

Novel Phased Array Designs Using Reconfigurable Reflection and Transmission Surfaces

Fan Yang*, Shenheng Xu, Xiaotian Pan, Xue Yang, Jun Luo, Min Wang, Yu Wang, Maokun Li
Department of Electronic Engineering, Tsinghua University, Beijing, China
fan_yang@tsinghua.edu.cn

Phased array antennas are essential devices in radars, wireless communications, remote sensing, and many other applications. In order to achieve the phase control, microwave components such as phase shifters or T/R modules are used in conventional phased array designs. However, the power efficiency and system cost are critical concerns in these phased arrays, especially for large scale designs or millimeter-wave operations. Recently, reconfigurable reflectarrays (RRAs) and reconfigurable transmitarrays (RTAs) provide an alternative solution to phased arrays, which have numerous advantages, such as high gain, high efficiency, conformal geometry, feasibility for millimeter-wave and THz operation, and low system cost.

This invited paper presents an overview of recent progress in RRAs and RTAs for phased array applications. An RRA consists of a feed structure and a reconfigurable reflection surface, as shown in the left of Figure 1. Each element on the surface can be individually controlled. The phase control function and the scattering function are integrated within each unit cell. For RRAs, three representative examples will be discussed, namely, a W-band RRA design, a 2-bit RRA design, and a large-scale RRA consisting of 10240 elements.

An RTA consists of a feed structure and a reconfigurable transmission surface, as shown in the right of Figure 1. Compared to RRAs, it is more challenging to design RTAs, since both the transmission magnitude and phase need to be considered. Two design approaches will be presented: the frequency selective surface (FSS) approach and the receive-transmit (Rx-Tx) approach. To demonstrate the feasibility of these approaches, corresponding antenna designs and prototypes will be illustrated. As a new solution for phased arrays, it is believed that the RRA and RTA have a great potential for practical engineering applications.

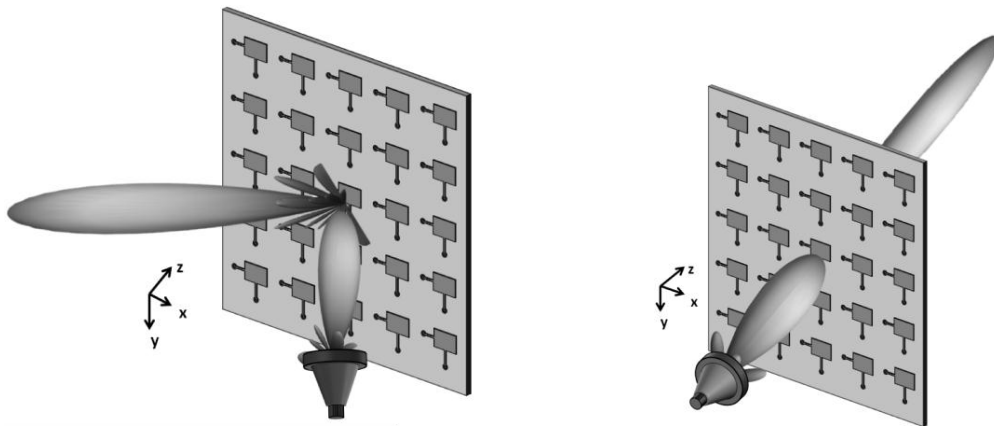


Figure 1. Novel phased arrays using reconfigurable reflection surface (left) and transmission surface (right).