Quality Systems Group

Presentation & Discussion at the 28th ITTC Conference

ITTC 28th WUXI 2017

Quality Systems Group

Final Report and Recommendations to the 28th ITTC

Monday, September 18th 2017

ITTC 28th WUXI 2017

Membership and Meetings

Benedetti L., CNR-INSEAN (Secretary)
Chen W., SSSRI
Clelland D., Strathclyde Univ.
Ferrando M., University of Genova, (Chair)
Kobayashi E., Kobe Univ.
Morabito M. G., US Naval Academy
Park J. T., NSWC Carderock Div.
Sena Sales Jr J., LOC UFRJ
Woodward M. D., UTAS

Corresponding member:
Johnson B., US Naval Academy (ret.)

From January 1st 2016 Woodward M. D. moved from Newcastle University to University of Tasmania, continuing his activity into the Quality Systems group.
From July 2016, Sales Jr J. finished his PhD and moved from LabOceano to LOC (Laboratory of Waves and Current), at the same Federal University of Rio de Janeiro.

Membership and Meetings

The Group held four meetings as follows:

Copenhagen, September 5th 2014 *during 27thITTC*
Newcastle, July 16th to 17th 2015
Annapolis, July 21st to 22nd 2016
Rome, January 12th to 13th 2017.

28TH QSG TERMS OF REFERENCE

The list of QSG Terms of reference comprehends 18 items, which will be addressed specifically in the following slides

1) **Update all ITTC Recommended Procedures and Guidelines to conform to the requirements of Recommended Procedure 4.2.3-01-03, Work Instruction for Formatting ITTC Recommended Procedures and Guidelines.**

The procedures not going to be revised by 28th ITTC Committees have been updated to the format prescribed in procedure 4.2.3-01-03.

The updating regarded 56 documents listed in the Annex A of the QSG Final Report.

The "*Version*" and "*Effective date*" fields of the procedures were left untouched while the field "Updated / Edited by" was changed in Quality Systems Group of the 28th ITTC and the relevant date adjourned.

Since the rest of the documents have been reviewed after the updating by the Committees, all of the ITTC Recommended Procedures and Guidelines comply now with the format prescribed in procedure 4.2.3-01-03.

2) **Support technical committees in their work on Recommended Procedures**

Relevant instructions and files containing the procedures to be updated, together with the template to be used for drafting new procedures has been sent to the Chairmen of the ITTC Committees throughout the 3 years of activity.

3) Maintain the Manual of ITTC Recommended Procedures and Guidelines 1/2

The revision of the Manual of ITTC Recommended Procedures and Guidelines concerned 81 documents:

- 3 existing procedures were deleted
- 19 new Procedures/Guidelines have been approved
- 59 existing procedures have been reviewed or updated.
- The document 0.0 Register has been updated accordingly.

The revision outcome is illustrated in Annex B of the QSG Final Report.

Since two procedure arrived after the deadline for delivering the final report, the data relevant to procedures and guidelines in the printed version are not current. Please, for an accurate account refer to the QSG Final Report on the ITTC web site.

3) Maintain the Manual of ITTC Recommended Procedures and Guidelines 2/2

These two late document have been included:

New/ Rev./ Del	Number	P /G	Title	Effec tive Date
N	7.5-02-07-02.8	P	Calculation of the weather factor f_w for decrease of ship speed in waves	2017
R	7.5-03-02-02	P	Benchmark Database for CFD Validation for Resistance and Propulsion	2017

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4) Observe the development or revision of ISO Standards regarding Quality Control (1/5)

ISO has presented its new version of the Standard for Quality Management System – ISO 9001:2015. This new version implemented a so called "high level structure" (ISO/IEC 2016a) in order to accommodate a common frame or base structure between different standards throughout ISO (for instance, ISO 14001). **The Standard is to be implemented until September 2018, date from which ISO 9001:2008 will no longer be valid**.

The structure of the new version is as follows:

1 Scope

2 Normative references

3 Terms and definitions

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4) Observe the development or revision of ISO Standards regarding Quality Control (2/5)

4 Context of the organization

- 4.1 Understanding of the organization and its context;
- 4.2 Understanding the needs and expectations of interested parties;
- 4.3 Determining the scope of the quality management system;
- 4.4 Quality management system and its processes

5 Leadership

- 5.1 Leadership and commitment
- 5.2 Policy
- 5.3 Organizational roles, responsibilities and authorities

6 Planning

- 6.1 Actions to address risks and opportunities
- 6.2 Quality objectives and planning to achieve them
- 6.3 Planning of changes

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4) Observe the development or revision of ISO Standards regarding Quality Control (3/5)

7 Support
- 7.1 Resources
- 7.2 Competence
- 7.3 Awareness
- 7.4 Communication
- 7.5 Documented information

8 Operation
- 8.1 Operational planning and control
- 8.2 Requirements for products and services
- 8.3 Design and development of products and services
- 8.4 Control of externally provided processes, products and services
- 8.5 Production and service provision
- 8.6 Release of products and services
- 8.7 Control of nonconforming outputs

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4) Observe the development or revision of ISO Standards regarding Quality Control (4/5)

9 Performance evaluation
- 9.1 Monitoring, measurement, analysis and evaluation
- 9.2 Internal audit
- 9.3 Management review

10 Improvement
- 10.1 General
- 10.2 Nonconformity and corrective action
- 10.3 Continual improvement).

The Quality Systems Group suggests to the next ITTC to assess if a transition to the ISO 9001:2015 standard is desirable for the ITTC Quality Systems Manual.

4) **Observe the development or revision of ISO Standards regarding Quality Control (5/5)**

The Quality Systems Group warns the ITTC that if this course of action is pursued the ITTC Quality Systems Manual will be completely rewritten.

This will include the renumbering of all the ITTC Recommended Procedures and Guidelines. Many of these documents reference to other procedures or guidelines by their number and this will require a careful reading of all of the documents and editing the text of many of them, beside the complete renumbering.

This process will be long and time consuming, so adequate man power needs to be allocated to this task in case it is pursued.

5) **Update the ITTC Symbols and Terminology List (1/2)**

The former definition of C_{AA} has been transferred to two new symbols: C_{DA} and C_X. The definition of C_{AA} has been consequently rectified, in order to render it compatible with the rest of the resistance coefficient relative to the ship:

$$C_{DA} = \frac{R_{AA}}{A_V q_R}$$ from Fujiwara

$$C_X = \frac{R_{AA}}{A_V q_R}$$ in common use by wind tunnels

The new definition of C_{AA} consequently is

$$C_{AA} = \frac{R_{AA}}{S\,q} = C_{DA}\frac{\rho_A}{\rho}\frac{A_V}{S} = C_X\frac{\rho_A}{\rho}\frac{A_V}{S}$$

5) Update the ITTC Symbols and Terminology List (2/2)

The following new symbols were also added:

C_{APP} Appendage resistance coefficient
ρ_0 Seawater density at standard conditions
k_P Propeller blade roughness
k_S Roughness of hull surface
R_{AW} Mean added resistance in waves
R_U Pod unit resistance
T_U Pod unit thrust

The great number of procedures edited, updated or drafted during the 28th ITTC prevented a thorough check of symbols by QSG.

A systematic effort regarding symbols check could be asked to committees, in order to find out symbols that are used without appearing into the Symbols and Terminology List.

6) Develop a liaison with ISO with a view to reconcile the differences in definitions (1/2)

A comparison between:

7.5-04 -01-01.1 Preparation and Conduct of Speed/Power Trials
7.5-04 -01-01.2 Analysis of Speed/Power Trial Data

Now consolidated in **7.5-04 -01-01.1**

and

ISO 15016:2015 Ships and marine technology – Guidelines for the assessment of speed and power performance by analysis of speed trial data;

has been conducted

6) Develop a liaison with ISO with a view to reconcile the differences in definitions (2/2)

Main differences were:

- References to ISO procedures should be updated,
- Table of symbols and abbreviated terms to be added,
- G-module value in absence of material certificate,
- 'Currents' – conditions under which currents are not acceptable for conducting a test are not specified in detail,
- Measurement of Bow acceleration is not required as in ISO 15016:2015,
- Number of speed runs differs from the ISO 15016:2015

Have now been addressed in the consolidated procedure

7) Update the ITTC Dictionary of Hydromechanics

The dictionary has undergone only normal maintenance. Several errors and typos have been rectified.

