SVA items
SCHIFFBAU-VERSUCHSANSTALT POTSDAM GmbH
No. 4, February 1998

International Cooperations

The Potsdam Model Basin (SVA) has a scientific orientation for cooperation since it's foundation in 1953. Only in this way it is possible to solve the manifold problems in ship hydrodynamics.

In the national framework is it much easier to find partners and fonds for these targets than in the international field for a newcomer. The International Towing Tank Conference (ITTC) was and is our natural homestead for these purposes at the beginning (as a newcomer) and in the present.

The first participation was in 1957 in Madrid by Dr. Gutsche and he was our representative together with Dr. Henschke till 1966 respectively 1969. In the time of the cold war the personal participation was not able mainly in the sixties and the beginning of the seventies. Nevertheless the SVA belongs since the creation of the Advisory Council of ITTC to it's members.

With the liberalization of international contacts from the middle of the seventies it was possible to take part at the ITTC-conferences and to delegate specialists into committees once again. Potsdam Model Basin took part in international joint ITTC-projects like Esso Osaka Propeller, Foil-Headform-Combination and Series 60 wake and boundary layer measurements.

At the same time there were set up joint projects in Comecon shipbuilding industry with hydrodynamic aspects too. Especially the Model Basins in St. Petersburg, Gdansk, Galati, Varna and Potsdam had have a fruitful cooperation bilateral as well as multilateral. They dealt with such problems like propellers for tankers and container ships, seakeeping prediction, pressure pulses and cavitation prognosis as well as with the development of new measurement devices and testing methods.

The Potsdam Model Basin has now after unification a free access not only to the market but to international conferences and international cooperation too. The economy settles the limits only.

Now we can be an active member of ITTC in the Advisory Council as well as in the Resistance Committee and Quality Systems Group. In addition to this we got experiences with EC projects as „Liuto" in this field.

The Potsdam Model Basin is in this way not only a new member in the international community of hydrodynamic research institutions, it is also a new place for scientifical disputes with new inputs. In the last years we have started the SVA Forum as a new initiative. After a break in this year we will continue in 1998 with a workshop in the area of podded propulsion and we hope it will be a good contribution for international cooperation.


Palace Marmorpalais

1997 - a good year for SVA

By the end of the year, it is time to thank all our clients and partners for good cooperation. When we look over the SVA work during this year, many trends can be observed. One of them is the increasing number of long term projects in comparison with the common towing tank work. The role of SVA in such projects is not only the improving of hull forms or propeller designs but also the developing of new products using advanced numerical and experimental technologies as example modern computational fluid dynamics methods and the new installed LDV-measuring system in our towing tank. The SVA developed new slamming simulation device will offer our clients new ways to carry out this kind of model testing. In the next year the SVA will continue its research work in the important fields as new propulsion systems, propeller optimisation algorithms, computation of viscous propeller flow and wake field prediction for full scale. We wish a happy and healthy prosperous New Year.

Moustafa Abdel-Maksoud
Head of Numerical
Simulation Department

Azimuthing propulsion systems for ships

Double-ended ferries with two Z-drive units

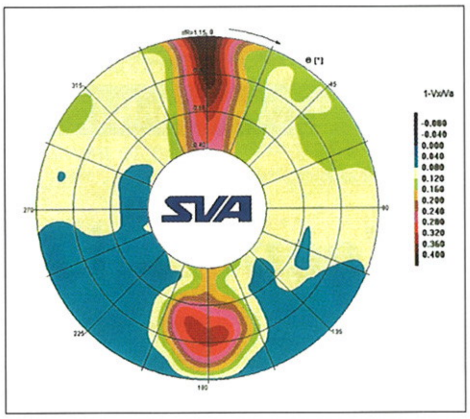
Many small ferry projects with two Z-drives (one in front and one aft of the ship hull) have been tested in the SVA in the last years. The model test programmes include normally resistance and self propulsion tests. The prognosis calculations and the model tests have to be carried out very carefully.

Resistance

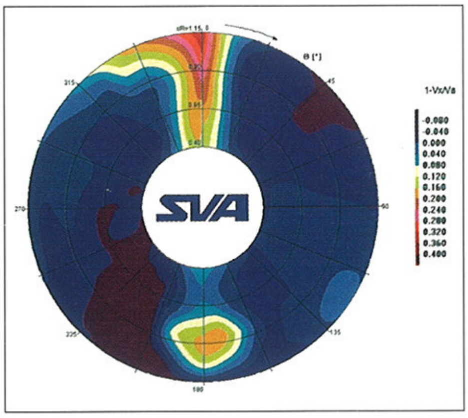
The arrangement of the Z-drive (gondola and shaft) is influencing the flow around the hull and the resistance of the ship due to the self-resistance and the interaction with the hull. The resistance of the double-ended ferry can be distinctly influenced by small changes in the hull lines or in the arrangement of the Z-drive-housings.

