



FFI Forsvarets
forskningsinstitutt
Norwegian Defence Research Establishment

Behavioral Analysis for Maritime Safety

Martin Gjesdal Bjørndal
Espen Messel

October 9, 2019

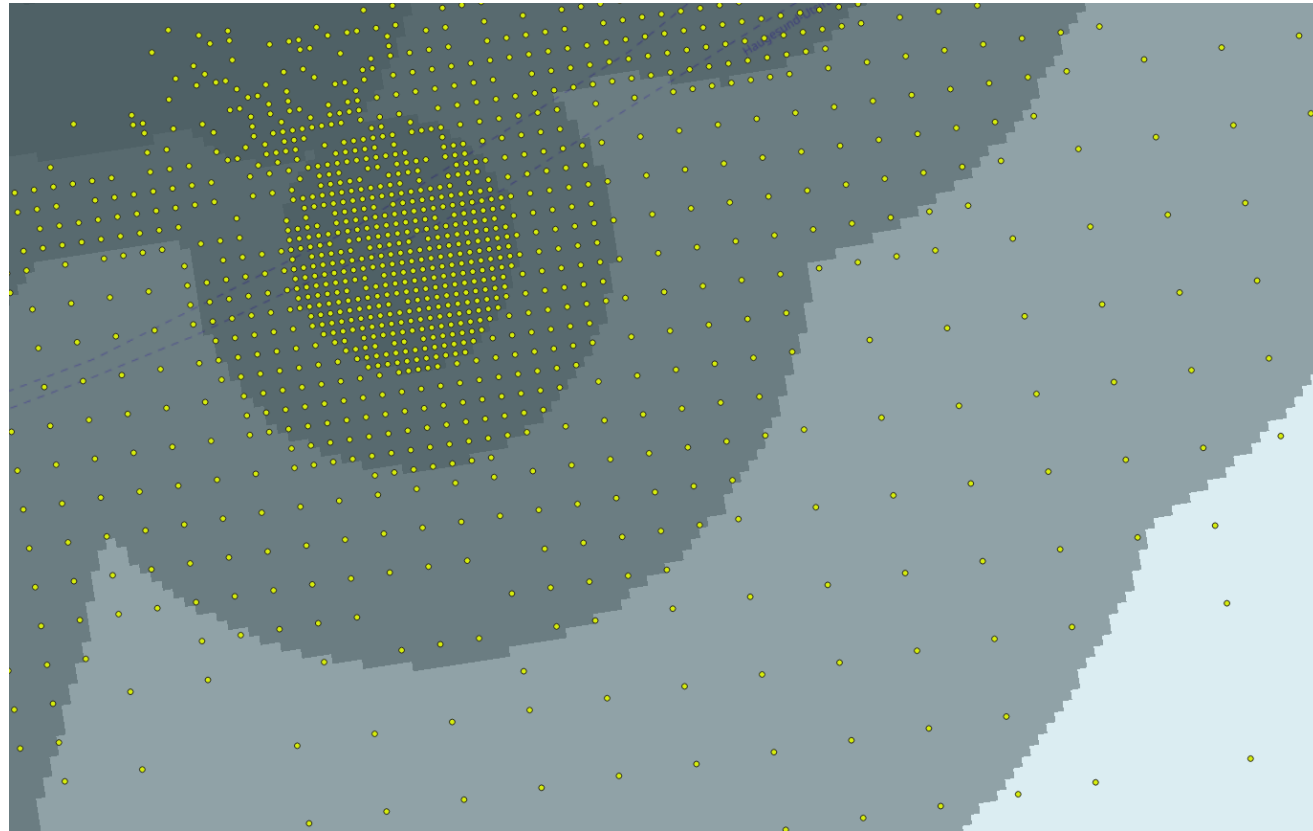
Motivation

Increased ship traffic means a higher workload on VTS operators. In an attempt to aide the operators, we propose software to partly automate surveillance by comparing online vessel tracks to historical data from the same area.

