Route Optimization for Offshore Maintenance Tasks & Case Study

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Summary
The costs for maintenance are significant in the planning and operation of offshore wind farms. In order to improve the scheduling of corrective maintenance tasks and the CTV routes, an optimization method is developed and tested for a wind farm of 80 turbines over a period of 20 years. The influence of different logistic strategies on wind farm availability and annual costs is analysed and (short-term) strategies to improve wind farm performance are evaluated.

1. Routing

1.1 State of the Art

In the past years, several routing and scheduling algorithms for CTVs have been presented [1] [2], but due to the exponential increase of possible routes with the number of maintenance tasks, the maximum number of tasks was limited to 5-12, serviced by 1-3 CTVs. O&M simulation models, such as [3] [4], don't optimise the CTV routes, but either use a first-come-first-served approach or a dynamic model where each task is scheduled instantly at failure notification.

1.2. Route Optimization Code

In order to decrease the number of routes to be checked, an optimization code is developed based on simple rules to apply and to be changeable by the user.

1. Finish as many tasks as possible
2. Finish all tasks as early as possible
3. Take the shortest route possible

The tool can handle 1-6 CTVs with 1-5 teams per CTV for all cases between 0-80 turbines requesting maintenance, and can therefore be used as a simulation model over several years.

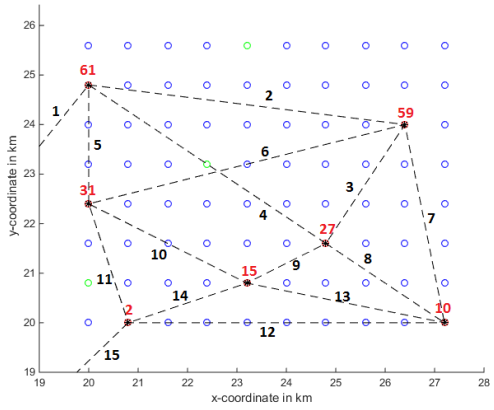

Fig. 1: Visualization of CTV Route in Wind Farm

2. Case Study

2.1 Case

For a wind farm of 80 turbines, the simulation tool is run for 20 years. On a daily basis, the occurring maintenance tasks are scheduled for the next day. For different logistic strategies, the wind farm availability and total costs are analysed. Thereby, the number of CTVs are changed, as well as the CTV specifications and the position of the maintenance base (onshore/offshore).

2.2 Strategies for Improving Wind Farm Performance

In order to improve performance, short-term strategies are evaluated with the simulation tool, such as changing the number or type of CTVs for a certain time in the winter months (when bad weather limits the accessibility of the wind farm).

3. References

[1] L. Dai, M. Stålhane and I. Utne, "Routing and Scheduling of Maintenance Fleet for Offshore Win L. Dai, M. Stålhane and I. Utne, "Routing and Scheduling of Maintenance Fleet for Offshore Wind Farms," Wind Engineering 39, pp. 15-30, 2015.d Farms," Wind Engineering 39, pp. 15-30, 2015.

[2] M. Stålhane, L. M. Hvattum and V. Skaar, "Optimization of routing and scheduling of vessels to permorn maintenance at offshore wind farms," Energy Procedia 80, pp. 92-99, 2015.

[3] M. Hofmann, I. B. Sperstad and M. Kolstad, Technical Documentation of the NOWIcob tool, Trondheim: SINTEF Energy Research, 2014.

[4] T. Münsterberg and C. Jahn, "Offshore Windenergie: Kostensenkung durch Logistiksimulation," Simulation in Production and Logistics, 2015.