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Wearable Antennas on flexible substrate

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Antenna is still one of the major devices in any wireless application. It has a direct impact on the size, shape and performance of the global wireless system. The physical integration of antennas to devices is a major issue for the designers as they must deal with additional features like safety and regulation constraints. Nowadays, the tendency is to integrate more and more wireless devices as near as possible to the human body which is however known to be very hostile to RF signal because of its absorbing properties [1].

In this work we present a new concept for the design and the implementation of on-body wearable antennas for wireless communication, in particular for 5G and internet of things. The main idea behind this new design is to use a group of elementary antennas with a specific feeding system that produces the suitable radiation pattern with very large space coverage. This specific design also protects the human body from electromagnetic radiation without the need of a ground plane or an artificial magnetic conductor usually used. The basic principle involved is to create by destructive interference a region in which the radiated electromagnetic field is greatly reduced. Placing any object in this region, like a human body, will not significantly modify the field distribution, and the object will not receive or absorb significant radiation. The system is thus fully compliant to the specific absorption rate (SAR) constraints and frequency masks. The group of antennas and their feeding system are integrated in the same design and can be fully uni-planar which allows their realization on flexible substrate like fabric. We will present the design approach as well as the simulation results. Some realizations and the experimental performance in both anechoic environment and real application will be presented and discussed.

This emitting system is very ergonomic, the person wearing them do not see or feel the antennas and can move freely. Also, the antennas conform to the body's shape, more specifically to the arms/shoulders shape [2]. The system is of general purpose. As such, it is suitable for communication with any wearable sensors. Depending on the emission power, transmitting range goes from one meter to more than a km. We experimentally demonstrated a communication range of 1.4 km with a 1W power at the frequency 2.06 GHz.

[1] Y. Hao, A. Alomainy, P. Hall, Y. Nechayev, C. Parini, and C. Constantinou, "Antennas and Propagation for Body-Centric Wireless Communications", Artech House, 2006.

[2] T. Andriamiharivolamena, P. Lemaitre-Auger, D. Kaddour, S. Tedjini, F. Tirard, and J. Mourao, "Bending and crumpling effects on a wearable planar monopole antenna," in 2012 15 International Symposium on Antenna Technology and Applied Electromagnetics, 2012, pp. 1-4.