Summary of Master Thesis

Machine Learning-Based Classification of Wind Turbines by Data Fusion of Weather Radar Data and Passive Satellite Data

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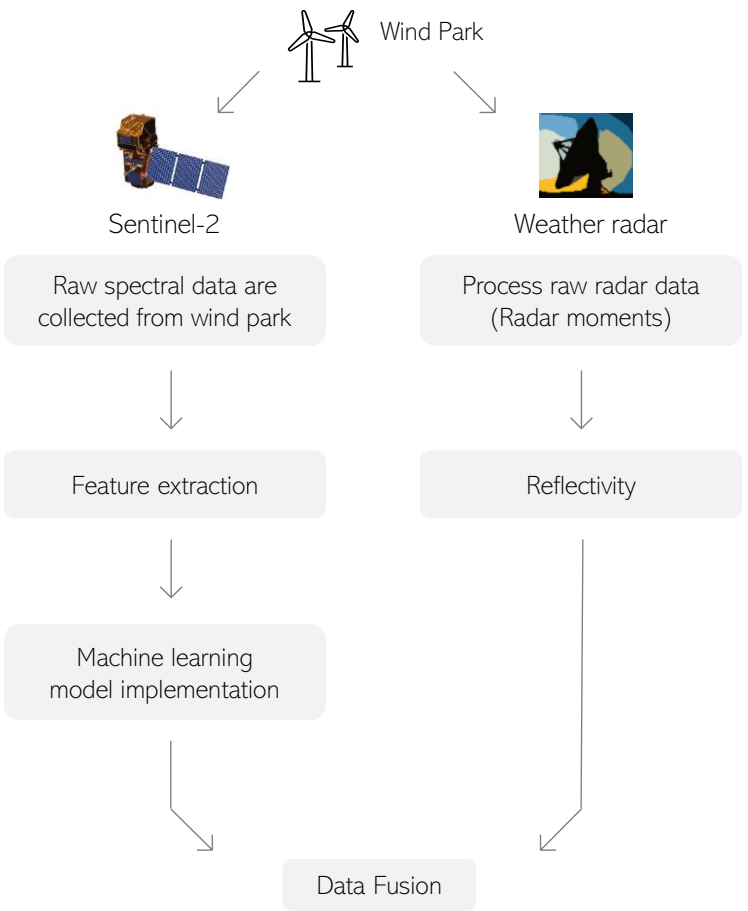
Motivation

Wind turbines create interference in weather radar measurements according to their physical characteristics. Result of this, they are falsely recognized as precipitation. This can reduce the accuracy of meteorological forecasts and cause negative impacts in fields where these forecasts are used. Therefore, there is a need for alternative detection methods to distinguish wind turbines from precipitation. This thesis aims to develop a new method for the detection of wind turbines, which have high reflectivity values in weather radar measurements.

Proposed Method

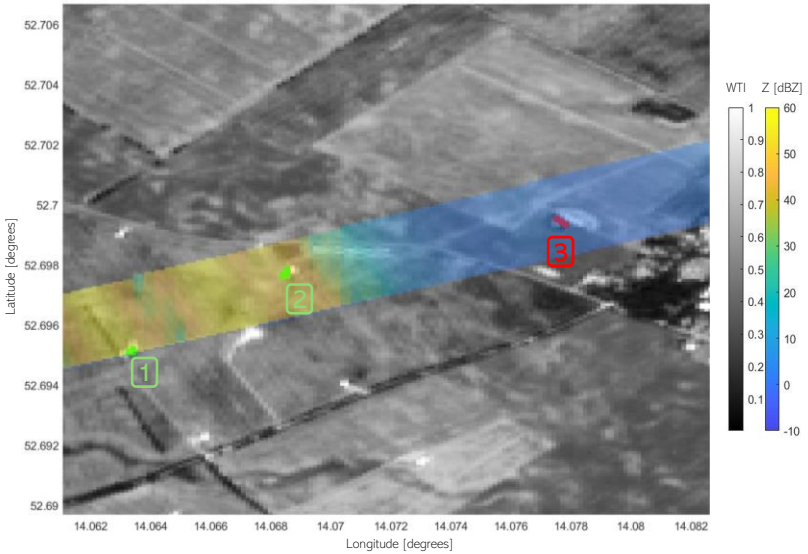
Weather radar data only is not sufficient for the detection of wind turbines. Therefore, the Sentinel 2 satellite, which provides spectral imaging, is selected as the second sensor. A machine-learning based approach is applied to eliminate the requirement for manual analysis and to fully automate wind turbine detection. The model is trained using features derived from Sentinel-2 spectral data. During the training process, samples from different wind parks are used, and the model is evaluated in validation and testing phases. After that, data fusion is applied by combining the predictions obtained from the model with weather radar reflectivity values. The results of this thesis demonstrate that data fusion improves wind turbine detection accuracy and provides a more reliable classification approach.

Implementation



Fuse machine learning predictions with radar reflectivity

Results



Data fusion of Sentinel-2 and weather radar

[1] [2] These pixels predicted as wind turbines “wt” by the machine learning model and have high radar reflectivity. The fusion stage preserves the wind turbine label.

[3] These pixels predicted as wind turbines “wt” by the machine learning model but have low radar reflectivity (possibly buildings or rooftops). The fusion stage reclassifies them as non turbine “nowt”.