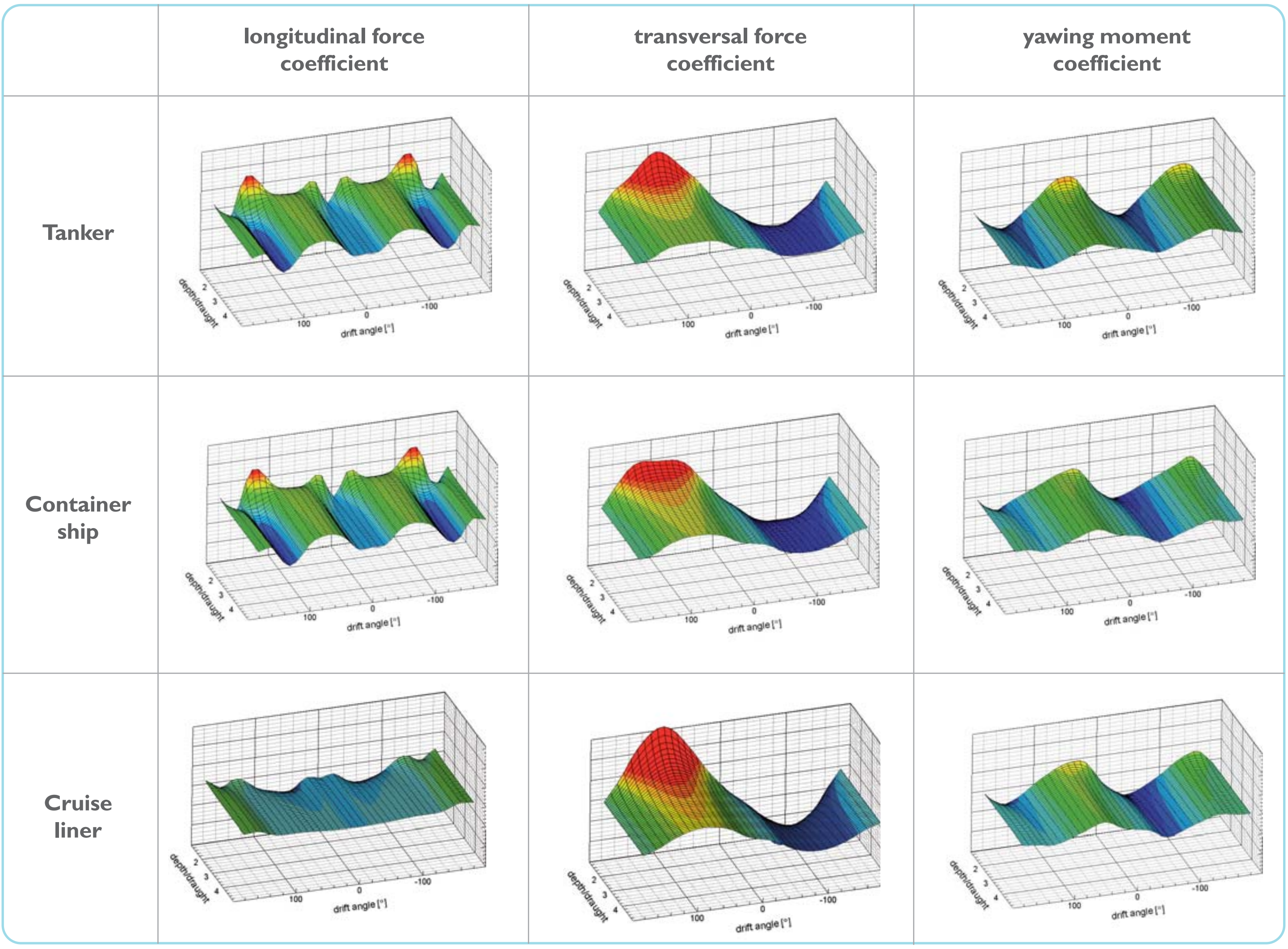



*Fig. 1: Oblique towing test results in deep and shallow water*

Fig. 1 presents the hydrodynamic reactive loads of a ship hull during oblique towing. Each diagram shows the drift angle from left to right, with sailing ahead (0° of drift angle) in the centre and sailing astern (180° of drift angle) on the sides. Deep water conditions are on the front side and extreme shallow water conditions are on the rear side of each diagram. It can be seen that shallow water increases resistance to all three motion components.

For those cases which cannot be measured, for example cases involving turning in shallow water, RANS (Reynolds Averaged Navier Stokes) simulations have been performed. Numerical grids, one for each water depth, with about one million cells had been generated. They subdivide the computational domain surrounding the ship into a finite number of control volumes. The Navier Stokes equations have to be solved for this domain. Thus, the conservation equation of mass and the conservation equation of momentum have to be fulfilled for each control volume. In these equations all unknown quantities are averaged by using a mean part and a fluctuating part. This leads to further unknown quantities, the so called Reynolds Stresses, which are determined by a suitable turbulence model.

The accuracy of the numerical results has first been checked comparing them with measured cases. They show good agreement with experimental data as shown in Fig. 2, where the yaw moment N and the side force Y are compared for a 45° drift condition for various depth/draught ratios H/T. Even the computation time is acceptable for industrial applications. Fig. 3 shows the velocity distribution at the stern section (left) and at a midship section (right) of the cruise liner under oblique flow in deep water (top) and in shallow water (bottom) with H/T=1.2. The results show that RANS computations are a suitable tool for predicting forces and the manoeuvring behaviour with acceptable accuracy if model tests are not possible.

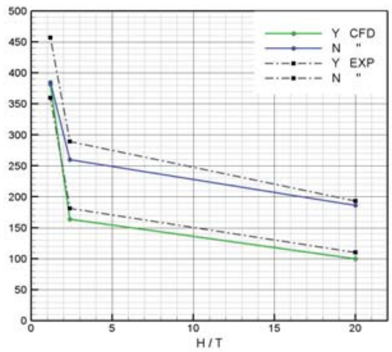



*Fig. 2: Comparison of experimental data with RANS results*

But it analyses the ship hull within minutes or less. Fig. 4 shows the streamlines around individual sections of the heeled tanker at a depth/draught ratio of 1.4. As expected, this new algorithm has confirmed that in shallow water the added masses of sway and yaw are much larger than in deep water.

The R&D project will enhance HSVA's capabilities with respect to harbour manoeuvres, dynamic positioning and further scenarios of slow manoeuvring.

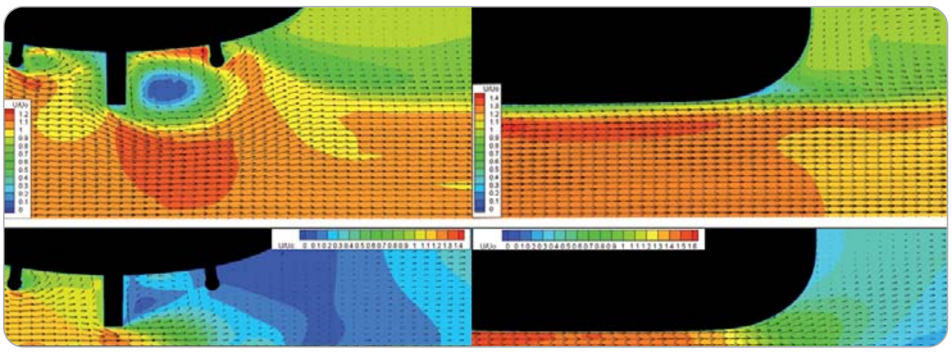


*Fig. 3: Velocity distribution of a RANS computation in deep and shallow water*

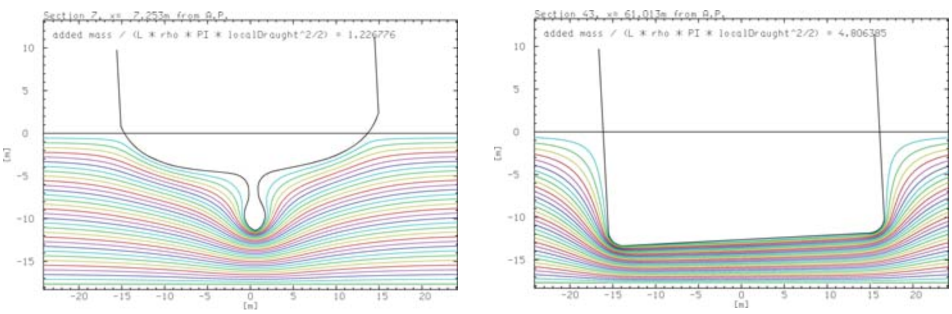


*Fig. 4: Simple potential flow in shallow water for a fast estimation of hydrodynamic added masses*

