Dual-polarization Feed Systems for Satellite Communication Earth Station Antennas

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This thesis contributes to the spread of satellite communications and efficient use of frequency resources, by establishing design methods and improving the performance of dual-polarization feed systems for satellite communication earth station antennas. According to the diplexing order from the antenna, two types of feed systems have been studied: a frequency-polarization selective feed system (FPSF) and a polarization-frequency selective feed system (PFSF).

The key components limiting the operational bandwidth of the FPSF are a dual-polarization branching filter (DBF) and polarizers. A DBF using the fourth power cosine tapered waveguide is proposed. A design method is given based on concise approximated formulae derived from the generalized telegraphist's equations for waveguides. A DBF for 6/4 GHz bands was designed, and 800 MHz operational bandwidth has been obtained in both bands. The bandwidth is 1.6 times wider than that of a conventional DBF.

A design method has been established for a wideband polarizer with metallic posts. The axial ratio in dB of the polarizer has been improved to a quarter of that of a conventional one, utilizing the frequency characteristics of susceptance of posts shorter than 1/8 wavelength.

The key components of PFSF are an ortho-mode transducer (OMT) and a transmit/receive-band diplexer. An OMT using a crossed rectangular waveguide is proposed, and the deign method is given. The designed OMT operates well in 30 percent fractional bandwidth over 14/11 GHz bands.

A hybrid diplexer using branch waveguide directional coupler with ridged main and auxiliary waveguides is proposed, and its design method is given. The wide operational bandwidth has been theoretically estimated, and experimentally verified.

As the result, wideband dual-polarization feed systems for satellite communication earth station antennas have been developed, which operate respectively in 6/4 and 14/11 GHz bands allocated at the 1979 World Administrative Radio Conference.