Manoeuvring Committee
Report & Recommendations

Andrés Cura Hochbaum

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  4. Benchmark data and capabilities of prediction tools
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Members of the 26th MC

- Andrés Cura Hochbaum, HSVA & TU Berlin, Germany, Chairman
- Frans Quadvlieg, MARIN, The Netherlands, Secretary
- Kristian Agdrup, FORCE Technology & OSK-Offshore A/S, Denmark
- Riccardo Broglia, CNR-INSEAN, Italy
- Sun Young Kim, MOERI, Korea
- Evgeni Milanov (until 2010), BSHC, Bulgaria
- Kazuo Nishimoto, University of Sao Paulo, Brazil
- Hironori Yasukawa, Hiroshima University, Japan
- Zao-Jian Zou, Shanghai Jiao-Tong University, China

Meetings

- CNR-INSEAN, Italy, January 2009
- Shanghai Jiao-Tong University, China, September 2009
- Technical University of Berlin, Germany, May 2010
- University of Sao Paulo, Brazil, January 2011

Most members attended all meetings

Tasks given to the 26th MC

1st Task: Update the state-of-the-art

- Potential impact of new developments
- Manoeuvring and course keeping in waves
- New experimental techniques and extrapolation methods
- New benchmark data
- Practical application of computational methods
- Need of R&D for improving methods

State-of-the-art thoroughly described in the report

Tasks given to the 26th MC

2nd Task: Review procedures

- Needed changes
- Requirements for new procedures
- With support of SCUA review procedure on UA for PMM tests

3rd Task: Based on SIMMAN '08 workshop

- evaluate capabilities and drawbacks of simulation tools
- update proc. "Validation of Manoeuvring Simulation Models"

Section 10 describes the status of the manoeuvring procedures

Sections 4 describes capabilities and drawbacks of simulation tools

Tasks given to the 26th MC

4th Task: Based on SIMMAN '08 workshop

- Evaluate capabilities and discrepancies of time domain RANS based simulations
- Produce a guideline on V&V of RANS tools, and a guideline on the use of RANS tools in the prediction of manoeuvring behaviour

Section 4 describes capabilities and discrepancies of RANS simulations

A new guideline on use of RANS tools has been written

A new guideline on V&V of RANS tools has been initiated

Tasks given to the 26th MC

5th Task:

- With support of SCUA write a procedure on Uncertainty Analysis for free model tests

Progress made on procedure on UA for free tests reported in section 7
The procedure is not ready for adoption yet

Tasks given to the 26th MC

6th Task:

- Review developments in ship manoeuvring in confined waters
- Produce draft outlines of procedures for experimental and numerical methods as a basis for recommended procedures for manoeuvring in restricted waters

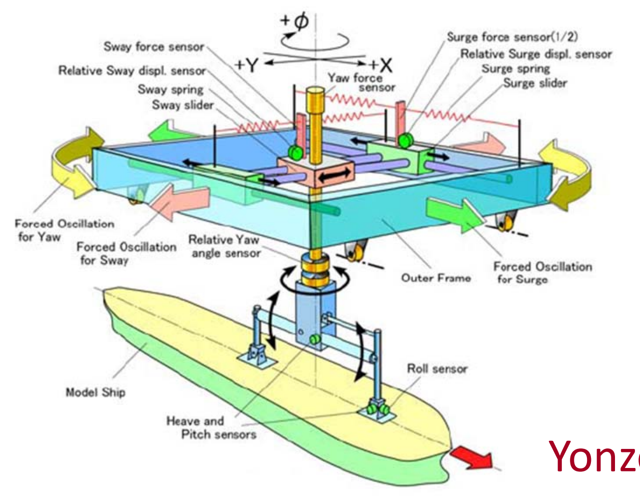
Section 6 gives an overview of developments in confined waters

An outline of procedure for numerical methods has been initiated

the one for experimental techniques could not be treated

Progress in Experimental Techniques

- **Captive model tests**
  Many papers about predictions for different types of ships reported.
  Some new PMM systems to measure forces and moments during forced motions in waves to be used for mathematical models.



Yonze et al.

- **Free model tests**
  Several studies for surface ships and AUV, where key issue is communication.
  Measurement of motions crucial as well, but few papers on new techniques.
  Some efforts also on scale effects (RPM strategy, assistant force) reported.

- **Full scale trials**
  Papers on measurements using DGPS. However not yet GALILEO nor GLONASS

- **New measurement techniques**
  Several attempts to measure velocity field at a manoeuvring model with PIV.
  Most of them in a fixed setup during oblique towing or steady turning motion

Conclusions (Section 2)

Progress in experimental techniques

- For free model tests on ships with pods, the inclusion of a RPM-control (constant RPM / torque) is of prime importance to obtain realistic results.

- When captive tests are used for the prediction of manoeuvres, it is essential that enough degrees of freedom are considered. Four degrees of freedom is already often used. The effect of the roll motion can be very important. For higher speeds or shallow water, trim and sinkage can also be very important.

- The publications show a trend towards increased use of free model tests, even for areas where captive tests have been used up to now, such as high-speed vessels and submarines.

Progress in Simulation Techniques

Empirical methods

- No papers reporting substantial progress

Inviscid methods

- Still used and developed for manoeuvring tasks, especially for close proximity problems and for restricted waters

RANS methods

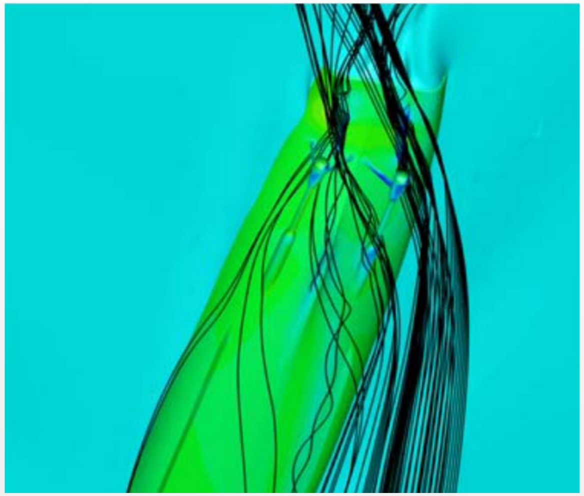
- Majority of publications on numerical techniques for manoeuvring tasks are related to RANS codes. Strong development, but very few predictions of manoeuvring behaviour reported

Overview of Manoeuvring Simulation Methods

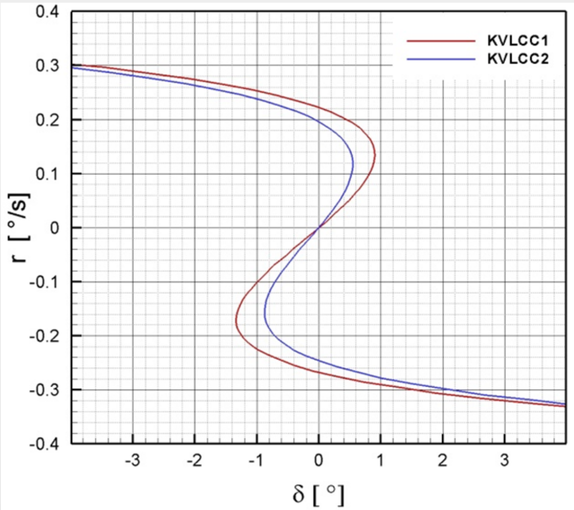
Based on empirical Methods	Very quick, low effort Accuracy, reliability and applicability of used methods are limited
Based on potential flow CFD	Fast answers In general less accurate prediction than based on viscous flow or even not suitable
Based on viscous flow CFD	Comprehensive physical insight. Possible for full scale. Good results achievable Quality of answers strongly depend on user. Required resources can be prohibitive
Hybrid methods	Effort depends on the components of the procedure used. Quality of results too.

Viscous Flow Simulation Techniques

Forced motions (some examples)



Atsvanapranee et al. (2010)



Cura Hochbaum et al. (2009)

Virtual static and dynamic PMM or CPMC tests with RANS codes increasingly used for determining derivatives for manoeuvring prediction but also to shed light on complex flow details.

Manoeuvring derivatives from virtual CPMC tests seem able to capture the slightly different yaw stability behaviour of KVLCC1 and 2.

