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SOUTENANCE DE THÈSE DE DOCTORAT

ÉCOLE DE GÉNIE

Soutenance de thèse de Muhammad Zaka Ali
Doctorat en ingénierie

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« Design and Development of Smart Wearable Antenna System for Wireless Body Area Networks (WBANs) »

Le **mercredi 27 mai 2026**
à 10 h au local C-200 du campus
de l'UQAT à Rouyn-Noranda

HUMAINE
>>>> CRÉATIVE
AUDACIEUSE

Muhammad Zaka Ali
Doctorat en ingénierie*

2022 à ce jour

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Design and Development of Smart Wearable Antenna System for Wireless Body Area Networks (WBANs)

Wireless body area networks (WBANs) have become an essential technology for body-centric wireless systems supporting applications such as healthcare monitoring, emergency response, augmented reality, and underground mining communications. These applications require reliable wireless connectivity, continuous real-time monitoring, and wearable devices capable of operating efficiently under dynamic body movements. Meeting these requirements strongly depends on the development of compact, flexible, and low-SAR wearable antennas capable of maintaining stable performance in close proximity to the human body.

This research work presents the design and development of a smart wearable antenna system for WBAN applications, with emphasis on reliable wearable off-body communication in dynamic and safety-critical environments. The proposed architecture combines higher-order mode (HOM) excitation, pattern reconfigurability, and artificial magnetic conductor (AMC) integration within a compact wearable platform. A reconfigurable antenna based on third resonant mode (TRM) dipoles is proposed to generate multiple directional beams while reducing structural and feeding-network complexity. In addition, an interdigital capacitor (IDC)-loaded AMC surface is integrated to suppress back radiation, improve forward gain, and reduce the Specific Absorption Rate (SAR) while preserving flexibility and compactness. The antenna system was designed, fabricated, and experimentally validated under realistic wearable conditions, including bending and body proximity. Experimental results demonstrate stable impedance matching, enhanced radiation efficiency, reduced SAR, and reliable beam steering capability under dynamic body motion. The obtained results further demonstrate, for the first time, that higher-order mode (HOM) excitation can provide compact and high-gain pattern reconfigurability without requiring complementary magnetic radiators, offering an efficient and practical solution for future wearable and adaptive wireless systems.