The QSG proposes to the Conference to evaluate if it is desirable to have two versions of the Dictionary: the structured and the alphabetical one. This in view of the workload required to maintain the two versions.

8) Revise and update the existing ITTC Recommended Procedures (1/5)

The QSG updated 9 documents:

Number	P /G	Title
1.0-03	G	General Guideline for the Activities of Technical Committees, Liaison with Executive Committee and Advisory Council
4.2-01	P	Adoption or Modification of ITTC Recommended Procedures
4.2-02	P	Updating the ITTC Symbols & Terminology List
4.2-03	P	Review of ITTC Recommended Procedures and Guidelines by the Advisory Council
4.2.3-01-01	P	Guide for the Preparation of ITTC Recommended Procedures and Guidelines
4.2.3-01-02	G	Guidelines for Preparation of Technical Committee and Group Reports
4.2.3-01-03	P	Work Instruction for Formatting ITTC Recommended Procedures
7.5-01-03-01	P	Uncertainty Analysis, Instrument Calibration
7.6-02-08	W	Calibration of Weights

8) Revise and update the existing ITTC Recommended Procedures (2/5)

Technical Procedures Guidelines updating

ITTC 7.5-01-03-01, Uncertainty Analysis , Instrument Calibration

- Calculation of local g from PTB web page
- Updated references
- Corrections to format and equations

ITTC 7.6-02-08, Calibration of Weights

- Greatly simplified (4 pages): classification, adjustment, marking, and certificates
- Uncertainty correlated for weight sets, ITTC 7.5-01-03-01
- Combined uncertainty for total load on calibration fixture

$$U_{\mathrm{c}} = \sum_{i=1}^{n} U_i = \sum_{i=1}^{n} \delta m_i$$

8) Revise and update the existing ITTC Recommended Procedures (3/5)

The following documents were also reviewed:

4.0-01	Guidelines for Benchmarking	No revision is needed
7.5-01-02-01	*Terminology and Nomenclature for Propeller Geometry*	To be deleted
7.5-03-01-01	*Uncertainty Analysis in CFD, Verification and Validation Methodology and Procedures*	To be reviewed by Resistance Committee
7.5-03-01-02	*Uncertainty Analysis in CFD, Guidelines for RANS Codes*	To be reviewed by Resistance Committee
7.5-03-02-02	*Benchmark Database for CFD Validation for Resistance and Propulsion*	To be reviewed by Resistance Committee
7.6-01-01	*Control of Inspection, Measuring and Test Equipment*	No revision is needed
7.6-02-01	*Calibration of Steel Rulers*	Probably obsolete, consider deleting

8) Revise and update the existing ITTC Recommended Procedures (4/5)

The following documents were also reviewed (continued)

7.6-02-02	*Calibration of Vernier Calipers*	Probably obsolete, consider deleting
7.6-02-03	*Calibration of Height Calipers*	Probably obsolete, consider deleting
7.6-02-04	*Calibration of Micrometers*	Probably obsolete, consider deleting
7.6-02-05	*Calibration of Dial Gauges*	Probably obsolete, consider deleting
7.6-02-06	Calibration of Chronometers with Pointer Indication	Probably obsolete, consider deleting
7.6-02-07	*Calibration of Chronometers with Digital Indication*	Probably obsolete, consider deleting
7.6-02-09	*Calibration of a Load Cells*	Probably obsolete, consider deleting
7.6-02-10	*Calibration of Non Self Indicating Weighing Instruments*	Probably obsolete, consider deleting

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8) Revise and update the existing ITTC Recommended Procedures (5/5)

The following documents were also reviewed (continued)

7.6-02-11	*Calibration of Liquid-in-Glass Thermometers*	Probably obsolete, consider deleting
7.6-02-12	*Calibration of Bourdon Tube Pressure Gauges, Pressure-Vacuum and Vacuum Gauges for General Use*	Probably obsolete, consider deleting

As regards new procedures, the following new documents were prepared as per request of AC/EC:

1.0-05	Guidelines for delegates representing ITTC vis-à-vis external bodies
4.2.4-01-01	Record of Interim decision regarding ITTC Recommended Procedures and Guidelines

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9) Review and edit new ITTC Recommended Procedures with regard to formal Quality System requirements (1/4)

The QSG review process regarded 50 existing and 15 new procedures adding to a total of 65 documents, as illustrated in Annex D of the QSG Final Report.

The great majority of the procedures required an enormous amount of editing with respect to format.

Since two procedure arrived after the deadline for delivering the final report, the data relevant to procedures and guidelines in the printed version are not current. Please, for an accurate account refer to the QSG Final Report on the ITTC web site

In the printed version, the document 7.5-02-07-03.12 Uncertainty Analysis for a Wave Energy Converter has been erroneously listed under Ocean Engineering, rather than Renewable Energy

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9) Review and edit new ITTC Recommended Procedures with regard to formal Quality System requirements (2/4)

Addition/Correction to the printed version of Annex D

Committee	Procedure No.	Procedure title
Seakeeping	7.5-02-07-02.8	Calculation of the weather factor f_w for decrease of ship speed in waves
Resistance	7.5-03-01-02	Uncertainty Analysis in CFD, Guidelines for RANS Codes
Renewable Energy	7.5-02-07-03.12	Uncertainty Analysis for a Wave Energy Converter

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9) Review and edit new ITTC Recommended Procedures with regard to formal Quality System requirements (3/4)

To write new procedures in the next ITTC period (in compliance with Procedure *4.2.3-01-03 Work Instruction for Formatting ITTC Recommended Procedures and Guidelines)*, a template in word format has been prepared :

ProcTemplate_XXXX.dotx

The XXXX group is generally updated according to the year of the next Conference. This template is a Microsoft Word template file that includes the basic elements that constitute a formatted text, e.g. headings, captions etc.

9) Review and edit new ITTC Recommended Procedures with regard to formal Quality System requirements (4/4)

When starting to write a procedure one has to double click on the ProcTemplate_XXXX.dotx file. Microsoft Word will open a new document that will be based on the ProcTemplate_XXXX.dotx model. The new file will contain all of the formatting styles that have been prepared by QS Group, it can be saved as a regular docx file.

The file relevant to the next ITTC will be ProcTemplate_2020.dotx, and will be available on the ITTC Web site through a link placed into Procedure ***4.2.3-01-03 Work Instruction for Formatting ITTC Recommended Procedures***

10)Support the technical committees with guidance on development, revision and update of uncertainty analysis procedures

QSG, considered the number of tasks to perform and having no sufficient man power to follow the work of all technical committees, decided to respond to request of assistance.

QSG assisted Stability in Waves Committee reviewing the new procedures:

7.5-02-07-01.4	Single Significant Amplitude and Confidence Intervals for Stochastic Processes
7.5-02-07-01.5	Confidence Intervals for Significant Wave Height and Modal Period.