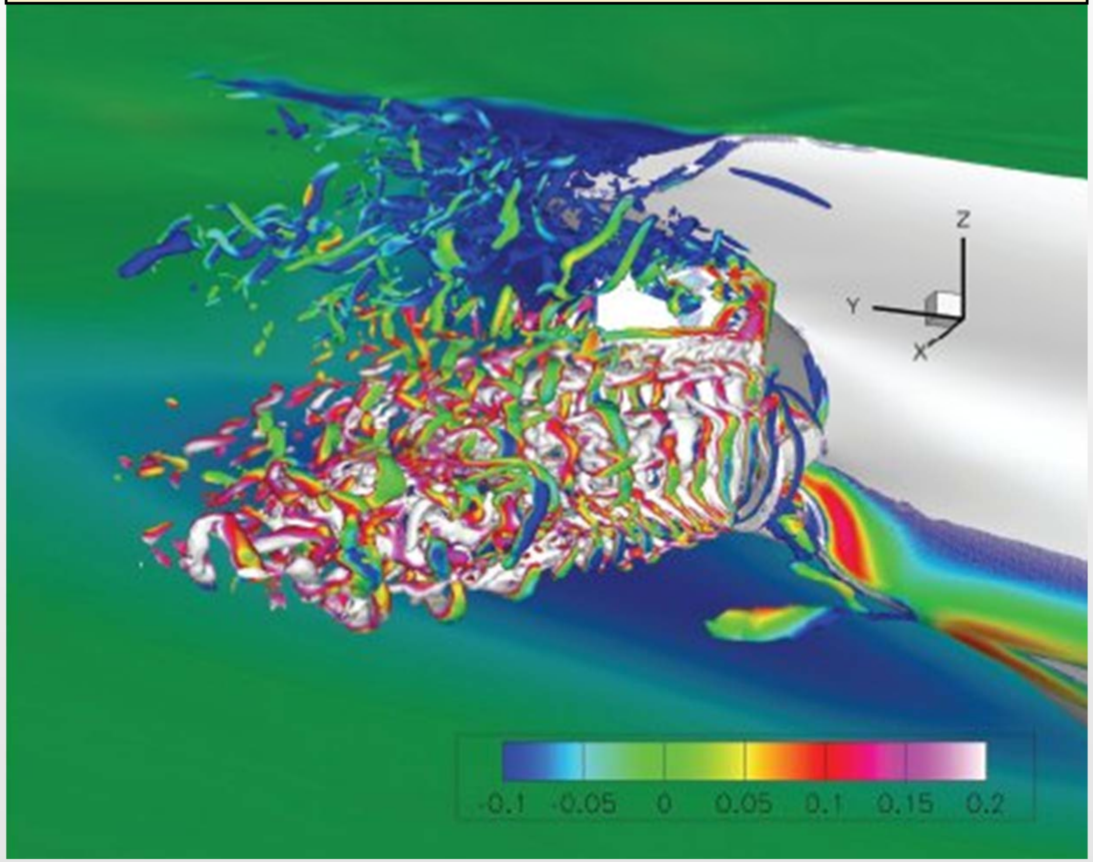
Interestingly, no attempts to clear the influence of considering the free surface and S&T reported.

Propellers mostly replaced by body forces, but some exceptions with “real” propellers reported.

Viscous Flow Simulation Techniques

Direct manoeuvring simulations (some examples)

Virtual turning circle and zigzag tests for KVLCC1



Carrica and Stern (2008b)

Several papers show that this has become feasible. However, high requirements regarding computational power and CFD expertise.

DES including free surface and rotating propeller allows for capturing the interaction between hull, propeller and rudder, including the vortical structures produced by the propeller blades and hub

Conclusions (Section 3)

Progress in simulation techniques

- Manoeuvring prediction based on virtual captive tests more popular and able to yield good results. Still only sporadically applied by towing tanks.
- Direct manoeuvring simulation (DMS) with RANS or DES has become more feasible but is still restricted to research projects.
- Systematic validation of RANS methods for manoeuvring still needed; few examples can be found for forced motion tests, even less for DMS. SIMMAN'08 represents a step in this direction. CFD methods seem to perform well, but not enough submissions to draw definitive conclusions.
- Body force models improved and commonly used instead of propellers. Usual models based on potential flow calculation seem to underestimate thrust variations and propeller side forces when oblique inflow.

Benchmark Data, Capabilities of Prediction Tools

Benchmark ships SIMMAN'08

KVLCC 1 & 2

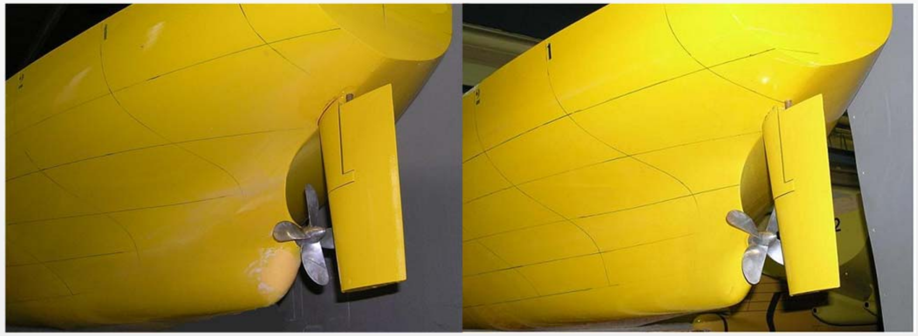
L_{PP} = 320 m

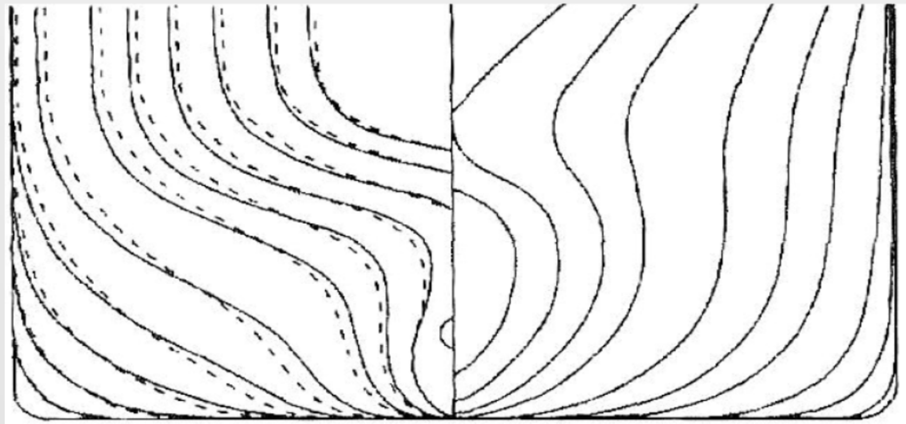
B = 58 m

T = 20.8 m

C_B = 0.81

V = 15.5 kn





Different aft body shapes were expected to yield different manoeuvring behaviour

Benchmark Data, Capabilities of Prediction Tools

Benchmark ships SIMMAN'08

KCS

L_{PP} = 230 m

B = 32.2 m

T = 10.8 m

C_B = 0.651

V = 24 kn

DTMB 5415

L_{PP} = 142 m

B = 19.06 m

T = 6.15 m

C_B = 0.507

V = 30 kn

No full scale ships have been built for these four hull forms.
However, all relevant ship data and also model test data available to everybody

All information in www.simman2008.dk

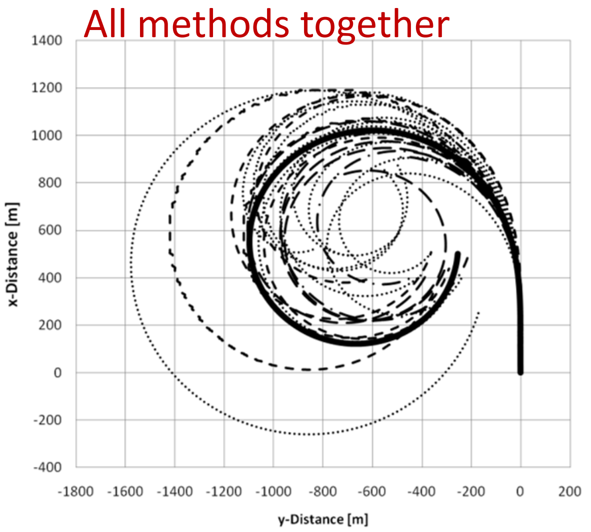
Benchmark Data, Capabilities of Prediction Tools

