SVA items

SCHIFFBAU-VERSUCHSANSTALT POTSDAM GmbH No. 5, September 1998

SVA Services Today

For a service institution like a model basin the client is the focus of interest because he is paying the salaries of the staff. For the Potsdam Model Basin is this coherence more true because it is private and has non state supported funds. Time to time we think about this "disadvantage" and come to the result that funds are a nice thing but a filled stomach makes lazy and this is dangerous as well for the client as for the institution itself.

In the last years we have doubled our income from industrial work and the share of foreign clients was raising up to 25 p. c. This is for us an indicator that our services are not old fashioned and that we serve our clients. Otherwise we know that this position has to be obtained by fighting for every contract new.

To have a close contact to our clients we have new agents for the Near East in Egypt and for the Far East in Singapore and if necessary we will widen this network to other regions in the world. So we can guarantee a fast and professional reaction for all questions.

The Potsdam Model Basin offers the standard spectra of model tests in deep water towing tank and in medium sized cavitation tunnel. Important news for our clients will be that we are able by the end of this year to offer model tests for seakeeping behaviour with wave packets. In result of this possibility the necessary time for seakeeping tests will be shortened and/or the quality and quantity of information will be raising up. The already existing slamming simulator is in this connection a good completion. For the cavitation tunnel we have developed a new facility for testing overlapping propellers which make it possible to change the distances between the shafts and also to change independent of each other the longitudinal position. The wake field will be simulated by a dummy. In using advanced numerical technologies we are now able to offer computation of the pressure field of a propeller in the behind condition for the model and the natural ship. This is an important step on the way to the numerical towing tank. Naval architects get now so much information about flow behaviour around ship hull that they have to learn first to interpret then in their design work. Now we offer the calculation of the wake field for the natural ship as a routine work as well as the design of propellers with sophisticated numerical tools.

We hope you have heard good and interesting news for solving your problems. If you like to test our services including the nice area around Potsdam town with its famous gardens and palaces please contact us and we will serve for you.

Palace Schloß Charlottenhof

Hamburg SMM'98

With our third participation in the Shipbuilding Machinery and Marine Technology Exhibition and Conference we can say it is a tradition for us to be there and in this tradition we will continue to present a special SVA items too.

In the last two years we have worked very hard and we think successful in both research and development and industrial work for our client's. From this necessary mixture of theory and practice we get the input for new ideas. It is not the guarantee but a essential base for success.

We never expected that our engagement in numerical methods and their use in ship and propeller design and our knowledge in propulsion systems would force us so strong as in the last two years. Our last workshop "Azimuthing Propulsion – new challenges and chances" was a confirmation for us that we are on the right way.

If you are curious about more information after reading this issue of SVA items or you are an old client and/or friend of Potsdam Model Basin you are kindly invited to join us in Hamburg at SMM'98 in exhibition hall No. 1 EG place 1075. My colleagues and I would be pleased to meet your there or any where in the would.

Manfred Mehmel
Managing Director

Unsteady Viscous Flow Computation of Hull Propeller Interaction

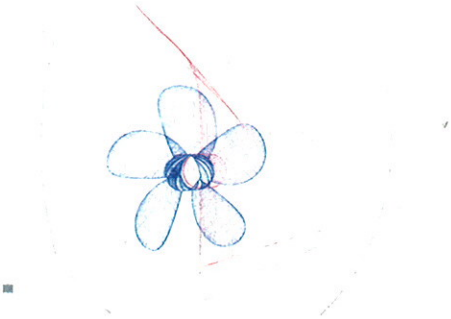
One of the most important problems in the design of ships and marine propellers is the interaction between the flow around the stern of the ship and flow induced by the propeller. Current design tools generally ignore the interaction and optimise the two components independently.

The major problems are the necessity to include viscous forces and turbulence effects, the complexity of the geometry and the resulting effort to discretise the problem, the interaction between the rotating propeller and the stationary ship and the inherently unsteady nature of the flow.

In the joint research project between SVA Potsdam and AEA Technology, the CFX-TASCflow code has been optimised to allow an accurate solution of the current problem. To perform fully unsteady computations, all terms in the equations via an unsteady interface between the stationary grid on the ship and the rotating one on the propeller have been taken into account.