Data

- Historical data from 2017 and 2018 preprocessed into a graph.
- Observations are rounded off to the nearest node.
- Statistics are computed per node.
- Data are divided into categories based on ship type and size, and a separate graph is constructed per category.

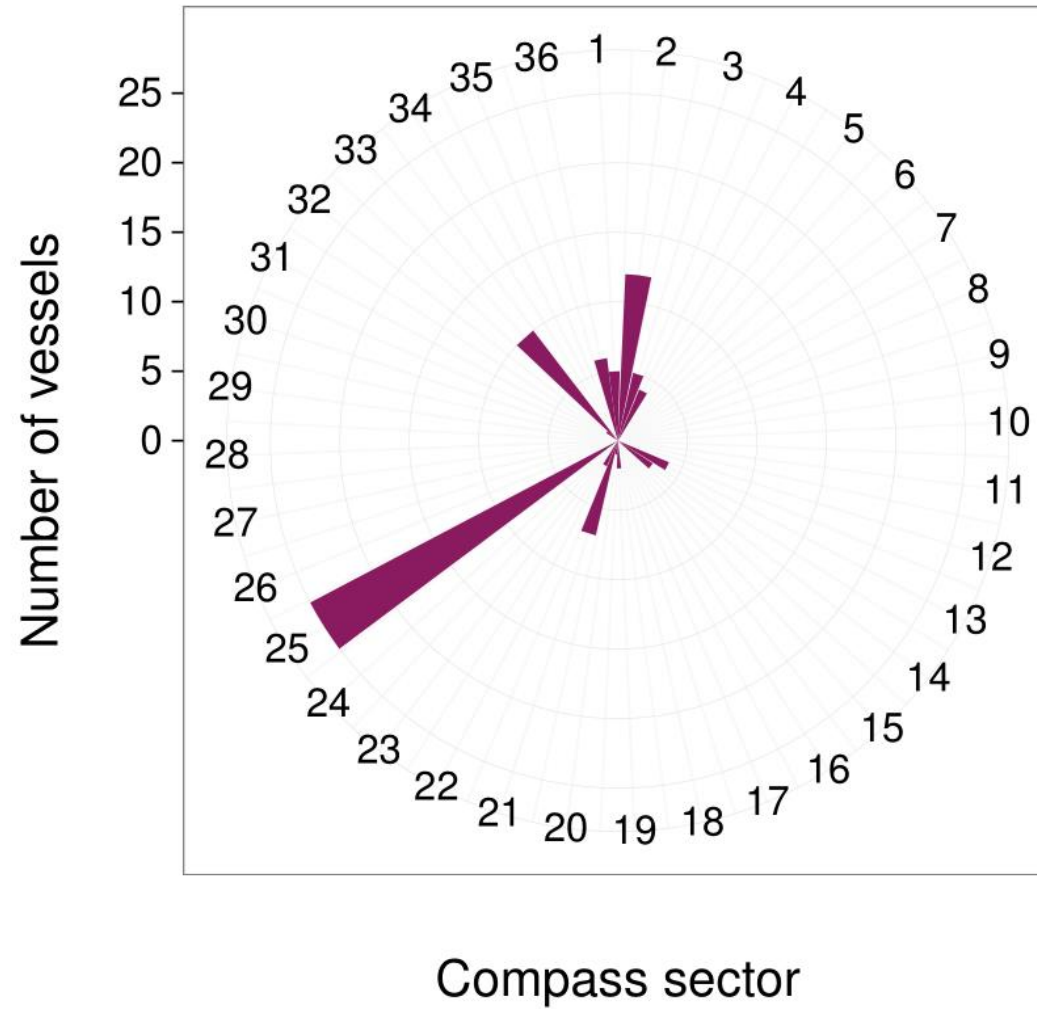
Data



Data

- A node contains statistics about the speed and direction of vessels registered nearby. Data regarding direction is presented using a circular histogram, a so-called compass rose.

Data



Anomaly detection

The anomaly detector has two main components:

- Comparison of an observation with statistics from its closest neighboring nodes.
- A triangle constructed symmetrically about the course over ground and the distance to the closest node inside this triangle.

