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[Invited Talk]
Various antenna design techniques for medical applications

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Abstract

In this talk, various antenna design techniques for medical applications are introduced. Three types of antennas for medical application are proposed. To minimize the body effect, high dielectric material, zeroth-order resonance configuration, and an inverted-F structure with a meandered strip line techniques are utilized.

I. An implanted compact antenna for an artificial cardiac pacemaker is proposed. The dimension of the pacemaker system, including the antenna element, is 30 mm × 35 mm × 7 mm. Taconic CER-10 with a relative permittivity of 10 is used for the substrate and two superstrates to reduce the effect of high conductive body tissue on the antenna. When the antenna is embedded in a semi-solid flat phantom with equivalent electrical properties as the human body, S11 value is -19.2 dB at 403.5 MHz. The measured specific absorption ratio (SAR) value of the proposed antenna is 0.0079 W/Kg (1 g tissue). Moreover, to estimate the communication performance of the proposed antenna operated in the real environment, a link budget analysis is performed.

II. An implantable zeroth-order resonance (ZOR) antenna is proposed. By using chip inductors, an epsilon negative ZOR was generated, while achieving an extremely compact antenna size. The antenna has the overall dimensions of 0.021λ0 × 0.017λ0 × 0.002λ0 at the Medical Implantable Communication Service (MICS) band (402–405 MHz). Furthermore, the performance of the proposed antenna is insensitive to the electrical properties of the human body by virtue of the ZOR phenomenon.

III. A capsule antenna used in an ingestible medical device is proposed. To achieve miniaturization and a wide bandwidth, an inverted-F antenna with a meandered strip line was used. The antenna performance in a human voxel model is analyzed through simulation, and the performance of the fabricated antenna is verified by comparing the measured data with that of the simulation when the antenna is placed in a human-equivalent liquid phantom.

About the speaker

Jaehoon Choi received the B.S. degree from Hanyang University, Korea, the M.S. degree and the Ph.D. degree from Ohio State University, Ohio, in 1980, 1986, and 1989, respectively. From 1989-1991, he was a research analyst with the Telecommunication Research Center at Arizona State University, Tempe, Arizona. He had worked for the Korea Telecom as a team leader of the Satellite Communication Division from 1991 to 1995. Since 1995, he has been a professor in the Department of Electronics and Communication Engineering at Hanyang University, Korea. He has published more than 120 refereed journal articles and numerous conference proceeding papers. He also holds over 50 patents. His research interests include antenna, microwave circuit design, and EMC. Currently, his research is mainly focused on the design of compact, multi-band antenna for mobile wireless communication, software defined radio (SDR) systems, ultra-wideband (UWB) systems, and wireless body area network (WBAN). He was a former chair of AP technical group of KIEES. He now serves as the chair of IEEE AP-S Seoul chapter and the executive vice president of KIEES. He was Dean of Engineering College II, Hanyang University from 2010 to 2011. Currently, He is Dean of Engineering College, Hanyang University.