Results were presented in this year for the series 60 model with rotating propeller at the Third Osaka Colloquium on Advanced CFD Applications to Ship Flow and Hull Form Design and the Summer Meeting of the ASME International Fluids Engineering in Washington.

Figure 1 shows the topology of numerical grid around the stern of the ship and the propeller.



Grid topology around stern and rotating propeller

Calculated unsteady propeller inflow

The computational domain started one quarter of ship length in the front of the ship and ended one ship length behind it. For the simulation of the ship-propeller interaction, all blades of the propeller were considered. The calculation domain around the ship was divided into 140 blocks. In the grid of the ship a cylinder behind the ship was left for the grid of the propeller. The diameter and the length of the cylinder were equal to the outside dimension of the propeller grid.

For the unsteady computations the numerical grid of the propeller was rotated every time step and the connectivity of the control volume faces at the interface was recalculated. The calculated surface pressure shows the pressure decrease due to the propeller action. The surface pressure at the starboard side is lower than at the port side. The rotation direction of the propeller is responsible for the differences on the surface pressure on both sides of the ship, as the propeller blades on the starboard side are more loaded than on the port side.

The calculated unsteady contours of the axial velocity component in front of the propeller disc and the effect of the different loading of the propeller blades on the effective wake field are shown in Figure 2. The highest thrust is generated from the propeller blade which is near the two-o'clock-position. For a right handed propeller, the upward component of the wake field increases the angle of attack and the formation of the tip vortex.

The comparison with the available experimental results shows that the numerical investigations are able to simulate the true unsteady interaction problem between a ship and a propeller and to estimate the induced unsteady forces of the propeller on the ship hull.

Using of Wave Packets for Slamming Investigation of Fast Ships

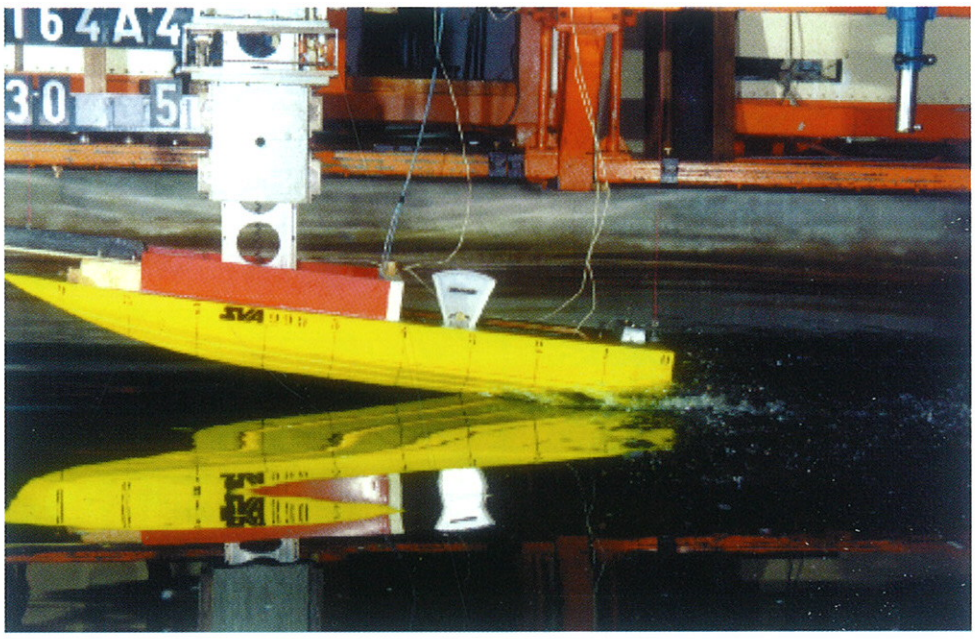
With the development of fast ships with modern bow shapes such as patrol boats, fast monohulls, catamaran ferries or fast containerships the slamming problem is continual rising already for small seastates. Nevertheless there is a great lack of measuring slamming pressures on ship models. Model tests for measuring slamming pressure were carried out during the last years most only for conventional ships at slow speeds.