To simulate manoeuvres where inertia plays a role, a calculation of the specific ship's hydrodynamic added masses is performed rather than using pre-fabricated results of similar reference ships. For this purpose, a simple and fast algorithm to calculate a lateral potential flow around the individual sections has been implemented. It may not be misunderstood as an alternative to RANS calculations as it is too simple to do anything else than hydrodynamic added mass estimation.

If model tests are not feasible, e.g. because of hurry, because shallow water tests would be too expensive or because a study with many design modifications would require too many of them, HSVA will be able to answer the customers' questions by semi-empirical calculations based on a database of a prospectively increasing number of reference ships and their model test or RANS results.

# EMSA lets HSVA test the new SOLAS 2009 Stability Rules

**The European Maritime Safety Agency (EMSA) has contracted a consortium led by HSVA to do research on the damage stability of RoPax vessels designed according to the new SOLAS 2009 stability rules.**

*Fig. 1: A ship model in an early phase of a damage stability test in waves in the HSVA towing tank. The photograph shows a breaking wave just before it hits the damaged ship side and pushes considerable amount of water through the damage opening mainly on to the vehicle deck.*

*by Petri Valanto*

The European Maritime Safety Agency (EMSA) has contracted a consortium led by HSVA to do research on the damage stability of RoPax vessels designed according to the new SOLAS 2009 stability rules. The HSVA led consortium consists of the Flensburger Schiffbau-Gesellschaft (FSG) - Shipyard, Hamburg University of Technology (TUHH), the company Ship Design and Consult (SDC) and HSVA.

The purpose of the project is to investigate whether the safety level of the RoPax designs according to the new rules is adequate. The work is directly related to the possible amendment of the two EU Directives 2003/25/EC and 98/18/EC dealing with ro-ro passenger ship stability.

According to EMSA the ro-ro passenger ships provide a significant means of transfer of passengers and goods between the EU-member states, and they form an essential part of the EU transport network.

*Fig. 2: A view of the vehicle deck during the outfitting of the model. In full scale the deck is about 44 m long. The arrays of the wave probes cross the otherwise open deck. The large black opening on the left side wall is the modeled collision damage by another ship bow.*

In general the accident rate of such RoPax ships may not be higher than with other ships, but the consequences of those accidents are usually far worse. Therefore this matter is considered to be of fundamental importance and worthy of significant further research.

The work includes the design of two RoPax ships according to the new rules by FSG, and an evaluation of the safety level of these designs according to the new and old SOLAS rules with Monte-Carlo simulation by TUHH. This should allow a rational comparison of the new and old rules. HSVA simulates the behavior of the damaged ship in seaways numerically and carries out damage stability tests in irregular seas. In addition to the ship motions the water elevations on the vehicle deck are measured. This provides valuable information for comparison with the numerically simulated results. It is possible to estimate the total water volume on the vehicle deck leading to capsize in a sea state of significant wave height of 4.0 m or less.

The numerical code HSVA ROLLS used in the simulations has a relatively powerful and robust model for the flooding of the vehicle deck of the ship moving in seaways. This model is based on the numerical solution of the shallow-water equations on the vehicle deck simultaneously with the time-integration of the ship motions. The numerically predicted flooding patterns appear to be very similar to those observed in the model tests. It is, however, difficult to numerically predict the exact amount of water coming onto the vehicle deck in irregular seas. Therefore proper damage stability tests in HSVA's main basin with sufficiently large physical ship models are indispensable in this project aiming to provide as reliable information as possible for the development purposes of the ship stability rules. Such a physics based approach is needed, in case the present level of safety is found to be inadequate. The final report should be ready before summer 2009.

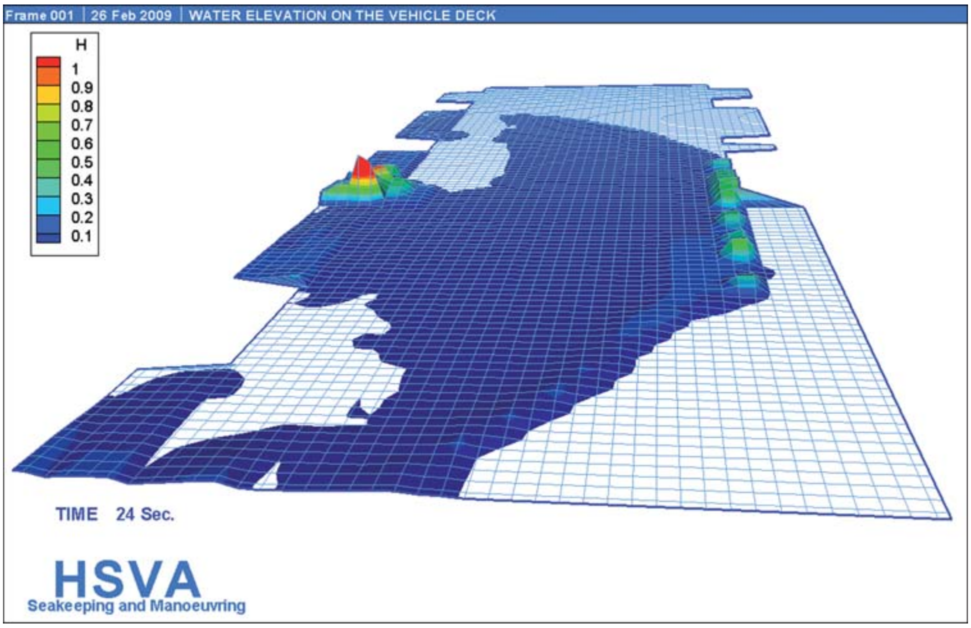
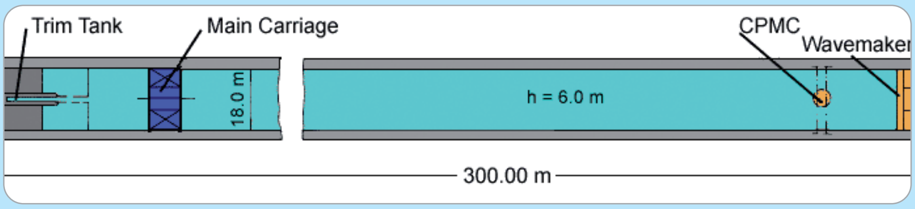



*Fig. 3: A snap-shot of the numerically simulated flow on the vehicle deck of the rolling ship in seaway shortly after the simulation started. The color-scale of the water height on the deck is in meters. The side compartments connected to the vehicle deck with door openings are included in the model.*

*Fig. 4: A ship model at the end of a short damage stability test in irregular seas.*