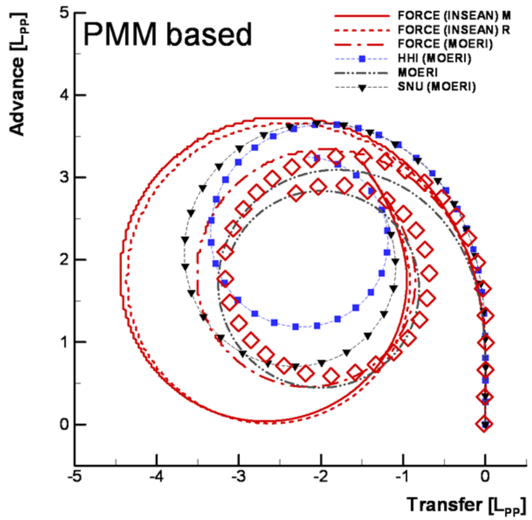
Model tests overview SIMMAN'08 and later

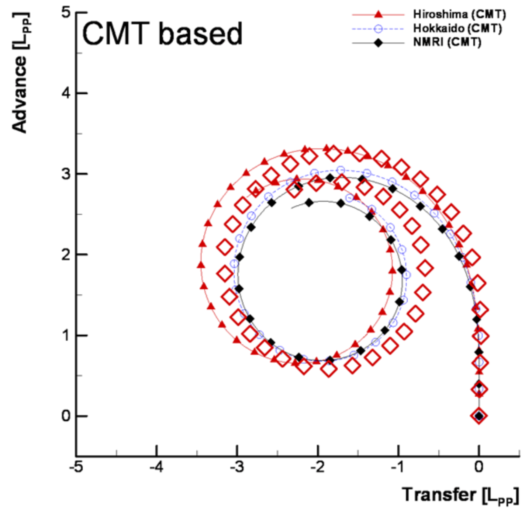
	CAPTIVE						FREE	
	PMM app. deep	PMM app. shallow	PMM bare deep	PMM bare shallow	CMT app. deep	CMT bare deep	Free app. deep	Free app shallow
KVLCC1	MOERI (1999) INSEAN (2006)	INSEAN (2006)	-	-	NMRI (2006)	-	HSVA (2006) MARIN (2007) CTO (2007)	-
KVLCC2	MOERI (1999) INSEAN (2006) BSHC (2011)	INSEAN (2006) FHR (2010)	INSEAN (2006)	INSEAN (2006) FHR (2010)	NMRI (2006)	-	HSVA (2006) MARIN (2007) CTO (2007)	FHR (2010)
KCS	CEHIPAR (2006) FORCE (2009)	FHR (2010)	FORCE (2009)	-	NMRI (2005) -	-	SVAP (2006) BSHC (2007) IHI (2008) MARIN (2009)	BSHC (2008) FHR (2010)
5415[1]	FORCE (2000) MARIN (2007)	-	FORCE (2004) IIHR (2005) INSEAN (2005)	-	MARIN (2007)	BEC (2006)	MARIN (2000)	-

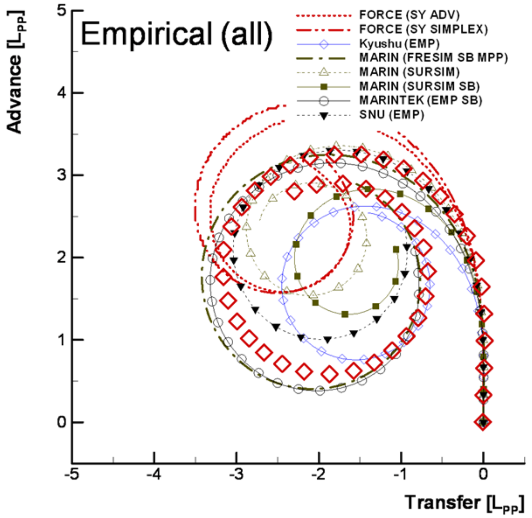
Workshop SIMMAN'08

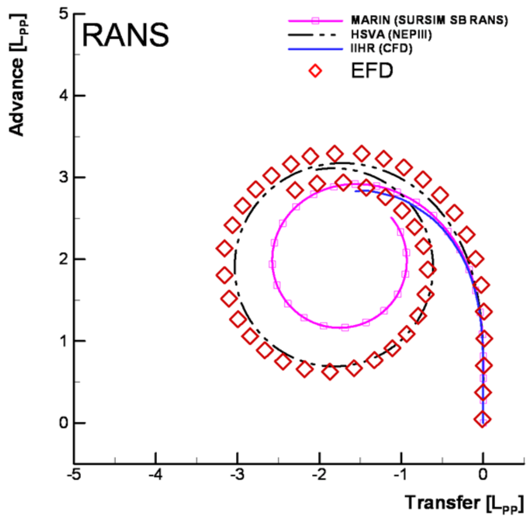
Predicted turning circle test for KVLCC1







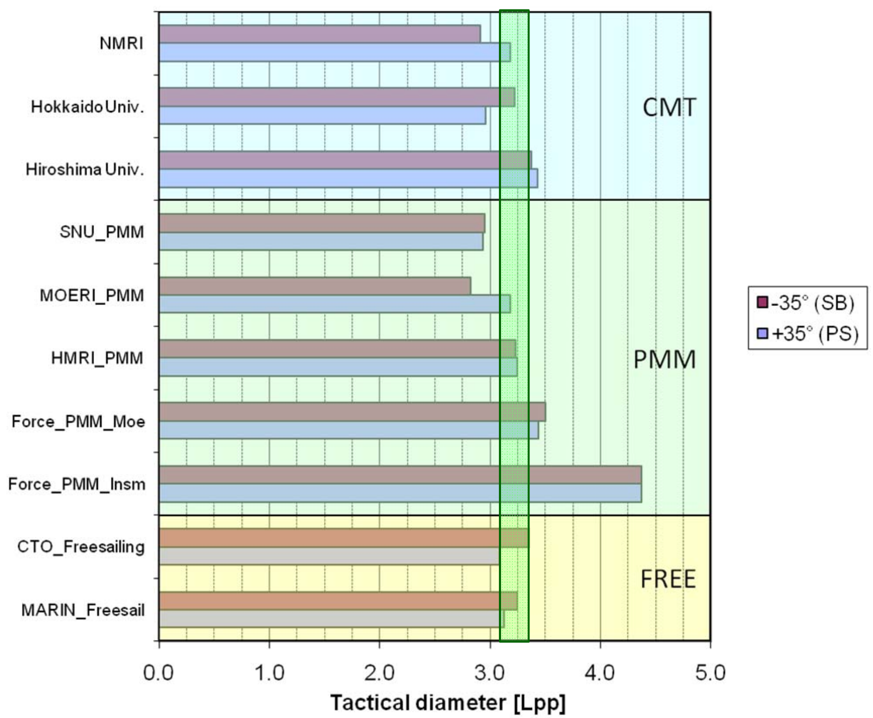


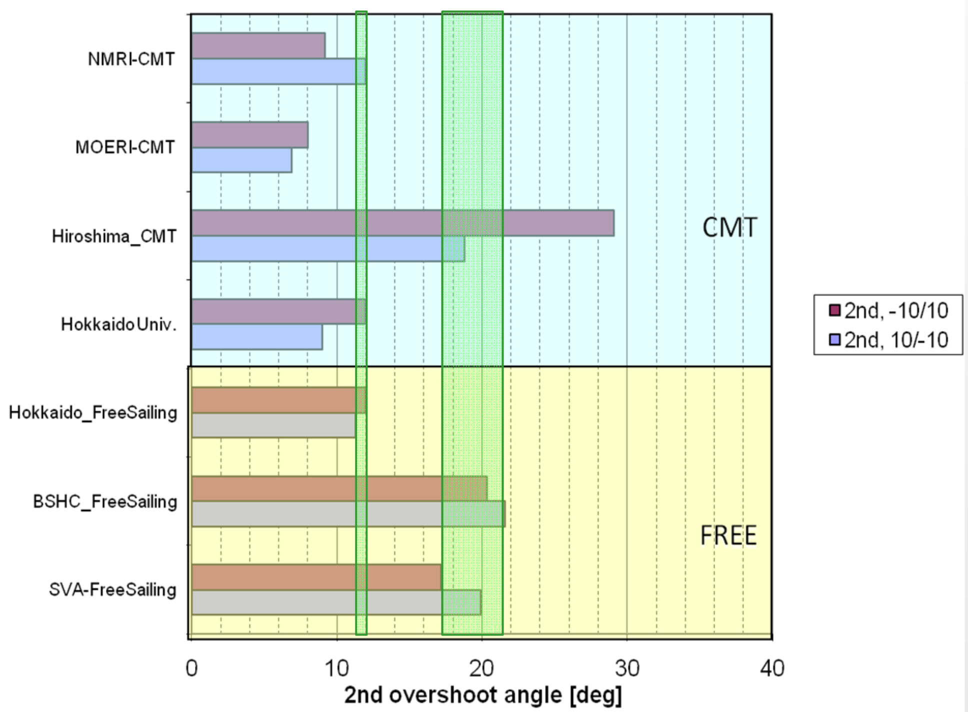


Grouping results by methods and further analysis shed more light on achievable accuracy of different methods