11) Observe BIPM/JCGM standards for uncertainty analysis (1/3)

- JCGM Working Group on the Expression of Uncertainty in Measurement (GUM)
  - ❑ JCGM 100:2008. Guide to the expression of uncertainty in measurement, GUM 1995, with minor modifications
  - ❑ JCGM 101:2008. Evaluation of measurement data — Supplement 1 to the "Guide to the expression of uncertainty in measurement" — Propagation of distributions using a Monte Carlo method
  - ❑ JCGM 102:2011. Evaluation of measurement data — Supplement 2 to the "Guide to the expression of uncertainty in measurement" — Extension to any number of output quantities
  - ❑ JCGM 104:2009. Evaluation of measurement data — An introduction to the "Guide to the expression of uncertainty in measurement" and related documents

11) Observe BIPM/JCGM standards for uncertainty analysis (2/3)

- JCGM Working Group on the Expression of Uncertainty in Measurement (GUM), continued

  - JCGM 106:2012. Evaluation of measurement data — The role of measurement uncertainty in conformity assessment
  - Documents in preparation
    - ❑ JCGM 100. Guide to uncertainty in measurement (Revision)
    - ❑ JCGM 110. Examples of uncertainty evaluation
    - ❑ JCGM 103. Evaluation of measurement data — Supplement 3 to the "Guide to the expression of uncertainty in measurement" — Developing and using measurement models
    - ❑ JCGM 105. Evaluation of measurement data — Concepts, principles and methods for the evaluation of measurement uncertainty

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11)Observe BIPM/JCGM standards for uncertainty analysis (3/3)

- JCGM Working Group on the Expression of Uncertainty in Measurement (GUM), continued
  - Future documents
    - ❑JCGM 107 – Evaluation of measurement data — Applications of the least-squares method
    - ❑JCGM 108 – Evaluation of measurement data — Supplement 4 to the “Guide to the expression of uncertainty in measurement” – Bayesian methods.
- JCGM Working Group on the International Vocabulary of Metrology (VIM)
  - JCGM 200:2012 (JCGM 200:2008 with minor corrections) (VIM3)
  - VIM4 Outline in progress
- ***Metrologia***, journal of pure and applied metrology published for BIPM
  Web page: http://iopscience.iop.org/journal/0026-1394
- Bureau International des Poids Mesures (BIPM), Sèvres, France
  Web page: http://www.bipm.org/en/committees/jc/jcgm/

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12) Review developments in metrology theory and uncertainty analysis (1/16)

American Society of Mechanical Engineers

- Verification and Validation Symposium
  - ASME V&V 2012 Symposium, first annual symposium
  - ASME V&V 2017 Symposium, 3 - 5 May 2017, Las Vegas, Nevada USA
    - Web page: https://www.asme.org/events/vandv
- ASME Journal of Verification, Validation, and Uncertainty Quantification
  - First issue March 2016, published quarterly
  - Editor, Ashley F. Emery, University of Washington
- ASME Standards
  - Test Uncertainty, PTC 19.1, 2013
  - Standard for Verification and Validation in Computational Fluid Dynamics and Heat Transfer, V V 20 - 2009

12)Review developments in metrology theory and uncertainty analysis (2/16)

30th American Towing Tank Conference

- Originally founded in 1938 due travel distances to ITTC
- 1st ATTC Stevens Institute of Technology, Hoboken, NJ 1938
- Original founders: Stevens Institute, Experimental Basin Washington Navy Yard (now NSWCCD), NACA Langley, National Research Council of Canada, Newport News Shipbuilding, and University of Michigan
- Technical conference with published proceedings and nominally meets every three (3) years
- 30th ATTC, NSWCCD, West Bethesda, Maryland 3 – 5 Oct 2017
- SNAME web page: http://www.sname.org/attc/home

12) Review developments in metrology theory and uncertainty analysis (3/16)

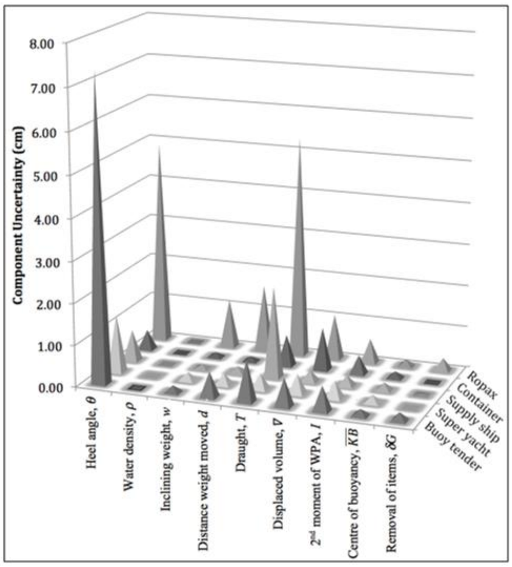
Ship Inclining Experiment

Model properties are important parameters in computer modelling of ship motion in waves. These properties include mass, vertical centre of gravity (VCG), longitudinal centre of gravity (LCG), transverse centre of gravity (TCG), moments of inertia (MOI) for pitch and roll, transverse metacentric height (GMT), and natural roll period (T_n).

The theory for the calculation of these quantities from measurements and their uncertainty estimates were described in a final report at the 27th ITTC, ITTC (2014c).

Experimental results for these methods are outlined here from Park, et al. (2016) for a 23rd scale free-running model of the R/V Melville.

12)Review developments in metrology theory and uncertainty analysis (4/16)



Ship Inclining Experiment, Graphic Results

Woodward, et al. (2016)

12)Review developments in metrology theory and uncertainty analysis (5/16)

Ship Inclining Experiment, Tabular Results

Parameter (units)	L_{bp} (m)	Δ_{Design} (tonne)	$\overline{KG}$ (m)	$u_c(\overline{KG})$ (m)	U_{95} (m)	$U_{95}(\overline{GM})$ (%)*
Buoy tender	37	453	3.580	0.075	0.15	100
Super yacht	50	698	4.340	0.016	0.033	22.0
Supply ship	51	904	4.173	0.024	0.047	31.3
Container	124	15718	10.245	0.014	0.029	19.3
Ropax	204	23370	16.620	0.077	0.15	100

* The expanded uncertainty is given as a % of an assumed metacentric height of 0.15m

Woodward, et al. (2016)

12)Review developments in metrology theory and uncertainty analysis (6/16)

SIO R/V Melville Photo

12)Review developments in metrology theory and uncertainty analysis (7/16)

Ship and Model (23rd) Scale Dimensions

		FS	Full	MS	Model	U95	U95
Nomenclature	Symbol	Units	Scale	Units	Scale		(%)
Length (LBP)	L	m	77.4	m	3.3652	0.0010	0.030
Beam	B	m	14.0	m	0.6087	0.0010	0.17
Area at water-plane	AW	m^2	867.8	m^2	1.64048	0.00099	0.060
Displacement weight	W	kN	28674	N	2291.50	1.46	0.064
Displacement mass	m	tonne	2923.93	kg	233.80	0.15	0.064
Longitudinal cg	xc	m	36.94	m	1.6061	0.0010	0.063
Transverse cg	yc	m	-0.03	mm	-1.304	1.0	
Vertical cg	zc	m	6.22	m	0.2704	0.0010	0.38
Metacentric height	GMT	m	1.09	mm	47.39	1.0	2.1
Pitch MOI	Iyy	kg-m^2		kg-m^2	165.484	0.41	0.25
Pitch radius of gyration	kyy	m	19.35	m	0.8413	0.0010	0.12
Roll MOI	Ixx	kg-m^2		kg-m^2	13.1758	0.113	0.86
Roll radius of gyration	kxx	m	5.46	m	0.2374	0.0010	0.43
Yaw MOI	Izz	kg-m^2		kg-m^2	165.484	0.41	0.25
Yaw radius of gyration	kzz	m	19.35	m	0.8413	0.0010	0.12
Natural roll period	Tn	s	10.493	s	2.189	0.025	1.2

12)Review developments in metrology theory and uncertainty analysis (8/16)

Moment of Inertia (MOI) in Roll

- MOI equation in roll at pivot

$$I_{xx} = mgd(T_\phi / 2\pi)^2$$

- Roll decay equation for regression analysis

$$y = a\exp(-bx)\cos(2\pi x / c + d) + e, c = T_\phi$$

- Translation of MOI from pivot to CG

$$I_{xx} = I_{xx\mathrm{H}} - m_{\mathrm{H}} d_{\mathrm{H}}^2$$

- Radius of gyration

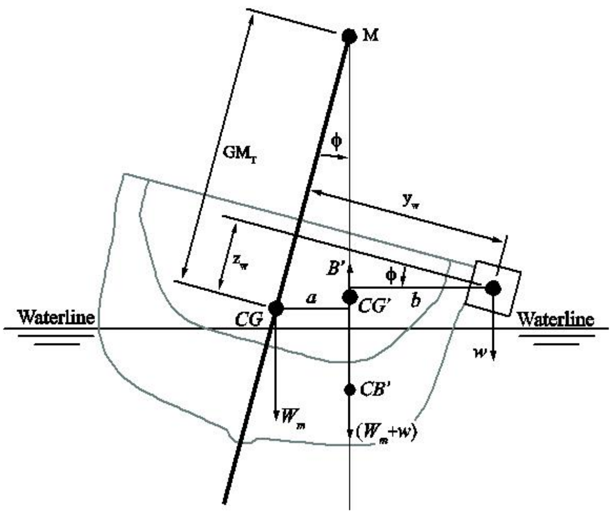
$$k_{xx} = \sqrt{I_{xx} / m}$$

- Natural roll period

$$T_{\mathrm{n}} = 2\pi k_{xx} / \sqrt{g_{\mathrm{M}} GM_{\mathrm{T}}}$$

12)Review developments in metrology theory and uncertainty analysis (9/16)

