Design optimization of bottom-fixed support structures for mass production

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Abstract

The aim of this PhD project is to contribute to significant cost savings for deep water wind farms. Three levels are regarded in the process of designing the support structures:

- **Module:** mass producible units that can be repeated to build a structure.
- **Structure:** assembly of modules that satisfy mechanical and manufacturing constraints of a specific wind turbine in a farm.
- **Farm:** complete set of structures in the farm.

A cost model is used to optimize the design of all structures in a farm within mechanical and manufacturing constraints.

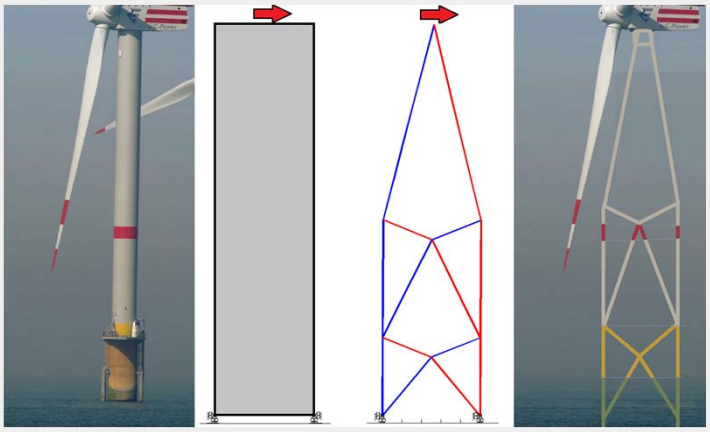

Figure 2: Topology optimization of a simple 2D truss structure illustrates how optimization can be used in structural design of support structures.

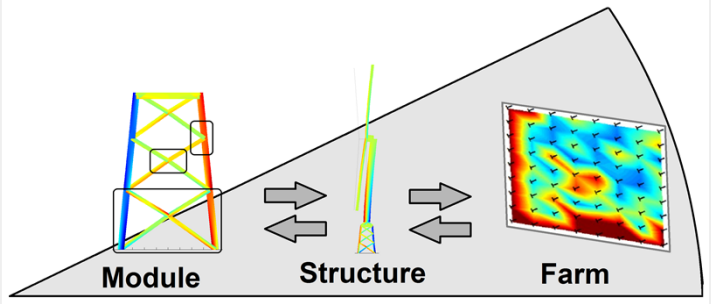

Figure 1: The optimization works at different levels that interact during the design process. For example will the static analysis in *module* and *farm* levels have to be checked with a dynamic analysis in the *structure level*.

Project summary

- **Objective:** Optimize support structures and take mass manufacturing into account.
- **Methodology:** Develop ad hoc design optimization tools that can work and communicate over different levels. Develop or apply simulation codes that deliver sufficient accuracy at each level.
- **Expected results:** Mathematical models, reliable numerical optimization techniques and software for optimal structural design of cost effective bottom-fixed offshore wind turbine support structures.

Tools

This project, as a part of the Danish strategic research project www.ABYSS.dk, will reduce the cost of jackets by:

- …using a **cost model** that includes mass production, installation and manufacturing.
- …develop **software for optimal structural design** that can work and communicate over all three design levels.
- …apply state of the art **numerical optimization techniques**.

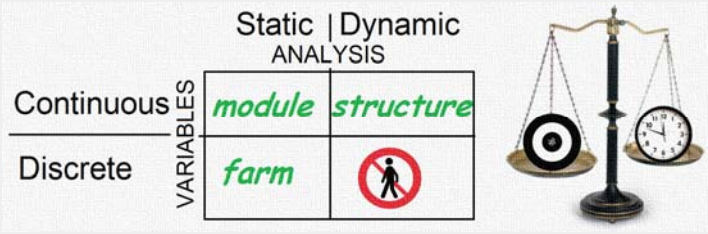

Figure 3: There is a trade-off between accuracy and computational expense that motivates different analysis and variable-types at each level. Therefore, communication between the levels is vital to utilize the best of all worlds.