Workshop SIMMAN'08

Methods based on captive model test results





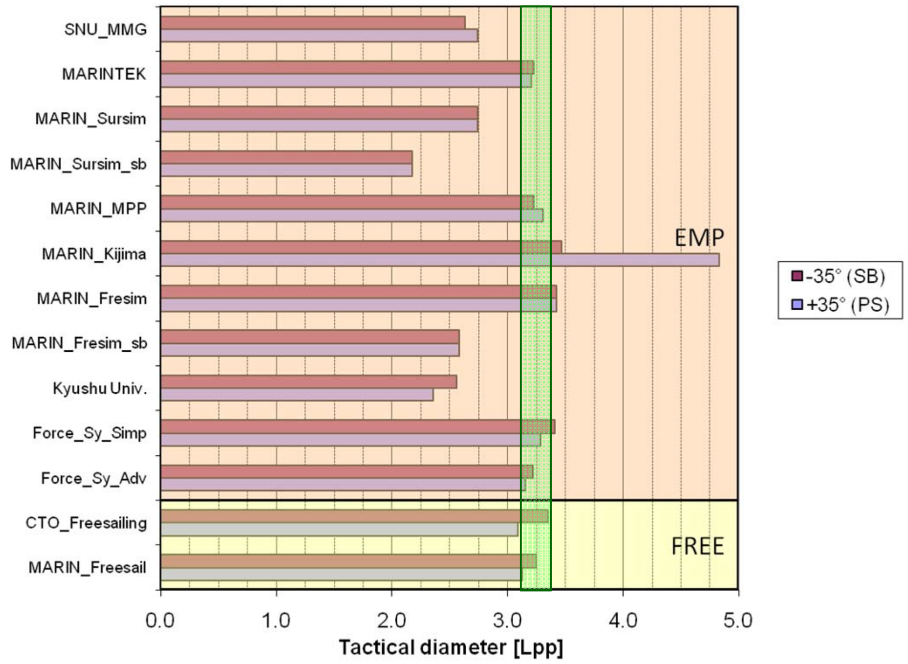
KVLCC1: Tactical diameter for δ=35°

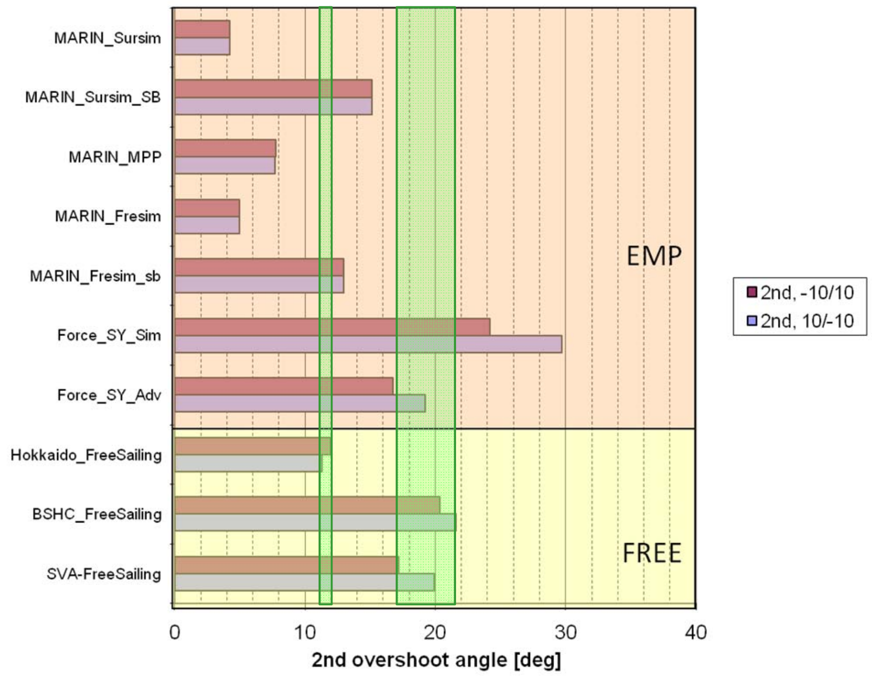
KCS: 2^{nd} overshoot angle during Z 10°/10°

- Some methods yield good results
- Scatter and differences with free model tests are unsatisfactory

Workshop SIMMAN'08

Empirical methods





KVLCC1: Tactical diameter for δ=35°	**KCS**: 2nd overshoot angle during Z 10°/10°

- Some methods show good agreement on some individual parameters but also discrepancies for other parameters or for other tests.
- Very large scatter. No consistently good results especially for KCS.

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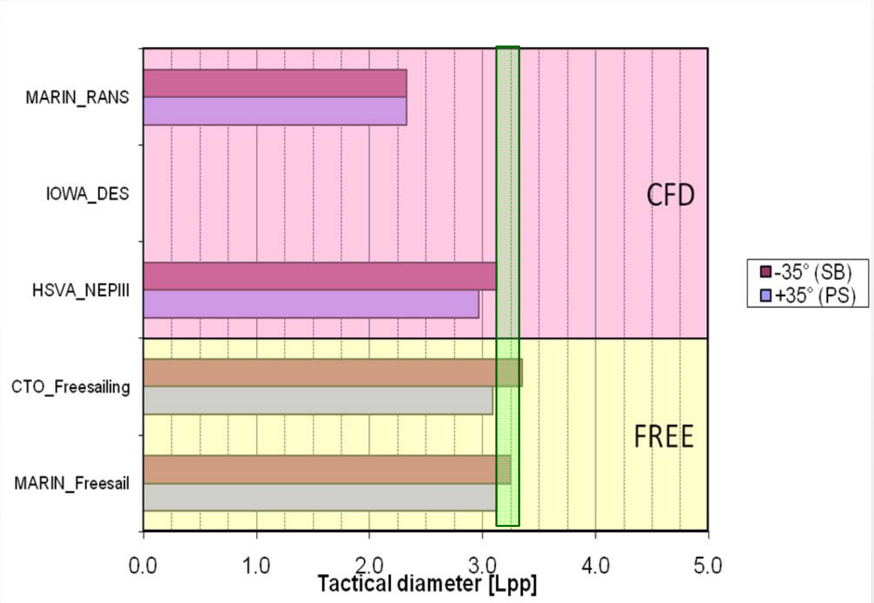
CFD based methods



KVLCC1: Tactical diameter for δ=35°

Methods used for calculating derivatives and predicting manoeuvres:

- The one fully CFD based method performed well; all results consistently
- Only two submissions ⇨ no general conclusion can be drawn on this basis

Methods used for predicting manoeuvres directly (no derivatives):

- Only one submission. Promising results.