# Fullscale Submarine Component Testing in HSVA's Large and Fast Towing Tank




**Technical Data:**

| | | | |
|---|---|---|---|
| Tank: | | Carriage: | |
| Length: | 300.00 m | max. Speed: | 10.00 m/s |
| Breadth: | 18.00 m | max. Acceleration: | 0.80 m/s² |
| Depth: | 6.00 m | max. Deceleration: | 1.40 m/s² |
| | | Drive: | 4 Wheels each 2 Servos |
| | | Power: | 560 kW |

*Fig. 1: Data of HSVA's Large Towing Tank*


*Fig. 2: Actual submarine*


*Fig. 3: Support frame with wire*

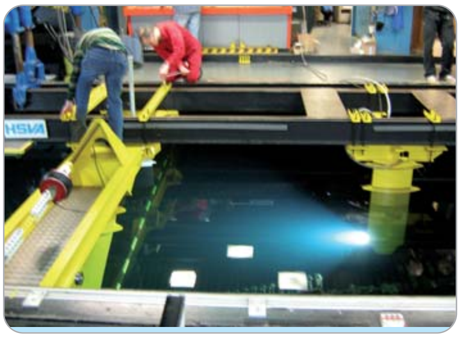


*Fig. 4: Towing carriage installation*

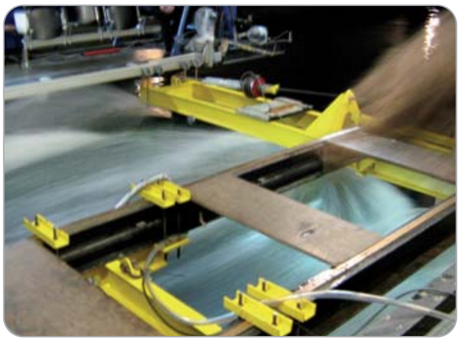


*Fig. 5: Tests with a towing speed of 10 m/s*

*by Herbert Bretschneider*

## Part 1: The Wire Protection System

Thyssen Krupp Marine Systems (TKMS) ordered HSVA to test a submarine system that prevents guide/communication wires from drifting into the propeller disk and from being destroyed. Simplified, this system consists of a streamlined wire spanned around the ends of the x-rudders located in front of the propeller.

Some of the objectives of this test were to determine the static horizontal and vertical elongation of the wire, its dynamic behavior due to the flow and the resulting vibration excitation as a function of wire tension. Due to the expense and the challenging technical demands of sea trials and the fact that no submarine was available, TKMS decided to test a.m. system in HSVA's large towing tank at scale 1.

This resulted in challenging requirements concerning dimensions, speeds and loads:

- Carriage Speed up to 10m/s corresponding to about 20kts
- Wire transverse span 7m and dived at 2m
- Wire tension up to 30 kN
- Towing force up to 15 kN

The support frame as well as the carrier for the underwater spot light and cameras were designed and manufactured by Dipl.-Ing. Christian Bruhn of TKMS in cooperation with HSVA. Thanks to the refit of the towing carriage two years ago towing speeds up to 10m/s, accelerations of 0.8m/s² and towing forces up to 15 kN could easily be achieved.

Interesting results were obtained at relatively low costs, which will help to optimize the wire protection system further.

## Part 2: The Transverse Launching System

Howaldtswerke-Deutsche Werft (HDW) as subsidiary of ThyssenKrupp Marine Systems (TKMS) ordered HSVA to test transverse launching systems for two different full scale bodies. They were integrated into a streamlined aluminium body of quite impressive dimensions – 2.6m length, 3.7m width, 0.75m height, about 600kg weight and dived at 2m depth – constructed and manufactured by Walterwerke Kiel GmbH. For recharging the launching systems the streamlined body had to be lifted and laid down onto the towing tank beach.

These challenging tests performed in HSVA's Large Towing Tank were designed to approve the operating conditions for a sure ejection, to document the process by High Speed Video Recording (512 x 512 Pixel resolution, up to 5000fps, electronic shutter down to 1μ s, projected area 2m x 2m), to measure characteristic data (trigger signals, forces, pressure) and to determine the trajectory of the ejected bodies. During the towing and launching tests with high carriage speeds towing forces up to 20 kN were measured. To ensure the safety of the participating persons, the towing carriage and the installation, despite the high ejection speeds, extensive safety measures had to be carried out. The perfect cooperation of HDW and HSVA before and during the towing tests enabled a smooth test procedure with various modifications of the setup without time delay. The brilliant High Speed Video Recordings as well as the detailed measurement data from each test run allowed deep insight into the launching process, helped to optimize the components and reduced the risk of a sea trial.

