ABSTRACT

The work considered here discusses two related topics. First, the development of a novel pattern reconfigurable printed antenna element for Global Positioning System (GPS) applications is presented. This antenna element consists of a microstrip patch, fed by four probes, and surrounded by a parasitic octagonal metallic ring loaded with diode switches. The patch and ring are located on top of a thick dielectric substrate. This novel concept is based on controlling the propagation characteristics of surfaces waves within the substrate by using a metallic parasitic ring. If properly designed, this ring can control the radiated surface waves that interact with the main beam radiated by the patch itself. It is shown through computer simulations and measurements that the beamwidth of the antenna can be changed by turning the diode switches on and off. This dissertation discusses the complete design of the radiating patch, diode switches and biasing circuitry. The effect of these additional structures on the radiation pattern is also discussed since our computer models do include these components. This antenna concept was developed to minimize the effect of interfering signals incident on the antenna along the horizon. This dissertation also shows that microstrip antennas can be fabricated with a thick substrate without the usual surface wave problem.

The second topic considered in this dissertation is the development of the theory of characteristic modes using a time domain Maxwell equations solver. This method

can provide a clear physical insight to the behavior of antennas. The conventional approach for computing the characteristic modes has been in the frequency domain in conjunction with the Method of Moments. The method described here uses the finite difference time domain (FDTD) technique. The proposed method provides a major advantage over previous frequency domain algorithms because the resonances of the structure can be captured in a single FDTD run. To illustrate the method, we compute the resonances as well as the characteristic modes for several structures, such as, a printed dipole antenna, a reconfigurable printed antenna for application in the global positioning system (GPS) and a log-periodic antenna which is a wideband structure. To access the validation of our proposed method, we compare the simulated results to the analytical solutions, and discover an excellent agreement between the resonances predicted by both methods.