Workshop SIMMAN'08

Overall comparison of methods

	benchmark (*1)		RMS error (all)		RMS error (captive)		RMS error (empirical)	
	port	stbd	port	stbd	port	stbd	port	stbd
Number of submissions(*2)	2/3	2/3	10/11	10/11	5	5	4	4
10/10 ZZ 1st OS (deg)	7.8	8.5	2.3	2.5	3.0	2.4	1.9	3.3
10/10 ZZ 2nd OS (deg)	15.7	17.6	5.3	6.5	4.6	8.5	7.6	5.5
20/20 ZZ 1st OS (deg)	12.8	13.0	2.6	2.9	3.2	2.7	2.2	3.9
20/20 ZZ 2nd OS (deg)	12.9	14.6	3.7	3.5	2.9	3.7	4.7	2.7
35 TC Adv (Lpp)	2.73	3.04	0.36	0.20	0.37	0.24	0.41	0.21
35 TC TactDiam (Lpp)	3.20	3.19	0.47	0.48	0.25	0.36	0.48	0.45

KVLCC2: Deviation from benchmark for captive and empirical methods

- Both kind of methods show substantial scatter relative to measured values

Conclusions (Section 4)

Benchmark Data and Capabilities of Prediction Tools

- Workshop SIMMAN'08 has given large amount of benchmark data for 4 ships. Some of the data sets still require clarification and correction or replacement.
- Large number and variety of methods for predicting standard manoeuvres. Scatter in results is larger than expected.
- Part of submissions were based on captive test data. Consistency between the model test program and the applied mathematical model it is essential. No general conclusions made regarding comparative performance between modular and whole-ship methods. It is important to include the 4th DoF (roll).
- Empirical methods are still in wide use. They should be applied with caution. Some of them can give reasonable predictions when restricted to the application for which they were developed.
- CFD has the potential to provide data fully equivalent to PMM/CMT data. Also DMS showed promising results. Too few submissions on prediction of free manoeuvres to draw definitive conclusions yet.

Manoeuvring and Course Keeping in Waves

- **Experimental methods**

  Not many papers in the last 3 years. Among them, measurement of wave forces and determination of derivatives by PMM tests in regular waves.

- **Simulation methods**

  - based on two-time scale models: low freq. manoeuvring motions with 4 DoF model and high freq. motions in 6 DoF by seakeeping theory

  - based on "unified theory": mean wave forces with strip methods or 3D panel codes yield corresponding hydrodynamic coefficients for manoeuvring prediction in 4 or 6 DoF

  - using field method CFD: few publications found, e.g. Ferrant et al. (2008) using SWENSE, a combination of potential and viscous flow computation around the ship for computing flow and motions. However, several research activities going on where RANS codes are being extended for seakeeping & manoeuvring prediction

- **Course keeping in waves**

  Papers on control algorithms and autopilots for course keeping reported

Conclusions (Section 5)

Manoeuvring and course keeping in waves

- The requirement for a safe and energy-efficient navigation of ships in real sea conditions has led to intensive investigation on ship manoeuvrability in waves.
- The rapid development of computational techniques has provided a powerful tool for simulation-based studies of ship manoeuvring in waves; accurate predictions may be achieved in the near future.
- However, the mechanism of ship manoeuvring motion in waves is not fully understood yet. More experimental research is needed to provide objective benchmark data for comparison and validation purposes.

Manoeuvring in Confined Waters

- **Model tests**

  Force measurements in shallow water and in inhomogeneous current

  Free model tests for different h/T reported

- **CFD simulations**

  Some studies on predictions for steady turning and steady oblique motion in shallow water show the influence on hydrodynamic forces depending on h/T

  Also in this field several studies running but few publications till now

- **Bank effects**

  Studies still seldom; examples are papers from Vantorre's group, DST, BAW

- **Ship-ship interaction**

  Model tests and full scale measurements

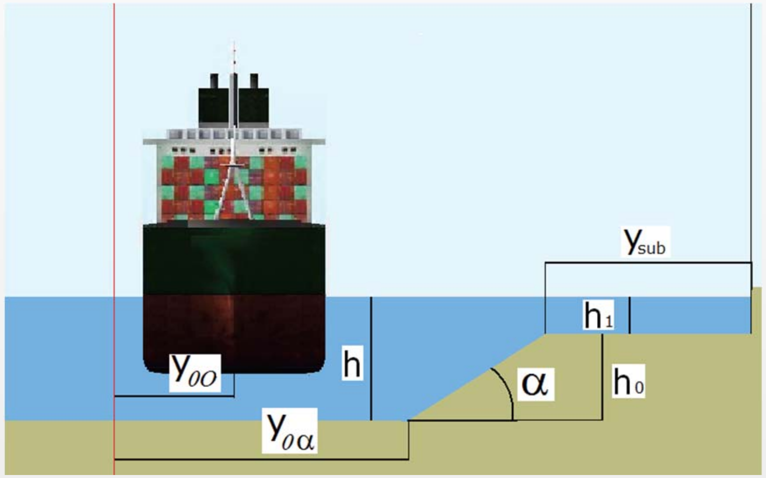
  Unified seakeeping & manoeuvring mathematical models

  Simulations with 3D panel codes and increasingly with RANS codes

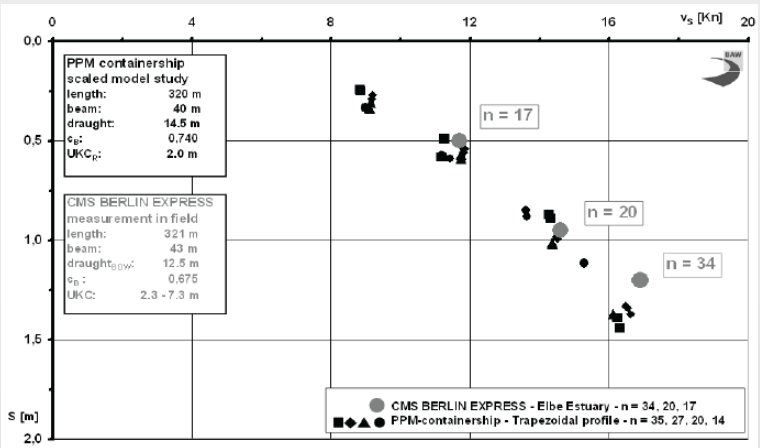
2nd Int. Conf. on Ship Manoeuvring in Shallow and Confined Water not included

Manoeuvring in Confined Waters

Bank effects (some examples)



Lataire et al. (2009b)



Uliczka and Kondziella (2009)

A subset of very extensive measurements of bank induced forces and moments and a mathematical model was presented in Lataire et al. (2009b)

Gronarz (2009b) investigated forces on model sailing straight along a bank as well as obliquely and showed interaction of wall and drift effects

Uliczka and Kondziella (2009) investigated bank effects on squat in model and full scale

Conclusions (Section 6)

Manoeuvring in confined waters

- Manoeuvring in shallow and confined waters and ship-ship interaction received much attention in the past three years.
- Dedicated conferences are organised in this area. The methodologies for model testing and simulation are not the same in different researches.
- The applicability of RANS tools opens new possibilities, but needs also proper validation.

Uncertainty Analysis

- Workshop held at NRC in St. John's in June 2010 showed that considerable effort would be needed to transfer the existing procedure on UA for captive manoeuvring tests towards ISO, especially the example. This could not be done by this MC.

- UA being applied for captive tests but focussing on measured hydrodynamic forces rather than the most important outcome, i.e. manoeuvring derivatives or even the end result in form of overshoot angles, tactical diameter, etc.

- A guideline on UA for free manoeuvring tests has been initiated. It is based on a pragmatic approach and should be completed with an elaborated example.

Conclusions (Section 7)

- The use of uncertainty analysis for manoeuvring tests at facilities around the world is slower than expected, judging from the published material.

Scale Effects

Discussion of effects by components

- **Scale effects on rudder forces**

  Reported statements sometimes contradictory. However, mostly accepted:

  - no/low influence on slope while more incidence on maximum lift and stall angle
  - influence reduced for rudder working in turbulent propeller slipstream

- **Scale effects on hull forces**

  22nd ITTC (2002) concluded that no effects present for ESSO Osaka, but no general.

  RANS calculations for model and full scale (Kim et al. 2003) seem to indicate some influence of Rn, yet validation still missing.

- **Scale effects on rudder inflow**

  Considerable effects due to larger wake and larger propeller load (if free sailing).

  These effects may balance (at least partially) for single screw models.

  Some differences in flow straightening by hull and propeller reported.

