DP Stationkeeping Accuracy - A Calculation Approach, Integration in DP Plots and Results of a Case Study

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Marin
DP STATIONKEEPING ACCURACY
A CALCULATION APPROACH, INTEGRATION IN DP PLOTS
AND RESULTS OF A CASE STUDY

Hans Cozijn and Jorrit-Jan Serraris
• Study Objective
• Available Analysis Methods
• Proposed Calculation Approach
• Concluding Remarks
Propose a calculation method that combines the advantages of time-domain simulations and static DP capability calculations.

- Results give an immediate impression of the vessel DP capability in a single diagram
- Results include information on stationkeeping accuracy and other operational parameters.
• Background
• **Available Analysis Methods**
• Proposed Calculation Approach
• Concluding Remarks
DP STATIONKEEPING ANALYSIS METHODS

- **Static Calculations**
- Time-domain Simulations
- DP Model Tests
- Sea Trials

+ Simple and fast
+ Easy to compare thruster types, sizes and positions
+ Easy to analyze effects of thruster failure

- Mean loads only
- No stationkeeping accuracy
- Difficult to compare calculations from different sources
• Static Calculations
• *Time-domain Simulations*
• DP Model Tests
• Sea Trials

- Complete simulation model of DP vessel in wind, waves, current
- Dynamic effects are included
- Determine stationkeeping accuracy
- Optimize filter and control settings
- Investigate transient response

- More input data required
- Need to run many simulation cases
- Run sufficiently long simulations
- Post-processing of results
DP STATIONKEEPING ANALYSIS METHODS

- Static Calculations
- Time-domain Simulations
- **DP Model Tests**
- Sea Trials

+ Complete representation of DP vessel in wind, waves, current
+ All physics are included (possible unexpected behavior)
+ Safely investigate limiting cases
+ Optimize filter and control settings
+ Generic or commercial DP system

- Costs
- Risk of scale effects
DP STATIONKEEPING ANALYSIS METHODS

- Static Calculations
- Time-domain Simulations
- DP Model Tests
- *Sea Trials*

+ "The Real Thing"
+ No simplifications or assumptions

- Costs
- Vessel availability
- No control over environment
- Too late for design changes

*Photo: Havyard Design & Solutions AS*
PRESENTATION OUTLINE

• Background
• Available Analysis Methods
• **Proposed Calculation Approach**
• Concluding Remarks
• **Time-domain Simulation Model**

• **Execute Simulations**
  • *Current*; variation $V_c$, direction
  • *Waves*; variation $H_s$, $T_p$, direction (IMCA)
  • *Wind*; linked to waves (IMCA, ERN)
  • *Swell*; variation $H_s$, $T_p$, direction
  • Several 1,000 individual simulations

• **Store Results in Database**

• **Apply Operational Criteria**
• **Time-domain simulation model**
• Execute simulations
• Store results in database
• Apply operational criteria
STEP-BY-STEP APPROACH

- Time-domain simulation model
- **Execute simulations**
- Store results in data base
- Apply operational criteria

- "CONDOR" batch simulations
- 250+ desktop PCs (in network)
- 20,000 or more cases
- +/- 1 night, or 1 weekend
STEP-BY-STEP APPROACH

- Time-domain simulation model
- Execute simulations
- *Store results in database*
- Apply operational criteria
STEP-BY-STEP APPROACH

- Time-domain simulation model
- Execute simulations
- Store results in data base
- **Apply operational criteria**
EXAMPLE - ACCESS SYSTEM MOTIONS

Gangway Stroke 5 m  Gangway Stroke 7 m  Gangway Stroke 9 m

Motions Exceeding Criteria;
Gangway placed **Midship** and at **Stern**
ADVANTAGES AND LIMITATIONS

• Advantages
  • Evaluation of stationkeeping **capacity** and **accuracy**, as well as other operational criteria (motions, accelerations)
  • Presentation of results in familiar polar plots
  • Set of operational criteria can be up-dated, without the need to re-calculate

• Limitations
  • More detailed input data required, compared to static calculations
  • Computational effort
• Background
• Available Analysis Methods
• Proposed Calculation Approach
• **Concluding Remarks**
SUMMARY REMARKS

- Different Methods Exist to Evaluate DP Capability
  - Static
  - Time-domain
  - Model tests
  - Sea trials

- Time-domain Simulation Based Calculation Method is Proposed
  - Presentation of results similar to static calculations
  - Benefits of a time-domain simulation approach
  - Evaluation of multiple operational criteria
THANK YOU!

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