D5.2 Development and Implementation of Parametric Models – Detailed Hullform Optimization

April 2016
Introduction

- In this task the IST activities can be summarized as follows:
  - Generate parametric variations of the two assigned ship hulls, a ferry and a containership
  - Analyze the added resistance of the produced hulls
  - Identify the bow shape parameters with a larger influence in the added resistance and the relevant intervals
- Refine the generation of hulls focusing on the identified parameters
- Derive conclusions
The ferry hull used has the following main dimensions:

- Lpp = 230.0 m
- Breadth = 28.80 m
- Depth = 18.00 m
- Draught = 6.80 m
Ferry Bow Shape

- In this model the bow shape is characterized by the following initial set of parameters:
  - bulbOffsetToFp
  - dv_bulbFairingSpreadFactor
  - dv_bulbFairingZAft
  - dv_bulbLowElevationAtFp
  - dv_bulbLowFullness
  - dv_bulbLowSectionFullness
  - dv_bulbTopElevationAtFp
  - dv_bulbTopFullness
  - dv_bulbTopSectionFullness
  - dv_bulbTopTanAtFp
  - dv_halfBeamBulbAtFp
  - dv_halfBeamElevationAtFp
  - dv_halfBeamFullness
  - dv_bulbLength
  - dv_tipElevation
Ferry Bow Shape

• Some of the initial parameters were specified in terms of absolute values
• In order to allow a more generic shape control, some of the parameters were modified creating new parameters that express relative values in terms (percentage) of the main dimensions
  • $C_{lpr}$
  • $C_{zb}$
  • $C_{za}$
  • $C_{hb}$
  • $C_{hbe}$
  • $C_{bb}$
Ferry Bulb Shape

• For each parameter, a range of variation was defined, based on the limits found from the analysis of a set of existing hulls:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>C_lpr</td>
<td>0.008</td>
<td>0.040</td>
</tr>
<tr>
<td>C_zb</td>
<td>0.205</td>
<td>0.917</td>
</tr>
<tr>
<td>C_zu</td>
<td>0</td>
<td>0.222</td>
</tr>
<tr>
<td>C_hb</td>
<td>0.777</td>
<td>1.462</td>
</tr>
<tr>
<td>C_hbe</td>
<td>0.265</td>
<td>0.905</td>
</tr>
<tr>
<td>C_bb</td>
<td>0.094</td>
<td>0.348</td>
</tr>
</tbody>
</table>

• Next, sets of 10 values were created in each interval
Ferry Bulb Shape – Parametric Variations (1)

Clpr = 0.0144

Clpr = 0.0313

Original

Clpr = 0.0208

Clpr = 0.0368
Ferry Bulb Shape – Parametric Variations (6)

Original

Cbb = 0.0940
Cbb = 0.1389
Cbb = 0.1194
Cbb = 0.1448
Ferry – Design Waterline (DWL)

• In this hull model the Design Waterline shape is characterized by the following initial set of parameters:
  • EntranceAngle
  • Fullness
  • relFOSemerge

• For the parameters that directly influence the hull shape, a range of variation was defined, based on the limits found from the analysis of a set of existing hulls:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>EntranceAngle</td>
<td>0</td>
<td>90</td>
</tr>
<tr>
<td>Fullness</td>
<td>0.5</td>
<td>0.9</td>
</tr>
<tr>
<td>relFOSemerge</td>
<td>0.1</td>
<td>0.9</td>
</tr>
</tbody>
</table>
Ferry DWL – Parametric Variations (1)

Entrance Angle = 0°

Entrance Angle = 12°

Entrance Angle = 27°

Original
In this model the Sectional Area Curve shape is characterized by the following set of parameters:

- coeffAtFosEmerge
- coeffAtFwdBase
- tanAtFosEmerge
- tanAtFwdBase

For the parameters that directly influence the hull shape, a range of variation was defined, based on the limits found from the analysis of a set of existing hulls:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>coeffAtFosEmerge</td>
<td>0.70</td>
<td>1.00</td>
</tr>
<tr>
<td>coeffAtFwdBase</td>
<td>0.06</td>
<td>0.45</td>
</tr>
</tbody>
</table>
Ferry SAC – Parametric Variations (1)

coeffAtFosEmerge = 0.70

coeffAtFosEmerge = 0.82

coeffAtFosEmerge = 0.90

Original
DTC Containership

The containership hull used has the following main dimensions:

- $L_{pp} = 355.0$ m
- Breadth = 51.00 m
- Depth = 30.15 m
- Draught = 14.50 m
In this model the bow shape is characterized by the following initial set of parameters:

- xTip
- zTip
- x_keel_start_Tan
- x_top_start_Tan

Once again, in order to allow a more generic shape control, some of the parameters were modified creating new parameters that express relative values in terms (percentage) of the main dimensions:

- C_lpr
- C_zb
DTC Containership – Bulb Parametric Variations (1)

Clpr = 0.0144

Clpr = 0.0240

Clpr = 0.0176

Clpr = 0.0304

Original
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