Schematic of Incline Test for GMT



12)Review developments in metrology theory and uncertainty analysis (10/16)

Equations for GMT

$$GM_T = w(y_w / \tan\phi + z_w)/(w + W_M)$$
$$c_1 = \partial GM_T / \partial w = W_M (y_w / \tan\phi + z_w)/(w + W_M)^2$$
$$c_2 = \partial GM_T / \partial W_M = w(y_w / \tan\phi + z_w)/(w + W_M)^2$$
$$c_3 = \partial GM_T / \partial y_w = w / [\tan\phi(w + W_M)]$$
$$c_4 = \partial GM_T / \partial \phi = w y_w / [\sin^2\phi(w + W_M)]$$
$$c_5 = \partial GM_T / \partial z_w = w / (w + W_M)$$

$$U_{GMT} = \sqrt{(c_1 U_w)^2 + (c_2 U_{WM})^2 + (c_3 U_{yw})^2 + (c_4 U_\phi)^2 + (c_5 U_{zw})^2}$$

12)Review developments in metrology theory and uncertainty analysis (11/16)

DTMB Model 5720 Model Properties

			Measured				Design	
Nomenclature	Symbol	Units	Value	U95	U95 (%)	Source	Value	Diff (%)
Length	L	m	3.3652	0.0010	0.030	CAD Dwg	3.3652	0.00
Measured mass	m	kg	233.21	0.46	0.20	Fairbanks	233.80	-0.25
Measured weight	W	N	2285.7	4.5	0.20	Fairbanks	2291.5	-0.25
Longitudinal CG	xc	m	1.6061	0.0011	0.067	CAD Dwg	1.6061	0.00
Transverse CG	yc	mm	-1.3	1.0	---	CAD Dwg	-1.3	---
Vertical CG	zc	m	0.2640	0.0017	0.63	Wyler	0.2704	-2.4
Metacentric height	GMT	mm	47.76	0.61	1.3	Wyler	47.39	0.77
Pitch MOI	Iyy	kg-m^2	165.91	0.93	0.56	Wyler	165.5	0.26
Pitch radius of gyration	kyy	m	0.8434	0.0024	0.28	Wyler	0.8413	0.25
Roll MOI	Ixx	kg-m^2	12.65	0.46	3.6	Wyler	13.18	-4.0
Roll radius of gyration	kxx	m	0.2329	0.0042	1.8	Wyler	0.2374	-1.9
Natural roll period	Tn	s	2.139	0.041	1.9	Wyler	2.189	-2.3

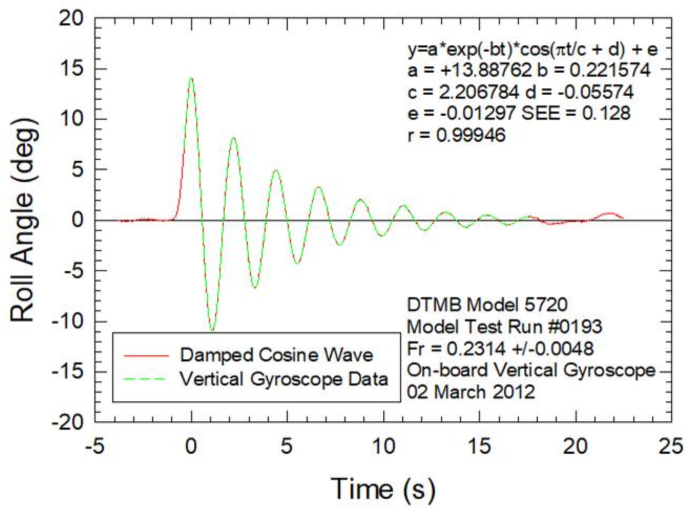
12)Review developments in metrology theory and uncertainty analysis (12/16)

Differences in Ship & Model Properties

- Incline Tests
  - GMT measured in both model & ship scale
  - CG measured directly in model test
  - CG inferred from GMT in ship test
- Displacement
  - Weight measured directly for model: 233.21 ±0.46 kg (±0.20 %) for DTMB model 5720
  - Waterplane area for model: 233.80 ±1.6 kg (±0.70 %) for DTMB 5720 with waterline uncertainty of ±1.0 mm
  - Waterplane area for Melville: ±0.70 % from model scale or waterline uncertainty of ±23 mm, likely low estimate at full-scale
  - Ship scale: waterline uncertainty fixed with larger relative uncertainty for smaller ships, i. e. Melville displacement uncertainty larger

12)Review developments in metrology theory and uncertainty analysis (13/16)

Roll Decay at Fr = 0.2314 Corrected for Offset

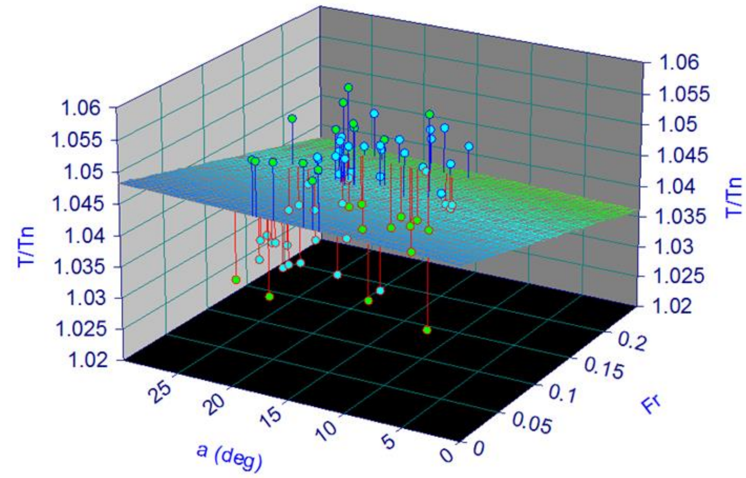


$$T_\phi = c$$

$$N = bc/(2\pi)$$

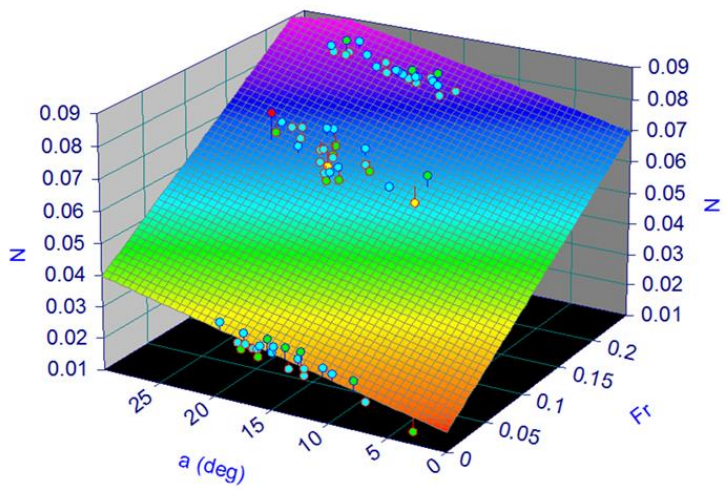
12)Review developments in metrology theory and uncertainty analysis (14/16)

Roll Period Results



12)Review developments in metrology theory and uncertainty analysis (15/16)

Roll Decay Coefficient Results



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12)Review developments in metrology theory and uncertainty analysis (16/16)

Local Acceleration of Gravity

- Requirements for local g and its uncertainty
  - Froude Number $Fr = V/\sqrt{gL}$
  - Force transducer calibration by mass $F = mg(1-\rho_a/\rho_w)$
- Computation by Latitude and Longitude from PTB Web Page
  - http://www.ptb.de/cartoweb3/SISproject.php
- Example calculations

