Combination of Wearable Axial and Planar Magnetoinductive Waveguide for Low Loss WBANs

Connor Jenkins[1], Vigyanshu Mishra[1], *Graduate Student Member* and Asimina Kiourti[1], *Senior Member, IEEE*

[1]ElectroScience Laboratory, Department of Electrical and Computer Engineering, The Ohio State University, OH 43210, USA;

Abstract

We have recently demonstrated [1], [2] wearable axial and planar magnetoinductive waveguides that enable extremely low loss wireless body area networks (WBANs) as compared to state-of-the-art technologies (e.g., Radio-Frequency, human body communication, magnetic induction) [3], [4]. These are formed by arranging electrically small resonant loops in series to enable the formation of magnetoinductive waves that help communicate information across the human body. The axial design utilizes loops arranged such that the axis of limbs aligns with the axis of the loops, while for planar design, the plane of the loops lies along the plane parallel to the part of the human body. Although both designs offer several advantages, there are a few limitations. Specifically, axial designs are restricted to certain anatomical parts of the human body, while planar designs have relatively lower tolerance to loop failures.

In this work, we take a step forward and propose a new wearable magnetoinductive waveguide that is formed using combinations of axial and planar designs. The arrangement of loops for this design can be made in various ways, details of which will be presented at the conference. This combination of axial and planar magnetoinductive waveguides serves two main purposes. First, by allowing transitions from planar to axial designs and vice versa, it empowers designs that best suit any given anatomical part and achieve optimal performance. For instance, planar designs can be employed upon the torso and axial designs can be employed upon the limbs (arm/leg) for the same WBAN. Second, it can be used as a standalone design for even a certain part of the body to ultimately combine the advantages of both axial and planar designs.

In conclusion, the proposed design is capable of further advancing the state-of-the-art WBANs in terms of functionality and performance. In future, this technology can be seamlessly integrated in garments to allow seamless wearable wireless connection across the human body. The significance of the technology lies in sectors deploying wearable technologies including, but not limited to, healthcare (rehabilitation and remote monitoring of patients), gaming, virtual reality, and consumer electronics.

REFERENCES

[1] V. Mishra and A. Kiourti, "Wearable magnetoinductive waveguide for low-loss wireless body area networks," *IEEE Transactions on Antennas and Propagation*, vol. 69, no. 5, pp. 2864–2876, 2021.

[2] V. Mishra and A. Kiourti, "Wearable planar magnetoinductive waveguide: A low-loss approach to WBANS," *IEEE Transactions on Antennas and Propagation*, vol. 69, no. 11, pp. 7278–7289, 2021.

[3] K. Hasan, K. Biswas, K. Ahmed, N. S. Nafi, and M. S. Islam, "A comprehensive review of wireless body area network," *J. Netw. Comput. Appl.*, vol. 143, pp. 178–198, Oct. 2019.

[4] B. Latré, B. Braem, I. Moerman, C. Blondia, and P. Demeester, "A survey on wireless body area networks," *Wirel. Netw.*, vol. 17, no. 1, pp. 1–18, Jan. 2011.