Quality Systems Group

27 September 2024

QSG Membership

- *Prof. Marco Ferrando (Chair) University of Genoa, Italy
- Weimin Chen, Shanghai Ship and Shipping Research Institute, China
- Prof. Gregory Grigoropoulos, National Technical University of Athens, Greece
- *Dr. Spyros Hirdaris, ABS Hellenic SM LLC, Athens, Greece
- Prof. Kwang-Jun Paik, Inha University, Incheon, Korea
- Chengsheng Wu, China Ship Scientific Research Centre, Wuxi
- Prof. Daisuke Kitazawa, University of Tokyo, Japan
- *Prof. Tahsin Tezdogan, University of Southampton, UK
- Joel Park, Ph. D. (Secretary), Naval Surface Warfare Center CD, Bethesda, USA
- *Prof. Joel Sales Sena Jr., LabOceano, Rio de Janeiro, Brazil

*Not Attending

Marco Ferrando, QSG Chair

- ITTC Contributor for 28 years
  - 22nd ITTC, 1996-1999, member of Specialist Committee on Unconventional Propulsors
  - 23rd-26th ITTC, 1999-2011, member of Quality Systems Group
  - 27th-30th ITTC, 2011-2024, Chair of Quality Systems Group
- University of Genoa 1993-present
- Director, University Campus of La Spezia
  - 1000 students
  - 150 faculty

Task Summary for QSG

1. Review procedures format and content
2. Review procedures for uncertainty analysis (UA)
3. Review titles and numbering
4. Maintain Register of procedures
5. Review Machine Learning for uncertainty analysis
6. Observe ISO standards for QC
7. Update ITTC Symbols and Terminology
8. Update UA in ITTC Symbols and Terminology
9. Update ITTC Dictionary
10. Expand ITTC Dictionary
11. Support technical committees
12. Observe BIPM/JCGM for UA
13. Review developments in metrology
14. Develop collection of benchmark data
15. Update benchmark data in ITTC repository with technical committees (TC)
16. Produce questionnaire on benchmark data with TC
17. Establish benchmarks with TC
18. Prepare calibration procedure for steel rulers

Task 1. Review of ITTC Procedures & Guidelines

- Perform a detailed review of all ITTC Recommended Procedures and Guidelines for compliance with ITTC quality requirements with regard to format, references, symbols, terminology, uncertainty analysis and parameter lists
- Format from ITTC Procedure 4.2.3-01-01 Guide for the Preparation of ITTC Recommended Procedures
- Documents reviewed: 114
  - Slightly different: 14
  - Different: 65
  - Strongly different: 35
- Revisions for 31st ITTC

Task 2. Review of Uncertainty Analysis

- Perform a detailed review of all uncertainty analysis procedures for compliance with ITTC quality requirements about format, references, symbols, terminology and parameter lists
- Procedures Reviewed: 113
- Six elements reviewed
  - Format
  - References
  - Symbols
  - Parameter List
  - Example
- Results summarized in Appendix B
  - Three elements: Example, Reference, Symbols
  - Comments column

Task 3. Review of Titles & Numbering

- Review the titles and numbering of technical procedures and propose changes, if any, for approval by the Advisory Council before 31.12.2021
- Procedure to Guideline

7.5-02-01-03	P	Fresh Water and Seawater Properties
7.5-02-05-04.1	P	Excerpt of ISO 2631, Seasickness and Fatigue
7.5-03-02-02	P	Benchmark Database for CFD Validation for Resistance and Propulsion
7.5-02-05-05	P	Evaluation and Documentation of HSMV

- Name change: High-Speed Marine Vehicle (HSMV)
- Name and number change: ITTC Guideline 7.5-02-03-03.10 Experimental Wake Scaling Methods for Cavitation Test
  - Formerly, 7.5-02-03-02.5 Experimental Wake Scaling Methods