The investigation of fast naval ships in regular and irregular waves is time consuming due to the lot of measuring runs to get a representative number of wave encounters for example in irregular waves. Transient wave packets are recommended for significant reducing the measuring time.

The creation of experimental and theoretical foundations for assessment the slamming behaviour of fast ships by the use of specific wave packets will be realised an appropriate current research project at SVA till to the end of 1998.

The advantage is a decrease of the measuring time of model tests related to conventional measuring techniques because of minimisation the demand of preparation and evaluation the tests. The smaller demand results in lower costs for the tests. Moreover the quality and quantity of the results will be improved by minimising the inevitable faults of conventional techniques.

With the use of the new technique other research projects on the field of the slamming problem can be assisted. Test results may be delivered for validation of methods for theoretical slamming prediction.



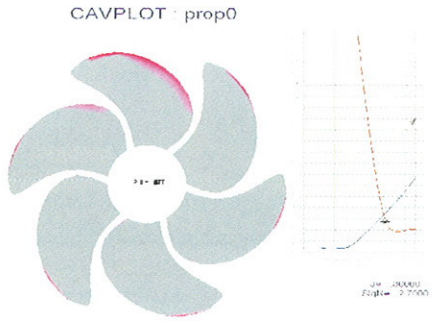
Seakeeping test with a model of a patrol boat V = 45 kn, λ/L = 3.0

Propeller Design

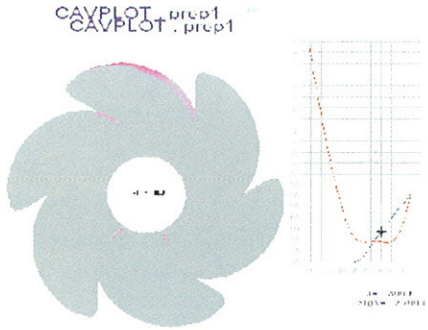
In several R&D projects the propeller design tools of the SVA were optimised in past. For example the SVA has developed a powerful vortex lattice code for the propeller design. The kernel of the program VORTEX is a quasi-stationary calculation program. With the included optimisation tool it is possible to vary the geometry of a starting propeller to optimise the propeller, regarding the efficiency, the cavitation behaviour or the propeller induced pressure impulses. A design strategy for the reduction of the tip vortex was integrated in the VORTEX program in the last two years. The SVA has used the vortex lattice code UNCA93 for the complete instationary analysis of the propeller characteristics since one year. This program calculates among other things the cavitation behaviour and the propeller induced pressure impulses in the wake field of the ship full instationary.

The initial propeller design PROP0 has been optimised with the program VORTEX in connection with a new developed optimisation tool. The calculated open water characteristics and cavitation buckets of the starting propeller design PROP0 and the optimised propeller design PROP1 are compared in the following figures.

The result of the optimisation process was a distinctly improvement of the cavitation behaviour of the propeller PROP1. The maximum values of the pressure pulses for the propeller PROP0 are computed to 2.5 kPa. The maximum pressure pulses of the propeller design PROP1 are in the range of 0.8 kPa.

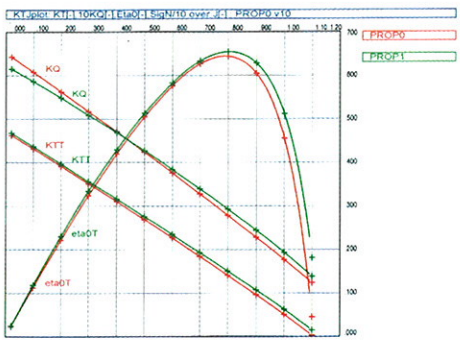


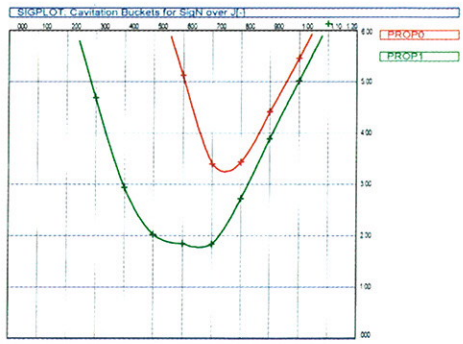
Cavitation behaviour for 6 positions in the wake field