Propulsion

The arrangement of the Z-drive systems is important for the interaction between propeller (propeller flow) and the ship hull. The propulsion coefficients, like the thrust deduction fraction, the wake fraction and the hull efficiency should be estimated for both Z-drive systems. The effect of the propeller flow of the forward Z-drive on the hull has to take into consideration for the design of the ship lines, the arrangement of the propulsion systems and the power distribution between both systems. The necessary delivered power of a double-ended ferry with two Z-drive units will be dominate by the thrust deduction. The thrust deduction fraction of the forward Z-drive could be greater than 0.30, if the power is in the range between 35 - 50 percent of the total power. The thrust deduction fraction of the aft Z-drive is normally in the range between t = 0.10 to 0.20.



Wake field without working Z-drive

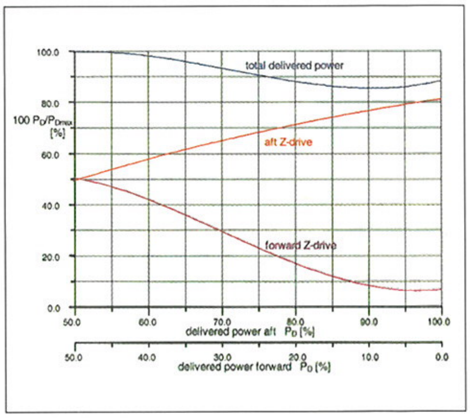


Wake field with working Z-drive (50 % of total power)

The figures show the wake field in the propeller plane of a double-ended ferry in the propeller plane of the aft Z-drive without and with a working propeller at the forward Z-drive. The wake field is changing distinctly.

Power distribution

Model tests have been carried out with different distributions of total power between the aft and forward Z-drive units. The Z-drives were arranged midships. The nearly optimum power distribution for this arrangement was 90 % of the total power for the aft Z-drive and 10 % for the forward Z-drive. The results are strongly influenced by the ship lines and the arrangement of the Z-drives.



Total power of a double-ended ferry as a function of the power distribution

Steering and manoeuvring

Steering and manoeuvring tests are important to check the dynamically course stability of the double-ended ferry, which could be strongly effected by the main hull parameters and the working propeller forward the hull.

Podded propulsors

Podded propulsors present a new propulsion solution which opens not only new possibilities in the ship design and in the propulsion but also in the building of ships.

A podded propulsor is an electric motor which is installed outside the hull in a pod underwater of the stern of the ship. This motor drives directly the propeller.

Kværner Masa-Yards and ABB Industry had developed podded propulsors and propagated as a new propulsion system Azipod (Azimuthing podded drive) since 1988. The companies Siemens and Schottel-Werft are developing the so called SIEMENS SCHOTTEL Propulsor (SSP) since 1996.

Podded propulsors could be an efficient alternative to traditional propulsion systems, especially for vessels with varying service profiles needing high manoeuvrability, low noise and good vibration characteristics, and a flexible machinery arrangement, such as research vessels, cable and pipe laying ships, offshore vessels, icebreakers, passengers and naval vessels. The analysis of the developments in the field of ship propulsion shows that there will be a growing market for podded propulsors.

In this way the SVA has investigated the use of podded propulsors for different ships under the aspect of the propulsion efficiency and the ship and propeller design since 1995.

Interaction between pod and propeller

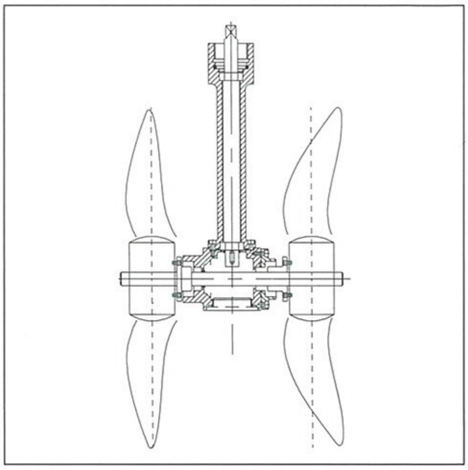
The characteristic of the propeller is influenced by the pod. The thrust and torque coefficients of the propeller are growing due to the interaction with the pod. The pod resistance and the total efficiency of the podded propulsion system is normally lower in comparison with a free running propeller. The variations of the shape and the length of the gondola have a considerable effect on its resistance.

Systematic tests with propeller at the pod are not known. An first impression of the effect of different shapes of the pod on the characteristic of the propeller can be given by the analysis of experiments with airscrews. The next figure shows results of tests with an airscrew at different pusher bodies. The efficiency of the system airscrew with pusher body is decreasing with the increasing of the size of the body.

