Standardization and the Need of New Tools for the DP Industry

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Standardization and the need of new tools for the DP industry

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Introduction

- Design, planning and operation
  - Experience of team is crucial
  - Several tools, data, studies
    - Metocean data & criteria
    - Consequence analyses
    - Drift-off/Drive-off studies
    - Simulation studies
    - Sea Trials analyses
    - Etc.

- Station Keeping
  - DP successful technology

- Involved in many complex operations
Introduction

• For DP operations Capability Plots (CP) is essential

• The paper reviews the standards and states proposition of updates

• Another crucial point is the simulation studies
Introduction

• Dynamic Positioning Systems subject to certification societies (DNV, ABS, GL, BV, etc.)

• Edition of system and hardware guidelines

• No specific guidelines for HMI which is the principal interface with the user
Introduction

• Plan of the presentation
  • Capability plots (For Operators)
  • Simulators (For DP manufacturers)
  • HMI (For DPOperators)
Capability Plots

A proposition of standardisation
Capability Plots

• Essential tool for DP industry
• Aims to represents the theoretical limit of DP ability
• Used in design, planning and operation stage
Capability Plots

• Example of a capability plot
Capability Plots

- Proposed procedure

Calculation of Wind coefficients

Calculation of Wind coefficients

Tunnel tests

If not available

CFD

If not available

Blendermann

Result
Capability Plots

- Proposed procedure

Calculation of Wind coefficients

Calculation of Current coefficients

Calculation of Current coefficients

Model tests/CFD

If not available

Databse

Result

If not available

CFD
Capability Plots

- Proposed procedure

1. Calculation of Wind coefficients
2. Calculation of Current coefficients
3. Calculation of Waves coefficients

- Calculation of Waves coefficients
- Numerical tools
- Database
- Result

(if not available)
Capability Plots

- Proposed procedure

- Calculation of Wind coefficients
- Calculation of Current coefficients
- Calculation of Waves coefficients

! Updated Tool shall be able to input different Sea/Wave Modelling !!
Capability Plots

- Proposed procedure:
  1. Calculation of Wind coefficients
  2. Calculation of Current coefficients
  3. Calculation of Waves coefficients

- North Sea Wave Spectrum
  - 5m, +/-30°
  - 10m, +/-10°
  - 10m, +/-10°
  - 20m, +/-7.5°
Capability Plots

- Proposed procedure:
  - Calculation of Wind coefficients
  - Calculation of Current coefficients
  - Calculation of Waves coefficients
  - Calculation of North Sea Wave Spectrum
  - Calculation of Forbidden zones
  - Calculation of Thruster efficiency

![Graph](image-url)

- Forbidden zones
- Thruster efficiency

- Variables:
  - [kt]
  - [%]
Capability Plots

- Proposed procedure

- Calculation of Wind coefficients
- Calculation of Current coefficients
- Calculation of Waves coefficients
- Dynamic Effects
  Global losses (Thruster/Thruster, Thruster/Hull, etc.)
- Calculation of Forbidden zones
- Calculation of Thruster efficiency
- Limitation of 80% of thrust per propeller
Capability Plots

- Proposed procedure

1. Calculation of Wind coefficients
2. Calculation of Current coefficients
3. Calculation of Waves coefficients
4. Calculation of Forbidden zones
5. Calculation of Thruster efficiency
6. Limitation of 80% of thrust per propeller
7. North Sea Wave Spectrum
8. Solve CP Problem
Capability Plots

- Interest of such procedure
  - Same framework for marine platforms
  - Real comparison between platforms
  - Tracability and repeatability
  - Complementary with existing studies and approaches
### Capability Plots

- Update with new operational needs and areas
  - Example: in South Africa or South America (Brazil) different sea/waves relation
  - Conservative approach (use of NS) may be a project killer

<table>
<thead>
<tr>
<th></th>
<th>Area A South America</th>
<th>Area B North Brazil</th>
<th>Area C North Sea</th>
<th>Area D South Africa</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Extreme Hs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(100yr / 10yr /1yr)</td>
<td>15.0/12.2/9.4</td>
<td>5.8/4.5/3.6</td>
<td>17.6/14.8/11.9</td>
<td>16.5/13.8/11.0</td>
</tr>
<tr>
<td><strong>Max Hs over hindcast duration</strong></td>
<td>11.4</td>
<td>5.4</td>
<td>16.7</td>
<td>16.0</td>
</tr>
<tr>
<td><strong>99%/95%/90% Quantile Hs</strong></td>
<td>6.3/4.5/3.8</td>
<td>3.3/2.8/2.5</td>
<td>14.5/7.5/6.4</td>
<td>9.0/7.0/6.0</td>
</tr>
<tr>
<td><strong>Associated Tp: most probable and range</strong></td>
<td>11s (9-16s)</td>
<td>9s (6-18s)</td>
<td>11s (4-22s)</td>
<td>11s (6-18s)</td>
</tr>
</tbody>
</table>
Reference simulator