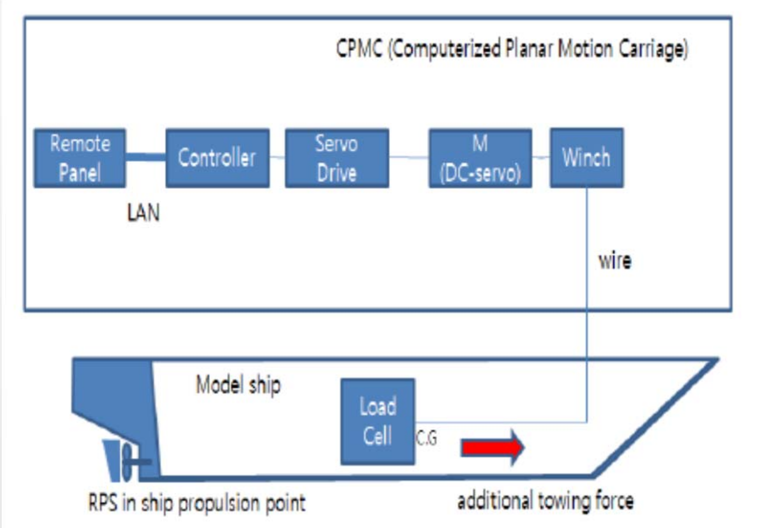
  Further important aspect can be the rpm strategy adopted during model tests.

Scale Effects

Effects of propulsion point

- Choice of propulsion point (SSPP or MSPP) is still controversial. Free tests usually at MSPP but Oltmann et al. (1980) showed that the propulsion point for best prediction may be different to both, MSPP and SSPP.

- Son et al. (2010) investigate the effect of the propulsion point on zigzag and turning circle tests with a KCS model with a towing assistance device. The results were better for MSPP (as expected). Similar to Oltmann et al. the assistance force was not adapted to the instantaneous model speed.



Son et al. (2010)

- Shen et al. (2010a) show tactical diameters for a twin screw twin rudder ship in full scale being (other than expected) smaller than for the model and analyze different effects including cavitation.

Conclusions (Section 8)

Scale effects

- Manoeuvring prediction techniques based on free model tests or captive model tests could fail to predict the full-scale performance accurately due to scale effects. Careful review of the present model test technique needed.

- The proper propulsion point during manoeuvring tests is still controversial. Some guideline for choosing optimum propulsion point to predict full scale manoeuvring performance is required.

- Development of CFD technology shows a promise in computing full-scale manoeuvring motion in the future.

- It is necessary to establish a standard model-ship correlation method for predicting full-scale manoeuvring performance from model tests. For this, systematic EFD and CFD research on scale effects and well documented full scale data required.

Slow Speed Manoeuvring

- **Mathematical models for low speed and large drift angles**
  - Cross flow models (Oltmann & Sharma 1983, Obokata 1983, Wichers 1988)
  - Polynomial models (Abkowitz 1964, Norrbin 1971, Takashina & Hirano 1990)
  - Fourier expansion models
  - Tabular models
  - Models based on CFD
- **Applications for low speed and large drift angles**

  Recent papers just show the simulation results but not the models used.

- **Validation data**

  Contrary to manoeuvring at speed, no comprehensive benchmark data for well defined typical low speed manoeuvres available.

Conclusions (Section 9)

Slow speed manoeuvring models

- Although there are many publications which treat current forces and low speed manoeuvres, the mathematical models used are not explained up to a scientific detail.
- There are different approaches in mathematical models applied. A proposal for a label to these groups is made to use these labels for identification of models used in studies. It is recommended to extend this labelling to the Ocean Engineering committee.
- Adequate experimental validation material for these applications would be welcomed, not only on force level, but also on trajectory level.
- RANS calculations represent an opportunity.

Procedures

7.5-02-06-03 Validation of Manoeuvring Simulation Models	Based on results of SIMMAN'08, the procedure has been updated.
New procedure on Uncertainty Analysis for Free Model Tests	Theoretical part completed; inclusion of example needed to complete work
New guideline on V&V of RANS Tools for Manoeuvring Prediction	Draft written. This should be used as a starting point by the next MC.
New guideline on Use of RANS Tools for Manoeuvring Prediction	Guideline has been written.
Draft outline of procedure for Numerical Methods for Shallow and Restricted waters	Draft written. This should be used as a starting point by the next MC.

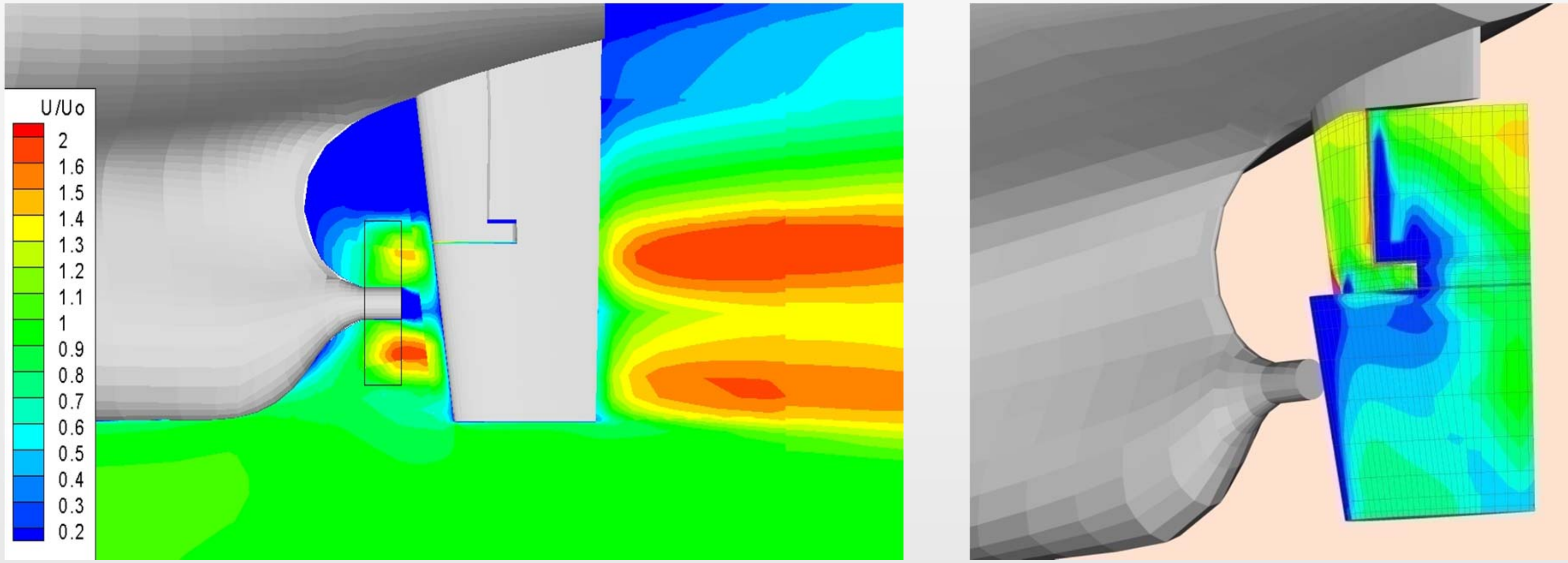
Guideline on
Use of RANS Tools for Manoeuvring Prediction

Table of Contents

Propeller effect modelled with Body Forces

Axial velocity in central plane

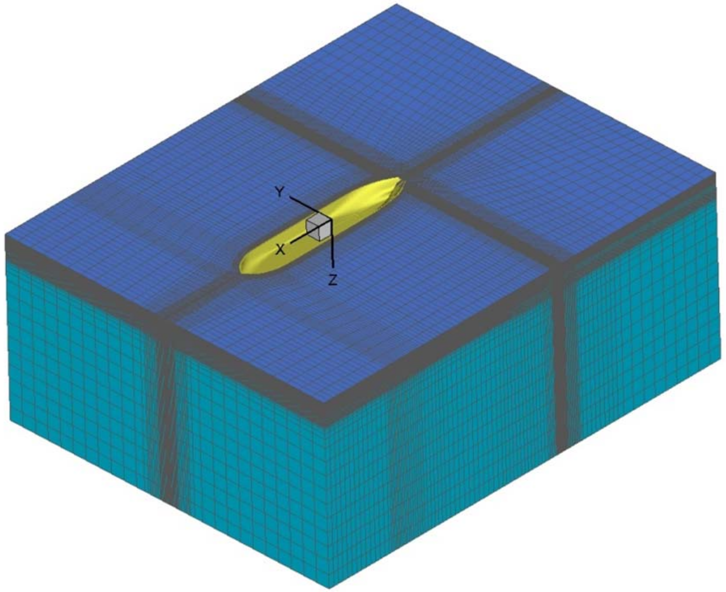
Ship model moving straight ahead with 0° and 35° rudder angle



