Mechanically Steerable Array Antennas Using Controllable Microwave Phase Shifters

Abstract

Low-cost antenna systems are important issues of the recent and the future flexible wireless communication systems. The most flexible satellite to ground/airplane communication systems are based on the phased-array antenna technology. However, the cost of phased array antenna is related to the number of active elements, and the present systems are too expensive for many commercial/military applications. In this paper, a novel design is proposed for a low-cost mechanically steerable array antenna. First, we fabricated and measured that a movable dielectric slab placed close to a coplanar waveguide (CPW) with gap used as a phase shifter. The added dielectric slab on CPW changes the effective dielectric constant and the characteristic impedance of CPW. Second, the 4-element array patch antenna with feeding network is fabricated and measured. Finally, based on previous ideas the mechanically steerable antenna designed and fabricated. The antenna consists of 4 patch antennas, 3 phase shifters, delay lines, and feeding network at 5.8GHz. The total antenna is fed from a 50Ω microstrip transmission line and the array antenna is designed to have an input impedance of 98Ω. The phase shifter consists of an adjustable phase shifter which uses the movable dielectric slab placed on a CPW and a fixed delay line to preset the phase of each feed line. Unfortunately, when the dielectric slab is added to CPW, reflection can be increased. To minimize reflection due to a dielectric slab, we set the length of the modified section to be $\lambda/2$ (or $m\lambda/2$ where m is an integer). Therefore, impedance mismatch can be avoided by choosing the slab dielectric constant and length carefully.