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Data science for understanding physics –modelling ship wake detectability using machine learning

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The detectability of wake signatures in satellite-based Synthetic Aperture Radar (SAR) acquisitions is dependent on various physical parameters describing the present situation during the detection. Ship wake signatures in SAR are complex structures consisting of multiple wake components appearing differently depending on the present detection situation. The physical parameters with influence on the detectability of those wake components are in the following called influencing parameters. Although various methods for automatic detection of wakes are being developed since decades, the dependency between detectability of wake components and the influencing parameters is not systematically analyzed. In this study, machine learning is applied to model the dependency between all wake components taking all influencing parameters into account. The composition of the machine learning models is analyzed in order to derive statements on physical relationships between influencing parameters and detectability of wake components. For this type of application, a figure of merit for detectability and a measure for uncertainty of derived statements is introduced. The results are contrasted against literature based on simulations and/or physical deductions on ship wakes in SAR imagery and their detectability.

It is demonstrated that data science is not only useful for solving a specific task, i.e. wake component detection, but also to systematically generate understanding of the task's underlying physics, i.e. wake component detectability. The systematic modelling of underlying physics can finally be applied for improving the specific task.

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