On-Body Calibration of a Personal Distributed Exposimeter for Wireless Fidelity for Indoor and Outdoor Measurements

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An individual's personal exposure to radio frequency (RF) electromagnetic radiation is typically measured using Personal Exposimeters (PEMs). These are on-body worn devices that measure the instantaneous power density (S_{inc}) incident on a subject wearing the device. However, PEMs are faced with relatively large measurement uncertainties, mainly caused by the influence of the body on the measurements using PEMs. These uncertainties can be reduced when using a personal, distributed exposimeter (PDE): a device consisting of multiple, body-worn antennas. These devices have already been demonstrated for measurements in outdoor environments, but have not yet been calibrated and used for indoor measurements. This abstract describes the design and calibration of a PDE for the on-body detection of RF electromagnetic fields due to Wireless Fidelity (WiFi) networks.

Numerical simulations are executed, to show, see Figure 1, that using a combination of two RF nodes placed on the front and back of the body reduces the 50% prediction interval (PI_{50}) on S_{inc}. Median reductions in measurement uncertainty of 10 dB and 9.1 dB are obtained compared to the PI_{50} of a single antenna placed on the body, using a weighted arithmetic and geometric average, respectively.

Therefore, a simple PDE topology, based on two nodes, which are deployed on opposite sides of the torso, is chosen for calibration. The PDE is constructed using flexible, dual-polarized textile antennas and wearable electronics. The PDE is calibrated both in an anechoic chamber, to emulate specular (outdoor and indoor) exposure, and in a reverberation room, to emulate diffuse (indoor) exposure.

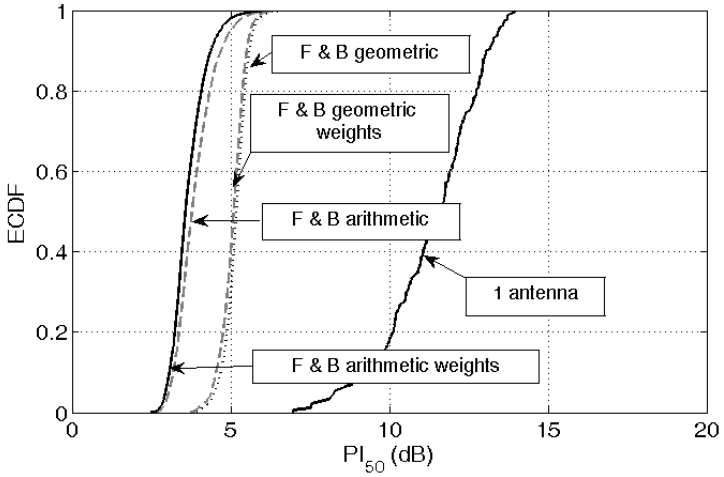

Figure 1: Numerically determined Experimental Cumulative Distribution Function (ECDF) of the PI_{50} of a single textile antenna placed on the upper body, compared to the PI_{50} of a (weighted) average of two antennas placed on the front (F) and back (B) of the torso at 2450 MHz in the 'Urban Macro-cell' environment.