Bachelor / Master Thesis

Optimal Cabling of Offshore Wind Farms

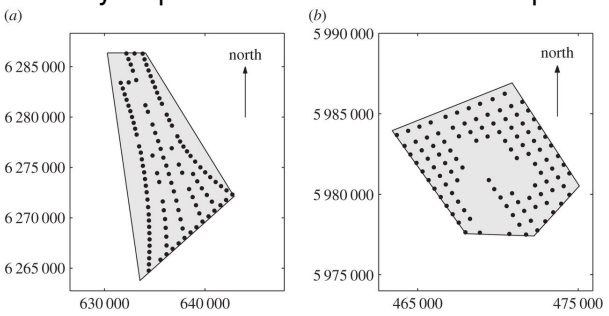
Course of study:	Mathematics, Computer Science, Computational Engineering
Kind of thesis:	Programming, Simulation, and Optimization
Programming language:	C++
Start:	Winter term 2019/20

Topic

The transformation of wind power into electrical power is performed by wind turbines, which are usually grouped into wind farms in order to exploit considerations relative to economies of scale, such as lower installation and maintenance costs. But as costs decrease, grouping turbines leads to a reduction in the produced power because of the presence of wake effects within the wind farm. In large wind farms wake effects lead to considerable power loss, and thus it is desirable to minimize them in order to maximize the energy.

Preliminary work

A physical simulation model and an optimizer are already implemented which find the optimal positions of the wind turbines in a given area. The program is implemented in C++. So far, the electrical losses for the power return through cables are not considered in the model. The costs for cabling are about 20 % of the total investment costs of an wind farm and should therefore be considered within the optimization process.



Task

Within this project, the wind farm optimizer has to be extended such that the optimal cable costs are considered. The following tasks have to be solved:

- Model the optimization problem for the two different structures: string structure and closed loop structure. Consider costs for cable thickness and electrical losses. Consider scaled prices for the cables and the selection of the best n out of N given cables.
- Implement the ILP solution for both optimization problems using AMPL.
- Implement heuristic optimizers (e.g. Minimum Spanning Tree, or Esau Williams) for both optimization problems within the existing C++ code infrastructure.
- Optimize the cables for the existing wind farms *HornsRev*, *DanTysk* and *Sandbank*. Compare the exact solutions against the heuristic solutions.

Contact This project is offered by the *Theory of Hybrid Systems* (i2) research group headed by Prof. Dr. Erika Ábrahám and will be co-supervised by Dr. rer. nat. Pascal Richter. For further questions please contact us via email:

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