Evaluation of SAR for Integrated EBG Textile Monopole Antenna for Space Health Monitoring Application

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Wearable textile antennas are of interest for utilization in space biomedical application since they may provide lighter and smaller form factor while they can integrated into space garment. In this paper we focus on the safety concerns and Specific Absorption Rate (SAR) evaluation of a compact wearable antenna system designed at operating frequency of 2.45 GHz in the Industrial, Scientific and Medical (ISM) band, intended for integration into a flight jacket of the astronaut inside the habitat. The purpose of the system is to constantly monitor vital signals of the astronauts. The habitat is designed by a team of researchers at the University of North Dakota (http://human.space.edu/projects/NDX-2.htm)

Initial simulation results show that the original monopole antenna has a high radiation level towards the body, while the Front-to-Back Ratio (FBR) was enhanced as much as 14.67 dB, by integrating the antenna with an electromagnetic band gap structure (EBG). The simulations were performed using a three-layer model of human body tissues (muscle, fat, and skin). The antenna was conformed to the body or placed in the proximity of it. Mass averaged SAR method (typically 1g and 10g) was used in the simulation for 1 Watt delivered power.

The EBG antenna characteristics in terms of return loss, realized gain, FBR, and -10 dB bandwidth remain robust when it is placed close to the human body model as compared with the conventional antenna design. For the considered input power, the proposed EBG antenna experiences SAR levels of 0.6053 W/kg and 0.3393 W/kg for 1g and 10g tissues, respectively, which are less than the maximum limits imposed by the most commonly used SAR standards. IEEE 1.6W/Kg for any 1g tissue, and ICNIRP (International Commission on Non-Ionizing Radiation Protection) standard imposes 2W/kg for any 10g tissue. Moreover, EBG antenna has reduced SAR by 96.3% for 1g and 96.4% for 10g tissues in compare to the original monopole antenna. Further details on the simulation results will be presented at the conference.