Task 4. ITTC Register 1/2

- Maintain the Register of ITTC Recommended Procedures and Guidelines
- New footnote with copyright and placeholder for DOI
  - © 2024 ITTC.A Switzerland
  - Revision to ITTC Procedure 4.2.3-01-01 Guide for the Preparation of ITTC Recommended Procedures and Work Instruction 4.2.3-01-03 for Formatting ITTC Recommended Procedures
    - Authors
    - Abstract
    - List of Symbols at end

Task 4. ITTC Register 2/2

- Register revisions
  - 2 existing procedures deleted
  - 7 new procedures
  - 72 procedures reviewed or updated
  - 34 cover pages updated to new format
  - 2 procedures corrected for typographical errors
- Table of revisions in Appendix C

Task 5. New Uncertainty Analysis Guidelines

- Introduce New Uncertainty Analyses Guidelines to include data anomalies in Machine Learning Algorithms for Autonomous and Intelligent ships
- Not performed for lack of expert on the topic

Task 6. Revisions of ISO Standards 1/3

- Observe the development or revision of ISO Standards regarding Quality Control
- 42nd ISO/TC8 Plenary meeting in Athens
- Topics of interest to ITTC
  - ISO/TC188 Small Craft (97 standards)
  - ISO/TC204 Intelligent Transport Systems (340)
  - ISO/TC43 Acoustics (221)
  - ISO/TC067 Materials, equipment and offshore structures (203)
    - Offshore Structures (22)
    - Artic Operations (6)
- ISO/TC8/SC6/WG17 Update ISO15016:2015 Speed/Power Trials Procedure and Analysis

Gregory Grigoropoulos, National Technical University of Athens

Task 6. Revisions of ISO Standards 2/3

Sub-Committees (SC)

SC1	**Maritime Safety (56)**
SC2	Marine Environment Protection (32)
SC3	Piping and Machinery (57)
SC4	Outfitting and Deck Machinery (80)
SC6	Navigation and Ship Operations (42)
SC7	Inland Navigation Vessels (34)
SC8	Ship Design (66)
SC11	Intermodal & Short Sea Shipping (8)
SC12	Large Yachts (12)
SC13	Marine Technology (15)
SC25	Maritime GHG reduction (4)

Working Groups (WG)

WG3	**Special Offshore Structures and Support Vessels**
WG4	Maritime Security
WG6	Ship Recycling
WG8	Liquid and Gas Fuelled Vessels
WG10	Smart Shipping
WG11	Dredger
WG12	Aquatic Nuisance Species
WG14	Maritime Education and Training

GHG: Greenhouse Gas

Task 6. Revisions of ISO Standards 3/3

- Standards to be developed or updated
  - Alternative fuels (biofuels, synthetic fuels, green fuels, hydrogen, ammonia, methanol)
  - Carbon capture on board
  - Transportation of CO2, or its transformation to other substances.
  - Transportation of H2, NH3 and biofuels.
  - Use of various Energy Saving Devices.
  - Air-Assisted Propulsion (sails, kite, Flettner rotors)
  - Alternative auxiliary propulsion devices (flapping foils, ducts etc.)
  - Digitalization and onboard information
  - AI-driven operations onboard
  - Cyber-security in data handling and transfer
  - Electrification in ship operation

Task 7. Revision of ITTC Symbols & Terminology List 1/3

- Update the ITTC Symbols and Terminology List
- Acronyms in separate table from ITTC Symbols

Acronym	Definition
AC	Advisory Council
EC	Executive Council
BIPM	Bureau International des Poids et Mesures
CFD	Computational fluid dynamics
EFD	Experimental fluid dynamics
ESD	Energy saving device
GUM	Guide to the expression of Uncertainty in Measurement
HSMV	High-speed marine vehicle
IMO	International Maritime Organization
ISO	International Organization for Standardization

Kwang-Jun Paik,
Inha University,
ROK

Task 7. Revision of ITTC Symbols & Terminology List 2/3

Acronym	Definition
JCGM	Joint Committee for Guides in Metrology
JCGM-WG1	JCGM Working Group 1
JCGM-WG2	JCGM Working Group 2
LDV	Laser Doppler velocimetry
MSC	Marine Safety Committee
NMI	National Metrology Institute
PIV	Particle imaging velocimetry
QSG	Quality Systems Group
SPIV	Stereo-PIV
TC	Technical committee
UV	Underwater vehicle
V&V	Verification and validation
VIM	International vocabulary of metrology
VIM	Vortex induced motion
VIV	Vortex induced vibration

