Flexible Dual-band Wireless Capsule Endoscopy Antenna Applied to Different Human Bodies

Ma Ping, Wu Xujing, Zheng Hongxing, Wang Mengjun

School of Electronics and Information Engineering, Hebei University of Technology, Xiping Road No. 5340, Beichen District, Tianjin, 300401, China
(wangmengjun@hebut.edu.cn)

Abstract

Antenna is absolutely necessary for the development of wireless capsule endoscopy(WCE) system, as a bridge for information transmission in vitro and in vivo. In the past few years, many WCE antennas have been proposed, which have different performance parameters and characteristics. However, the stability is relatively poor and sensitive to the surrounding environment for most antennas [1-3]. In addition, the tissue model is relatively single, which is insufficient to evaluate the stability of antenna in different environment. Therefore, it is important to research a WCE antenna which can work in different environment with good robustness.

In this work, we present a flexible dual-band WCE antenna, which contains two bands: industrial, science, medical band (ISM:433-434MHz) and wireless medical telemetry service band (WMTS:1.395-1.4GHz) for telemetry or wireless monitoring and wireless power transfer (WPT), respectively. 0.05 mm thickness polyimide as a substrate, introduces a new resonance and extends the bandwidth by loading a L-shaped branch, realized WCE antenna with ultrathin and dual-band characteristics, the geometric structure and detailed dimensions of the antenna is shown in Figure 1 and Table I. In order to evaluate the stability of the antenna, seven 3D human voxel models with different age, sex, somatotype, tissue thickness and internal environment are applied and showed in Figure 2. For saving computation time, intercepting the human voxel model abdomens, and the antenna is placed in different gastrointestinal tract organs of different abdomen models for simulating. S-parameters of the dual-band antenna in the same part of different human bodies are plotted in Figure 3. The obtained results indicate the proposed antenna is insensitive to the different human environment, has a good robustness, and suitable for various populations for transferring gastrointestinal information and power.

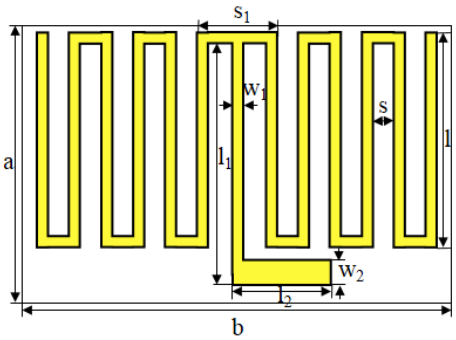

Figure 1: Geometry of the proposed dual-band antenna

Table I: Detailed dimensions of the proposed antenna (units: mm)

a	b	l	s_1	s	w_1	l_1	w_2	l_2
30	20	15.5	4.2	1.5	0.8	16.7	1.8	7.1

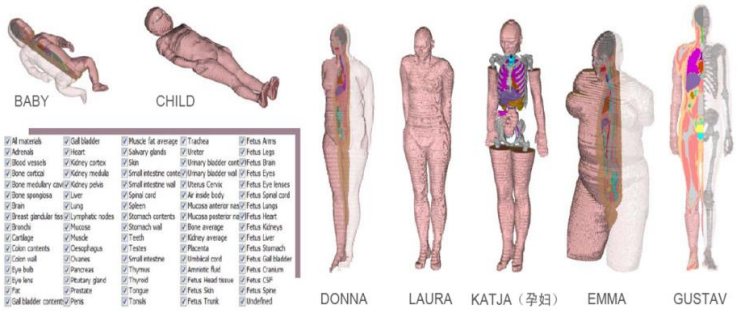

Figure 2: Seven 3D human voxel models with different age, sex, somatotype, tissue thickness and internal environment

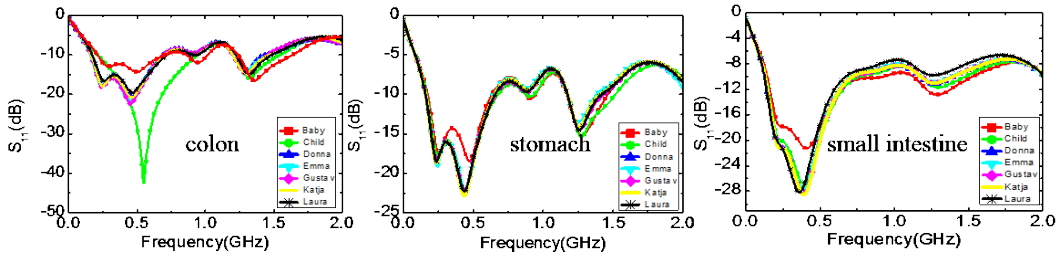

Figure 3: Reflection coefficients of the proposed antenna simulated in the same part of different human bodies

References

[1] X. Cheng; D. E. Senior; C. Kim *et.al*: A Compact Omnidirectional Self-Packaged Patch Antenna with Complementary Split-Ring Resonator Loading for Wireless Endoscope Applications. IEEE Antennas and Wireless Propagation Letters, Vol. 10, pp. 1532-1535, 2011.

[2] P. M. Izdebski; H. Rajagopalan; Y. Rahmat-Samii: Conformal Ingestible Capsule Antenna: A Novel Chandelier Meandered Design. IEEE Transactions on Antennas and Propagation, Vol. 57, No. 4, pp. 900-909, 2009.

[3] R. Das; H. Yoo: A Multiband Antenna Associating Wireless Monitoring and Nonleaky Wireless Power Transfer System for Biomedical Implants. IEEE Transactions on Microwave Theory and Techniques, Vol. 65, No. 7, pp. 2485-2495, 2017.