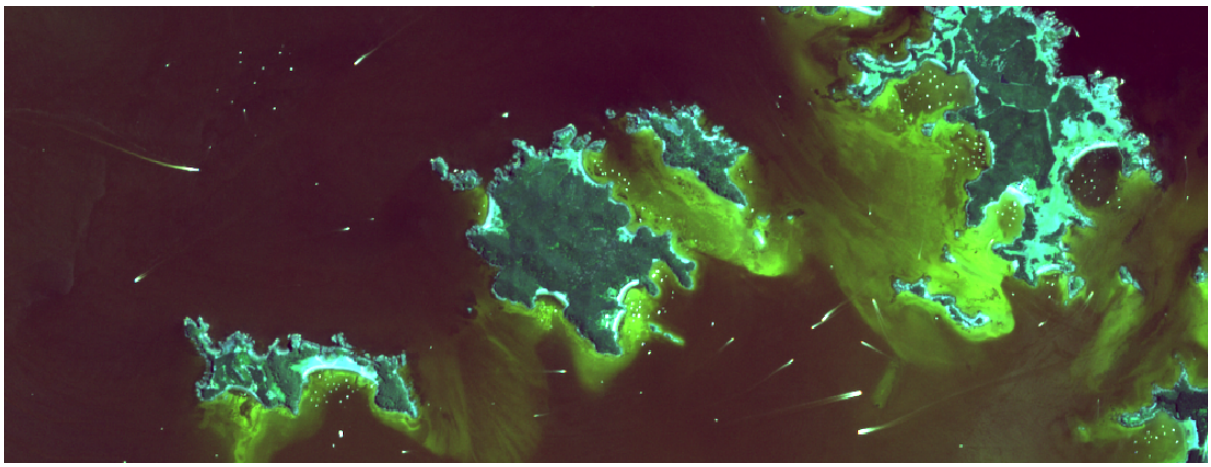
Ship detection and classification

NTNU *Master Thesis 2020*

Problem Description

All ships are obliged by the UN to yield their position at all time, but for different reasons the vessels turn their signal to be invisible. The reason for for going dark might be illicit activity like illegal fishing, smuggling or covert military operations. This is an important part of global Maritime Domain Awareness.

Vake tackles this problem by using independent sources of information, like satellite imagery. This way we can provide insight into this dark activity even when the vessel goes dark. The goal is to fully automate the process by analyzing the images in realtime, to reduce manual inspection, and to lower the response time.



The student will research different methods and neural network architectures to maximize the precision as well as minimizing the false alarm rate. The task of classifying the vessels, i.e. size, speed and ship class will be addressed. The student will compliment the on-going development as well as researching unexplored methods.

Company

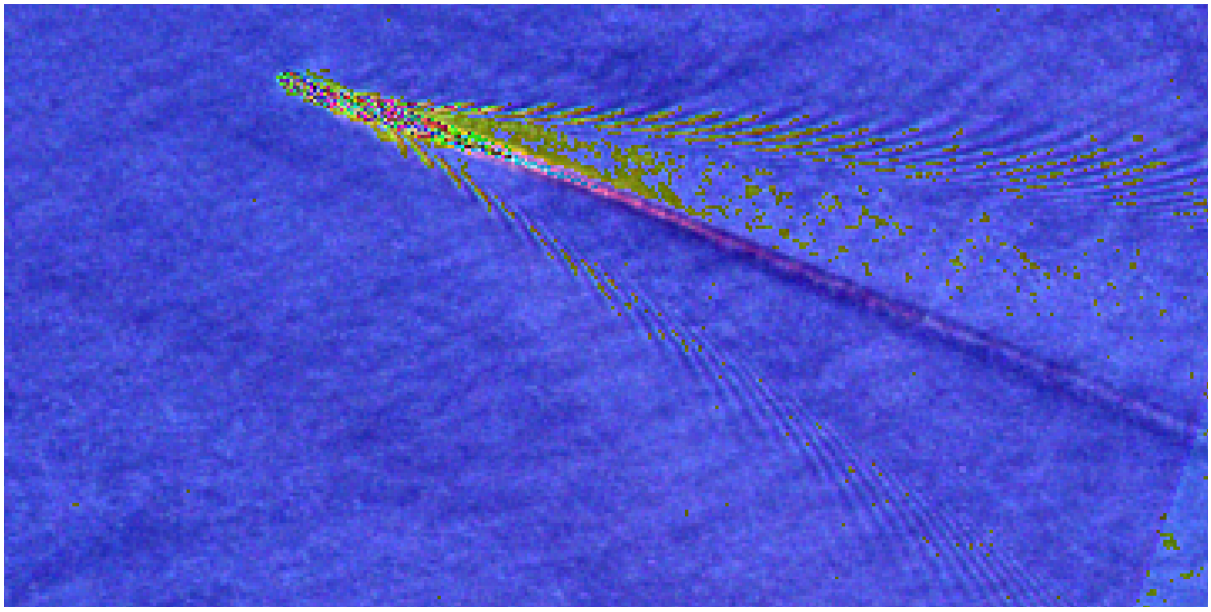
Vake's is a Norwegian space tech startup providing insight into global ship movements. It all started as a Master Thesis delivered by the founders in 2018 at NTNU. Vake has later received awards for their innovation from both NATO and the European Space Agency (ESA). The student will work closely with the founding team to support the core development of the company. The team mentored a Master Thesis in 2019 which led to great results that are put into use in todays solution. The founding team has a background in Machine Learning and Geospatial data analysis from NTNU, and will be invested into following up the student.