The anomaly score is then defined to be the largest of the two subscores.

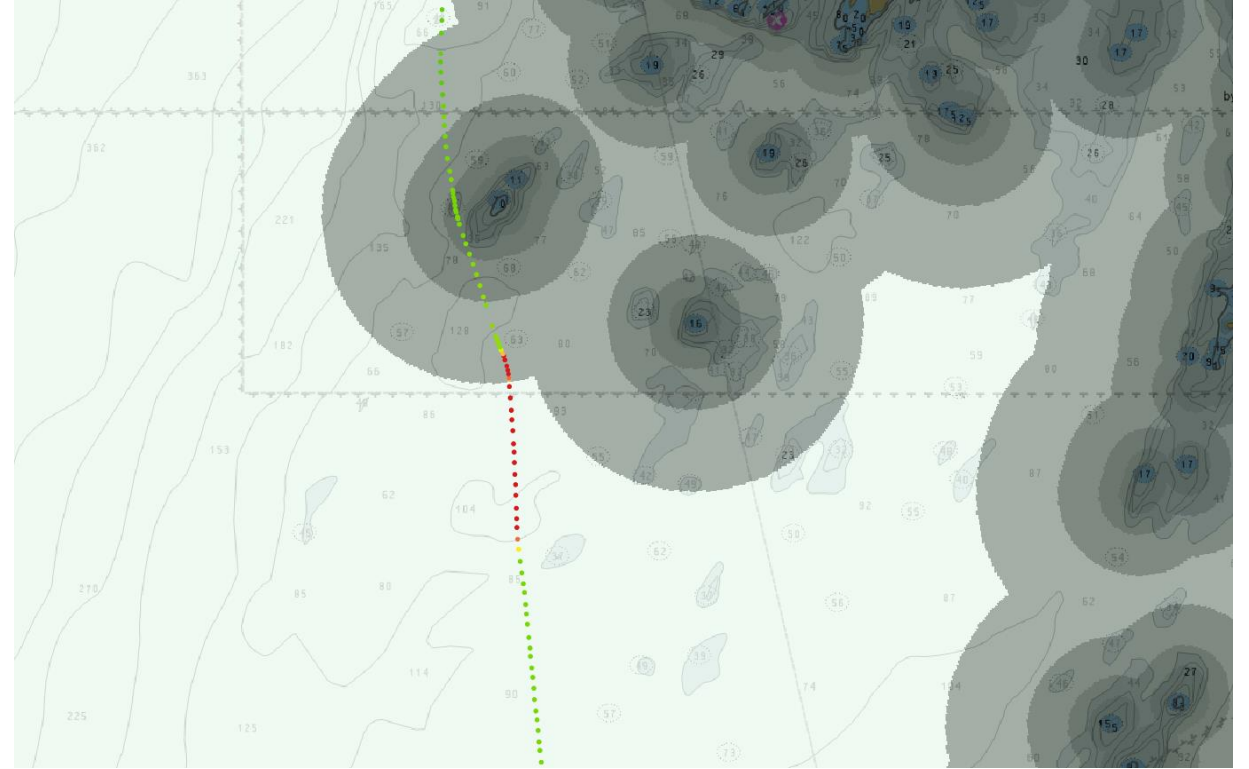
Anomaly detection

The first subscore is a function of the following:

- Deviation from mean speed.
- Deviation from dominant course (determined using the compass rose).
- Distance to the mass center of the area.