Lab	Local g	U95	Source
CSSRC	9.79439	0.00020	PTB
	9.7946	---	ITTC
DTMB	9.80101	0.000040	NGS
	9.80106	0.000045	PTB

CSSRC: China Ship Scientific Research Centre, ITTC (2014b)
DTMB: David Taylor Model Basin, USA

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13)Continue to maintain the online Wiki (1/4)

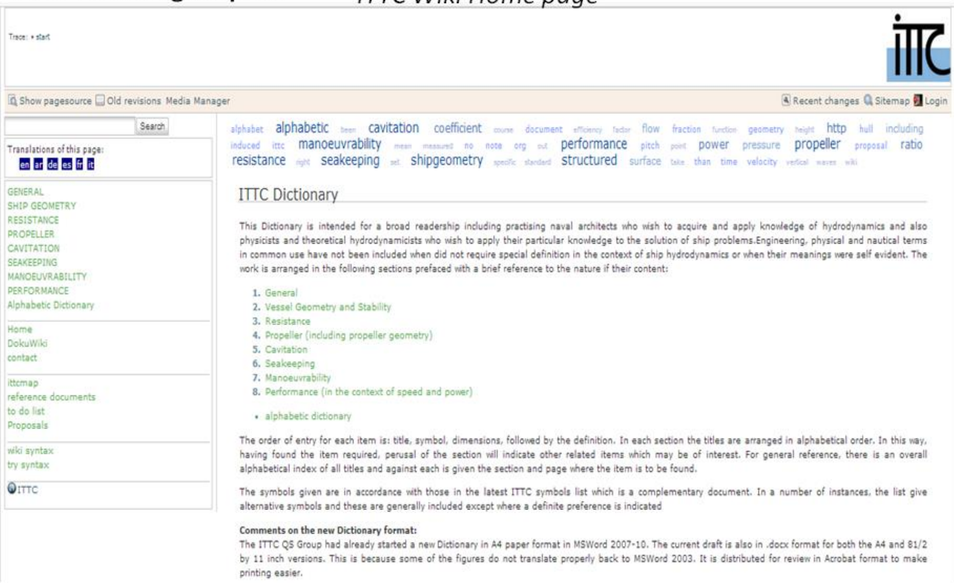
The ITTC Wiki online tool has been maintained operative since 25th ITTC. The online version of the Wiki Dictionary has been updated to reflect the changes approved at the 27th ITTC

Link is available on ITTC website www.ittc.info or directly accessible from at http://www.ittcwiki.org/doku.php hosted at **CNR-INSEAN, Roma, Italy**

13)Continue to maintain the online Wiki (2/4)

ITTC WIKI usage report

ITTC Wiki Home page



Trace: • start

Show pagesource Old revisions Media Manager | Recent changes Sitemap Login

Search

Translations of this page: en ar de es fr it

alphabet alphabetic been cavitation coefficient course document efficiency factor flow fraction function geometry height http hull including induced ittc manoeuvrability mean measured no note org out performance pitch point power pressure propeller proposal ratio resistance right seakeeping set shipgeometry specific standard structured surface take than time velocity vertical waves wiki

GENERAL
SHIP GEOMETRY
RESISTANCE
PROPELLER
CAVITATION
SEAKEEPING
MANOEUVRABILITY
PERFORMANCE
Alphabetic Dictionary

Home
DokuWiki
contact

ittcmap
reference documents
to do list
Proposals

wiki syntax
try syntax

ITTC

ITTC Dictionary

This Dictionary is intended for a broad readership including practising naval architects who wish to acquire and apply knowledge of hydrodynamics and also physicists and theoretical hydrodynamicists who wish to apply their particular knowledge to the solution of ship problems.Engineering, physical and nautical terms in common use have not been included when did not require special definition in the context of ship hydrodynamics or when their meanings were self evident. The work is arranged in the following sections prefaced with a brief reference to the nature if their content:

1. General
2. Vessel Geometry and Stability
3. Resistance
4. Propeller (including propeller geometry)
5. Cavitation
6. Seakeeping
7. Manoeuvrability
8. Performance (in the context of speed and power)

- alphabetic dictionary

The order of entry for each item is: title, symbol, dimensions, followed by the definition. In each section the titles are arranged in alphabetical order. In this way, having found the item required, perusal of the section will indicate other related items which may be of interest. For general reference, there is an overall alphabetical index of all titles and against each is given the section and page where the item is to be found.

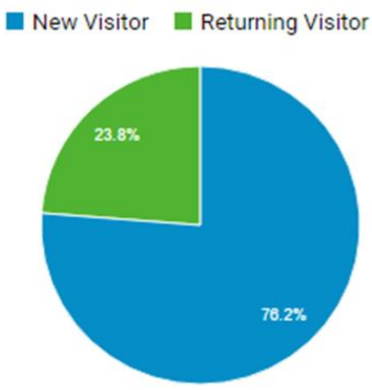
The symbols given are in accordance with those in the latest ITTC symbols list which is a complementary document. In a number of instances, the list give alternative symbols and these are generally included except where a definite preference is indicated

Comments on the new Dictionary format:
The ITTC QS Group had already started a new Dictionary in A4 paper format in MSWord 2007-10. The current draft is also in .docx format for both the A4 and 81/2 by 11 inch versions. This is because some of the figures do not translate properly back to MSWord 2003. It is distributed for review in Acrobat format to make printing easier.

13)Continue to maintain the online Wiki (3/4)

Relevant data collected between September 2014 (26th ITTC) and April 2017

SESSIONS
18,627
USERS
14,349
PAGE VIEWS
35,951
BOUNCE RATE
69.82%



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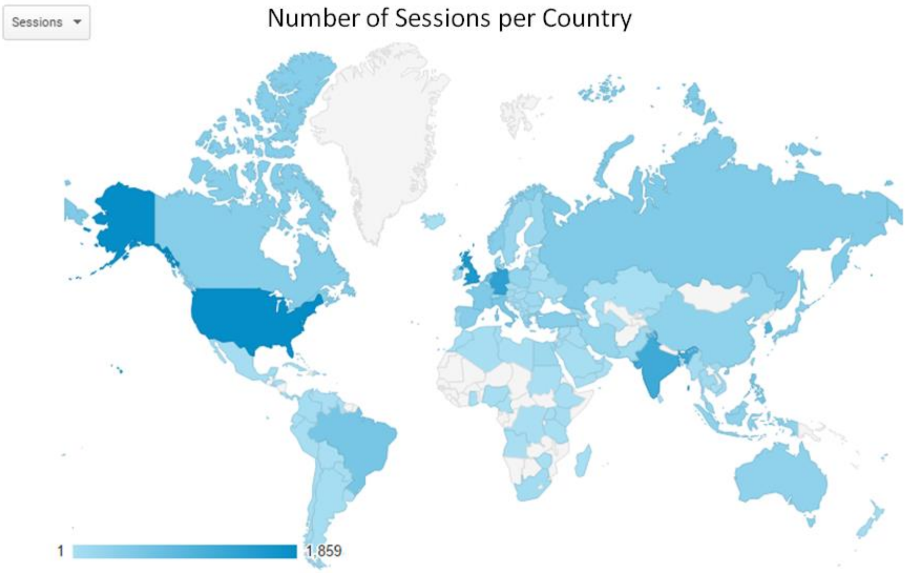
13)Continue to maintain the online Wiki (4/4)



ITTC 28th WUXI 2017

14)Develop a procedure on the determination of a type A uncertainty estimate of a mean value from signal analysis, based on Brouwer et al. (2013) (1/13)

PURPOSE OF PROCEDURE (7.5-02-01-06)

Single time histories such as those obtained from measurements in a towing tank, wind tunnel or full scale ship trail are often subjected to low frequency random disturbances caused by long transient responses to startup conditions e.g.

- towing carriage acceleration profile,
- low damping,
- recirculation effects and
- a host of external factors such as varying environmental conditions.

Accurate estimation of the mean value can be problematic in cases where the low frequency random variation in the mean value is large compared to the estimated mean value.