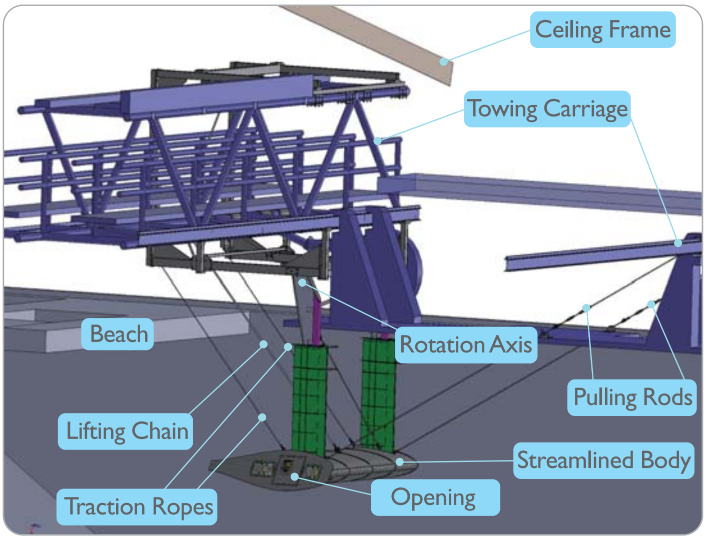



*Fig. 6: Setup for launching tests*

*Fig. 7: Recharging of the launching system on the beach*

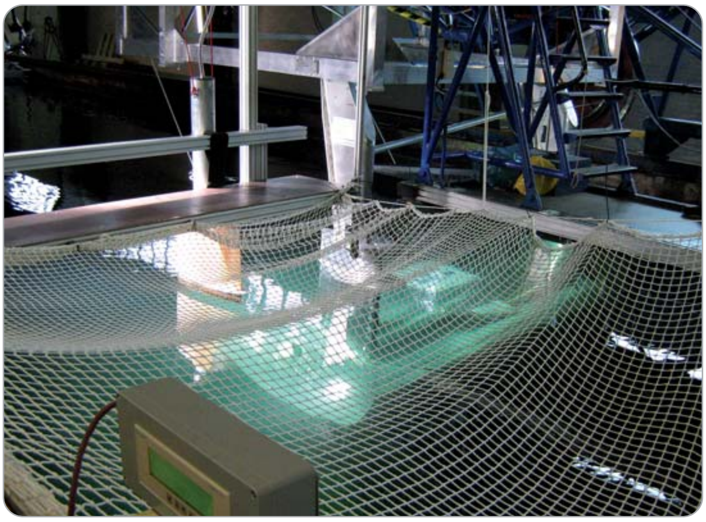


*Fig. 8: The submerged streamlined body is ready for the next run*

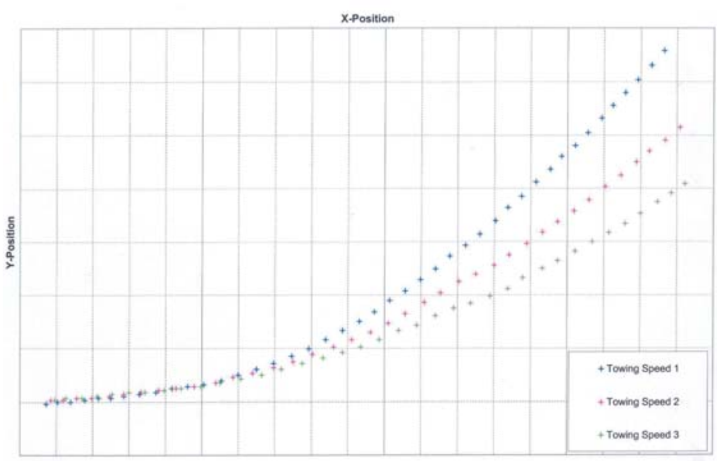



*Fig. 9: Tracking data for launcher No. 1*

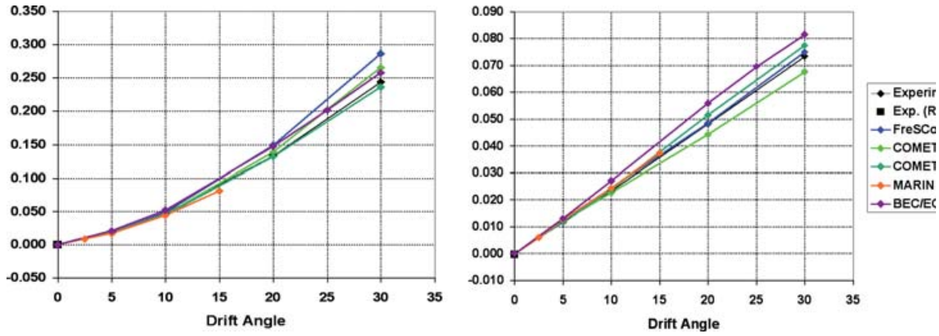
# Introducing FreSCo

# The New RANS Solver for Maritime Applications

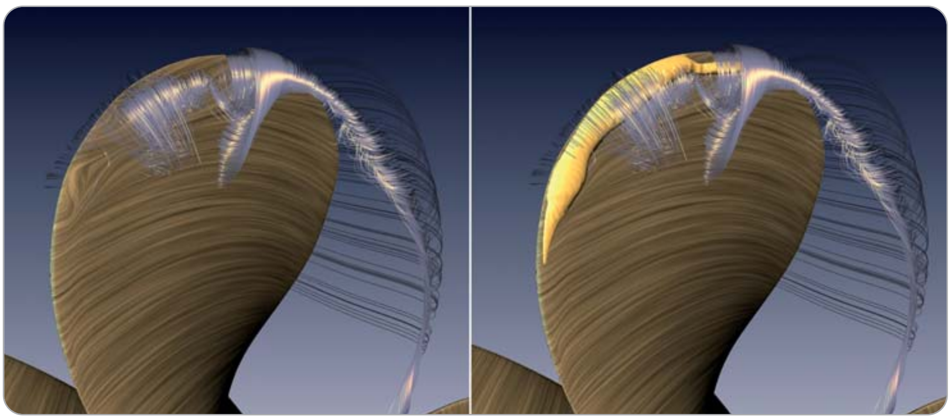
*by Jochen Marzi*

### Intro/Short History

2009 marks another CFD-milestone at HSVA. *FreSCo*, the new multi-purpose maritime RANS solver is introduced in regular work and applied in customer projects. Starting as an in-house development in the CFD department, HSVA joined forces with the Technical University Hamburg Harburg to develop a complete new RANS code in 2005. Further development work was carried over into the VIRTUE project where the code was also used by MARIN for propeller and cavitation predictions. *FreSCo* was designed as a multi-purpose flow code with particular emphasis on characteristic maritime applications. The particular requirements arising from the analysis of typical ship flow problems, e.g. boundary layer / wake predictions, free surface flow and cavitation predictions have lead to a versatile RANS code which is successively introduced in HSVA's range of standard applications.




*Comparison of predicted normalised side forces and yaw moments from different flow codes (VIRTUE – WP 3)*

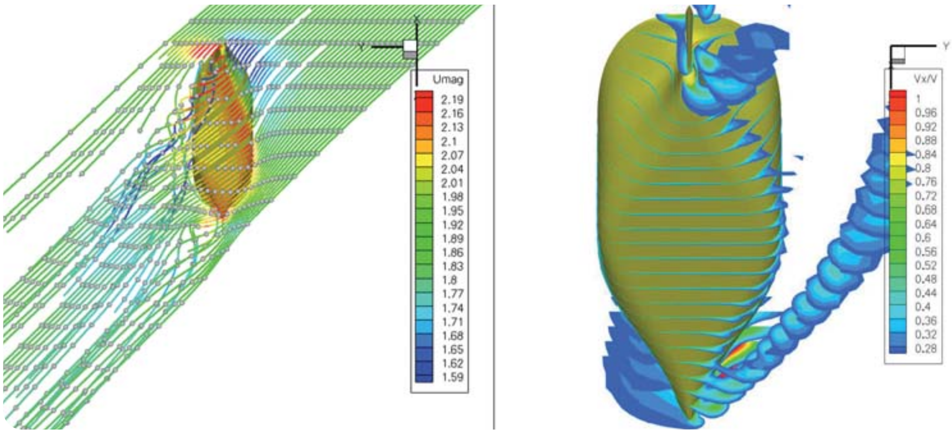


*Predicted Tip Vortex roll-up and cavitation pattern (right) for the INSEAN Test Case in VIRTUE*

### Applications

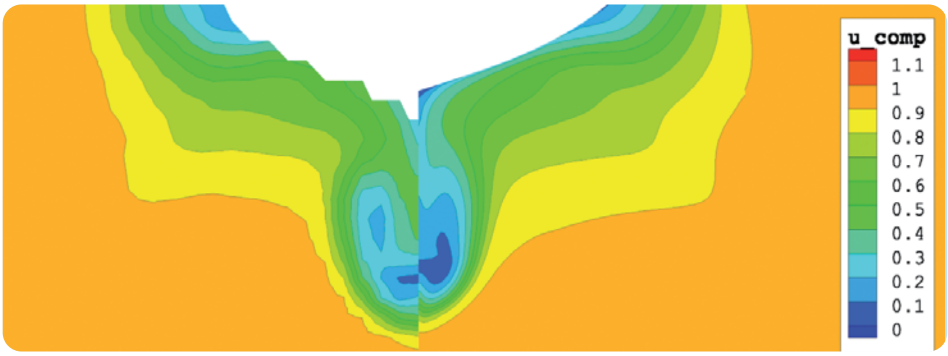
The development brief for *FreSCo* contained a wide range of requirements arising from routine applications met in analysis and consultancy projects. Besides standard work such as the prediction of ship wakes, being a prerequisite for any propeller design, dedicated analysis of the flow about propulsors including the prediction of cavitation phenomena was among the most important elements on the development agenda. This lead to the implementation of a large range of turbulence and cavitation models in the code which have been successively tested on a range of standard and dedicated test cases, e.g. the propeller flow data which have been used in a workshop exercise in the VIRTUE project. Here *FreSCo* proved to be the best RANS code participating in this exercise, the results only being paralleled by an LES code at prohibitive computing time.

Encouraged by the results obtained in the propeller workshop, the code was in turn transferred also to other areas. The forecast of manoeuvring performance is another important area of hydrodynamic ship design. Again in the context of the VIRTUE project, *FreSCo* has been applied to the prediction of manoeuvring coefficients for a large range of standard manoeuvres which could be validated with experimental data obtained from model tests in HSVA's large towing tank. In a workshop with 6 participants using different flow codes, HSVA's *FreSCo* predictions again are among the best submitted results. The code proved to be accurate, fast and versatile and hence is a valuable means for the prediction of manoeuvring performance at the design stage of a new ship. Besides, the overall amount of flow field information yielded (see the predicted streamlines and hull pressure distribution for a yaw angle of 30°) provide deeper insight into the mechanisms and will help to suggest improvements for critical cases. Wake analysis and propulsion optimisation are among the most important elements during ship design as propulsive efficiency largely determines the commercial viability of any new design. It is hence of great importance for all RANS solvers applied in wake predictions to validate results on approved experimental data. *FreSCo* underwent a series of validation exercises on standard cases such as the KVLCC2 tanker and other hulls before finally released.

