INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Offset reflector antennas (ORA) are popular due to their low aperture blockage and good isolation between the feed and the reflector. However, the asymmetry in ORA geometry also leads to depolarization of the waves incident on the reflector, thereby generating high cross-polarization in the asymmetric plane of the reflector. Such high cross-polar levels can be reduced by conjugate field matching (CFM) technique. In this technique, an asymmetric higher order mode similar to the asymmetric focal-plane field component, is generated in the reflector feed. The higher order mode is generated at an appropriate ratio with respect to the dominant mode in order to achieve optimal field matching. This technique is often employed in traditional matched horn feeds. Use of microstrip antennas as alternate feeds has generated lot of interests among the research community due to their low profile, light weight and low cost attributes. This thesis investigates the performance of the matched feeds using microstrip antenna and arrays working on the principle of CFM. A total of 6 matched feed designs are proposed in this thesis, which includes: (1) A dual-mode (TM_{11} and TM_{21}) CMPA generating both the modes at an appropriate ratio is designed for cross-polar reduction in the reflector pattern. (2) A single layer centered circular array (CCA) of 9 elements as matched feed is proposed, which consists of 8 TM_{11} mode operating ring CMPA elements and a central TM_{21} mode generating CMPA. (3) A dual-layer CCA matched feed of 10 elements is studied as matched feed, which is further investigated for reflector pattern re-configurability in terms of beamwidth control and beam shifting. The top layer of CCA consists of 9 CMPAs each operating in TM_{11} mode while the bottom layer contains a CMPA, placed below the central element and operates in TM_{21} mode. (4) A dual-layer CCA matched feed of 10 elements similar to the previous design is investigated for dual-band application. The ring elements and the central dual-mode CMPA elements operate at 4 GHz and 6 GHz, respectively, (5) A dual-mode matched feed is designed in which the TM_{21} mode is generated by an annular ring patch. The dimension of the annular ring patch is adjusted for best cross-polar suppression at the operating frequency. (6) A dual-mode matched feed is designed in which the top layer consists of a rectangular microstrip patch antenna generating TM_{10} mode and a CMPA generating TM_{21} mode. In all the proposed matched feeds, the cross-polarization is reduced well below -30 dB while maintaining the sidelobe level better than -18 dB. The last two designs are also optimized for small offset reflectors (diameter less than 10λ) and specifically targeted for 5G sub-6GHz band applications. In addition, the thesis also includes a brief study on the performance of conventional microstrip array as a feed for offset reflectors.