



## **Demarcation of marine geogenic reefs using Haar-like features**

Rune Michaelis, Svenja Papenmeier, and H. Christian Hass

Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Wadden Sea Research Station, List/Sylt, Germany  
([rune.michaelis@awi.de](mailto:rune.michaelis@awi.de))

Geogenic marine reefs composed of cobbles and boulders are important subtidal habitats for various sessile and mobile species. This is especially the case in marine environments dominated by a sandy seafloor like the North Sea. Despite their ecological importance for the marine ecosystem reefs and their ecosystem functions are threatened by human activities (e.g. fishery) besides the natural disturbances induced by ongoing environmental change.

The protection and monitoring of this habitat type requires an accurate demarcation based on survey methods with a resolution high enough to detect individual reef-building features. Just recently, the German Federal Agency for Nature Conservation proposed a guideline to demarcate reefs based on the number and distance of individual boulders (diameter >25 cm) using side-scan sonars. At present, there is no reliable way to accomplish this other than to manually identify and pinpoint boulders which is a difficult and time-consuming process.

To address this and similar requirements, we here present an approach based on Haar-like features to automatically detect objects on side-scan sonar mosaics. Haar-like features are digital image features (i.e. groups of pixels-forming objects) that are used to more precisely categorize images than using e.g. pixel intensities. The Haar detector was trained using thousands of positive and negative images (i.e. extracted images of real objects versus real and artificial non-object images). The automatically detected objects revealed a good spatial accordance when compared to manually extracted objects. However, the automatic detection never reached the sheer number of manually-picked objects. This occurs in particular when the boulder fields are very dense and touching each other. Work is continuing to tackle this problem using more and better matching training images. For the time being this method presents a suitable and reproducible way to scan sidescan-sonar mosaics of unknown areas for possible occurrences of boulders. Areas under suspicion can then be selected for further in-depth analysis.

We conclude that the utilization of Haar-like features is an useful approach to detect individual objects on the seafloor and to create the data base necessary for the spatial demarcation of geogenic reefs.