- Strong acceleration and rotation of rudder inflow should be taken into account by the used body force model

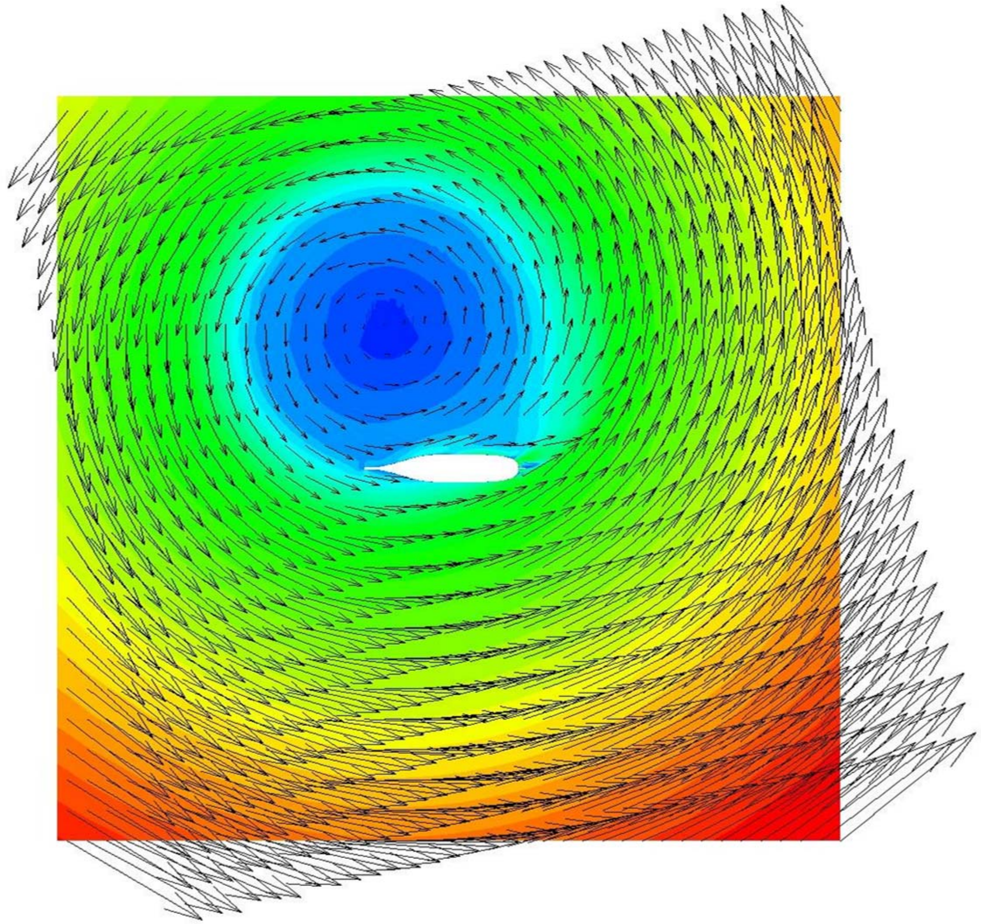
Boundary Conditions

Example steady turning with given drift angle



$$u_{inlet} = -(u - y\,r)$$

$$v_{inlet} = -(v + x\,r)$$



- Boundary conditions crucial for convergence and results

Motion Equations in 4 DoF

e.g. written in hybrid (semi-body fixed) coordinates

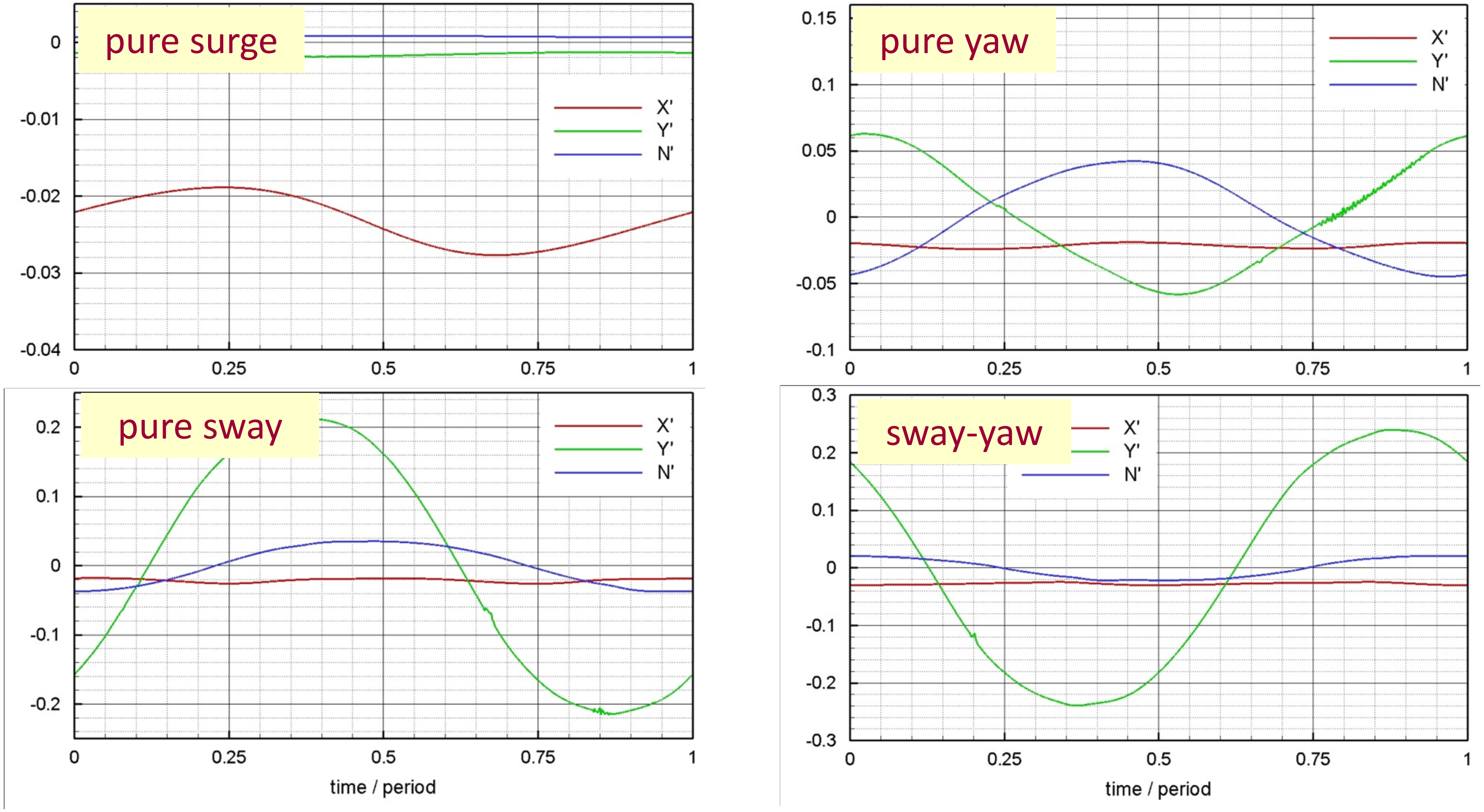
$$m\left[\,\dot{u}\,-\dot{\psi}\,v-x_G^*\,\dot{\psi}^2+z_G^*\left(2\,\dot{\psi}\,\dot{\varphi}\,\cos\varphi+\ddot{\psi}\,\sin\varphi\right)\right]=X$$

$$m\left[\,\dot{v}+\dot{\psi}\,u\,+x_G^*\,\ddot{\psi}\,+z_G^*\left(\left(\dot{\psi}^2+\dot{\varphi}^2\right)\sin\varphi-\ddot{\varphi}\,\cos\varphi\right)\right]=Y$$

$$I_{xx}\,\ddot{\varphi}\,-I_{xz}\,\ddot{\psi}\,\cos\varphi\,+\left(I_{zz}-I_{yy}\right)\dot{\psi}^2\sin\varphi\,\cos\varphi\,-m\,z_G^*\,\cos\varphi\,\left(\dot{v}+u\dot{\psi}\right)=K$$

$$\left(\,I_{yy}\,\sin^2\varphi+I_{zz}\,\cos^2\varphi\right)\ddot{\psi}\,+2\,\left(I_{yy}-I_{zz}\right)\dot{\psi}\,\dot{\varphi}\,\sin\varphi\,\cos\varphi-$$
$$I_{xz}\left(\ddot{\varphi}\,\cos\varphi-\dot{\varphi}^2\,\sin\varphi\right)+m\,x_G^*\left(\dot{v}+u\,\dot{\psi}\right)+\,m\,z_G^*\,\sin\varphi\,\left(\dot{u}-v\,\dot{\psi}\,\right)=N$$

