Diversity Evaluation for Multiple Body-Worn Antennas

Gil-Young Lee, Dimitris Psychoudakis, Chi-Chih Chen, and John L. Volakis

Dept. of Electrical Engineering and ElectroSicence Laboratory
The Ohio State University
1320 Kinnear Road, Columbus, OH 43212, USA

Interest in wearable antennas has increased with the emergence of new conductive textile materials that allow for flexible and lightweight body-worn antennas. In addition, wearable antennas can improve practicality in their applications with personal communications, law enforcement, and military training because of their conformality and invisibility. Furthermore, body movement, clothing, posture and body shape are all constantly varying parameters that radically alter the performance of any radiator in the presence of the human body. However, the design of specialized antenna systems for each clothing item, situation or individual would be extremely impractical. Therefore, techniques used for analyzing communication channels can readily be applied for body-worn antennas and in fact are vital. Only recently, however, have such statistical techniques, typically used for MIMO systems, been introduced into body-worn antenna design.

In this paper, we present a modified diversity evaluation method for body-worn antennas. The novelty introduced in this method amounts to considering only the human body interactions separately from the surrounding environment. This formulation can then be easily adapted to different environments. The environment is modeled through the stochastic distribution of polarization and incident angle of the incoming waves. They can therefore be added in a post-processing step to minimize computation time. Our study for antenna diversity includes three human postures (standing, kneeling, and prone) to increase generality and assess antenna performance. Initially, a variety of single body-worn antenna configurations are investigated to establish the best antenna locations for each posture. Subsequently, more antenna locations are included to increase communication data throughput using the minimum set of antennas. The considered operational frequency is 500 MHz – 600 MHz and the setup focuses on the upper hemisphere with random polarization excitations.