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	Testing and Extrapolation Methods Resistance, Uncertainty Analysis Spreadsheet for Wave Profile Measurements	Effective Date 2002	Revision 00

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Date	Date

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Uncertainty Analysis Spreadsheet for Wave Profile Measurements

1 PURPOSE OF PROCEDURE

Provide a spreadsheet for calculating the bias and precision limits and total uncertainty using single or multiple test methods for model scale towing tank wave profile test following the Quality Manual Procedures 7.5-02-01-01 “Uncertainty Analysis in EFD, Uncertainty Assessment Methodology,” and Longo, J. and Stern, F., (1998) “Resistance, Sinkage and Trim, Wave Profile, and Nominal Wake and Uncertainty Assessment for DTMB Model 5512,” Proc. 25th ATTC, Iowa City, IA.

2 PARAMETERS


The data reduction, bias and precision limit, and total uncertainty equations are given in Longo, J. and Stern, F., (1998) “Resistance, Sinkage and Trim, Wave Profile, and Nominal Wake and Uncertainty Assessment for DTMB Model 5512,” Proc. 25th ATTC, Iowa City, IA. The uncertainty analysis spreadsheet for wave profile test implements this procedure. Spreadsheet inputs and outputs are given in Sections 2.1 and 2.2, respectively, using definitions as Longo, J. and Stern, F., (1998) “Resistance, Sinkage and Trim, Wave Profile, and Nominal Wake and Uncertainty Assessment for DTMB Model 5512,” Proc. 25th ATTC, Iowa City, IA. Spreadsheet table of contents is as follows:

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1. General information
2. Data reduction equations
3. Single or multiple test uncertainty
4. Input variables
5. Uncertainty analysis equations
6. Bias Limits
 - 6.1 Wave profile \square bias
 - 6.2 Sensitivity coefficient
7. Point Uncertainty
 - 7.1 X-position Bias
 - 7.2 Point Measurement Uncertainty Table

2.1 Inputs

Symbol	Units	Definition
		Facility
		Type of ship
		Period of tests performed
		References
M		Number of Tests
σ_{ζ_p}	m	Standard deviation of wave profile ζ_p (single test)
x	m	x -position along hull
$z_{p,M}$	m	Wave profile measured at each point along hull (single or multiple test)
L_{WL}	m	Length along waterline
B	m	Beam
T	m	Draft, even keel

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K		Coverage factor for standard deviation	θ_x	1/m	Sensitivity coefficient for x -position
$B_{\zeta 1}$	m	Scale placement bias	$B_{\zeta p}$		Point wave profile bias
$B_{\zeta 2}$	m	Marker placement bias			% of $(U_\zeta)^2$
$B_{\zeta 3}$	m	Mark reapplication bias	P_ζ		Point precision
$B_{\zeta 4}$	m	Wave elevation reading bias			% of $(U_\zeta)^2$
B_x	m	x -position bias	U_ζ		Point wave profile total uncertainty
dz/dx		Point wave profile slope			% of ζ
					Wave profile plot with uncertainty error bars


2.2 Outputs

Symbol	Units	Definition
		Statement of purpose
z_p	m	Average wave profile measured (single or multiple test)
ζ_p		Average wave profile measured (single or multiple test)
$\sigma_{\zeta p}$		Standard deviation of wave profile ζ_p (single or multiple test)
Fr		Model Froude Number
ζ	m	Range of wave profile % of $(B_\zeta)^2$ % of $(B_\zeta)^2$ % of $(B_\zeta)^2$ % of $(B_\zeta)^2$
B_ζ	m	Wave profile bias % of ζ
θ_ζ	1/m	Sensitivity coefficient for wave profile
$B_\zeta \theta_\zeta$		Product of wave profile bias and sensitivity coefficient % of L

3 PROCEDURE

3.1 Instructions

The inputs appear as empty white boxes. The outputs appear as grey boxes and are calculated for the user. The user can select single or multiple test method by entering the corresponding number of tests, 1 for single test method, >1 for multiple test method. For single test method, enter measured wave profile z_p in column $z_{p,1}$ only and standard deviation of wave profile z_p from best available data in the empty box preceding the table. For multiple test method, enter measured wave profile z_p in the columns of the table from each test. There are 5 wave profile z_p inputs for multiple test method. If the user does not have 5 wave profile z_p inputs, use as many as necessary and leave the remaining column inputs blank, not zero. The x positions should be non-dimensionalized by the model length. Upon entering of all inputs, the uncertainty will be calculated for the user at the end

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of the spreadsheet and the wave profile will be plotted with uncertainty error bars.

3.2 Spreadsheet

The uncertainty analysis spreadsheet for wave profile test is provided by attached Wave Profile-blank.xls excel document.



Wave
Profile-blank.xls

4 VALIDATION

Example use of the uncertainty analysis spreadsheet for wave profile test for single and multiple test methods are provided by

attached Wave Profile-single test example.xls and Wave Profile-multiple test example.xls excel documents. The examples are based on Longo and Stern (1998).



Wave
Profile-single test



Wave
Profile-multiple test

5 REFERENCES

- (1) Longo, J. and Stern, F., (1998) “Resistance, Sinkage and Trim, Wave Profile, and Nominal Wake and Uncertainty Assessment for DTMB Model 5512,” Proc. 25th ATTC, Iowa City, IA.