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MU レーダー実時間アダプティブクラッター抑圧システムの開発
Development of MU radar real-time processing system with adaptive clutter rejection

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Strong clutter echoes from a hard target such as a mountain or building sometimes cause problems of observations with atmospheric radars. In order to reject or suppress clutter echoes, it is effective to use DCMP-CN (Directionally Constrained Minimum Power-Constrained Norm) method, which makes null toward the direction of the clutter, if we can receive signals independently from plural antennas. It has been demonstrated that the DCMP-CN method is effective to real observation data with the MU (Middle and Upper atmosphere) radar, but it was processed in off-line. The objective of this study is to implement the clutter rejection by DCMP-CN method into the on-line processing system of the MU radar. Namely, we can adaptively suppress clutter echoes in real time without changing any MU radar hardware.

The MU radar which located in Shigaraki, Shiga Prefecture, Japan is one of the most powerful VHF-band atmospheric radars, which can observe atmospheric motion and circulation between the troposphere and the upper atmosphere and which has contributed to a wide variety of research areas. Its operational frequency, occupied frequency bandwidth, and peak output power are 46.5 MHz, 3.5 MHz and 1 MW, respectively. The MU radar has an active phased array system. Its antenna consists of 475 elements of crossed Yagi antennas and is divided into 25 groups. Each group has 19 antenna elements. After installing the ultra multi-channel digital receiving system in 2004, we can receive signals from each 25 group, independently.

We cannot apply simple DCMP method for the MU radar signals. Because DCMP method suppresses clutter echoes too much to break main robe of antenna pattern in high SNR case. In order to solve this problem, Nishimura et al. supposed DCMP-CN method, which can maintain the shape of main robe with suppressing clutter echoes to add pseudonoise and demonstrated its effectiveness for atmospheric radar observations. So far we sum up independent signals without weighting from 25 channels (groups). Applying DCMP-CN method before summing enables on-line processing. Now, we are implementing DCMP-CN method into observation system and expect to show test results in our presentation. In order to apply DCMP-CN method appropriately, we have to change constraints which depend on desired SNR. Through the real observation data, we will optimize constraints. In this presentation, we have taken account of clutter echoes from only fixed targets such as mountain, but we are going to deal with airplane and meteor echoes. Furthermore, we can apply the achievement of this study to the Equatorial MU radar (EMU), which is proposed to be constructed at West Sumatera, Indonesia. The EMU system is the similar as the MU radar, but its antenna consists of 1045 Yagi antennas with 55 groups.

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