![TU Delft logo]

Gradient-based optimization of jacket support structure for offshore wind turbines with the local approach

Offshore wind turbines are exposed to complex irregular and highly fluctuating environmental conditions. The analysis is, therefore commonly performed in the time domain, resulting in a time consuming and computationally demanding optimization process. In order to reduce the computational cost, an optimization approach using the principle of decomposition can be utilized. Here, it is assumed that when changing dimensions of a structural members, sectional response forces and moments remain constant. This assumption is made for both the actual changed member and for all other members of the structure. Additionally, this is assumed to be valid for a simultaneous change of all members all over the structure. It is the so-called local optimization approach and allows for an individual (local) optimization of each member of the structure.

The objective of this thesis is the development of a gradient based optimization framework for the local optimization of structural members of an offshore wind turbine with jacket support structure and the implementation of an algorithm using the principle of decomposition. The development of the gradient based method for the local optimization necessitate the study of changes in global performance when modifying structural members locally and a method to receive these sensitivities in structural performance elementwise.

Thereafter, the algorithms were used with the local optimization approach. The implementation was carried out using customized Matlab scripts for the automated load analysis with the finite element solver Fedem WindPower. The UpWind reference jacket used within the OC4-project and the generic NREL 5MW turbine atop were used as the case study for this work. In addition, as the objective function for the optimization process, a cost model that considers both manufacturing and material costs was developed. Finally the evaluation of the speed and the accuracy of the methods proposed is presented and the efficiency of the method is proved.

Key Words: structural optimization, sensitivity analysis, jacket support structure, local approach.

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