The Manoeuvring Committee

Committee Chairman: Dr. Andres Cura Hochbaum
Session Chairman: Dr. Stig Sand

1. DISCUSSIONS

1.1 Discussion to the 25th ITTC Manoeuvring Committee by Yasuo Yoshimura, Michio Ueno and Kouichi Shouji, Hokkaido University, NMRI and IHI corporation, Japan

The 24th and 25th Manoeuvring Committee have been conducted the workshop SIMMAN2008 in order to validate the prediction methods of manoeuvring ship motion. The workshop was successfully held in April 2008, where the predicted manoeuvring ship motions from many participants were compared with 4 ship models VLCC1, VLCC2, KCS and 5415. The predicted results were obviously compared with the results of free running model tests in order to validate the predicted results. Therefore, the results of free running model tests become the key data when evaluation of each predicting methods.

However, the some of the results of free running model test were very suspicious particularly for the free running model tests with the KCS model.

The measured tactical diameter of 35deg of rudder angle was relatively smaller than VLCC's. As the results, almost every predicted tactical diameter became larger than the "measured" one.

Recently, the discussers carried out the free running model tests in IHI's model ship basin in Yokohama, with the KCS model that was used for the captive model test in MNRI. The principal particulars are listed in Table 1.

Tested items are turning tests, zigzag tests and reverse spiral tests. Ship position has been measured by acoustic and optical methods. These tests have been done fully following to the ITTC's standard procedure. Obviously, the accuracy has been checked by the uncertainty analysis. The measured tactical diameter of 35 deg turning circle test is compared with SIMMAN2008 workshop in Table 2, where it is clear that the SIMMAN's free running data are 17-18% smaller.

Table 1 Principal particulars of KCS model

L_{pp}	3.0464	m	$x_G(=-Lcb)$	-0.0451	m
B(molded)	0.4265	m	κ_{zz}/L_{pp}	0.2313	
d (molded)	0.1430	m	GM	0.0679	m
displacement	0.1209	m^3	Dp	0.1046	m
trim	0.0000	m	$A_R/L_{pp}d$	1/54.86	

Table 2 Comparison of the tactical diameter of KCS model

	Port 35 deg	**S**tarb. 35 deg
HU/IHI/NMRI free running (L_{pp}=**3**.046**m**)**l**	3.19 Lpp	3.34 Lpp
SIMMAN2008 free running (L_{pp}=4.367m)	2.65 Lpp	2.74 Lpp
	−17.0%	−18.0%

As SIMMAN's free running test data will be widely used in future for the validation of prediction method, the free running model data should be well examined and authorized.

1.2 Discussion to the 25th ITTC Manoeuvring Committee by Marc VANTORRE, Ghent University, Ghent, and Flanders Hydraulics Research, Antwerp, Belgium

First of all I would like to express my appreciation for the work that has been performed by the Manoeuvring Committee. Besides an excellent overview and state-of-the-art of manoeuvring prediction methods, simulation techniques, and CFD in the field of manoeuvring, the Committee has tackled the difficult issue of validation with the SIMMAN Workshop.

In this respect, I would like to take the opportunity to recommend an extension of the scope of SIMMAN to shallow and confined water effects. Harbour and waterways authorities are nowadays confronted with a continuous, sometimes spectacular increase of ship dimensions, especially in shipping of container and LNG. They are concerned about the safety of shipping traffic, but often it is not feasible to increase the waterway dimensions proportionally.

As a result, restrictions of waterways in depth and width become more and more important. The need of benchmark data for shallow and restricted water manoeuvring characteristics is perhaps even higher than for deep water. As stated by the Committee in section 9.2, "it is very difficult to apply low speed manoeuvring standards based on sea trials as for the IMO manoeuvring standards", so that validation data are nearly non-existent, except for the historic *Esso Osaka* shallow water trials. One of the main tasks within a possible "shallow water SIMMAN" – and perhaps the most difficult one – would therefore consist of the acquisition of full-scale benchmark data. The widespread use of position measurement and registration systems will certainly make this task somewhat more feasible; on the other hand, it seems to be more and more difficult to receive the co-operation of ship-owners for the availability of ships' lines and other data.

