X帯気象用フェーズドアレイレーダにおける修正Capon法の適用
Capon beamforming with diagonal loading for X-band phased array weather radar

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The X-band Phased Array Weather Radar (PAWR) at Osaka University has performed three-dimensional precipitation observations in less than 30 seconds [1]. The observation range is 60 km. As a transmitted waves of the radar, a fan-shaped transmission beam is used, with a narrow beamwidth (1.2 [deg]) in azimuth and a wider beamwidth (5.0 [deg]) in elevation. In elevation angles, Fourier beamforming method is used for electronic scanning, with 128 antenna elements. The fan beam is useful to support rapid scanning. However, the received signals tend to be affected by the influence of ground clutter. The PAWR is intended to operate in urban areas, where many tall buildings exist. Consequently, clutter echoes have much influence, even at high elevations.

The PAWR is developed on the premise of being applied to advanced digital beamforming (DBF) is used for electronic scanning in elevation methods, such as the Capon beamformers [2,3]. In this paper, we applied the Capon beamforming with diagonal loading for the X-band phased array weather radar.

To discuss the impact of the clutter reduction using the Capon beamforming with diagonal loading (CPDL), the signals received by the 128 channels of the PAWR on July 1, 2016, 13:56:15 (JST) are used. The proposed correction procedure was shown to be capable of handling those errors in both domains (phase and amplitude). From the comparison between the results of the different DBF methods (FR and CPDL), FR overestimated the received power from low elevation angles (0˚–*5*˚) to high elevation angles (10˚-30˚) because the beam pattern has the high sidelobe level. On the other hand, CPDL was shown to be very effective in mitigating the clutter at all elevation angles, because of its better suppression of the sidelobes at low elevation angles.

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