Task 7. Revision of ITTC Symbols & Terminology List 3/3

- Addition of verification and validation (V&V) recommended
- V&V definition should be consistent: simulation result S minus experimental data D

$$E = S - \mathrm{D}$$

- Equation format changed to MS Equation

Task 8. Update Uncertainty Analysis Section

- Update the Uncertainty Analysis section of the Symbols & Terminology List
- Revision of table to Annex J of JCGM 100:108 (GUM)

Kwang-Jun Paik, Inha University, ROK

Task 9. ITTC Dictionary of Hydromechanics

- Update the ITTC Dictionary of Hydromechanics
- Date changed to Version 2024
- Equations in current Word format and symbol format corrected
- One column format
- Links to figures corrected
- Typographical errors and omissions corrected
- “which see” and similar expressions to be removed in future edition

Daisuke Kitazawa, University of Tokyo

Task 10. Expansion of ITTC Dictionary

- Expand the content of current ITTC dictionary version, considering CFD, MASS, etc.
- Keywords related to Computational Fluid Dynamics (CFD) have been added
  - 12 extracted from CFD related procedures: 7.5-03-01-01 to 7.5-03-04-02
  - 76 in total added from various sources
  - Added to ITTC dictionaries
  - Titles updated

Daisuke Kitazawa, University of Tokyo

Task 11. Technical Committee Support

- Support the technical committees dealing with stochastic processes with guidance on development, revision, and update of procedures for the inclusion of confidence bands on their computational and experimental results
- No requests for support
- Reviewed uncertainty analysis for ITTC Procedure 7.5-02-05-03.3 for Resistance and Propulsion Committee
- Assisted uncertainty analysis on ice resistance tests for Specialist Committee on Ice

Task 12. BIPM/JCGM Standards on Uncertainty Analysis 1/2

- Observe BIPM/JCGM standards for uncertainty analysis, in particular the uncertainty analysis terminology
- Guide to the expression of Uncertainty in Measurement (GUM)
  - JCGM 100:2008, GUM
  - JCGM 101:2008, Propagation of distributions using Monte Carlo method
  - JCGM 102:2011, Extension to any number of output quantities
  - JCGM 106:2012, The role of measurement uncertainty in conformity assessment
  - JCGM GUM-1:2023, Part 1: Introduction, replaces JCGM 104:2009
  - JCGM GUM-6:2020, Part 6: Developing and using measurement models
- Supplements renumbered as Part #

Task 12. BIPM/JCGM Standards on Uncertainty Analysis 2/2

- Working Group 1 (WG1)
  - Responsible for GUM
  - WG1 Newsletter, twice per year
  - JCGM GUM-5:202x, Examples of uncertainty evaluation, in preparation
  - JCGM GUM-7:202x, Propagation of distributions using Monte Carlo method, to replace JCGM 101:208
- Working Group 2 (WG2)
  - JCGM 200:2012 International Vocabulary of Metrology (VIM)
  - 4th Edition in review

Task 13. Developments in Metrology

- Review developments in metrology theory and uncertainty analysis and issue appropriate procedures
- No new uncertainty analysis procedures
- Journals reviewed for uncertainty analysis
  - Metrologia, journal for BIPM, 16 relevant articles from 2021 – 2023
  - ASME Journal of Verification, Validation, and Uncertainty Quantification
  - Ocean Engineering, an Elsevier publication
- ASME annual conference on Verification, Validation, and Uncertainty Quantification (VVUQ)
  - No technical papers or conference proceedings
  - Presentations provided