Cavitation behaviour for 6 positions in the wake field

Propeller design with the program VORTEX using an optimisation tool





Comparison of the calculated open water characteristics and cavitation buckets

Experimental Prediction of Slamming Loads

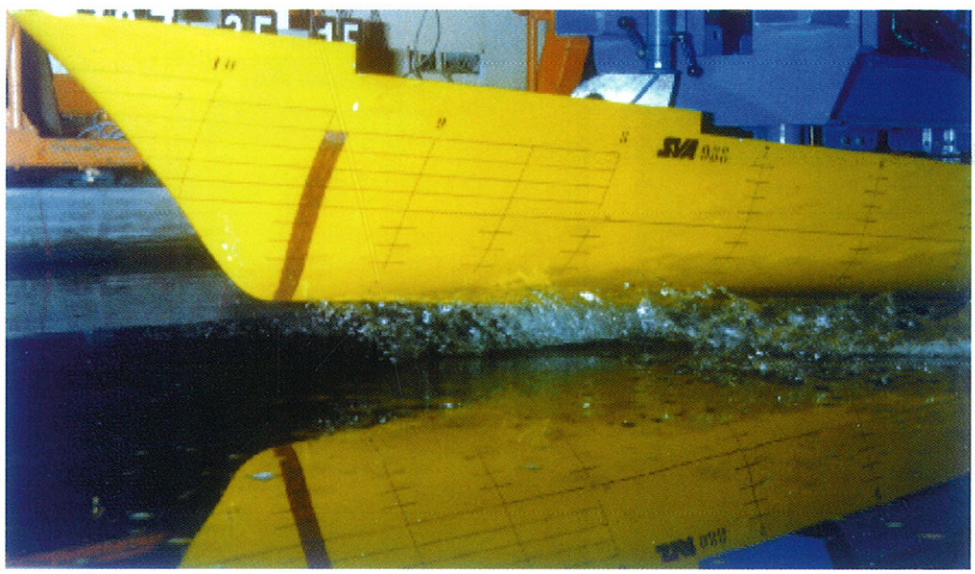
For experimental investigation of slamming loads a special measuring technique is needed. which is able to realise an exact reproduction of different test conditions. This can be achieved only with a slamming simulation with accurate impact conditions. For that reason an oscillation generator is favourable.

A slamming simulator developed at SVA consists of a framework with two hydraulically cylinders, which are arranged one after the other. Complete ship models or parts of a ship model can be flanged on the simulator.

With change of frequency, amplitude, trim angle, static position and running speed the model can be generated to defined oscillations with the following parameters:

- Frequency: $f_{max} = 3.5$ Hz
- Amplitude of oscillation: $r_{max} = 0.1$ m
- Mass of the model: $m_{max} = 1000$ kg

At present the slamming simulator is in use for different research projects of the SVA. The main objectives are the validation of calculation methods, the improvement of model test techniques on the field of slamming measurement and the evaluation of optimum wing keels of sailing yachts under the influence of forced oscillations. Moreover the slamming simulator can be used to experimental prediction of hydrodynamic mass and to force measurement of oscillated bodies.



Slamming simulator in operation with a ship model

Members of the staff

Heike Manke

The care of our fair stand at SMM' 98 will realised by Mrs. Manke at all along.

First time Mrs. Heike Manke got in touch with the business was at the shipyard Warnowwerft - Warnemünde where she learned how to become an enginefitter. Afterwards she studied shipbuilding technology at the academy of seafaring. She finished the academy with an engineering diploma about bending stress in hull plates.

In 1989 Mrs. Manke began to work at the SVA Potsdam GmbH. Her work area included evaluation of model tests for propellers and nozzles and working on research projects covering different propulsion systems. During the last years she worked at the towing tank department in the ship design department.

Mrs. Manke has got two children who are eight and ten years old. She spends her spare time with doing thinks with the family, practising sports and reading good novels.