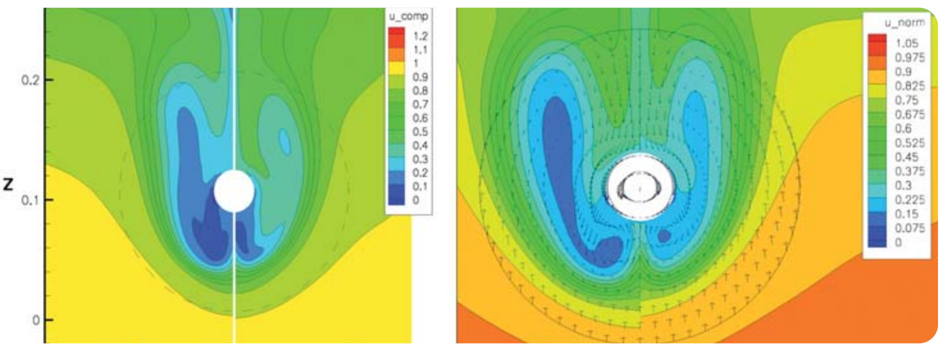



Predicted streamlines and hull pressure distribution (left) and axial flow field velocity (right) for a yaw angle of 30°

Having gained confidence in the numerical results obtained from *FreSCo* predictions, the more challenging tasks of optimising a hullform for improved wake flow was addressed in 2 in-house projects during the last months. The first one aimed at the optimisation of the aft body of a tanker hull where first comparisons of the wake alone were performed. In a more thorough exercise performed in a second project a full optimisation of the hullform of a bulk carrier was performed, accounting for wake quality and all relevant resistance components. This was based on a parametric CAD model allowing for quick modifications of the hull form and subsequent analysis. This was the first example for an integrated process chain in which *FreSCo* could be used within a complete design environment comprising CAD, RANS analysis and optimisation.

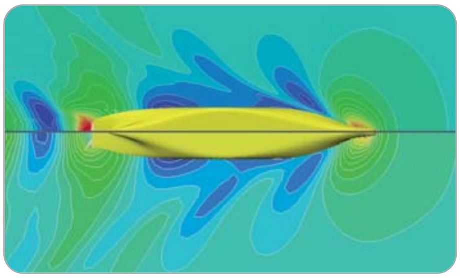



*Validation: Tanker Hull: FreSCo Results (right) vs. experimental data (left)*




*Wake Optimisation: Tanker hull (left), Bulk Carrier (right), each showing the baseline design on the left and the optimised hull on the right.*

Free Surface computations are traditionally the major playground for CFD applications in a model basin. Although potential flow methods such as HSVA's well known V-SHALLO code are well established and versatile tools, the limits of such methods when being applied to very full hullforms or problems involving breaking waves or partially immersed transom sterns are known. Here RANS methods applying a two phase flow model such as Volume-of-fluid (VOF) or level set are clearly superior to the more simpler potential flow codes. This is demonstrated in the following figure comparing wave patterns for the Hamburg Test Case Container vessel obtained from both, V-SHALLO and *FreSCo*, the latter clearly showing more pronounced bow and especially stern waves as would be expected from a RANS code prediction. *FreSCo* has been successfully applied to several standard test cases already and shows very promising results. These applications will soon be integrated in routine analysis of free surface ship flows.



*Free Surface prediction (coarse grid) for a standard test ship: FreSCo (top) and V-SHALLO (bottom)*

## The Way ahead

Having matured over the past development period, *FreSCo* is now being introduced in routine work for a number of standard applications arising from HSVA's customer projects. Building on this, further developments necessary to address even more comprehensive applications are targeted in the near future. These will comprise seakeeping analysis, multi-body dynamics and further integration of *FreSCo* into existing HSVA-process chains. This will allow to offer an even further expanded range of cutting edge CFD analysis services in customer projects.

# NOISE from Shipping and its Influence on Marine Organisms

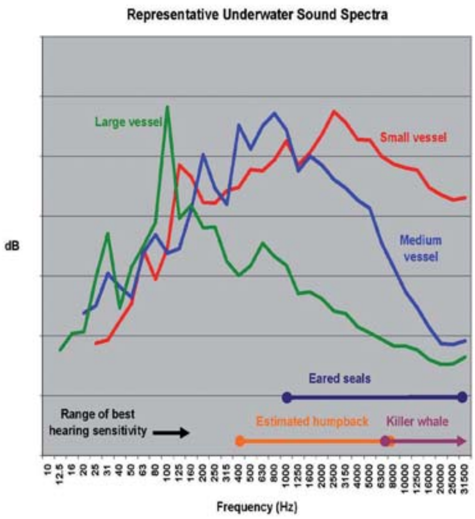
Courtesy of OKEANOS

*by Juergen Friesch*

There is increasing recognition within scientific communities, regulatory agencies and the general public that human sounds can affect marine organisms in various ways. While much of this focus has centered on relatively high-power but intermittent sound sources (e.g., active sonar systems), there is also an increasing recognition that lower-level sound sources may also have impacts on marine species. Foremost among such chronic sound sources in the oceans are the many thousands of large commercial vessels. In the past, commercial ships have not been in the focus concerning their contribution to radiated noise in the ocean. While there has been increasing recognition of the potential of shipping noise to significantly contribute to the underwater acoustic environment in many areas, many unknowns remain, including whether the demonstrated capabilities to quiet military and research vessels may realistically and economically be used for application on large commercial vessels.

There is a relationship between commercial shipping and the amount of underwater noise. Given that shipping is increasing and expected to expand into new areas, e.g., the Arctic, incidental noise from shipping will continue to rise.

The main sources for shipping noise are cavitating propellers and the propulsion machinery. They may dominate the noise level in the low frequency spectrum at any distance. On behalf of Dokumente des Meeres GmbH, Darmstadt, Germany, a study of propeller pressure fluctuations for container and tanker vessels was performed to find the pressure amplitudes of state of the art vessels, the dependence on propeller speed and the influence of propeller design parameters like skew and pitch distribution.




Courtesy of OKEANOS, KIPPLE

Full scale pressure fluctuation data of progressive speed tests of 8 vessels were analyzed to determine the dependence on propeller speed. An interpolation function was found describing the pressure fluctuation of the 1. harmonic to a sufficient degree and allowing prediction of arbitrary intermediate conditions. For a large container vessel operating at 60 MW, 26kts, 100RPM pressure amplitudes of typically 5.6 kPa have to be expected. For a reduction to 4.6 kPa the propeller speed has to be lowered to 96.77RPM. The resulting ship speed / delivered power will be about 25.12kts / 54.73MW.

The empirical equations have been derived from HSVA's database and referenced from literature. They are valid for the first harmonic order and have a limited precision of about 1-2 kPa. The propeller design parameters skew, pitch distribution and camber offer possibilities to reduce significantly the first harmonic order of propeller pressure fluctuation and these mean also a reduction of noise in the low frequency range.

