

赤道MUレーダーの観測角度範囲拡大のためのアンテナ配置に関する研究 Study on Antenna Arrangement of Equatorial MU Radar for Widening Observation Angle Range

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Cumulonimbus convection is active in the equatorial atmosphere. It generates various atmospheric waves that propagate upward to transport energy and momentum into the upper atmosphere including the ionosphere. The Equatorial Atmosphere Radar (EAR) has been operated in Kototabang, West Sumatra in Indonesia (0.20S, 100.32E) since 2001. The EAR has a circular antenna array of approximately 110 m in diameter, consisting of 560 three-element Yagis. However its peak power is only 100 kW, which is 1/10 of the MU radar in Shigaraki, Japan. It is proposed to construct the Equatorial MU radar (EMU) which has the similar function and performance as the MU Radar. The antenna of EMU consists of 55 groups, and each group consists of 19 three-element crossed Yagi antennas. Its peak output power is 500 kW in total.

We investigate the optimum antenna arrangement of EMU. Antenna arrangement of the MU Radar and EAR, triangular arrangement, has a problem of generating a grating lobe when the beam zenith angle is over 40 degrees. We tried to find the optimum antenna arrangement that has no grating lobe, lower sidelobe level and simple arrangement by using optimization method of trial and error (antenna potential function method) [Nishimura and Sato, 2009]. We use this method under various restricting conditions, and get various antenna arrangements that are possible to be the optimum antenna arrangement.

We conclude that the following arrangement is the best for EMU in this method: Each group (having 19 antennas) is hexagon-shaped triangular arrangement, and groups are arranged so that each ridge of the hexagon is in parallel with ridge of an adjacent hexagon. In the best arrangement, a grating lobe is reduced by 5 dB. Therefore, it becomes possible to observe low elevation angle by using adaptive clutter rejection method [Kamio et al., 2004]. However, sidelobe levels of other directions are increased by 15 dB at most. Further investigation is needed to decide to adopt this arrangement or not to EMU.

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