Detection of Small Fishing Vessels from ALOS PALSAR Data with CFAR and MLCC Techniques

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In recent years, there have been some development in ship detection by incorporating AIS (Automatic Identification System), ground-based maritime radars and SARs for ocean traffic monitoring, fshing control, identification of ships responsible for oil pollution and protecting from maritime crime by pirates (Gredanus et al., 2006). Most of ships used for these previous experiments were large compared with the SAR resolution cell, and little work was reported on the detection of ships of sizes comparable with the resolution cell. Thus, it is a challenging work to investigate the ability of spaceborne SARs to detect small boats.

During the Cal/Val stage of ALOS-PALSAR in 2006, we deployed three small fishing boats in the Tosa Bay in Kochi, Japan, for the purpose of testing the ability of PALSAR to extract small boats by means of CFAR (Constant False Alarm Rate), MLCC (Multi-Look Cross-Correlation) and CCF (Cross-Correlation Function) techniques. We deployed 3 types of small fishing boats of length 9, 12 and 14 m, which were made of FRP (Fiber Reinforced Plastics) with attached winches and fishing equipments on deck. During the time of PALSAR observation over the test site, three fishing boats separated by 50 m in the azimuth direction were cruising with a speed of 8 knots in the range direction. Each boat started with 2 min time intervals. It means each boat was separated about 500 m in the range direction. The same experiment was repeated 4 times for the different modes, including FBD 41.5, FBS 21.5, FBS 34.3 and PLR 20.5. The CFAR algorithm with Weibull distribution for the noise model (Sekine et al., 1990) was applied to full-look images, MLCC to the 2-look images of each mode (Ouchi et al., 2004), and CCF of different polarization images in PLR mode.

Detectability assessment was made by SNR (Signal to background Noise Ratio) value and comparison was made in terms of different PALSAR modes and different ship detection algorithms.

As a result, we have obtained the following results. Both the algorithms of MLCC and CFAR performed well in the FBS and FBD modes, highlighting their characteristics, i.e., extraction of boats embedded in noise by MLCC, and increase in SNR by CFAR. The CCF algorithm using HH and HV polarization amplitude images in PLR mode was also shown to be effective. In this study, we have analyzed only a limited amount of data, but the present results demonstrate the ability of PALSAR in ship detection in which the sizes of ships are comparable with the resolution scale.