14)Develop a procedure on the determination of a type A uncertainty estimate of a mean value from signal analysis, based on Brouwer et al. (2013) (2/13)

Traditional solutions :

Increase the length of the measurement time, requiring a very long towing tank/test region. The assumption being that the non-stationary behavior diminishes with time, which may not always be the case.

Carry out repeats and combine the results in order to obtain a mean value within acceptable limits … often at odds with the commercial realities of limited time and test budgets.

Brouwer et al. proposed their 'Transient Scanning Technique' which

- determines whether a signal approaches a stationary state or not.
- provides information to allow non-stationary behavior (typically from startup and end effects) to be removed from the signal so that the uncertainty in the mean value can be estimated more accurately.

14)Develop a procedure on the determination of a type A uncertainty estimate of a mean value from signal analysis, based on Brouwer et al. (2013) (3/13)

Theoretical background

A time series $x_i(t)$ with finite length T is considered as a sample record of an ergodic stationary random process. The sample average m_i is an estimate of the true mean of the process μ_x.

$$m_i = \frac{1}{T}\int_0^T x_i(t)dt \qquad 1$$

The sample variance s_i^2 is an estimate of the true variance of the process σ_x^2

$$s_i^2 = \frac{1}{T}\int_0^T (x_i(t) - m_i)^2 dt \qquad 2$$

Due to the finite length T of the time series there will be a difference between the estimated mean m_i and the true mean μ_x.

14)Develop a procedure on the determination of a type A uncertainty estimate of a mean value from signal analysis, based on Brouwer et al. (2013) (3/13)

The expected value of the variance of the mean can be written as

$$s_m^2 = E[(m_i - \mu_x)^2] \qquad 3$$

Substituting equation 1 into equation 3 and after some manipulation, the standard deviation of the mean can be written as:

$$s_m = \sqrt{\frac{2}{T}\int_0^T \left(1 - \frac{\tau}{t}\right) C_{xx}(\tau) d\tau} \qquad 4$$

where:

s_m is the standard deviation of the mean,
(a measure of the standard uncertainty of mean: $u_1 = s_m$)
T is the measurement length
$C_{xx}(\tau)$ is the autocovariance function
τ is the time difference or lag

14)Develop a procedure on the determination of a type A uncertainty estimate of a mean value from signal analysis, based on Brouwer et al. (2013) (4/13)

TRANSIENT SCANNING TECHNIQUE

The inverse relation between u_1 and T can be verified visually in a graph with T plotted on the x-axis and u_1 on the y-axis, both with logarithmic scales.

- For stationary signals, the trend should form a line with a slope of minus one.
- If the slope differs from minus one then the signal is non- stationary.

The autocovariance method selected by the authors due to its good convergence properties uses equation 4 in a modified form

$$u_1 = \sqrt{\frac{1}{T}\int_0^T \left(1 - \frac{\tau}{t}\right) C_{xx,biased}(\tau) d\tau} \qquad 5$$

Where $C_{xx,biased}(\tau)$ is the biased estimator for the autocovariance - used to reduce numerical instability for large values of τ.

$$C_{xx,biased}(\tau) = \left(1 - \frac{|\tau|}{T}\right) . C_{xx}(\tau) \qquad 6$$

The autocovariance method was used to develop a technique, called the **Transient Scanning Technique**, TST.

14)Develop a procedure on the determination of a type A uncertainty estimate of a mean value from signal analysis, based on Brouwer et al. (2013) (5/13)

The TST identifies regions in the time history which exhibit non-stationary behavior and allows these regions to be removed from the signal analysis on order to obtain a more accurate estimate of the mean value.
The TST can be applied in two ways.

TST-A
Starting from the beginning of the signal t_{begin} the TST selects signal sections [t_{begin}, t_{begin} + T] for each section size T and calculates the cumulative u_1 using equation 5. The results are plotted against T on a logarithmic scale. TST-A is very strong in identifying end effects in the signal.

TST-B
Starting from the end of the signal $t = t_{tend}$ the TST selects signal sections [t_{end} – T, t_{end}] for each T and calculates the cumulative u_1 using equation 5. The results are plotted against T. TST-B is very strong in identifying start-up effects in the signal.

14)Develop a procedure on the determination of a type A uncertainty estimate of a mean value from signal analysis, based on Brouwer et al. (2013) (6/13)

EXAMPLE
The authors provide a number examples describing the application of the TST technique.

One example describes a realisation is picked from an artificially created stochastic process with the following properties:

- Mean is zero and it has no energy below 0.25 Hz.
- Realisation length is 100 s (long enough to be stationary)

A second signal is created from the realisation, which is made non-stationary by adding a small start-up effect in the first 20 s.

14) Develop a procedure on the determination of a type A uncertainty estimate of a mean value from signal analysis, based on Brouwer et al. (2013) (7/13)

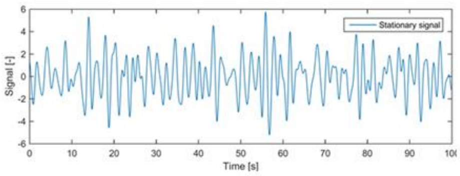


Figure 1 Realisation taken from a stochastic process.

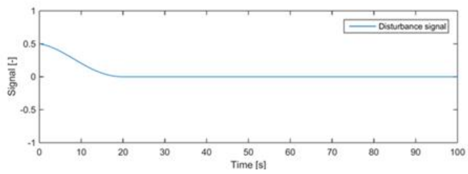


Figure 2 Start-up disturbance.

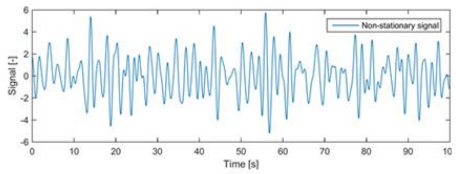


Figure 3 Realisation with added start-up disturbance (difficult to see start-up effect by visual inspection)

14) Develop a procedure on the determination of a type A uncertainty estimate of a mean value from signal analysis, based on Brouwer et al. (2013) (8/13)

In order to identify the startup effects the cumulative u_1 values are calculated from the end (TST-B), using the autocovariance method.

Both TST results show a large range where u_1 decays with the inverse of T. The signal is stationary in this range.

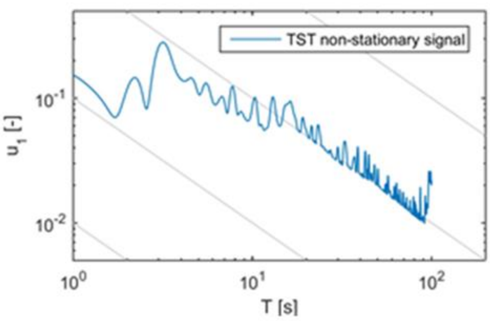


Figure 4 – TST-B applied to non-stationary signal

14)Develop a procedure on the determination of a type A uncertainty estimate of a mean value from signal analysis, based on Brouwer et al. (2013) (9/13)

Observations

- For small sections, approximately $T < 14$s the values of u_1 fall below the trend of the stationary range due to a too short realisation length.
- A sudden rise in u_1 of the non-stationary signal can be observed for T > 90 s. This rise is called a 'hockey stick'. Since the cumulative u_1 was calculated from the end of the signal, the hockey stick identifies a significant start-up transient for $t < t_{end}$ - 90.

14)Develop a procedure on the determination of a type A uncertainty estimate of a mean value from signal analysis, based on Brouwer et al. (2013) (10/13)

Since the cumulative u_1 was taken from the end of the signal, the last 90 s of the signal represent the optimal section. The first 10 s of the signal should be excluded. The non-stationary realisation and its optimal section are shown in Figure 5.

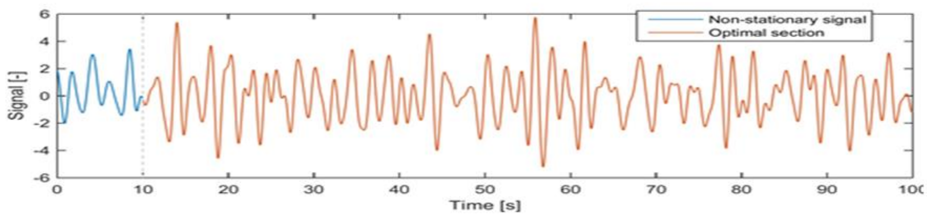


Figure 5 – Realisation with added start-up disturbance and the optimal section indicated.