A real need for the offshore community and DP manufacturers
Reference simulator

- Simulators studies are also of importance
  - Design of operations
  - Risk assessment
  - Training
  - Etc.

- Really needed for design of DP systems
Reference simulator

- For autopilot

Figure I.2 – Model block diagram
Reference simulator

• Candidates
  • Private companies?
  • Certification societies?
  • Open source simulators
    • Example: Marine Systems Simulator (MSS) of Prof. Fossen (NTNU, Trondheim, Norway)
    • Projects lead by laboratories
      • Example: Nemoh of LHEEA (ECN) open-source code for calculations of wave loads on structures
      • To be announced: French consortium working on the realization of a SDK
Standardization of HMI of DPS

Simple guidelines for homogenization of Human-Machine Interfaces
Standardization of HMI of DPS

• Analysis of DP Incidents
  • Between 10-20% due to Human errors since 2008

• Growing number of unexperienced staff
  • 2/3 in 2013 have less than 2 years of experience

• DPO activity

[Diagram showing monitoring & checking (80%), not automated task (19%), emergency situation (ca. 1%)]
Standardization of HMI of DPS

- First interaction between DPO and DPS
  - HMI
    - Joystick, Console, HMI

- Focus on the HMI
Standardization of HMI of DPS

• Review of existing systems and GUI (Graphical User Interface)
Standardization of HMI of DPS

- Review of existing systems and GUI (Graphical User Interface)
Standardization of HMI of DPS

- Review of existing systems and GUI (Graphical User Interface)
Standardization of HMI of DPS

• Review of existing systems and GUI (Graphical User Interface)
Standardization of HMI of DPS

- Analysis
  - Location of important informations
  - Naming of function
  - Colors
  - Conventions

- Huge differences between DPS manufacturers!
Standardization of HMI of DPS

- Proposition
  - Definition of the privileged area of seeing and center zone

Inclusion of the next signals:
- Position of the vessel
- Heading of the vessel
- Velocity over ground
- Current velocity and direction
- Wind velocity and direction
- Position deviation
- Heading deviation

Privileged area of seeing
Centre of the screen

width: 2/3
height: to 2/3
centered: the middle of the screen
Standardization of HMI of DPS

- **Proposition**
  - **Convention**
    - Wind is coming *FROM (origin of the direction of the wind)*
    - Current is going *TO (direction where is going the current)*

- **Colors**

<table>
<thead>
<tr>
<th>Data</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind</td>
<td>Purple</td>
</tr>
<tr>
<td>Current</td>
<td>Blue</td>
</tr>
<tr>
<td>Thrusters Orders</td>
<td>Black or Grey</td>
</tr>
<tr>
<td>Thrusters Feedback</td>
<td>Blue</td>
</tr>
</tbody>
</table>
Standardization of HMI of DPS

• Proposition
  • Function naming

<table>
<thead>
<tr>
<th>Mode</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joystick</td>
<td>Control of the ship with the joystick</td>
</tr>
<tr>
<td>Station Keeping</td>
<td>Automatic control of the heading and the position for holding the position and heading</td>
</tr>
<tr>
<td>Track keeping</td>
<td>Automatic control of the heading and the position for following a track</td>
</tr>
</tbody>
</table>
Standardization of HMI of DPS

- Proposition
  - Sound signals
    - Different sounds for alarm or warning is more than useful
Conclusion

• Future challenges for DP
  • Novel area and more and more complex operations
  • How to increase safety with increase of DP use and increase of unexperienced number of DPO?

• Enhancements/Update of standards required

• Propositions for
  • Capability Plots, the most used engineering tool
  • HMI design, the principal interface with DPO
  • Highlighting the necessity of a reference simulator

• Further work
  • Analysis after use of these propositions
  • Derivation of these methodologies for other tools and parts of DPS