Task 14. Collection of Benchmark Data 1/4

- Setup an effective way to collect benchmark data
- Definition: Benchmark model, either physical or numerical, is a standardized model to calibrate the results from model test configuration or numerical simulations. The main significance of Benchmark model is to provide a recognized benchmark for evaluating and comparing the performance and effects of ships at various stages, including design, construction, and operation. It can serve as a foundation for researching and developing new methods, based on validation and verification.
- Benchmark: Common term in TOR for most committees
- Benchmark data relevant to all committees
- Submission of benchmark data to ITTC Secretary for inclusion in ITTC benchmark repository

Weimin Chen, Shanghai Ship and Shipping Research Institute

Task 14. Collection of Benchmark Data 2/4

- Resistance and Propulsion Committee – report section on new benchmark data and benchmark study
- Manoeuvring Committee – collect benchmark data
- Seakeeping Committee – section on new benchmark data and experimental campaign
- Ocean Engineering Committee – section on new benchmark data, specifications for benchmark test
- Stability in Waves Committee – section on new benchmark data and benchmark data for V&V
- Full-Scale Performance Committee – section on new benchmark data and full-scale data
- Specialist Committee on Ocean Renewable Energy – benchmark study of comparisons
- Specialist Committee on Cavitation and Noise – available CFD benchmark data
- Specialist Committee on Ice – uncertainty analysis and benchmark study among ice model basins
- Specialist Committee on Combined CFD and EFD Methods – CFD benchmark campaigns and standard for CFD benchmark

Task 14. Collection of Benchmark Data 3/4

- Data type
  - Research areas: resistance, propulsion, seakeeping, manoeuvrability, cavitation, etc. with complete details
  - Scope: international and regional benchmark for different purposes
- Data source
  - Internet
  - International conference and workshop
  - Specific project or joint industry project
- Data sharing
  - Open benchmark data from international conference
  - Private benchmark data with confidential agreement

Task 14. Collection of Benchmark Data 4/4

- Maintenance and support
  - Management specified
  - ITTC benchmark repository
  - Committees with tasks related to benchmark
- Conclusions
  - Clear statement of needs and objectives
  - Type of ship with parameters and specifications
    - Not specific ship builder or operator
  - Widely used and studied
  - Full-scale ship database
- Future work
  - Data format and standard
  - Technical committee support

Task 15. ITTC Benchmark Data Repository 1/3

- Upload all the collected and verified benchmark data into the ITTC benchmark data repository
- Review of two series of benchmark data – upload procedure required
- Gothenburg 2010 Workshop on Numerical Ship Hydrodynamics
  - US combatant DTMB 5415 – 5 cases
  - Korea Container Ship KCS – 9 cases
  - Korea VLCC and VLCC2 – 7 cases
- Tokyo 2015 Workshop on CFD in Ship Hydrodynamics
  - Japan Bulk Carrier JBC – 9 cases
  - Korea KRISO Container Ship KCS – 5 cases
  - US ONR Tumblehome DTMB 5613 – 3 cases

Chengsheng Wu, China Ship Scientific Research Centre

Task 15. ITTC Benchmark Data Repository 2/3

Test cases	Series No.	JBC 1	KCS 2	ONRT 3
Calm water: Resistance				
w/o ESD: resistance, sinkage and trim	1	1.1	2.1*	
With ESD: resistance, sinkage and trim	2	1.2		
w/o ESD: time-averaged velocity field, turbulence, wave pattern	3	1.3		
with ESD: time-averaged velocity field, turbulence	4	1.4		
w/o ESD: thrust, torque, sinkage and trim	5	1.5	2.5*	

Test cases	Series No.	JBC 1	KCS 2	ONRT 3
Calm water: Self-propulsion				
with ESD: thrust, torque, sinkage and trim	6	1.6		
w/o ESD: time-averaged velocity field, turbulence	7	1.7	2.7*	
with ESD: time-averaged velocity field, turbulence	8	1.8		
Calm water: Free Self-propulsion				
thrust, torque, sinkage and trim	9			3.9