Another topic, related to the former, is squat. I would like to recommend strongly to keep this topic within the scope and the attention of the Manoeuvring Committee. Thanks to the development of positioning systems, acquiring full scale data has (at least in principle) become much easier, so that there is a potential for the validation of existing and newly developed methods for estimating squat, covering empirical, experimental and computational techniques.

In particular an active role of ITTC could be beneficial, to avoid a gap between practice and the research community; e.g. the January 2008 issue of *The Pilot*, the official organ of the U.K. Maritime Pilots' Association, reports a rather sharp polemic between the Houston and U.K. pilots on one side and Dr. Barrass on the other, generalised as a controversy between pilots and scientific experts.

Finally I would like to comment on the Manoeuvring Committee reviewed QM procedures under its responsibility, more particularly on procedure 7.5-02-06-02, *Captive Model Tests*. I note that section 4.2, entitled *Uncertainty Analysis*, "was extracted because a proposal for a separate procedure on Uncertainty Analysis for captive model tests has been written". Again, I appreciate the progress that has been made by the Committee on this topic. In particular, the example for the PMM test is a very valuable document that can be the base of a future procedure or guideline for estimating bias and precision limits and total uncertainties for the non-dimensional forces and moment.

On the other hand, several effects influencing uncertainty are not addressed:

- the effect of acceleration caused by fluctuating carriage speed during runs is not considered;
- the effect of data conditioning, such as filtering, fairing, Fourier series reconstruction, is not accounted for;
- the procedure does not provide uncertainty analysis for hydrodynamic derivatives derived from the forces and moment data.

It is somewhat surprising that the former section 4.2, as proposed by the Manoeuvring Committee at the 23rd ITTC in 2002, has been deleted completely without further notice, because it particularly focused on most of the effects that are not taken into account in the present version. Therefore, I am particularly interested to know why the removed section has not, even in a modified format, been kept into the procedure.

According to my opinion – and this opinion was shared by the other members of the 23rd ITTC Manoeuvring Committee at that time – the deleted section may give more insight into the effect of mechanical inaccuracies on the uncertainty of the measured force components, and leads to important conclusions concerning motivation for deleting the content of the former section 4.2 can be found in the present Report, one could only assume that the content of the former section was considered by the Committee as either incorrect, or irrelevant, or perhaps merely incompatible with the desired format. If this is not the case, I would like to suggest adding this particular section to the procedure again, with another title or in another format if desired. In general, one should be careful with procedures: unlike former Committee Reports, former versions of procedures will never be consulted again, and are lost forever.

In spite of this comment, I would like to repeat my appreciation for the excellent work the Committee has executed.

1.3 Discussion to the 25th ITTC Manoeuvring Committee by Ahmed Derradji, NRCC, Canada

General Comments

The ITTC manoeuvring general committee developed a procedure 7.5-02-06-02 for uncertainties in forces and moments in captive model testing, using the PMM (Planar Motion Mechanism).

Essentially, this procedure for forces and moments is a modification/extension to the Uncertainty Analysis section that exists in an older procedure 7.5-02-06-02 (Testing and Extrapolation Methods Manoeuvrability, Captive Model Test Procedure).

Only technical comments are outlined here, editorial comments are not included. These comments are a summary of those included in the Uncertainty Analysis Final Report. The comments are independent of the methodology, AIAA, ASME, or ISO; however, future revisions should incorporate the new ITTC Procedure 7.5-02-01-01 (Guide to the Expression of Uncertainty in Experimental Hydrodynamics) and ISO GUM.

Technical Comments

Jitter Method. Due to the complexity of Eqs. (2), (3), and (4), uncertainty should be propagated by the jitter method as outlined in

ISO (1995) and Moffat (1982). The analysis is essentially a central finite differencing method. The procedure would be simplified, and there will be no need for the tables of sensitivity coefficients (Tables 12-14).

