08:30 - 10:10
Room 401
Robin Augustine

Focus Session Body Area Communications

08:30 — R. 401

Assessing Cardiac Dynamics through Intracardiac RF Sensing for Hemodynamic Monitoring in Pacemakers

Ali Khaleghi[1]; Jacob Bergsland[2]; Ilangko Balasingham[2]
[1] NTNU; [2] Oslo University Hospital

This paper examines the use of radiofrequency (RF) channels for hemodynamic monitoring in cardiac pacemakers. It analyzes RF signal variations between intracardiac transceivers in the right ventricle (RV) and right atrium (RA), as well as subcutaneous receivers, to determine their correlation with cardiac dynamics. The study shows that temporal RF signal variations closely align with cardiac rhythm, allowing for the estimation of parameters such as chamber volume, valve behavior, and pressure changes. These results underscore the potential of RF-based sensing as a novel method for real-time cardiac monitoring in pacemaker systems.

08:50 — R. 401

MMSE Pre-emphasis Incorporating Spatial Diversity for Wideband Implant Communications

Lijia Liu; Kota Miyazaki; Jianqing Wang
Nagoya Institute of Technology

This study proposes a pre-emphasis technique, implemented using the minimum mean-square error (MMSE) algorithm, to incorporate spatial diversity and improve the bit error rate (BER) performance for wideband implant communications. A three-branch transmit diversity scheme is performed using a numerical human model and miniaturized antennas in simulation. Results confirm that the proposed communication system achieves a high data rate of 20 Mbps across antenna orientations spanning 0 to 180 degrees.

09:10

R. 401

Harmonic Backscattering and Wireless Power Transfer for Deep In-Body Implantable Wireless Sensors: A Novel Approach

Aminolah Hasanvand; Ilangko Balasingham
NTNU - Norwegian University of Science and Technology

The integration of harmonic backscattering and RF (Radio Frequency) wireless power transfer (WPT) technologies offers a new pathway for powering and communicating with deep in-body implantable medical sensors. This work introduces a novel system that addresses the critical challenges of miniaturization, low power consumption, and robust wireless communication in implantable devices. By employing a voltage doubler rectifier and leveraging harmonic modulation, the system harvests RF energy efficiently and transmits data reliably via harmonic backscattering. The approach separates uplink communication frequencies from WPT frequencies, reducing interference, mitigating self-jamming, and significantly enhancing receiver sensitivity. Experimental validation demonstrates reliable data transmission at receiver sensitivity levels as low as -97 dBm, even under deep implantation conditions. The compact design employs low-cost components, enabling battery-free operation while maintaining high performance. This innovative system presents a scalable and practical solution for longer-lasting, and more reliable devices for diagnostics and therapeutic applications.

09:30 From Microwave Measurement to Application: Enhancement of Fat-Intrabody Communication by Advanced Computational Techniques

R. 401

Robin Augustine[1]; Pramod Rangaiah[1]; Pradeep Kumar[2]

[1] Uppsala University; [2] HKBK College of Engineering

Fat-Intra Body Communication (Fat-IBC) leverages the unique dielectric properties of human adipose tissue for low-loss microwave signal propagation. This work presents a comprehensive analysis framework combining interpolation and extrapolation algorithms to predict transmission characteristics (S21) across varying phantom lengths and antenna configurations. Interpolation accurately models intermediate lengths, while extrapolation extends predictions to unmeasured distances up to 100 cm. A software application was developed to integrate these computational models with a user-friendly interface and compatibility with microwave design tools. The results validate the efficiency of Fat-IBC for inbody-to-inbody configurations while highlighting challenges in onbody setups. This study establishes a foundation for optimizing Fat-IBC systems for biomedical and wearable applications.

09:50 Health-care Based on Near Field Inter-body Coupling Communication: Modeling and Analysis of Characteristics

R. 401

Xu Zhang[1]; Yong Song[1]; Maoyuan Li[2]; Ya Zhou[1]; Yu Chen[1]; Meng Zheng[1]; Chang Yang[1]; Yizhu Ma[1]

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The Internet of Bodies (IoB) enables short-range, low-power communication for implantable medical devices, presenting significant advantages for leadless pacemakers and defibrillators. Near Field Inter-Body Coupling Communication (NF-IBCC) emerges as a promising approach, offering enhanced data security and reduced power consumption compared to traditional radio frequency (RF) methods. However, a comprehensive understanding of its channel model remains elusive. This study introduces a circuit-based channel model for NF-IBCC, validated through experimental analysis. The model characterizes key factors influencing NF-IBCC, including distance, posture, angle, and height, laying a theoretical foundation for its application in IoB and related healthcare applications.