Steerable Yagi Array Antennas Using Dielectric Phase Shifters

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Abstract

In our previous papers, we have demonstrated that the dielectric phase shifters fabricated on CPW can be used as the phase shifter of a steerable array antenna. Changes in the effective dielectric constant at varying dielectric slab positions on the CPW act as the phase shifter. The impedance matching and the desired phase shift conditions are satisfied at two slab heights with the use of low-loss dielectric materials. Our previous antennas at 20 and 24 GHz incorporated the series-fed microstrip patches (7 element for 24 GHz and 4 elements for 20 GHz) as the radiating elements. This is a broadside antenna and the bandwidth is limited by both the feeding networks and patch antennas. Although an array antenna based on patch is easy to fabricate, certain applications require the endfire radiation patterns. In order to design an endfire antenna and also to increase the bandwidth, we have investigated the use of Yagi antennas as radiating elements. We have also investigated the use of the balanced TL section of the Yagi antenna as the dielectric phase shifter. Numerical simulations using Ansoft HFSS and Designer are conducted to obtain the exact dimensions. Both 4x1 and 8x1 steerable Yagi antennas with phase shifters are designed and fabricated at 5.8 GHz. The E- and H-plane radiation patterns are measured at different phase shift positions and compared with the expected results. The potential application of this antenna will be for small UAVs. To transmit high-resolution video images from UAV to ground, a low-cost beam steerable antenna with a high bandwidth is desirable.