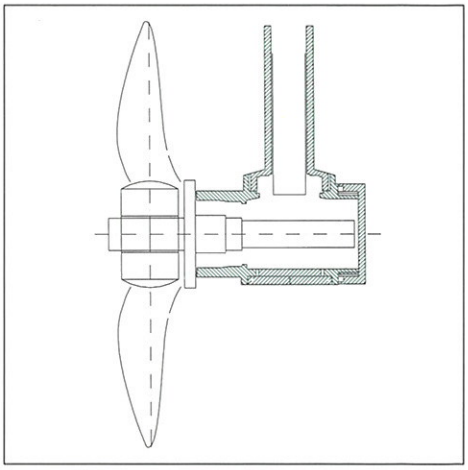
The SVA has manufactured different standard drives for model tests with podded propulsion systems. The standard drives consists of a vertical shaft, a rectangular drive in a hub and a propeller shaft. The drives are prepared for the use of a push or a pull propeller and also for the use of a twin propeller arrangement. The gondola and the vertical strut can be simulated by dummy bodies.

Drive No.	propeller diameter [mm]	maximum torque [Nm]
Z1, Z2	120 - 180	2.5
Z3, Z4	170 - 230	3.5
Z5, Z6	200 - 250	4.6

The measuring system allows the measurement of the total thrust and the torque during propulsion tests and the additional measurement of the transverse force and steering moment during manoeuvring tests.



Standard drive Z1, prepared for twin propeller arrangement

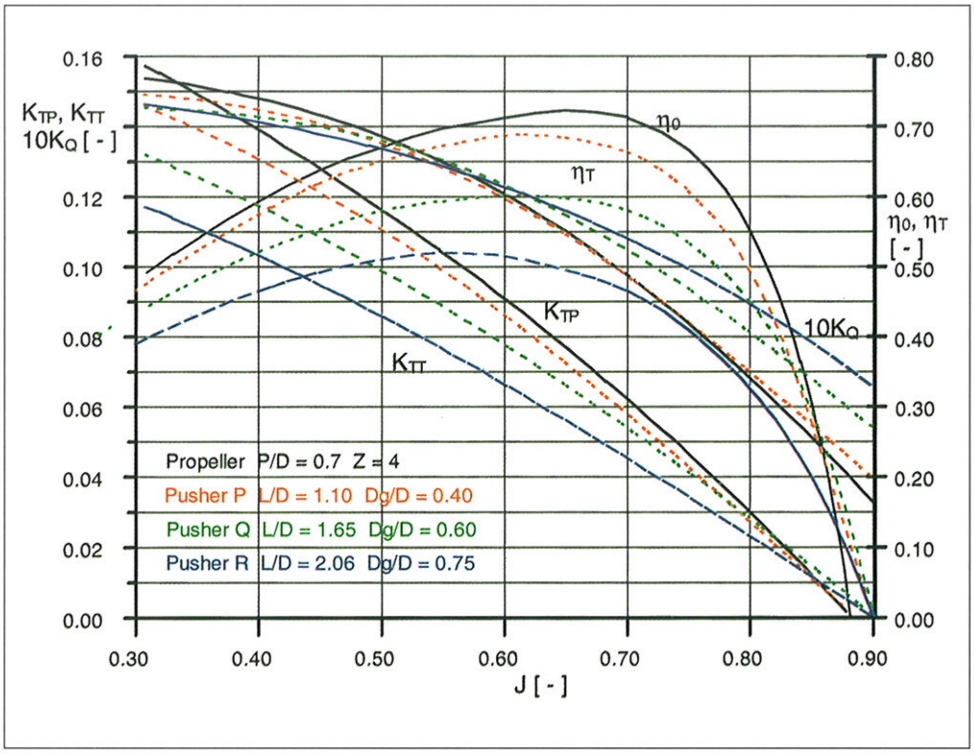


Standard drive Z5, prepared for pull propeller arrangement

The SVA will start a new research and development project „Integrated ship design for ships with podded propulsion systems". The priorities of this project will be in the use of CFD methods and model tests for the design of the ship hull and the optimisation of the arrangement of the pod at the after body.

An optimal application of podded propulsors requires an optimal determination of the geometrical configuration, which minimises the total resistance of the ship at maximum speed and creates the most regular wake possible at the average speed. Thus delaying the appearance of vibration and cavitation. That means an optimal shape of pods in keeping with the space requirements of electrical motorisation and producing minimal resistance in the interesting speed range. There could be interactions between the wave field of the ship and the pod (significant in wave resistance).

The hull form has to be optimised for the use of the podded propulsors. Therefore numerical calculations of the viscous flow around the ship with working propeller at the pod and model tests are necessary.