Results of Virtual CPMC Tests



- Time histories used to determine manoeuvring derivatives

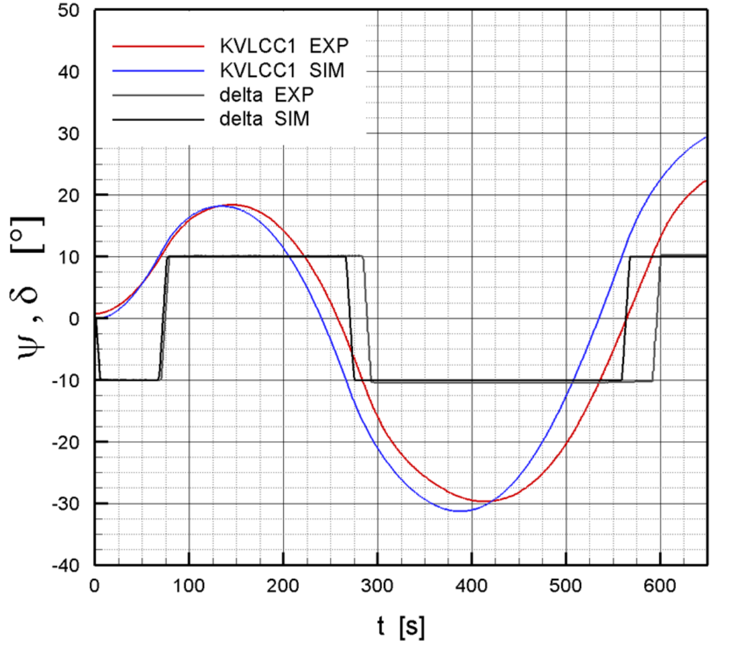
Manoeuvring Derivatives
KVLCC1

0	X'_o		Y'_o	0	N'_o	0
1	X'_δ	0	Y'_δ	4.44	N'_δ	-2.06
2	$X'_{\delta\delta}$	-2.09	$Y'_{\delta\delta}$	-0.24	$N'_{\delta\delta}$	0.16
3	$X'_{\delta\delta\delta}$	0	$Y'_{\delta\delta\delta}$	-2.95	$N'_{\delta\delta\delta}$	1.38
4	X'_u	-2.20	Y'_u		N'_u	
5	X'_{uu}	1.50	Y'_{uu}		N'_{uu}	
6	X'_{uuu}	0	Y'_{uuu}		N'_{uuu}	
7	$X'_{\dot{u}}$	-1.47	$Y'_{\dot{u}}$		$N'_{\dot{u}}$	
8	X'_v	0.11	Y'_v	-24.1	N'_v	-7.94
9	X'_{vv}	2.74	Y'_{vv}	2.23	N'_{vv}	-1.15
10	X'_{vvv}	0	Y'_{vvv}	-74.7	N'_{vvv}	2.79
11	$X'_{\dot{v}}$		$Y'_{\dot{v}}$	-16.4	$N'_{\dot{v}}$	-0.47
12	X'_r	-0.07	Y'_r	4.24	N'_r	-3.32
13	X'_{rr}	0.58	Y'_{rr}	0.56	N'_{rr}	-0.27
14	X'_{rrr}	0	Y'_{rrr}	2.58	N'_{rrr}	-1.25
15	$X'_{\dot{r}}$		$Y'_{\dot{r}}$	-0.46	$N'_{\dot{r}}$	-0.75
16	X'_{vr}	13.1	Y'_{vr}		N'_{vr}	
17	X'_{vrr}		Y'_{vrr}	-40.3	N'_{vrr}	8.08
18	X'_{vvr}		Y'_{vvr}	-9.90	N'_{vvr}	-3.37
19	$X'_{u\delta}$		$Y'_{u\delta}$	-4.56	$N'_{u\delta}$	2.32
20	$X'_{v\delta\delta}$		$Y'_{v\delta\delta}$	5.15	$N'_{v\delta\delta}$	-1.17
21	$X'_{vv\delta}$		$Y'_{vv\delta}$	7.40	$N'_{vv\delta}$	-3.41
22	$X'_{r\delta\delta}$		$Y'_{r\delta\delta}$	-0.51	$N'_{r\delta\delta}$	-0.58
23	$X'_{rr\delta}$		$Y'_{rr\delta}$	-0.98	$N'_{rr\delta}$	0.43

- Rather simple mathematical model of Abkowitz type

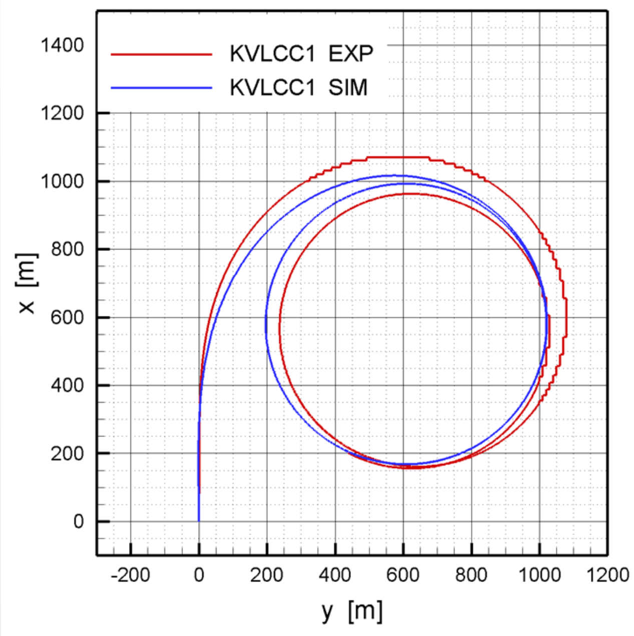
Manoeuvring Prediction for KVLCC1

Z-Test 10°/10°



10°/10°	SIM	EXP
τ_a [s]	67	69
Initial turning ability	1.66	1.73
α_{01} [°]	8.1	8.2
α_{02} [°]	21.4	19.4
r_{max} [°/s]	-0.42	-0.40

Turning circle test with δ=-35°



$\delta = -35°$	SIM	EXP
$x_{90°} / L_{pp}$	3.10	3.03
$y_{180°} / L_{pp}$	3.13	3.25
$\varnothing_{st} / L_{pp}$	2.58	2.44
V_{st} / V_o	0.39	0.37
r_{st} [°/s]	0.43	0.42

Recommendations

- Continue work in order to have a full set of well-documented experimental data for each of the four benchmark hulls (KVLCC1, KVLCC2, KCS, 5415)
- Capitalize the momentum created by SIMMAN ‘08 to continue the development of verification and validation of ship manoeuvring simulation methods (support organisation of a second SIMMAN workshop)
- The coming Manoeuvring Committee should propose standard manoeuvres for the validation of low speed manoeuvres
- Adopt the improved procedure 7.5-02-06-03, “Testing and Extrapolation Methods, Manoeuvrability, Validation of Manoeuvring Simulation Models”
- Adopt the new guideline, “Use of RANS Tools for Manoeuvring Prediction”

Tasks for the 27th MC

Tasks proposed for the new MC have been accepted almost without exception. Besides usual work, like updating the state-of-the-art and reviewing the procedures for manoeuvring, they can be summarized as follows:

- Intensify the work on explaining the quality of different prediction methods and on explaining scale effects
- Complete the initiated procedures and guidelines
- Support the organization of a 2nd SIMMAN workshop

Thank you very much for your attention !