Control of the Radiation Direction in an Aperture Array excited by a Waveguide 2-plane Hybrid

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The waveguide 2-plane hybrid [1] has 2x2 ports at the both sides of the coupled region as shown in Fig. 1. The ideal operation of this hybrid is as follows. For an incidence from Port 1 as an example, Ports 1–4 have no outputs and Ports 5–8 have equal division in amplitude. Ports 6 and 7 have 90-deg. delay and Port 8 has 180-deg. delay in comparison with Port 5. The radiation from these four ports tilts two-dimensionally. The four input ports switch the beam directions.

Each radiation aperture distance needs to be changed to control the beam direction. However, the positions of the ports cannot be changed because they affect the coupling characteristics of the coupler. We place a plate with taper waveguides and control the beam directions. In the taper waveguides, irises are introduced to reduce the reflection. Four edges in the plate are rounded to prevent from the diffraction effect on the radiation patterns.

Fig. 2 shows the simulated quasi E-plane patterns at the design frequency of 66.5 GHz. The solid lines present the results using tapered waveguides so that the aperture spacing is reduced to 1.21mm while the dashed lines present those for the aperture spacing equal to 1.85mm. The beam directions are changed from 32 degrees to 54 degrees. The 3dB beamwidth is almost unchanged (about 60 degrees). The hybird is under fabrication. The measured results of the radiation patterns as well as the scattering matrix of the hybrid will be shown in the conference.

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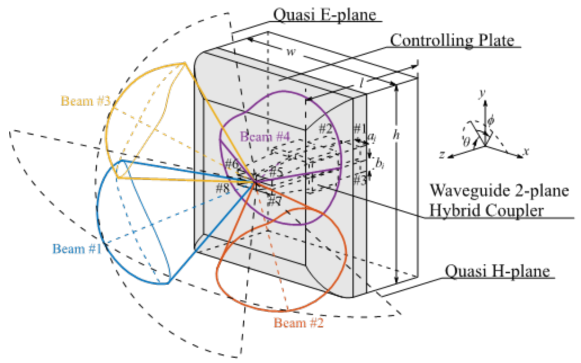

Figure 1. Waveguide 2-plane hybrid

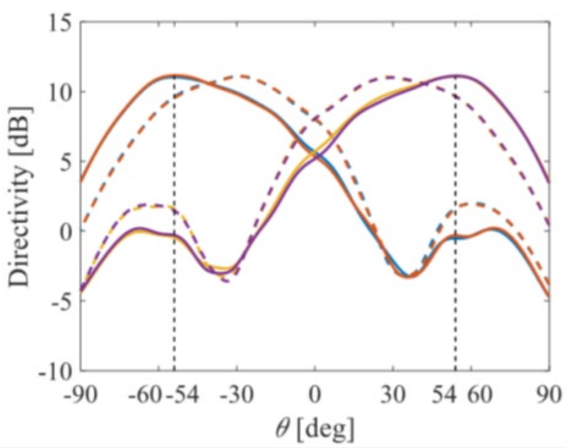

Figure 2. Quasi E-plane patterns

References

[1] D.-H. Kim, J. Hirokawa, and M. Ando, IEEE Trans. Microw. Theory Tech., vol. 64, no. 3, pp. 776–784, Mar. 2016.