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Announcement – 7th SVA-Forum "Innovative Technique in Inland Navigation"

Inland navigation can be an important factor for the efficient development in industry and trade. But many activities are required to overcome the problems and difficulties to improve the position of inland navigation in the competition between the different traffic carrier like road and railway. Under the aspect of reducing costs and minimum pollution the inland navigation must include intensively in closed transportation lines. It is necessary to improve as well as the image as the possibilities and efficiency of inland navigation like application of innovative techniques in inland navigation for the ship and it's operation tasks.

Following the SVA tradition, SVA is organising a new SVA-Forum for specialists in inland navigation, ship designer, ship builder and ship operators. The possibilities and applications of innovative techniques in the operations of inland vessels will be represented.

The Forum will be held at the Potsdam Model Basin (SVA) in November 1998.

6th SVA-Forum

Under the title "Azimuthing Propulsion – new challenges and chances" 58 specialists from 9 countries met to the 6th SVA-Forum on 29th April in Potsdam.

A historical review of azimuthing propulsion systems, from the first ideas till to possible developments in the future, presented by Dr. M. Mehmel (SVA Potsdam). Mr. H. O. Kristensen, Danish Shipowners's Association, described aspects of manoeuvrability and azimuthing propulsion units of double ended ferries in the design stage as well as in the stage of the first service. Mr. T. Fetzberger and Mr. J. Kuuskoski from ABB showed experiences of azimuthing propulsion units in services at example "Carnival Elation". CFD-Simulation of the interaction between an azimuthing propulsion unit and the ship hull was represented by Mr. B. Buchholz, MET Motoren- und Energietechnik Rostock. Mr. H.-J. Heinke, SVA Potsdam, focused to experiences in design, optimisation, test procedure and evaluation of podded propulsion systems and of CFD-calculations in his paper "Experiences of SVA". This papers are summarised in proceedings, which you can get about SVA.

Participants of the 6th SVA-Forum on 29th April in Potsdam

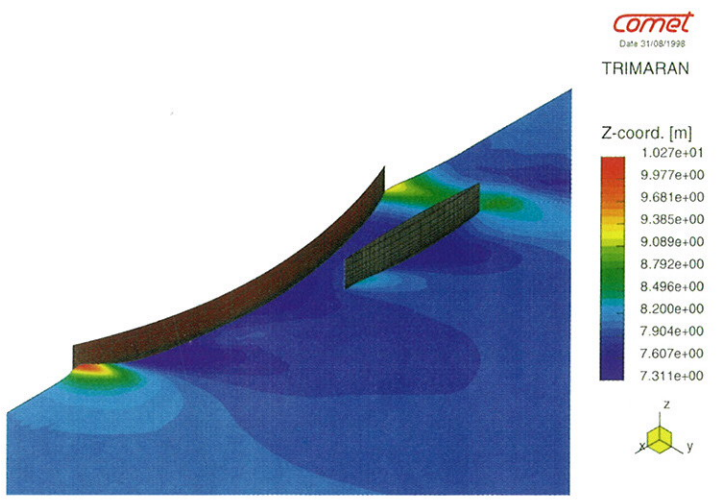
The representatives from yards, shipowners, producers of propellers and motors, engineering offices and other institutions discussed about new advances of propulsion systems. During a visit of the participants through the SVA the possibilities of SVA were presented especially in the field of propulsion and numerical hydrodynamic (CFD).

Computation of the Viscous Flow with Free Surface on a Trimaran

The trimaran hulls have many characteristics, which are interesting for a lot of civil and navy applications such as large deck area and increased stability also under damaged conditions. On other side the effect of the unavoidable increase of wetted surface should be limited. The use of interference between the wave systems of the main hull and outriggers can lead to considerable gains, specially at high speed conditions.

An accurate numerical method is required to capture the influence of the interaction between the main hull and the outriggers on the boundary layer and the change of the wetted surface area due to the change of the wave profiles along the hull. The Potsdam Model Basin uses the RANSE code COMET from ICCM GmbH to investigate the free surface and the viscous flow effects on single and multihull ships such as catamaran and trimaran.

Both air and water are considered in the computation. An additional transport equation for a void fraction of liquid is solved to determine the interface between two fluids. Some results of a recent research project is shown in the figure below.



Wave system around a trimaran