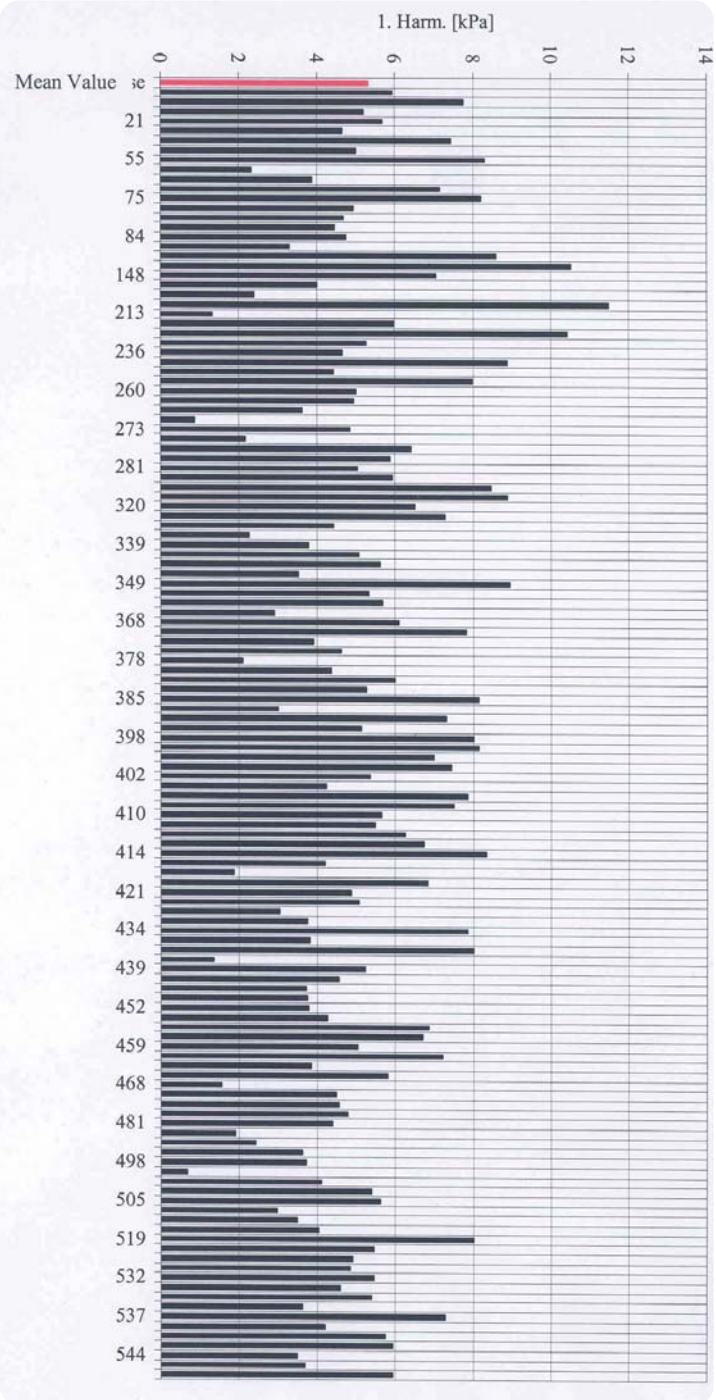
Acoustic countermeasures are used, known and well tried on warships and research vessels. Some of these countermeasures can be applied to commercial ships also, but low noise levels are often connected to high cost. This holds for example true for the typical noise reduction measures used on navy ship propellers. Some technology, however, is available which could be applied at comparatively low cost, such as active noise control or air injection into certain areas of the propeller. These will require further research for correct installation, safe prediction of their effect and efficient employment. Noise radiation of commercial ships at normal service conditions have been recorded by Wittekind at frequencies down to 10 Hz under favorable conditions. The results show that acoustically, ships can be categorized in three groups:

**A** In ships with fixed pitch propellers, which control speed by adjusting shaft speed. They show pronounced low frequency levels at propeller blade rate harmonics and machinery contributions from medium speed diesel generators.

**B** In ships with constant shaft speed and controllable pitch propellers, which adjust speed by controlling the pitch. They seem to contribute also to low frequency noise, likely increasing, when reducing speed.

**C** In some ships with high medium frequency levels.

Comparing results with other measurements and literature there are significant contradictions




which need to be clarified by further investigations. Also the current models in use for noise generation, radiation and propagation need further attention. Some current knowledge may serve as first basis to define a direction for noise limitation and registration. Unlike chemical pollution, noise does not persist in the environment. Thus, if a source of noise is reduced, the amount of noise energy in the water is immediately lowered. Under these favorable circumstances, the goal is to reduce the amount of incidental underwater noise from shipping to mitigate or eliminate the impacts of noise on marine mammals. But it is important to realize that many of the new ships - ships that came into operation within the last 5-10 years - have been subject to extensive optimizations and noise reduction. This is because of stringent requirements concerning the inboard noise and vibration levels. Most of those measures taken to reduce the inboard noise were related to propeller cavitation and definitely helped to reduce underwater noise. This is why many of the new and high value ship designs already show good data related to underwater noise excitation. Nevertheless further improvements should be discussed.

To achieve this goal a global action is necessary to reduce the contributions of shipping to ambient noise energy in the 10-300 Hz band by 3dB in 10 years and by 10dB in 30 years relative to current levels.

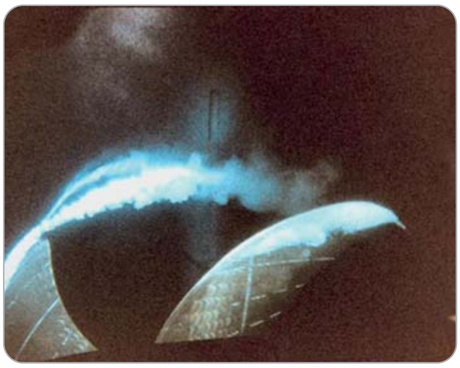
The main action to substantially improve noise in the ocean is the 50 Hz maximum in the background noise spectra which can be considered as a total of many ships. The cause of this phenomenon is still unknown. The main needs of research for HSVA are:

**1.** The cause of the 50 Hz noise contribution must be revealed and a solution as to reduction of its level be found.

**2.** Research into radiated propeller noise of commercial vessels is to be extended before rules and regulations to control noise levels are established.

Nevertheless, operational measures should be implemented immediately.

During a workshop in Hamburg, last year, organized by the OKEANOS-Stiftung für das Meer, the coordination of action on an international level, i.e. by the International Maritime Organization and its members was strongly recommended by scientists of different parties like ship owners, naval architects, biologists,... In the meantime the IMO's Marine Environment Protection Committee agreed to add to its agenda a new work item entitled "Noise from Commercial Shipping and its Adverse Impacts on Marine Life" and further agreed to the establishment of a correspondence group (CG) to address this issue! In January this year the initial meeting of the German mirror CG took place in Bonn, Germany, and prepared some input data for the upcoming IMO work. HSVA takes part in this work.



This result is a good example of what can happen when you bring people from all sides of an issue together and work honestly and openly through sometimes tough points all together.

# Hydrodynamic Upgrade for the MV Hammerodde


*Fig. 1: The MV Hammerodde arriving at Rønne on Bornholm for the first time on 22 April, 2005*

*by John Richards*

The MV Hammerodde is a RoRoPassenger ferry which serves Rønne on the island of Bornholm from the Danish port of Køge near Copenhagen and from the mainland port of Ystad in Sweden. She was built in the Netherlands by Merwede Shipyard in 2005 and has been in service since April of that year. Together with her sister ship, the MV Dueodde, she sails under Danish flag for Bornholmstrafikken A/S, which is headquartered in Rønne.

In order to fulfill a new contract with the Danish Ministry of Traffic, the Hammerodde will now be required to increase her cargo carrying capacity from the present 1200 lane meters up to 1500 lane meters. The required space will be made available by adding a further RoRo deck. The corresponding demand for about 10% more displacement will be fulfilled by increasing the draught and at the same time adding a set of sponsons and ducktail. The sponsons and ducktail not only provide more displacement but at the same time a larger waterplane area to ensure sufficient stability for the 'after conversion' hull form.

