A passively self-adjusting floating wind farm layout to increase the annual energy production: sensitivity analysis

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FOWT are able to relocate their position

- Ability of a FOWT to move in the crosswind direction
- New DoF that can be used in floating wind farm layouts optimization

Can we benefit from this DoF to decrease wake losses?
Yes we can benefit from relocating FOWT

Baseline layout

Optimize baseline layout?

no

yes

1. Conventional fixed bottom wind farm layout optimization

2. Wind farm layout optimization separately for each wind direction

3. Mooring system full factorial design matrix

4. Mooring system designs database

5. Customised MS design for each FOWT in the floating wind farm

Floating wind farm dynamic layout

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1. Conventional fixed bottom wind farm layout optimization

- Constraints:
  - Inside the farm boundary
  - Minimum Distance between turbines 2D

- Baseline layout

  - Optimize baseline layout?
    - no
    - yes
      1. Conventional fixed bottom wind farm layout optimization
      2. Wind farm layout optimization separately for each wind direction
      3. facet
      4. facet
      5. Customised MS design for FOWT in the floating wind

- Floating wind farm dynamic layout

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2. Wind farm layout optimization separately for each wind direction

- Constraints:
  - Motion only perpendicular to wind
  - Maximum displacement 0.5 D

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- 1/19/2023
3. & 4. Mooring system database

- Mooring system design variables:
  - Lines headings
  - Lines diameters
  - Lines length
  - Anchor radius
  - Save the watch circle
  - Motion cannot be more than 1D

[Diagram showing baseline layout, optimization decision, and mooring system database steps]

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5. Customized MS design for each FOWT in the floating wind farm

- Matching the targeted motion of each FOWT with the watch circle of the mooring system.

- **Objective:**
  - Increase AEP

- **Method:**
  - Iterate over the mooring systems from database with watch circles close to the targeted motion for each FOWT.
Sensitivity analysis of the method

Is it better to relocate the turbines in smaller or larger farms?

9 turbines

25 turbines

Does the windrose need to be multi-directional?
Baseline optimization
Reference layouts for energy comparison
## Results

<table>
<thead>
<tr>
<th>No. of turbines</th>
<th>Windrose IEA task 37 [10 m/s]</th>
<th>Windrose alpha ventus [10 m/s]</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 turbines</td>
<td><img src="image" alt="Windrose IEA task 37" /></td>
<td><img src="image" alt="Windrose alpha ventus" /></td>
</tr>
<tr>
<td>25 turbines</td>
<td><img src="image" alt="Windrose IEA task 37" /></td>
<td><img src="image" alt="Windrose alpha ventus" /></td>
</tr>
</tbody>
</table>

- **9 turbines**
  - 5.47% gain
  - 3.94% gain

- **25 turbines**
  - 2.16% gain
  - 2.57% gain
Conclusions

• The percentage gain of energy production from relocating the FOWT is higher in smaller wind farms

• Relocating the turbines will lead to energy gain even for wind roses with the wind coming from one section

• The gain for more layouts will be shown in the paper.
Thank you!

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