Assumptions. Too many assumptions are made concerning uncertainty estimates. The word "estimated" appears 28 times and the word "assumed" 9 times. All measurements should be traceable to a National Metrology Institute (NMI) with a known uncertainty. For example, in the USA, the NMI is NIST (National Institute for Standards and Technology). NIST is nowhere mentioned in this procedure. The following are some examples for these assumptions.

In an ideal case, no assumptions should be made. All measurements should traceable to NMIs.

Model Length. On page 8, the uncertainty in model length is assumed based upon an ITTC requirement of ±1 mm.

The uncertainty should be based upon on a manufacturing tolerance traceable to an NMI or direct measurement after manufacture from an instrument traceable to an NMI. Laser based measurement systems are now available for direct measurement of model manufacturing accuracy.

Drift Angle. On pages 10 and 23, uncertainty in model alignment is assumed to be 0.03 deg. This measurement should also be based upon an angular measurement traceable to an NMI with a known uncertainty.

Mass Uncertainty. The uncertainty in mass is estimated based the RSS of the masses. These include Table 6 on p. 9 and Table 9 on p. 11. Uncertainty in mass should not be based on RSS of the individual masses. Mass uncertainty is correlated, and its value is the simple sum of the individual uncertainties (not RSS), OIML R111-1 (2004). Typically, all masses are calibrated against the same reference standard; therefore, the uncertainty in mass is correlated. See). Also, this procedure does not identify the class of masses for the calibrations, such as in Tables 6 and 9. Class of mass should be identified, see ASTM E74-02 (2002).

Calibration and Acquisition. This terminology is somewhat confusing in the procedure. Calibration consists of 3 parts: (1) uncertainty in the reference standard for the calibration of individual points, (2) the uncertainty in the curve fit from linear regression analysis, (3) Type A (precision) uncertainty in the mean value of the data points if the calibration data are acquired from a time series by a digital data acquisition system. The Uncertainty Analysis (UA) Committee has written a draft procedure, which describes the process. In this procedure, the uncertainty in the curve fit is defined as 2*SEE.

This method describes the uncertainty at the time of calibration and does not define the uncertainty in application to the test. Application to future events is describe by statisticians as the prediction limit.

Water Density and Temperature. On page 9, the uncertainty in the temperature probe is stated to be 0.2 deg C. The specific type of probe and amplifier are not documented. Attainment of a temperature uncertainty of 0.2 C is non-trivial. Realistically, the uncertainty in temperature is more likely 0.5 to 1 deg C. The ITTC procedure number for the density equation, Eq. (27) on p. 8, or reference for the equation are not stated (ITTC 7.5-02-01-03).

Precision Limit. In general, data is acquired with a digital data acquisition system. (DAS). Data is then recorded as a time series, the precision limit in the mean values is computed from Eq. (42), where the number 12 is used (instead of the number of data samples). In some cases, the true uncertainty can be estimated only with repeat experiments due to uncontrolled elements in the test. In hydrodynamic test facilities, repeat tests for all conditions are cost prohibitive. In that case, a repeat test is performed for a representative case scenario.

In such a representative test, the value for standard deviation is obtained. The estimated uncertainty is then 2 times the standard deviation. This procedure should clarify why use square root of 12.

Carriage Speed. In Appendix C, uncertainty for carriage speed is given. The measurement details are outlined on p. 6, and the description is correct. However, an alternative and easier approach is recommended (see examples given by the UAC in their committee final report).

1.4 Discussion to the 25th ITTC Manoeuvring Committee by Anton Minchev, Force Technology, Denmark

The committee is to be congratulated for its hard and excellent work. Of particular interest is the cooperative work of the SIMMAN workshop. I would like to draw the attention on the presented comparison of experimentally derived first overshoot angles, which bias among various tanks is very large, and in some cases may even exceed the IMO (for example) first overshoot angle criteria.

Therefore, I would strongly recommend that further concerted effort is made to re-analyze the experimental data and on this basis try to clarify the causes of the exhibited scatter. This will also benefit the following benchmarking of the CFD simulations.