Data

Imagery

Vake is currently utilizing open data provided by the Copernicus Earth Observation Programme. More specifically Multi-Spectral Imagery captured by the Sentinel-2 satellite. The imagery have been sensed daily since 2015 and are available through ESA.

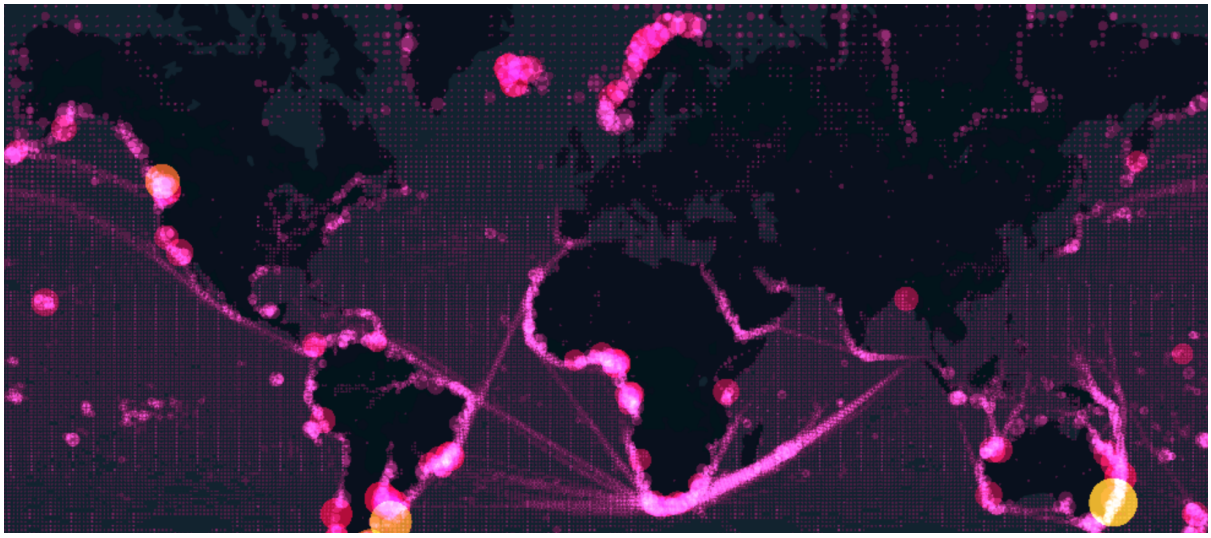
These images contain 13 spectral bands spanning red, green and blue, and near-infrared. This additional information helps classification of vessels. As seen in the image below, ship wake and kelvin waves formed in the ocean will also be important features for the neural network to infer from.

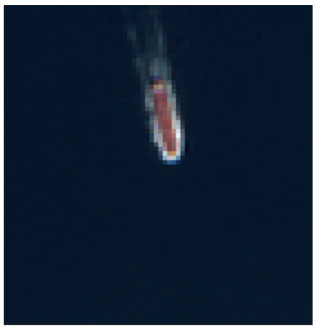


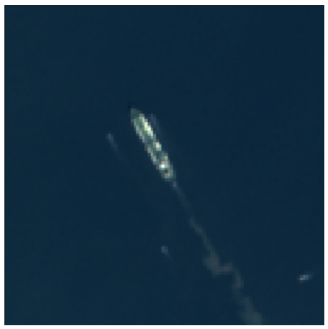
Ground Truth

As ground truth the Automatic Identification System is used, which contains positions and classifications of vessels globally. The imagery is fused with the AIS spatio-temporally to create unlimited amounts of training data. This topic was researched in the founders' Master Thesis and has been developed by Vake. The training data will be available for the student in the project period through our google cloud infrastructure.

Other sources of satellite imagery may be investigated, such as Very High Resolution imagery provided by Planet and Airbus.







Challenges

The business challenge is related to providing results in near-realtime and maximizing the detection recall while controlling the false alarm rate.

Scientific challenges may include developing a neural network architectures that:

- utilizes the spectral information in the imagery, i.e. the image depth
- are able to detect small objects in very large images
- can estimate vessel sizes, speed and class
- are optimized for fast computation, e.g. by neural network pruning and quantization aware training

This will require literature review of existing classification algorithms and techniques as well as gaining an in-depth understanding of the underlying mechanics of neural networks.

Thesis information

This will be available as a 6 month project thesis followed by a 6 month master thesis. The student will have the possibility of sitting in-house at our Oslo office, or remotely from Trondheim.

For more information, don't hesitate to reach out.

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More info about Vake