14)Develop a procedure on the determination of a type A uncertainty estimate of a mean value from signal analysis, based on Brouwer et al. (2013) (11/13)

The mean value of the complete signal is 0.031 and its estimated standard uncertainty u_1 is 0.022.
The 95% confidence interval is $u_1=0.022; k_{95}=1.96; m=0.031 \pm 0.044$

The mean value of the optimal section is -0.0034 and its estimated standard uncertainty u_1 is 0.0105.
95% confidence interval is u_1=0.0105; k_{95}=1.96; m=0.0034±0.021

- The true mean of the process μ which is zero, lies well within both estimated confidence intervals.
- Removing the start-up transient has reduced the error in the sample mean by a factor 10 and its corresponding uncertainty value by a factor of 2.
- The application of TST has increased the reliability of the mean value.

14) Develop a procedure on the determination of a type A uncertainty estimate of a mean value from signal analysis, based on Brouwer et al. (2013) (12/13)

STEP BY STEP PROCEDURE

Although the mathematical processes behind the procedure can be challenging for ‘non experts’ the process of obtaining the TST is straightforward and is summarized in the following steps.

1. Obtain the time history ensuring that the sample rate is sufficient. For measurements in the laboratory or the field the sample rate must be at least twice (often more) the highest frequency in the time history.

2. Try to ensure that the time history is as long as practicable.

14)Develop a procedure on the determination of a type A uncertainty estimate of a mean value from signal analysis, based on Brouwer et al. (2013) (13/13)

3. TST-A

a) Calculate the cumulative standard uncertainty for increasing sample lengths *T* using

$$u_1 = \sqrt{\frac{1}{T}\int_0^T \left(1 - \frac{\tau}{t}\right) C_{xx,biased}(\tau)d\tau}$$

b) Start at the beginning of the record with a small sample length *T*, calculate u_1 then increase the sample length *T* and recalculate u_1. Continue this process until *T*=total sample length.

c) Plot graph with *T* on the x-axis and u_1 on the y-axis, both with logarithmic scales.

d) Identify any region where the slope differs from -1. This indicates non stationary behavior in the measurement and this region should be removed from the mean estimation. Hockey sticks at large *T* indicate end effects.

4. TST-B

This procedure follows that of TST-A except the analysis begins at the end of the record with increasing values of T incorporating sample from the beginning of the record. Hockey sticks at large T indicate start-up effects.

15)Develop a guideline with working title: "Guideline to Practical Implementation of Uncertainty Analysis" (1/2)

PROCEDURE 7.5-02-01-07

The purpose of the guideline/procedure is providing a beginner's introduction to the subject of experimental uncertainty and its application to the maritime engineering hydrodynamic testing industry.

The document provides a general overview of the key steps to understand uncertainty in an experimental process, outlining the key subject specific knowledge areas and including key resources in the form of published material available to a beginner in the subject. Notions such as error, uncertainty, propagation law, sensitivity, combined uncertainty, repeatability and reproducibility are introduced with cross-reference to other available ITTC procedures for further reference.

15) Develop a guideline with working title: "Guideline to Practical Implementation of Uncertainty Analysis" (2/2)

The document addresses:

- Explanation of fundamentals of uncertainty analysis
- Carriage speed example from CSSRC, ITTC 7.5-02-02-02.1
- Froude number (Fr) from Longo & Stern (1998, 2005)
- Total resistance coefficient (CT) with forces in N from Longo & Stern
- Repeatability experiment for CT from Longo & Stern

Moreover, the guideline provides a worked example for a basic resistance test, which is intended as a learning tool for those studying the subject.

The QSG discussed at length the idea of introducing a specific chapter in the guidelines drawing-up the competencies that should be available to an individual for doing experiments in the area of hydromechanics respect to uncertainty analysis. The chapter on competencies was in the end not included in the draft procedure as it was felt not yet enough mature, however the QSG developed a structured approach with detailed requirements which could be further considered at next session if so agreed.

16) Organize an electronic repository of information and data on the benchmarks cases

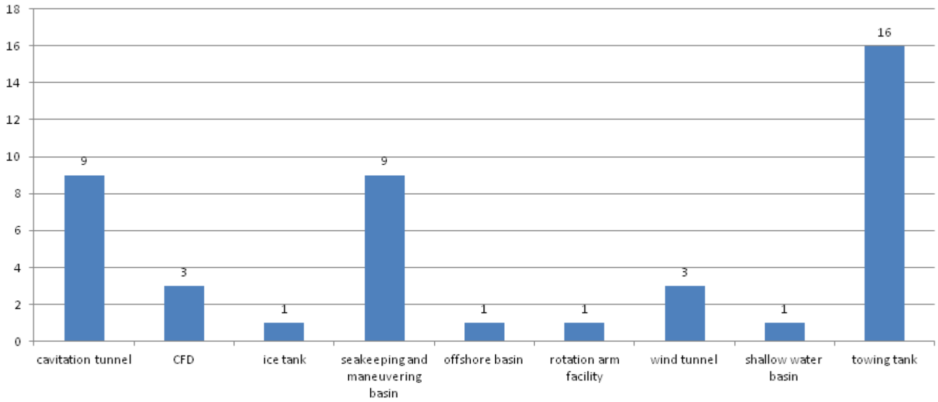
To date it has been impossible to find data relevant to past benchmark exercises. To this effect QSG decided to send a questionnaire to all ITTC member institutions to collect information and possibly past benchmark data. A number of benchmark exercises were identified, listed into the QSG Final report.

None of the answers provided information on the location of the past benchmark data.

Since it appears a hopeless effort to locate the data relevant to old benchmark exercises, QSG proposes that for the next ITTC benchmark the data should be compulsory uploaded into The Benchmark Data Repository.

17)<u>Survey the extent and breadth of the usage of uncertainty analysis techniques and procedures by the hydrodynamic testing community (1/3)</u>

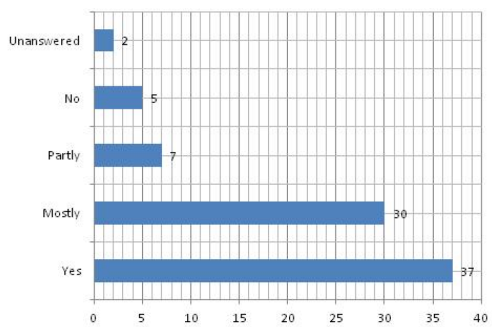
To collect information about the usage, by ITTC community, of working instructions and uncertainty analysis techniques a questionnaire has been sent to all the members of ITTC. Only **13** answers returned. Within these 13 replies, totally **44** facilities are involved.

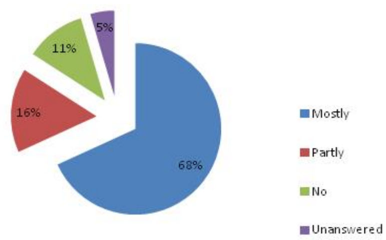


17)<u>Survey the extent and breadth of the usage of uncertainty analysis techniques and procedures by the hydrodynamic testing community (2/3)</u>

Conclusions about the questionnaire

Part one: ITTC recommended Procedures and Guidelines





It can be concluded that most of the members use ITTC procedures.

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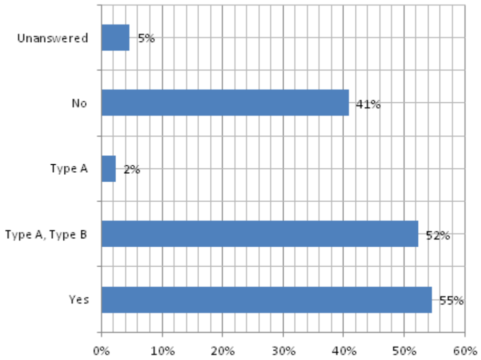
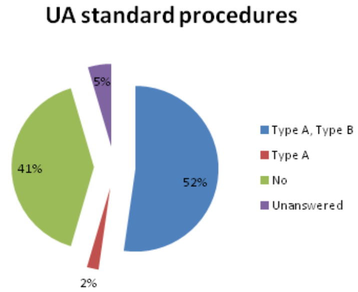
17)<u>Survey the extent and breadth of the usage of uncertainty analysis techniques and procedures by the hydrodynamic testing community (3/3)</u>

Conclusions about the questionnaire

Part two: UA standard procedures





Due to the lack of samples, it is impossible to separate the survey into every facility. However, it could be found out that the UA standard procedures are mostly used in towing tank.