A further and somewhat more challenging feature of the new contract is that the present speed of the vessel, which is now 18.5 knots, must be maintained. The idea of fulfilling this requirement via an expensive machinery upgrade is not particularly appealing to the ship owner. Therefore the Finnish marine consultants Foreship Ltd. were requested to apply their art to the task of adding more than 800 m³ to the volume while at the same time maintaining the speed without increasing the power requirement.

In November of 2008 HSVA was contracted to perform the model tests for the MV Hammerodde conversion project. The targets of the investigation included the sponsons/ducktail, an alternative bulbous bow and the introduction of an interceptor plate on the ducktail transom. For this purpose a very time and cost efficient test program was agreed upon and a multi-component ship model was manufactured.

In phase 1 of the testing work the hull form modifications and interceptor performance were investigated. In a second phase the concentration will be placed on the rudder design and also a shift of the rudder position. Here it is expected that the installation of a high efficiency rudder system in conjunction with flap rudders will not only increase the

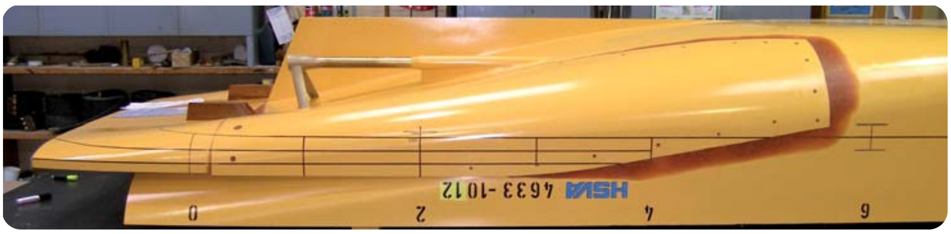


*Fig. 2: The model of the 'after conversion' Hammerodde under construction in HSVA's model workshop*

propulsive efficiency but especially also improve the harbour manoeuvring capabilities. These will be further investigated in a series of crabbing tests.

In the meantime the first phase of testing has been completed with a very encouraging result for the ship owner. In the past, conversions of this magnitude have usually resulted in an overall speed loss for the vessel. In the case of the MV Hammerodde however, the speed loss of about 0.5 knots due to the added volume and increased draught was just compensated by the introduction of the interceptor. Thus the contract point concerning maintaining the 18.5 knots speed has been met. Why invest in an expensive machinery upgrade when you can avoid it by upgrading the hydrodynamics instead?



*Fig. 3: Transom flow off the ducktail with and without interceptor*

Now the results of the rudder investigation are being awaited expectantly. Most likely the MV Hammerodde will be fulfilling her new contract with a reduced fuel bill.

# Beam Seas at HSVA's Large Towing Tank

*by Katja Jacobsen*

In January 2008, HSVA started the research project ViTa II, concerning the generation of beam and oblique waves in its Large Towing Tank. The research project is partially funded by the Free and Hanseatic City of Hamburg.

Increasing demands due to new standards and requirements on safety as well as economic aspects of ships in seaways convinced HSVA to invest in new testing facilities for extending its seakeeping test capabilities with long and short crested beam and oblique waves. By integrating a side wave generator on the long side of the existing Large Towing Tank the acceleration and deceleration phases of the ship model can be placed in front of and behind the actual measuring region, respectively. Thus, the side wave generator can entirely be exploited for the measurements, resulting in a very attractive concept. Moreover the same large models for e.g. resistance or propulsion tests can be used for the seakeeping tests – saving model manufacturing costs for our clients. Together with Bosch Rexroth, the leading company in manufacturing wave generation systems, a feasibility study was carried out in order to meet the special requirements when installing such a wave generator in an existing ship model basin. The most restricting factors – very limited space and no influence on all other tests - led finally to a concept of a retractable wave generator which is stored in the walkway beside the towing tank. By means of a dedicated hoisting system the side wave generator will be transited from stowage into operation mode within less than one hour. In order to avoid reflected waves in the measuring region an absorber system will be installed at the opposite tank wall. The wave absorber consists of vertically positioned, perforated steel plates with varying porosity. This sort of wave absorbtion is very efficient and space saving. On the wave generator system itself, provisions for active wave absorbtion are foreseen in order to damp away other unwanted waves, e.g. ship wave systems of passing models.

As a first step a demonstrator of 40m length will be installed in near future opening the possibility of a completely revolutionised seakeeping testing technique at HSVA. Upon successful demonstration tests of the technique and its applications at the end of the project phase in March 2010 it is planned to extend the side wave generator up to 140m length.

With the new side wave generator HSVA will gain the ability not only to carry out seekeeping tests in longcrested head (or following) waves, but also in beam and oblique seas, optionally long- or shortcrested. By combining the new oblique waves with waves generated by the existing wave maker seakeeping tests can be performed in highly realistic scenarios consisting of wind and swell seas. The new technique will increase therefore the seakeeping test capabilities of HSVA dramatically.

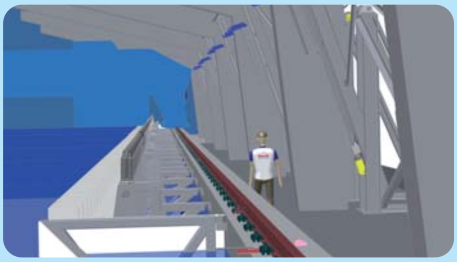


*Fig. 1: Impression of the new side wave generator in the Large Towing Tank*

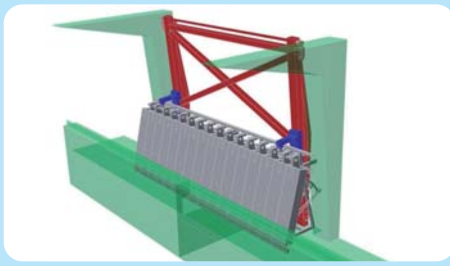


*Fig. 2: Stowed side wave generator with hoisting system*

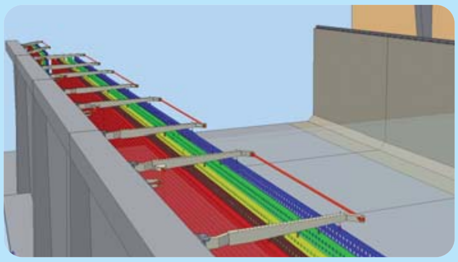


*Fig. 3: Wave absorbers on the opposite tank wall*

# HSVA Introduces New State of the Art Measurement and Data Collection System for Ice&Offshore Model Tests

*by Peter Jochmann*

Over the last decades HSVA's offshore ice projects have been demanding more and more accurate determination of the motions of marine structures and ships during ice model testing. In order to meet these requirements it is not sufficient to only increase the accuracy of the sensors. It is also of great importance to perform the tests without the influence of external forces caused by umbilical cables, string sensors etc. In response to this new challenge HSVA has upgraded its measuring equipment during the last year to the highest worldwide available standards by adding the following components in order to be able to carry out totally wireless ice model tests:

- QUALISYS optical tracking system
- HBM MGCpus DAQ System
- LANCOM Industrial Wireless LAN


*Fig. 2: Oqus 300 camera*

**QUALISYS optical tracking system**

The core components of the tracking system are 4 advanced, high-resolution and high-speed infrared video cameras (see Figure 2). The dedicated motion capture cameras, Oqus300, use a proven and unique concept of real-time marker detection inside the camera. The cameras are connected daisy chained via Ethernet 100 Mbps cable to a desktop computer which additionally hosts a 16 channel D/A converter. This provides the capability for outputting data as an analog voltage signal. A schematic layout of the system is shown in Figure 1.

The QUALISYS Tracking Manager QTM software provides among others the following features

- Hardware setup, camera control and calibration.
- 2D and 3D tracking & 6DOF position determination of a defined rigid body.
- Data acquisition and video capture.

