











# **Reliability-Based Optimization** of Floating Wind Turbine **Support Structures**

Output

Optimizer

Executing the

Simulation

• Post-processing

• Write results file

Check constraints for design

parameters

**F**ask

Mareike Leimeister (Mareike.Leimeister@cranfield.ac.uk/@iwes.fraunhofer.de)

Supervisors: Prof Athanasios Kolios, Dr Maurizio Collu, Philipp Thomas

### Introduction

- Floating offshore wind turbines as promising solution for deep water sites;
- Challenging complex system dynamics and harsh offshore environment;

## **Aims and objectives**

- Reliability methods for design optimization of floating wind turbine support structures
- Optimization strategy design and methodology

- Reliability-based design optimization for reducing downtimes and economic losses.

#### **Results and discussion**

- Review and classification of reliability methods (qualitative, semi-quantitative, quantitative) [1]
- Review of FOWT support structures for wind farm deployment [2]

Managing the

List of

processed

Number of

processors

models

Simulation

Framework for automated simulation and optimization [3]

Programming Framework: Python

Processing the

Set up interface

between tools

Redefined

parameters

Simulation

settings

∕lodel

- Examined design variables, load cases, objectives, and optimization settings



Conclusions

Simulation Tool:

Simulation

simulation with wind turbine

system model

settings Execution of

Dymola

Modeling Environment:

MoWiT

Model of wind

turbine system

equations and

Specified

Physical

relations

parameters

SWL

- Successful application of the framework to optimize the OC3 spar-buoy [3]
- High flexibility and broad application range (upscaling [4], controller tuning, ...)

#### **Future work**

- Application of the framework for optimizing an advanced structure
- Reliability-based design optimization of a spar-type geometry

#### [1] Leimeister and Kolios (2018). A review of reliability-based methods for risk analysis and their application in the offshore wind industry. RSER 91 (2018) 1065-1076. [2] Leimeister et al (2018). Critical review of floating support structures for offshore wind farm deployment. J. Phys.: Conf. Ser. 1104 012007. [3] Leimeister (2019). Python-Modelica Framework for Automated Simulation and Optimization. Proceedings of the 13th International Modelica Conference. [4] Leimeister et al. (2019). Larger MW-Class Floater Designs Without Upscaling? – A Direct Optimization Approach. Proceedings of OMAE 2019.

#### www.rems-cdt.ac.uk



— original design exemplary designs of individuals in start generation 0 — optimum design



IWES