A Novel Planar Microstrip Line Comparator Network for Monopulse Tracking Radar System

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By concurrently receiving and comparing the signals from multiple directional radiation beam, the monopulse tracking radar estimates the range, velocity of scatters, and the angles of objects in three-dimensional doppler map, which attracts great interest in wireless communication, radar, remote sensing, imaging, and autonomous driving applications. Typically, a microwave comparison network composed of rat-race coupler and crossover is applied to feed the radiating element in monopulse tracking radar. Due to unsymmetrical layout of sum (Σ) and delta (Δ) ports of rat-race coupler, the conventional comparator network heavily relays on expensive and complicated 3D fabrication technology for multistage ports connection, which causes additional power loss and became challenging at high frequency. Recently, a novel planar hybrid lumped element approach is proposed to overcome this issue at low frequency application. However, the parasitic of lumped element is not negligible when the frequency increases, whereas the frequency shift and distortion of insertion loss are key design challenges. Thus, in this paper, a novel planar microstrip line only comparator network is proposed to overcome the issues in conventional design and new lumped element hybrid design. As in Fig. 1, the proposed comparator includes novel symmetric 180° couplers and zero phase delay crossover, where two 90° couplers are cascaded by two different phase delay lines to form the symmetric 180° coupler. Here, the sum of phase delay from two phase shifters is 180°, and the shorter phase delay line determines the coupling coefficient of coupler, in which the coupling is 3 dB for proposed comparator network. To verify the proposed design theory, a prototype for proposed novel comparator network is fabricated on RO5880 LZ board, and the photo of device is shown in Fig. 1. Here, the signals are acquired by antenna array at P_1, P_2, P_3, and P_4 ports, and P_5, P_7 and P_8 ports generate the Azimuth, Elevation and Sum information of detected target.

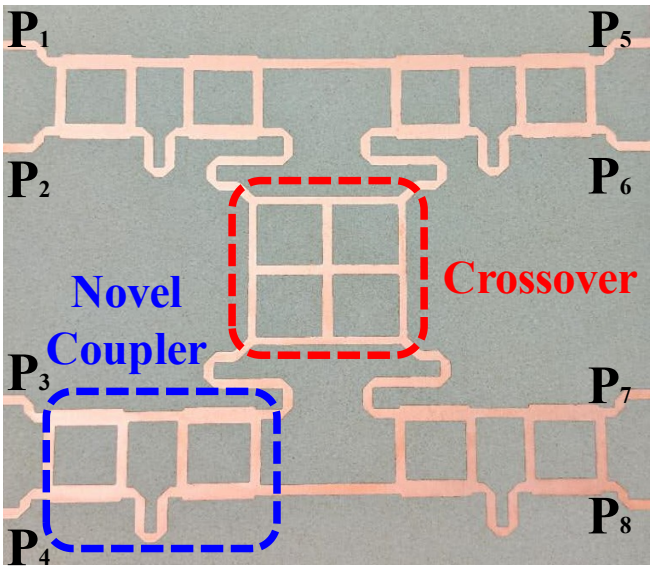

Figure. 1. The fabricated layout of novel feeding network