Ship Detection Using Synthetic Aperture Radar

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Synthetic aperture radar image includes waves, internal waves, vessel detection, and tides. With regard to the ship detection, the synthetic aperture radar PALSAR-2 mounted on ALOS-2 and AIS (Automatic Identification System), which transmits and receives identification codes, ship names, positions, speeds, etc., will cooperate. Surveillance is being conducted to identify suspicious vessels.

This study conducted the vessel monitoring in three steps:(1) Measuring the backscattering coefficient (s^0) from the orthocorrected image, and the ship is defined to be detected when the average value ($\sigma Avg.0$) over the small area exceeds the threshold value (σth). (2) Marking the estimated target area, converting the pixels-lines of the area into latitude and longitude, and comparing it with AIS location information.(3) Measurement of the displacement between the ship and the wake wave in azimuth direction, and estimating the line-of-sight component of the ship. This LOS speed is calsucrated also from AIS and used for the comparison.

We used three scenes of November 18, 2019 in the waters from the Pacific Ocean in Wakayama Prefecture to the Kii Suido and Osaka Bay, taking into account the number of vessels traveling and the expected speed of navigation. At the same time, AIS information of the same area was used to compare ship detection and speed calculation.

We performed the supervised classification in adopting Pacific data as a teacher, small areas are 3 pixels per side by trial and error, and the threshold is -8.0 dB. As a result, we obtained that, 1) the number of detected vessels containing AIS position information was 27/29 (95%) and 25/25 (100%). The percentage of detected ships was 31.02% and 8.38%. Because many coastal structures such as artificial islands and bridges were detected in the Kii Channel and Osaka Bay, the number of non-vessel detections increases. The larger number of vessels were found more than in the AIS information is probably due to that some vessels, such as small boats and destroyers, do not need to carry AIS or do not emit AIS. 2) For the velocity estimation, the relative error compared to AIS was -63.3% to 48.8%.

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