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 sometimes cause problems of observations with atmospheric radars. In order to reject or suppress clutter echoes, it is effective to use NC-DCMP (Norm Constrained-Directionally Constrained Minimum Power) method, which makes null toward the direction of the clutter, if we can receive signals independently from plural antennas [Nishimura et al., JTech., 2012]. It has been demonstrated that the NC-DCMP 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 NC-DCMP method into the on-line processing system of the MU radar. NC-DCMP method suppresses clutter echoes with maintaining the shape of main lobe to add pseudo-noise.

The MU radar is operated in a troposphere-stratosphere standard observation mode for about 100 hours every month. First we implemented the NC-DCMP processing to this standard observation mode. Observation data in this mode is obtained once every 8 seconds. Therefore it is necessary to perform all of the signal processing within 8 seconds in order to perform the clutter suppression in real-time. Now we can process the NC-DCMP in 1 second in average. Since the echoes from mountains and buildings do not change so quickly, it showed good results to determine the optimum weight vector using the received signal of the incoherent integration 7 times (about one minute). We have applied the NC-DCMP real-time processing since November 2015. Although it is not perfect for the echoes from the aircraft, the effect of suppressing is obtained.

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.

Key words: Atmospheric radar, Clutter rejection, NC-DCMP method, the MU radar