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# Overview of Radio Frequency Microelectromechanical Systems Reconfigurable Antennas

A.H.M. Zahirul Alam

Department of Electrical and Computer Engineering, Faculty of Engineering
International Islamic University Malaysia, Jalan Gombak, 53100 Kuala Lumpur, Malaysia
zahirulalam@iiu.edu.my

## ABSTRACT

A review of reconfigurable antennas based on radio frequency microelectromechanical systems (RF MEMS) technology, from the perspective of its design perspective is presented. An overview of designing reconfigurable antennas at different design aspects is presented. The importance of understanding the limitations for realizing the RF MEMS reconfigurable antennas is discussed.

## 1. INTRODUCTION

The last several years have seen an exponential growth in the development of reconfigurable antennas, i.e., antennas whose aperture can be dynamically modified to enable different functions at different times. The antenna aperture can be specifically tailored to the application at hand, greatly increasing antenna efficiency and signal-processing speed, while maintaining a high degree of flexibility. The development efforts include real-time or even partial reconfigurability using either semiconductor or microelectromechanical switches (MEMS).

Antenna functionality depends on the antenna's radiating elements' parameters, such as the sizes, shapes, and positions of the radiating elements over the aperture. Modifying (i.e., reconfiguring) the parameters of these radiating elements enables using the same antenna aperture for multiple functions [1]–[7].

In the reconfigurable antenna, the structure of the antenna can be changed, for example, by changing the state of switches, to optimize the performance of the antenna for application in different systems. Several approaches have been proposed for implementing the reconfigurable antenna. Most of these approaches make use of either electronic or electromechanical switches. The former includes switches based on the PIN diode or the field-effect transistor (FET), while the latter includes simple relays and a number of different types of microelectromechanical system (MEMS) switches. In some designs, the switches are used to change the length of an antenna element, such as a dipole or a slot, and, thereby, shift the frequency of operation (resonant point) [8]–[14]. Other designs involve structures with multiple layers. Each layer may be an array of antennas optimized to radiate in a particular frequency range or an image plane intended to reflect within a particular frequency range [15], [16]. The switches are then used to change which layer is operative. Other approaches make use of diodes with electronically variable capacitance (varactors) instead of switches. The diodes are incorporated into reflecting surfaces, and the variable capacitance is used to tune or steer the beam of an adjacent antenna [17], [18]. In plasma regions with fairly high electrical conductivity are temporarily created on a silicon substrate [19]. These regions define the antenna structure, and they can be changed to create different antennas.

Radio frequency microelectrical mechanical systems (RF MEMS) is an emerging technology that promises the potential of revolutionizing RF and microwave system implementation for the next generation of telecommunication applications. Its low-power, excellent RF performance, large tuning range, and integration capability are the key characteristics enabling system implementation with potential improvements in size, cost, and increased functionality. An RF MEMS switch is one of the