Rapid Millimeter-wave Antenna Measurements using the Bipolar Planar Near-field Technique

Yahya Rahmat-Samii and *Timothy Brockett*

University of California, Los Angeles, 420 Westwood Plaza, 64-118 Engineering IV, Los Angeles, CA, USA,
rahmat@ee.ucla.edu, brockett@ee.ucla.edu

Abstract

Bipolar planar antenna measurements have been used as an alternative to other planar scanning techniques such as plane-rectangular or plane-polar scanning. Bipolar scanning features important advantages such as the elimination of linear motion in measurement, increased stability, compact footprint, and a variety of data acquisition modes. These advantages mitigate many of the issues of measuring small antennas operating at millimeter-wave frequencies. These issues, such as over-sized ranges, cable loss, expensive equipment, long measurement times, and positional accuracy are just some of the issues that contribute to making measurements inefficient and cumbersome for most laboratories. As more compact millimeter-wave antenna designs are introduced, these measurement issues must be addressed to better allow cost-effective and efficient measurements to facilitate the antenna design cycle. This paper will describe and elaborate on the advantages of the bipolar scanner for millimeter-wave antenna measurement, including at introduction of new scanning modes that can help dramatically reduce measurement time over previously implemented scanning modes. Representative measurements using our millimeter-wave bipolar planar near-field antenna measurement system will show the capabilities of the bipolar scanner and verify its viability for efficient and accurate millimeter-wave antenna measurements.

Introduction

The bipolar planar scanning technique for the measurement of antennas was introduced by the authors and demonstrated to be a viable option for cost-effective measurement at millimeter-wave frequencies. Its inherent advantages make it an attractive option for the measurement of millimeter-wave antennas. With the design and characterization of small antennas operating at millimeter-waves becoming a focus of ever-increasing research and development, it is important to understand the capabilities of the measurement tools available. Fig. 1(a) shows the millimeter-wave bipolar planar near-field antenna measurement system that is located at UCLA.

Particular concerns are often considered in millimeter-wave antenna measurement. These include cable loss and flexing, positional errors, cost of measuring equipment, chamber perturbations, chamber size, and measurement time. Some of these issues such as the cable loss and flexing, positional errors and the cost of equipment are addressed inherently by the millimeter-wave bipolar scanner, while the others are addressed by unique spiral scanning modes and post-processing techniques such as the phase retrieval algorithm. Fig. 1(b) shows a diagram of the bipolar spiral scan geometry that is used for rapid measurements. These important features will be explored in this presentation and will be demonstrated with representative measurements. The authors believe that many of these features can make measurements of millimeter-wave antennas relatively painless.

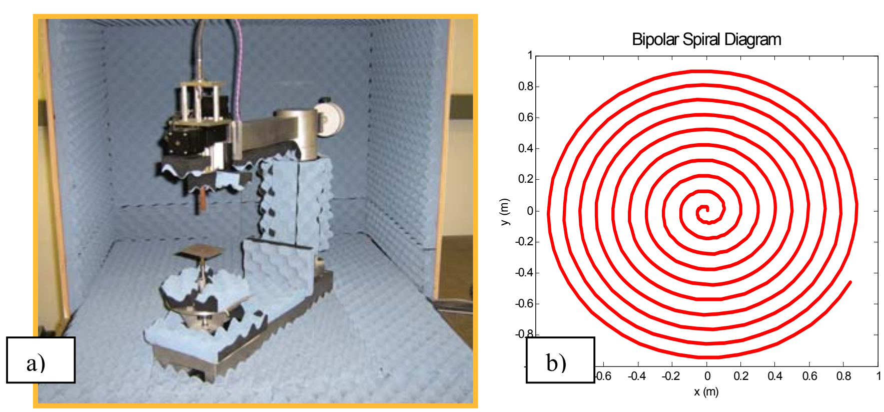

Fig. 1 – (a) The millimeter-wave bipolar planar near-field measurement system. (b) Bipolar spiral scan diagram.