EPIDERMAL UWB RFID TAG FOR APPLICATION ON-SKIN

Mohamad Ali Ziai, John, C. Batchelor
School of Engineering and Digital Arts, University of Kent, Canterbury-UK

UHF RFID tags have been demonstrated as transfer tattoos on-skin [1]. However, the performance of these designs are limited owing to their very close proximity to highly lossy tissues which makes them unsuited for application in dense environments required in many sensitive tracking and identification applications, because of the inherent high power narrow band requirements of UHF RFID. Conversely, many proposed high resolution internal location systems use Impulse Radio Ultra-Wideband (IR-UWB) transmission with narrow RF pulses of a few hundred picoseconds spread over several GHz of bandwidth and with a power spectral density in the noise floor. These low spectral power density pulses are very difficult to detect and almost invisible to unauthorized readers as UWB pulses are indistinguishable from the noise, and can be detected only by receivers using correlation [2]. UWB RFID tags have been shown in location systems to offer fine temporal and spatial resolution, with cm level accuracy in both outdoor and indoor localization in all three dimensions [3].

This work presents a two-band antenna (UHF RFID and UWB) proposed for passive RFID with high data rate secure communications. It includes separate receiving and transmitting ports for direct connection to a hybrid UHF/UWB RFID chip. The antenna receiving component is a linearly polarized narrowband structure for energy harvesting, whereas the transmitting section is an ultra-wideband (UWB) slot antenna for signal radiation. The receiving dipole includes a feed stub impedance transformer for conjugate match to the complex RFID ASIC impedance for efficient transfer of the collected energy at UHF to the RFID chip. Efficiency is critical as the tattoo transfer radiation efficiency is strictly limited. The transmitting planar slot is designed to reduce the interaction between the antenna and the skin using the receiving patch dipole as its ground.

Fig.1 shows that, when on-skin, the receiving antenna input reflection coefficient offers a good power transfer efficiency, capable of activating the chip at a distance of 1.2 m, Fig. 2. The transmitting antenna reflection coefficient is shown in Fig.3 and has low reflection across the FCC UWB when tattooed on-skin. With a suitably designed UWB receiver, the tattoo could be detected at many meters away making it suitable for high data rate secure communications and position location.

REFERENCES

[1] Ziai, M.A.; Batchelor, J.C., "Temporary On-Skin Passive UHF RFID Transfer Tag," Antennas and Propagation, IEEE Transactions on, vol.59, no.10, pp.3565,3571, Oct. 2011,doi: 10.1109/TAP.2011. 2163789

[2] Nekoogar, Faranak, Dowla, Farid, Ultra-Wideband Radio Frequency Identification Systems, Springer, 2011, ISBN1441997016, 9781441997012.

[3] Cruz, C.C.; Costa, J.R.; Fernandes, C.A., "Hybrid UHF/UWB Antenna for Passive Indoor Identification and Localization Systems," Antennas and Propagation.

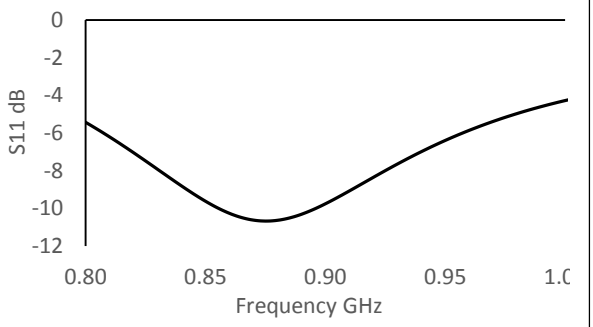

Fig. 1, Transmitting antenna reflection tattooed on

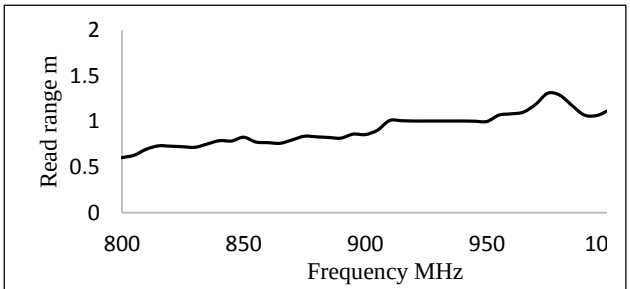

Fig.2, receiving antenna's measured read range tattooed on skin.

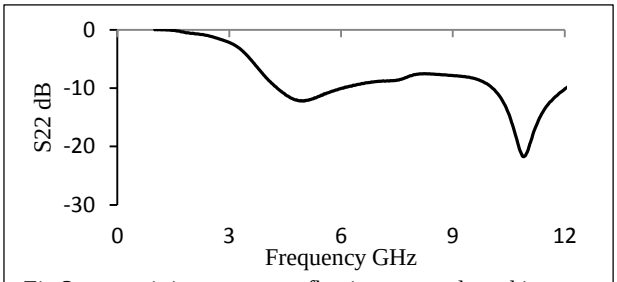

Fig.3, transmitting antenna reflection tattooed on skin