Ingenieursfakultät Bau Geo Umwelt
Engineering Risk Analysis Group
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Technische Universität München

Industrie Service

Master's Thesis

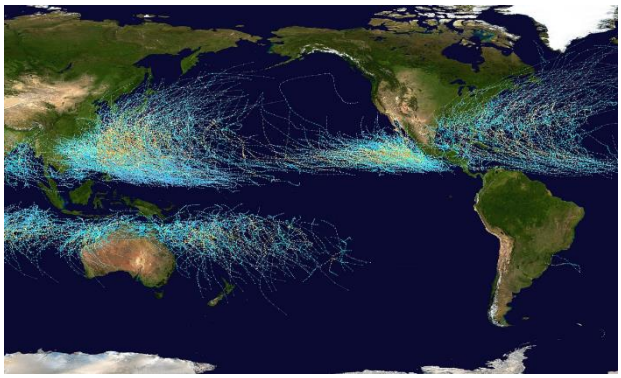
„Development of a validation strategy for a typhoon-induced extreme wind prediction model"

This Master's Thesis is in collaboration with TÜV-SÜD. Max Teichgräber would be the supervisor.

Background

When designing a wind farm, the operator is obliged to take extreme wind velocities into account to ensure that the installed wind turbines can resist such wind loads. The prediction of rare events is usually based on time series of wind measurements. However, in regions where tropical cyclones appear (e.g. western pacific – Japan, South Korea, etc.), the prediction using conventional methods is not useful as the data series often do not cover rare extreme events. Moreover, cyclones are complex weather phenomena affecting the wind conditions in a wide range of up to 500km distance along their tracks.
Therefore, a hybrid approach of a Monte-Carlo simulation together with a modified orthogonal decomposition is suggested by the international standard IEC 61400-1 to model the key parameters of a cyclone based on so-called best track cyclone observations and to generate synthetic data for an extreme wind prediction model.

By typhoon damaged wind turbine in September 2020 https://en.yna.co.kr/view/PYH20200903214900325 (25.02.2021)



Cyclone tracks 1985 – 2005 https://de.wikipedia.org/wiki/Tropischer_Wirbelsturm#/media/Datei:Global_tropical_cyclone_tracks-edit2.jpg (25.02.2021)

Task

Data from field observation are not always available or do not reach a time span that is long enough to validate the results of the prediction model. Therefore, a strategy is required to ensure that the predicted extreme wind events are reliable for the wind farm design and to ensure a safe and secure operation of the wind turbines.
In a first step, the candidate is asked to implement the suggested prediction model. In a second step, extreme wind events based on given input data should be predicted by running simulations for a site in the western pacific region. The focus of this Thesis, however, lies on the validation of the results as part of the postprocessing of the numerical data. For this purpose, a validation strategy should be developed and successfully tested within the scope of the Thesis, which will be a substantial contribution to both industry and science.

Key Skills

Good knowledge in probabilistic modelling and risk analysis, as well as good programming and data processing skills (e.g. using Matlab or Python) are essential for this Thesis. Basic knowledge in fluid dynamics would be desirable.

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