A Novel MEMS Reconfigurable Wideband E-Shaped Patch Element for Advanced Cognitive Radio Base Stations

Joshua M. Kovitz* and Yahya Rahmat-Samii
Electrical Engineering Department, University of California, Los Angeles
Los Angeles, CA 90095, USA
Email: jmkovitz@ee.ucla.edu, rahmat@ee.ucla.edu

Cognitive radio offers new possible enhancements through its use of *dynamic spectrum access*, exploiting unused spectrum bands to expand bandwidth and overall system capacity. Development of cognitive radio systems has been underway, but there have only been a few antenna designs fitting the required functionality for these dynamic systems, which could benefit from dynamic antennas as well. The functionality required in a system also depends on the network architecture being utilized, and this research focuses on cognitive radio networks using a pre-existing infrastructure such as base stations and access points. For base station applications, directional patch antenna arrays can be implemented in order to provide sectoral access for nearby users.

A wideband frequency reconfigurable E-shaped patch design is proposed for possible use in these directional base stations for cognitive radio applications. By adding RF-MEMS switches to dynamically change the slot dimensions, one can add frequency reconfigurability to the original E-shaped patch. A discussion on the RF switch models is provided, and the full design is optimized using Particle Swarm Optimization, a Nature-Inspired Optimization technique. Reconfigurable antennas also require bias circuits to actuate the RF-MEMS switches. A novel bias circuit technique using conductive adhesive is introduced and tested to determine their applicability to reconfigurable antennas. These new bias circuits offer several advantages over the conventional techniques including their simplicity and low cost.

Our design was also fabricated and measured to determine its performance, and overall the fractional bandwidth was nearly doubled in comparison to the original E-shaped patch antenna, providing roughly 50% bandwidth. The radiation performance also demonstrates its capabilities for possible array implementation. Therefore, this research entails a complete story, addressing all the necessary components in the design of a frequency reconfigurable antenna for possible implementation as an array element. To this end, it is anticipated that this design will provide the desired reconfigurability that will enable the future design of versatile communication systems.