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Project schedule assessment with a focus on different input weather data sources

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Abstract

During all planning stages of offshore projects, the assessment of the effects of adverse weather is essential. In order to address this problem, the WaTSS (Weather Time Series Scheduling) method and its application will be presented. The defined project schedule and the environmental data in form of weather time series are the input data.

Three different case studies were carried out using one project schedule and different input time series. Within the first case, differences in the project progress due to minor differences in model and measurement data are displayed. In the second case, the effects of variations or uncertainty in the input time series are studied. Within the third case, the method is applied for a number of spatial distributed locations in the North Sea.

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1. Introduction

Most offshore project schedules consist of a number of different tasks which have to be executed in a particular order and are subject to environmental restrictions. An example is the installation of a wind turbine foundation which consists of the following tasks: positioning the vessel, fixing the heavy lift vessel and lifting the foundation. Due to the different vessel sensitivities to sea states within the different tasks as well as the high number of tasks, project schedules tend to be complex. Hence the assessment of the mean project duration, weather down times, alternative vessel concepts or weather risks is difficult.

Considering [1], the expected downtime has to be calculated using statistical weather conditions. An often used method are weather window or persistence statistics [2]. These statistics define the relative available time for a given task in a given time period, like a distinct month. For the assessment of the duration of process parts or the whole installation process, the statistics for different tasks are combined. Due to possible correlations between the different

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statistical results and difficulties assessing extreme durations, the application of weather window statistics must be questioned at least for complex schedules.

The Fraunhofer Institute for Wind Energy and Energy System Technology (IWES) developed the Weather Time Series Scheduling (WaTSS) method implemented in the Comprehensive Offshore Analysis and Simulation Tool (COAST) software in order to solve this issue. By combining the project schedule with time series of the environmental variables, the offshore procedure is analyzed. Within this paper, we focus on the input time series environmental data and different analysis methods [3]. For all test cases, a project schedule for the installation of an offshore wind farm comprising about 1400 tasks was used.

2. WaTSS method and implementation

The project schedule data consist of a number of tasks that have to be executed in a particular order. Examples are the before mentioned foundation installation, nacelle replacements, offshore substation installation or the installation of a whole wind farm, comprising foundations, wind turbines, cables and substation. For each task within the project schedule, the duration is defined as well as one or more constraints if necessary. Typical constraints are wind speeds on distinct altitudes or wave height thresholds that must not be exceeded during the duration of the task. Also parallel installation processes can be considered in the project schedule.

The input weather data may comprise meteorological and oceanographic data as well as further parameters, like working shift or daylight. The data can cover measured and model data, whereas the latter normally brings a number of advantages; hindcast model data often exists for longer periods in time until some decades, exist for a number of spatial distributed grid points, are consistent and normally do not suffer from corrupt or missing data. Using measurement data, effort has to be taken for meeting the aforementioned possible problems.

Within the WaTSS method, the execution of the project schedule is simulated using weather time series data. Hence a task will be executed if the time series weather conditions obey the task's weather restrictions for the task duration. If the weather is not appropriate, the start of the task is delayed until a fitting weather window occurs. After the completion of the task, the process will be repeated for the successor, see figure 1. Applying the WaTSS method using a given project schedule and a well-defined starting time, results are the realization time for each task as well as the overall duration of the complete project. The overall duration consists of the net working time and the additional waiting time due to waiting for the required weather conditions.

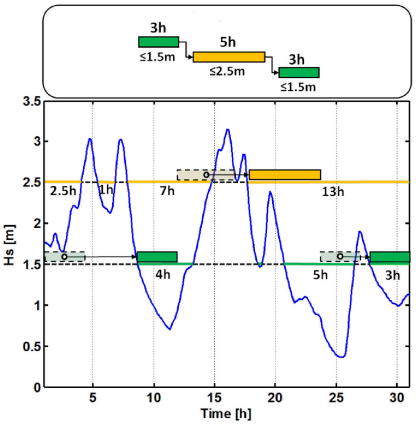

Fig. 1. Exemplary illustration of a project schedule with three tasks and restrictions. The WaTSS simulation using a significant wave height time series is illustrated.

Using a multiplicity of different starting dates, the WaTSS analysis provides a distribution of project durations which is the basis for the statistical analysis, e.g. in terms of mean values or percentiles. For finding optimal or avoiding unfavorable project starting periods, the starting time is systematically shifted by a fixed number of days. This method is called *constant interval simulation*. A result for the later used project schedule is depicted in figure