

Simulation and Optimisation of Offshore Renewable Energy Arrays for Minimal Life-Cycle Costs

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November 12, 2019

The problem

- Focus on modern windfarms in the North Sea
- Optimize logistics of operations on offshore windfarms (OWFs) in each phase of the life-cycle:
 - Installation
 - Maintenance
 - Decommission
- Various logistical decisions come into play
- Small optimisations can have significant effects on costs
- Methods used are optimisation and simulation

Key challenges

- Long lead-up times
- Strong maritime weather
- Many different types of decisions
- Differences between locations
- Phases are not independent

Research objectives

- Design an integrated optimisation and simulation model spanning the entire life-cycle of an Offshore Wind Farm, based on sub-models for each phase of the life-cycle.
- Sub-objectives:
 - Design an integrated optimisation and simulation model for the installation projects of an OWF.
 - Design an integrated optimisation and simulation model for the maintenance projects of an OWF.
 - Design an integrated optimisation and simulation model for the decommissioning projects of an OWF.

Existing literature

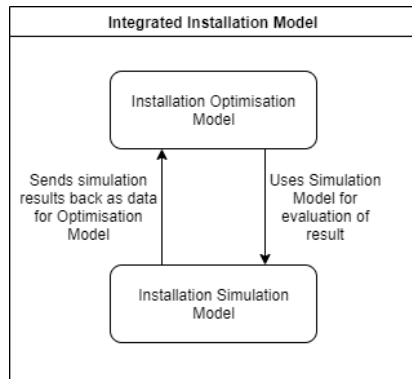
- Various attempts to improve the installation phase, through integer programming and local search, combined with simulation
- A lot of research has been done in various areas of maintenance, including supply chain management, mitigating failure rate, condition based maintenance
- Not a lot of research has been done on decommission projects, but they are similar in structure to installation projects
- No research at all has been found that looks at the entire life-cycle and how the different phases affect each other

Current Progress

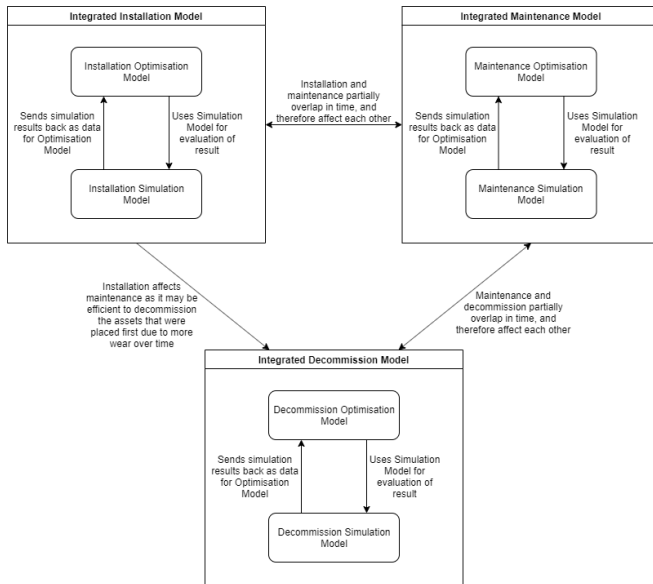
- Reviewed a large part of the literature, primarily on installation projects and secondarily on maintenance projects and general non-deterministic scheduling and logistics
- Laid the foundations for a decision support tool suited to analyse and optimise schedules for any phase of the life-cycle, based on site-specific characteristics of the project
- Planned the interactions between my various models

Model interactions - 1

- Primary process pipeline:
 - 1 Optimisation Model (OM) gets info about the site and task structure
 - 2 OM calculates new/improves existing schedule and sends it to the Simulation Model (SM)
 - 3 SM runs simulations with the schedule, returns metrics back to OM
 - 4 OM determines that end conditions are met or returns to step 2



Model interactions - 2



- Develop full models for each stage of the life-cycle
- Determine specific interactions between the stages
- Implement models in the tool, develop it further for full commercial functionality
- Validate and test the tool (and underlying models) using real(istic) data