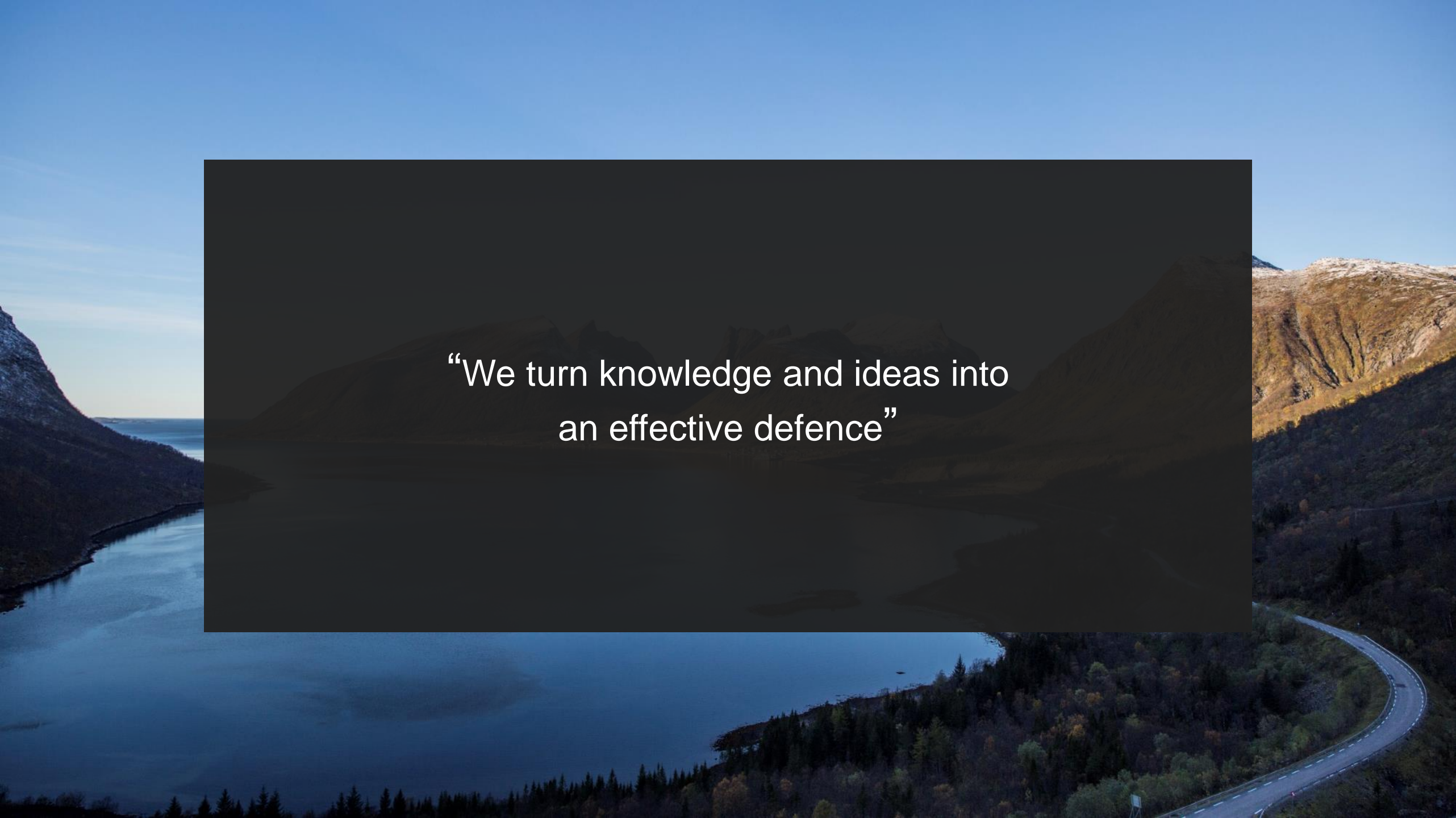
Example

- A vessel headed for a shallow. The anomaly score is colored from green to red. In this situation, the vessel was alerted by the VTS operator and advised to turn port to avoid grounding.
- The anomaly detector provides an early alert in this example.



Conclusions

- The anomaly detector is capable of detecting ships headed for shallows or shore.
- The anomaly detector can produce soft alarms for some anomalous behavior, such as ships sailing in disagreement with the leads.
- The data structure is suited to the task due to its ability to give preprocessed local context in a simple way.



“We turn knowledge and ideas into
an effective defence”