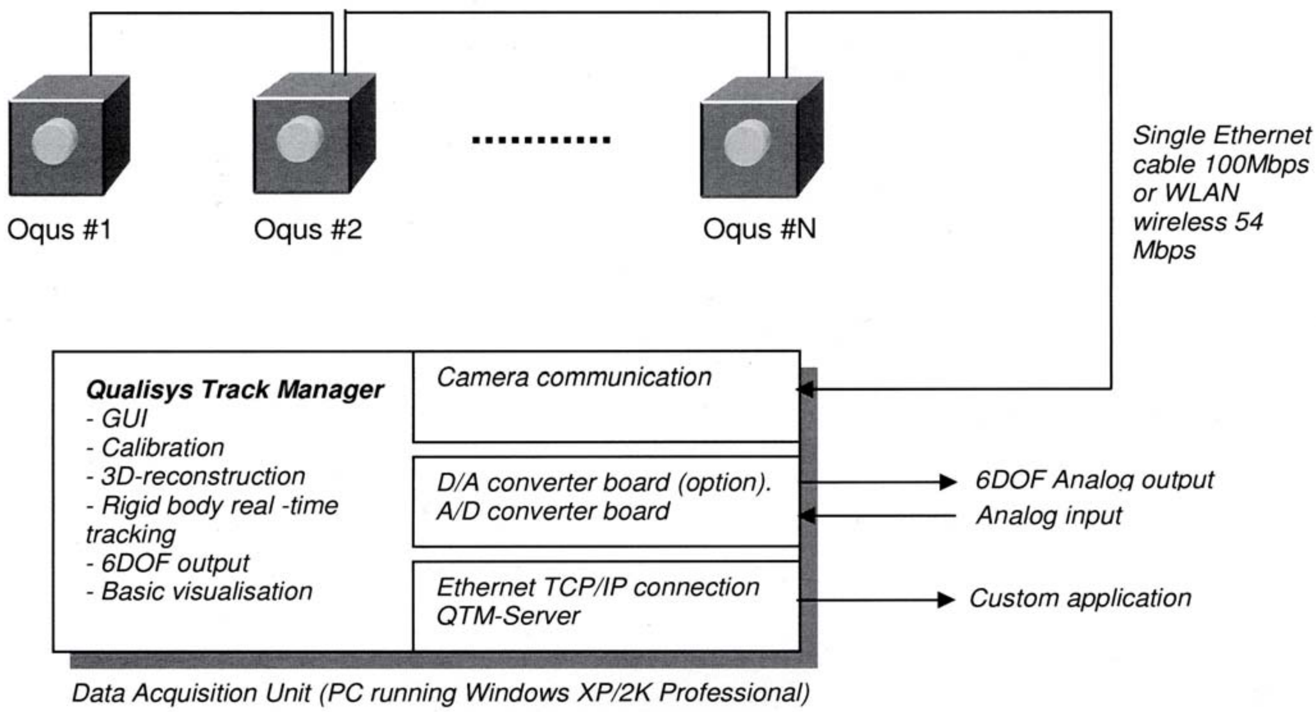



*Fig. 1: Schematic layout of optical tracking system*

The accuracy of the system within a measuring volume of L=10m x B=10m x H=1.5m is better than ±1mm for translational motions and ± 0.1° for rotational movements.

**HBM MGCpus DAQ System**

MGCplus is a multichannel configurable DAQ system supplied by HBM. The MGCplus combines the three main data acquisition components, amplifier, filter and ADC in one unit which provides several interfaces for communication with other systems and computers such as fieldbus, Ethernet etc. A wide variety of modules are available for measuring physical quantities such as force, displacement, pressure, temperature, acceleration, strain etc. Modules with high resolution and long-term stability are available for static measurements, For dynamic measurements of up to 50 kHz DC amplifier modules are also available. The maximum sampling rate is 19200 values/ second/channel.

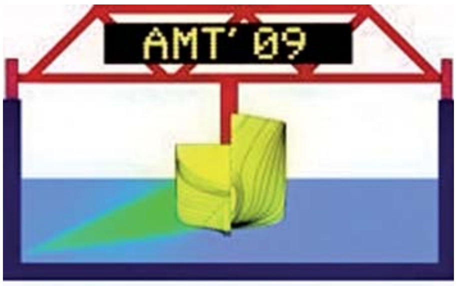
**LANCOM Industrial Wireless LAN**

A LANCOM IAP-54 industrial Wlan Access Point is used to establish communication between the MGCplus and the data acquisition notebook. With its 108-Mbps wireless module, the LANCOM IAP-54 Wireless offers considerable flexibility and is compliant with IEEE 802.11a/b/g/h and two dualband diversity antennas. Depending upon requirements, the access point can be operated in the 2.4 GHz frequency range and at 5 GHz. External antennas can be adapted if necessary for increasing the transmission reliability.

**Inauguration of wireless system**

Totally wireless ice model tests were carried out during February 2009. A moored structure installed in the deep water section of the Large Ice Model Basin interacted with a moving ice sheet. The sensors for measuring the ice loads, accelerometers and passive markers for the determination of the structure movements were all installed together with a battery, the MGCplus DAQ system and the LANCOM WLAN Access Point on the working deck of the structure (see Figure 3). The QUALISYS motion tracking system as well as a second DAQ system, a HBM spider 8 for picking up the mooring forces and the ice drift speed, were installed onshore together with the DAQ notebook. These communicated via WLAN with the structure based components. The application of the wireless data acquisition system was very fruitful and the test series were completed successfully and underlines the high technological standard of ice testing at the Hamburg Ship Model Basin.


*Fig. 3:Test setup of structure in ice model basin*





HSVA is an active partner in the FP6 Hydro-Testing Alliance (HTA)
Network of Excellence (NoE)
which organizes

## an International Conference on

## Advanced Model Measurement Technology for the EU Maritime Industry (AMT'09)

## Ist and 2nd September 2009, Nantes-France

This conference is of benefit to professionals, academics and students interested in advanced model and full-scale testing methodologies and measurements in the marine environment.

The conference topics include: PIV operation in hydrodynamic experimental facilities; Flow data analysis and visualization; 3-D wave field measurements; Podded propulsor dynamic forces; Wireless data transmission; High speed video; Intelligent materials and production methods; Wetted surface; Free running model technologies; other advanced measurement techniques.

Among others, HSVA's experts are there to discuss these interesting topics with you.

**For more information visit the conference website at: www.amt09.eu**

## Member of staff

Jutta Zerbst graduated as an engineer's assistant from the Physikalisch Technischen Lehranstalt in Wedel in Autumn 1970. Following her studies Jutta Zerbst joined HSVA where at the beginning she was responsible for the preparation and evaluation of resistance and propulsion tests, and also for preparing report documentation and statistics. In 1976 Mrs. Zerbst first took over as one of HSVA's commercial project managers. Since then she has been serving many of HSVA's key customers from both Europe and Asia for all kinds of commercial ship development projects, with the concentration being on container vessels. Her friendly, competent and very efficient working style has helped to secure long term customer satisfaction.

In her spare time Mrs. Zerbst enjoys her family and her cat, and she likes to unwind either on the west coast of Denmark or on the Baltic Sea in Germany.



**The Second Becker Twister Cup Championship for Model Sail Boats**
was sailed indoor in one of HSVA's towing tanks. HSVA and Becker Marine Systems invited their customers and friends, among them E.R. Schiffahrt, Norddeutsche Vermögen, Reederei NSB, Rickmers Reederei, Peter Döhle Schiffahrts-KG, NSC, CMA CGM, envise, IBMV and SDC.

The race was won by Michael Wächter from SDC, the Ship Design & Consult GmbH Hamburg, a daughter company of HSVA. More details, results and pictures can be found on
**www.twistercup.com**

The next race, the TwisterCup III will take place outdoors in
**Scharmbeck on April 25th, 2009**

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