My second comment refers to page 186 of the report. Table 10 presents manoeuvring indices for twin skeg and single skeg container ships. However, no corresponding text, which makes reference to this table was found further in the text As the comparison between single screw / rudder against twin skeg / rudder large ships (container ships) is important, I would like to recommend that the comments referring to the subject table 10 are included in the report (possibly in the amendments of 25th ITTC Volume 3 proceedings.

1.5 Discussion to the 25th ITTC Manoeuvring Committee by David Murdy, NRC-IOT, Canada

I have been unable to find the answer to a basic question related to the procedure for PMM tests.

The question is:

Under what circumstances is the recommended procedure to use a propelled model? When should a model without appendages be used?

The procedure gives information on how is carrying out tests in these two situations but does not appear to give guidance on when the different approaches should be used.

What is the answer to the question, and where is it documented?

1.6 Discussion to the 25th ITTC Manoeuvring Committee by Young Jae Sung, Hyundai Heavy Industries Co., Ltd., Korea

First of all, I would like to thank to the committee for the well-organized and comprehensive report. Our comment is about the propeller rate during the manoeuvring captive model test.

The SIMMAN 2008 workshop, co-organized by the ITTC Manoeuvring committee, provided the very valuable insight in the applicability of the (captive or free sailing) model test and the numerical approaches for the prediction of manoeuvring properties of ships.

However, it also revealed some differences among the predicted properties depending on the self-propulsion points of captive model test; model or ship self-propulsion point.

According to the ITTC recommended Procedures and Guidelines for manoeuvrability Captive Model Test (7.5-02-06-02), “Test should usually be carried out at the self-propulsion point of model or ship, at the self-propulsion point of model or ship, the latter requiring viscous correction.” That is the procedure seems to allow both rpm rate during the manoeuvring test. However, it is well known that the difference in propeller rate results in difference in stern flow and rudder efficiency.

So, for the more systematic comparison of the manoeuvrability prediction results, not only the agreement on the propeller rate during the model test but also the well-confirmed correction method seems to be suggested by the ITTC committee.

2. COMMITTEE REPLIES

2.1 Reply of the 25th ITTC Manoeuvring Committee to Yasuo Yoshimura, MichioUeno and Kouichi Shouji

During the SIMMAN workshop some concerns were raised about the validity of some experimental results. We applaud that also after the workshop, institutes have taken up the glove and produced more experiments. It is fantastic that Prof. Yoshimura with HU, IHI and NMRI submits these new results. The new test results presented by Prof. Yoshimura are for a GM of more than 5 meters and an approach speed of 18.6 knots, while the conditions specified for the benchmark test were 0.6 meters and 24 knots. We understand that this condition had to be chosen due to the freeboard of the model.

Table 2 shows measured results obtained at quite different conditions, so it is difficult to compare these results to each other.

We believe the difference in results is partly due to the difference in the roll angle. The presented new results show a good agreement with the simulation results of 3-dof methods. The 4-dof methods show better correspondence with the earlier experimental data. This illustrates how important the roll angle, the heel to yaw coupling and hence a 4-dof model is for manoeuvring.

The non-dimensional tactical diameters predicted by simulations for the specified conditions are in general larger than measured and the measured one appears relatively small, but this must not be necessarily wrong. Repeated tests performed at BSHC were very consistent so we cannot discard this data until having got more insight. On the other hand one has to mention that also these tests were performed with an approach speed different than stipulated.

Nevertheless, the now presented results can be used very well: they are very representative for a 3-dof model. The BSHC tests at a condition with a GM corresponding to 0.6 meters in full scale, is a situation where roll motion will be very important.

It is encouraged that also other facilities will carry out tests. We hope that some of the tests already performed can be repeated keeping the specified conditions more precisely.

We conclude that the work of processing and evaluating the results of the SIMMAN workshop will continue for a long time. The Manoeuvring Committee will not authorise results but recommend data and also will go on with the examination of data and supporting organisations that will work with this. We hope that the Hokkaido/IHI/NMRI data for the KCS can be included in the final proceedings of SIMMAN 2008.