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18)<u>Include new sections in the Dictionary dedicated to Offshore Engineering, Planing Craft and Pods</u>

The work on the new section about Off-shore Engineering has been started, but QSG faced a great difficulty due to the enormous extension of the Offshore Engineering field.

As a consequence the work was stopped, awaiting instructions whether to start an encyclopedic work or to receive suggestions by the committees on the topic to address.

As regards Planing Craft and Pods QSG feel that the amount of definitions is not worth a dedicated section for these topics. Besides, most of the definition are already included in the Dictionary.

CONCLUSIONS (1/3)

Revision of the ITTC Quality Manual

The revision of the ITTC Quality Manual concerned 81 documents. Three existing procedures were deleted, 19 new procedures/Guidelines have been added, 59 existing procedures have been reviewed or updated.

QSG suggests to set up a more structured revision process in order to ensure:

- a greater respect of deadlines by Technical Committees in delivering their documents
- a greater consideration by technical Committees of the usage of correct symbols in procedures and guidelines. A systematic effort regarding symbols check could be asked to committees, in order to find out symbols that are used without appearing into the Symbols and Terminology List.
- a better document flow between AC and QSG (this could be obtained implementing the usage of the ITTC web site that was started in this term).

CONCLUSIONS (2/3)

QSG work on Procedures and Guidelines

- 4 new procedure drafted
- 9 existing procedure updated
- 15 new procedures subjected to formal check
- 50 existing subjected to formal check
- 56 procedures formatted according to 4.2.3-01-03

134 procedures handled in total !!

CONCLUSIONS (3/3)

ITTC Dictionary and Symbol and Terminology List

The Dictionary and the Symbol and Terminology List have been updated and some errors and typos have been rectified. The time dedicated by QSG to these last documents has been less than desired, due to the unusual work load absorbed by procedures and guidelines.

Both the Dictionary and the Symbol and Terminology List need a substantial review and a decision whether or not to have both the structured and the alphabetic versions is required.

RECOMMENDATIONS TO THE CONFERENCE (1/3)

The QSG recommends to the Full Conference

To adopt the new procedures:

1.0-05 Guidelines for delegates representing ITTC vis-à-vis external bodies

4.2.4-01-01 Record of Interim decision regarding ITTC Recommended Procedures and Guidelines

7.5-02-01-06 Determination of a type A uncertainty estimate of a mean value from a single time series measurement

7.5-02-01-07 Guideline to Practical Implementation of Uncertainty Analysis

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RECOMMENDATIONS TO THE CONFERENCE (2/3)

The QSG recommends to the Full Conference

To adopt the revised procedures:

1.0-03	General Guideline for the Activities of Technical Committees, Liaison with Executive Committee and Advisory Council
4.2-01	Adoption or Modification of ITTC Recommended Procedures
4.2-02	Updating the ITTC Symbols & Terminology List
4.2-03	Review of ITTC Recommended Procedures and Guidelines by the Advisory Council
4.2.3-01-01	Guide for the Preparation of ITTC Recommended Procedures and Guidelines
4.2.3-01-02	Guidelines for Preparation of Technical Committee and Group Reports
4.2.3-01-03	Work Instruction for Format-ting ITTC Recommended Procedures
7.5-01-03-01	Uncertainty Analysis, Instrument Calibration
7.6-02-08	Calibration of Weights

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RECOMMENDATIONS TO THE CONFERENCE (3/3)

The QSG recommends to the Full Conference to:

To adopt the revised Symbols and Terminology List Version 2017;

To adopt the revised ITTC Dictionary of Hydromechanics Version 2017;

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RECOMMENDATIONS FOR FUTURE WORK (1/2)

The following future work is recommended:

1. Support the Technical Committees in their work on Recommended Procedures. Supply the chairmen of the new committees at the beginning of the period with the MS Word versions of the relevant procedures and the template for the production of new procedures.
2. Revise and update the existing ITTC Recommended Procedures according to the comments of Advisory Council, Technical Committees and the Conference.
3. After the third AC Meeting, review and edit new ITTC Recommended Procedures with regard to formal Quality System requirements including format and compliance of the symbols with the ITTC Symbols and Terminology List.
4. Maintain the Manual of ITTC Recommended Procedures and Guidelines. Co-ordinate the modification and re-editing of the existing procedures according to the comments made by ITTC member organizations at the Conference and by the Technical Committees.

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RECOMMENDATIONS FOR FUTURE WORK (2/2)

5. Observe the development or revision of ISO Standards regarding Quality Control.
6. Update the ITTC Symbols and Terminology List.
7. Update the ITTC Dictionary of Hydromechanics.
8. Continue to maintain the online Wiki keeping it up to date and in line with the adopted documents of the ITTC.
9. Maintain the Benchmark Data Repository adding to the database the data relevant to the Benchmark Exercises that will be performed by ITTC.
10. Support the technical committees with guidance on development, revision and update of uncertainty analysis procedures, in view to align ITTC documents to the current standards as laid down in ITTC 7.5-02-01-01.
11. Observe BIPM/JCGM standards for uncertainty analysis, in particular the uncertainty analysis terminology.
12. Review developments in metrology theory and uncertainty analysis and is-sue appropriate Procedures.

Discusser: Stephen Turnock
Affiliation: University of Southampton
Comments/Question(s):

The committee are to be thanked for their continued hard work on ensuring the ITTC's procedures are of the highest quality. I would particularly commend their Wiki site and encourage all those in education to promote its use as a valuable resource.

Response by Committee:

The QSG thanks Professor Turnock for his comments.

The QSG takes the chance to ask to all the ITTC community to provide any suggestion and proposal for improvement, in order to make the ITTC Dictionary of Hydromechanics a widely recognized and used source of information.

Discusser: Masaru Tsujimoto
Affiliation: National Maritime Research Institute, Japan
Comments/Question(s):

A new coefficient of Cx needs minus since it is defined by thrust.

$$C_X = \frac{F_{AA}}{A_V q_R} = -\frac{R_{AA}}{A_V q_R}$$

The coefficient is related to ITTC Recommended Procedure 7.5-04-01-01.1 Appendix F and Section 10.3.1

Response by Committee:

The QSG acknowledges the remark and thanks Dr. Tsujimoto for his valuable help.

The procedure will be corrected accordingly.

Discusser: Shotaro Uto
Affiliation: National Maritime Research Institute, Japan
Comments/Question(s):

Concerning the repository of old benchmark data, NMRI is willing to submit the data for 1998 RANS/PANEL METHOD Workshop.

Dr. Koyama, who was the researcher of Ship Research Institute (former NMRI) compiled data and published a booklet.

Response by Committee:

The QSG thanks Dr. Uto for his offer. ITTC considers of the highest importance the Benchmark Data Repository and any contribution to it is highly appreciated for it contributes to the continuous upgrading of ITTC collective knowledge.

Discusser: Rainer Grabert
Affiliation: Schiffbau-Versuchsanstalt Potsdam
Comments/Question(s):

Thank you first for the good work. I have no question but a proposal regarding the symbol lists.

In my opinion both, the alphabetical and the structured list are needed. On the other hand I see the problems to update and synchronize two lists. I would like to propose to transfer the alphabetical list into EXCEL and add one or more attributes to each symbol taken from the structured list. For example

CT - Total resistance coefficient - Resistance

CT - Thrust load coefficient. - Propulsion

An EXCEL sheet can easily sorted after the attributes and then is it a structured list.

Response by Committee:

The QSG thanks Dr. Grabert for his valuable suggestion. The suggested option will be considered in the next ITTC term when addressing the Upgrading of the ITTC S&T List.