ESD: Energy Saving Device

Task 15. ITTC Benchmark Data Repository 3/3

Test cases	Series No.	JBC 1	KCS 2	ONRT 3
Regular wave: head waves				
motion response, added resistance	10		2.10	
Regular wave: other headings				
motion response, added resistance	11		2.11	
Regular wave: head waves				
thrust, torque, RPS, motion response, speed loss	12			3.12
Regular wave: other headings				
thrust, torque, RPS, motion response, speed loss	13			3.13

Task 16. Questionnaire on Benchmark Data 1/3

- Liaise with relevant technical committees to complete a questionnaire about the demand and use of benchmarks, not to be limited to model scale

1. Question: What are your interests on benchmark data?
   Answer: Most of the participants show their interests on benchmark data related with resistance, seakeeping, manoeuvrability, CFD, full scale.
2. Question: what kind of data you like to share with other?
   Answer: Most of the participants show their interests on raw data, geometry, analyzed data, tables.
3. Question: What is the effective and feasible way to collect the benchmark data?
   Answer: Colleagues, publications, conference, and internet.
4. Question: What is your purpose to use benchmark data?
   Answer: Main purpose is to calibrate the model test results and calibrate the CFD results.

Weimin Chen, Shanghai Ship and Shipping Research Institute

Task 16. Questionnaire on Benchmark Data 2/3

5. Question: What kind of way you like to share the benchmark with others?

   Answer: Most participants would like to share on request of independent email or from ITTC benchmark repository.

6. Question: What kind of data you like to share with other?

   Answer: Analyzed data, tables and figures are selected mostly.

7. Question: What is your idea to work with ITTC community to develop benchmark?

   Answer: Most of the participants choose to work with TC.

8. Question: Would you like to take part in the research work about benchmark?

   Answer: most of the participants are willing to join such work.

Task 16. Questionnaire on Benchmark Data 3/3

- Conclusions
  - Strong interest in benchmark data
  - Concern with ITTC benchmark repository
  - Development of benchmark data within TC
  - Participation in work related to benchmark data

Task 17. Establishment of ITTC Benchmarks

- Cooperate with technical committees to establish the ITTC benchmarks
- More benchmark work to TC with less by QSG
- Communication of CFD/EFD on benchmark research
  - Bow wave breaking research
  - Paper in 34th Symposium on Naval Hydrodynamics in Washington, June 26-July 01, 2022

Chengsheng Wu, China Ship Scientific Research Centre

Task 18. Calibration of Steel Rulers

- Prepare a procedure on the internal calibration of steel rulers or a practical way to check length measurement
- ITTC Work Instruction 7.6-02-01, Revision 01, 2024, Verification of a Steel Ruler

Conclusions

- Revision of all procedures and guidelines to ITTC standard
- Separate table for acronyms not to be included in ITTC Symbols
- Expansion of Symbols list for uncertainty analysis
- New technologies for artificial intelligence and machine learning
- Liaison with International Ship and Offshore Structures (ISSC) on uncertainty analysis

Recommendations to 30th ITTC

- Adoption of following ITTC documents
  - 4.2.3-01-01, Guide for the Preparation of ITTC Recommended Procedures, Revision 04
  - 4.2.3-01-03, Work Instruction for Formatting ITTC Recommended Procedures Revision 05
  - 7.5-02-01-03, Fresh Water and Seawater Properties, Revision 03
  - 7.6-02-01, Verification of Steel Rulers

Recommendations for Future Work

1. Maintain Register of ITTC Procedures and Guidelines
2. New Uncertainty Analyses Guidelines for Machine Learning and Autonomous and Intelligent Ships
3. Review ISO Standards on Quality Control
4. Update ITTC Symbols and Terminology List
5. Harmonize uncertainty symbols with JCGM 100:2008, Annex J
6. Update ITTC Dictionary of Hydrodynamics
7. Support technical committees on stochastic processes
   - Development and revision of procedures
   - Inclusion of confidence bands for CFD and EFD results
8. Review BIPM/JCGM standards for uncertainty analysis
9. Review developments in metrology theory and UA and issue procedures
10. Upload benchmark data to ITTC benchmark data repository
11. Cooperate with TCs to establish benchmarks