Characteristics of an airscrew with different pusher bodies
(Fage, A.; Lock, C. N. H.; Bateman, H.; Williams, D. H.: "Experiments with a Family of Airscrews including Effects of Tractor and Pusher Bodies" Aeronautical Research Committee, No. 830, London, Nov. 1922)

Members of the staff

Reinhard Schulze

The first occupation of Reinhard Schulze was an electric mechanician at a research institute. After that Reinhard decided to study mathematics at the Humboldt-University of Berlin. He joined the department of numerical mathematics as a research assistant. Reinhard Schulze earned his Dr. rer. nat.-Math. on the application of stochastic methods for differential and integral equations. The topic of his habilitation thesis was the extrapolation methods for the solution of nonlinear equation systems and optimisation problems.

After working five years at the University of Greifswald as an assistant professor for numerical mathematics Reinhard Schulze has been employed as senior research scientist at the Potsdam Model Basin in March 1993. He has mainly engaged in the application of mathematical optimisation methods for the propeller design and development of software components. The last years he was project leader for research and development projects in the field of propeller design and development of innovative propulsion systems.

He has got a daughter in the age of eleven. His hobbies are skiing, hiking and photography. The splendid time are tours with his daughter in the nature.

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Tests with a Wing in Ground Effect Craft

In the towing tank of SVA the model of Wing in Ground Effect Craft was tested and improved by the firm TechnoTrans Rostock e.V., which developed the vehicle by working at the research project „Technical Development of Wing in Ground Effect Craft" - part one.

In part two of the research project there should find out the resistance, seakeeping behaviour, behaviour of plane and fly and the best body form and foil position at model tests.

The best angel position of foils was found by resistance tests and so the vehicle can easily start to fly. The optimisation of the hull resulted in a better wave system and a minimisation of spray water. The model tests show, that the vehicle can use the phenomenon of wing experiences near surface and so it can start and fly by towing test and self propelled with air screws also in sea. The manoeuvring behaviour was accommodated.

Presentation of the wing in the Baltic Sea

After the successfully model tests with the model in scale 1:16 there can built a big model in scale 1:2.5 with place for one person. The presentation of this model took place in the Baltic Sea in may this year.

Contrarotating propeller-nozzle thruster

In cooperation of SVA Potsdam GmbH and AIR Fertigung-Technologie GmbH a new effective thruster was developed. This thruster is provided preferably for the leisure-, sport- and relaxation sector.

The prototype of the thruster consists of a vertical arranged stream-lined housed water-cooled electric motor, of an on the motor flanged propeller nozzle and an in the nozzle arranged contrarotating propeller pair. The contrarotating propellers were driven by a Z-drive.

Such a driving system produces the thrust through the action of two propellers and a nozzle. The design procedure of this system is

Contrarotating propeller-nozzle thruster

complicated. The validity of the design method was examined and the quality of the driving system was estimated by experiments in the cavitation tunnel and in the towing tank of SVA.

The contrarotating propeller reaches in open water conditions efficiencies up to 80%. It is the result of the very small blade area ratio and the high pitch ratio. Both propellers absorb nearly the same power and produce nearly the same thrust.

In an arrangement with a nozzle the propellers are loaded significant smaller and the efficiency of the system increases. The nozzle produces a positive thrust in the whole realistically reach of advance velocity. The test results demonstrate, that with the available contrarotating propeller-nozzle arrangement an effective driving system was developed.

The housing of the electric motor has an important resistance so that the efficiency decreases significant. The maximum open water efficiency of the thruster lies by about $h_0 = 0.60$, and in realistic working modes the open water efficiencies amount to about $h_0 = 0.55$.

The new thruster was compared with a conventional mass-produced thruster. The hydrodynamic efficiency of the thruster lies only by about $h_0 = 0.30 ... 0.35\%$.

L.I.U.T.O. - Low Impact Urban Transport Water Omnibus

The aim of the research and development project L.I.U.T.O., a project in the BRITE EURAM programme, is the development of a new water omnibus for the passenger transport system of the Venice city and its lagoons. The L.I.U.T.O. project includes among other things the hull hydrodynamics, the propulsion and manoeuvring system, material related aspects of the ship design and a full scale demonstration of the new prototype.

Members of the L.I.U.T.O. project in the SVA

Following partners are involved in the joint project:
ACTV - Azienda del Consorzio Trasporti Veneziano (Italy)
INTERMARINE SpA, Sarzana (Italy)
SCHOTTEL-Werft, Josef Becker GmbH & Co. KG, Spay/Rhein) (Germany)
MARIN, Maritime Research Institute Netherlands, Wageningen (The Netherlands)
UNIVERSITY OF NAPLES FEDERICO II - Dept. of Naval Engineering, Naples (Italy)
SVA - Schiffbau- Versuchsanstalt Potsdam GmbH (Germany)

A meeting was held in the SVA at the 23[th] of July to discuss the results of calculations and model tests with different azimuthing propulsion systems for the water omnibus.