2.2 Reply of the 25th ITTC Manoeuvring Committee to Marc VANTORRE

As everybody knows, Prof. Vantorre was the forerunner in applying of uncertainty analysis to captive manoeuvring experiments. His work on for the 23rd ITTC was further than the present work which focussed on forces and moments only. Moreover, Prof. Vantorre is pointing out several aspects that are not included in the present approach yet.

One of the difficulties is that after Prof. Vantorre has specified his procedure, the ITTC recommended another procedure for uncertainty analysis.

We now would recommend to the future Manoeuvring Committee to translate those parts of Prof. Vantorre's work to the ITTC standard Uncertainty Analysis procedures, and to incorporate them into the procedure, and to extent the procedure towards hydrodynamic derivatives and even further: towards Uncertainty Analysis of manoeuvring parameters like overshoot angles and tactical diameters.

Regarding SIMMAN and squat: We agree in that shallow and confined waters including squat is very relevant.

However, we first have to complete the analysis and conclusions of SIMMAN 2008 before we can proceed with plans for a future workshop. At this point we only can recommend this subject to the next committee as we have done already.

2.3 Reply of the 25th ITTC Manoeuvring Committee to Ahmed Derradji

We have considered all of the comments you made. We should indicate that to some extent the different modus operandi comes from the fact that, in the first instance, the Manoeuvring Committee was told that the Specialist Committee on Uncertainty Analysis would make the Uncertainty Analysis procedures. At a later stage we were told that the Manoeuvring Committee had to write the Uncertainty Analysis procedure on PMM tests itself. At that point we did not receive any guidance and followed our own path, which has led to the present procedure. We appreciate your comments and would have preferred to have received them earlier, at the time of the writing of the procedure. We now would recommend that the next Manoeuvring Committee checks the considerations you made and takes them into account when reviewing the procedure. We would recommend very much that the Specialist Committee on Uncertainty Analysis would have regular contact with the Manoeuvring Committee on these subjects.

2.4 Reply of the 25th ITTC Manoeuvring Committee to Anton Minchev

Thank you for your comments on SIMMAN. As stated before, the scatter of the experimental data and of the simulation results as well, is being and will be further analysed. We proposed this as one major task for the next Manoeuvring Committee already.

With respect to your second comment, it seems you have overlooked the text belonging to Table 10 on page 186 of the ITTC proceedings. This text and the corresponding cited paper are placed on page 185.

2.5 Reply of the 25th ITTC Manoeuvring Committee to David Murdy

Whether bare hull or appended tests will need to be carried out depends on the objective of your tests. For instance, if you are looking for the coefficients of a mathematical model which does take into account for rudder and propeller forces separately, you will need bare hull tests in order to get just the forces acting on the bare hip hull and appended tests for the propeller rudder hull interactions.

On the other side, if your mathematical model considers the whole system consisting of hull, rudder and propeller, including their interactions, the choice will be appended PMM tests. This is not documented in the procedures.

2.6 Reply of the 25th ITTC Manoeuvring Committee to Young Jae Sung

During the SIMMAN workshop, we saw differences in KVLCC prediction results. One of the causes was that some people submitted data for Ship Self Propulsion Point (SSPP) and others at Model Self Propulsion Point (MSPP). This *could* be a significant factor, but these differences are not larger than other influences. The scatter in submitted results is showing this.

The viscous effect which is meant in the procedure 7.5-02-06-02 for captive model tests is just the correction of the propeller rpm due to the relatively higher frictional resistance at model Reynolds number.

The determination of the SSPP (if required) is done in a relatively easy way as mentioned and documented in earlier ITTC's. For other scale effects there exists no known scaling method. It is also not possible to correct results obtained at SSPP for MSPP and vice versa in a reliable way. We understand that you thought that SIMMAN was recommending the SSPP and missed to explain how. On the contrary: The SIMMAN organizers specified the use of MSPP. The procedure for MSPP and SSPP should be elaborated more clearly by the future Manoeuvring Committee. This may be suggested as a future task for the Manoeuvring Committee.