IEEE Sensors France Chapter

Grenoble | June 13-14, 2024

5th Workshop of IEEE Sensors France Chapter

June 13-14, 2024 – Grenoble

Book of Abstracts

Papers available during the workshop:

https://drive.google.com/drive/folders/1htedo7_qyWOEPuUO5wggcN7SSxH6v2uK

5TH WORKSHOP OF IEEE SENSORS FRANCE CHAPTER

►►► The aim of the Workshop of IEEE Sensors France Chapter is to bring together researchers working on sensors, sensor integration, packaging and instrumentation. Young researchers, PhD students and post-doctoral fellows, have the opportunity to present their works through oral presentations or posters. Moreover, invited talks from renowned French and international researchers complete the program of the conference (presentations will be in English).

►►► The 5th edition will be focused on Sensors for complex environments.

►►► The emergence of new collaborations, or the reinforcement of existing ones, between academia and/or industry is also one of the objectives of this conference.

Topics included:

- Sensors in biological media and for healthcare applications
- Sensors for industries and telecommunications
- Packaging and Instrumentation
- Sensors for environmental challenges
- Sensors for harsh environments

Organizing Committees

Program committee

- J. Rossignol (ICB, Univ. Bourgogne)
- E. Martincic (C2N, Univ. Paris-Saclay)
- J. Launay (LAAS, Univ. Toulouse)
- S. Hage-Ali (IJL, Univ. Lorraine)
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- S. Boisseau, CEA-Leti Grenoble
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- A. Sylvestre, FMNT / UGA / G2ELab
- S. Basrour, FMNT / UGA / TIMA

Supports & Sponsors

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Invited Speakers

Pantelis GEORGIOU - IEEE Sensors Distinguished Lecturer
Imperial College, London, (UK)
Talk: Microchip Technology enabling Rapid Diagnostics for Infectious Diseases – From AMR to COVID-19
Professor of Biomedical Electronics, Department of Electrical and Electronic Engineering Centre for Bio-inspired Technology Imperial College London (UK)

Adriana MORANA
Univ. Jean Monnet - Laboratoire Hubert Curien, Saint-Etienne (France)
Talk: Optical fiber sensors for harsh radiative environments
Associate professor at University Jean Monnet and Laboratoire Hubert Curien, Saint-Etienne (France)

Xavier LEFEVRE
CSEM, Neuchâtel, (Switzerland)
Talk: Porous layers for environmental electrochemical sensors
Research and Development Engineer at CSEM, Neuchâtel (Switzerland)

Perceval COUDRAIN
CEA, Grenoble, (France)
Talk: Beyond the component: How advanced packaging drives innovation in microelectronics
Research and Development Engineer at CEA, Grenoble (France)

Aktham ASFOUR
Univ. Grenoble Alpes & G2Elab, Grenoble, (France)
Talk: Giant Magneto-Impedance (GMI) sensors for electrical current measurement
Associate professor at University Grenoble Alpes and Grenoble Electrical Engineering Lab (G2Elab)

Céline TERNON
Grenoble INP & LMGP, Grenoble, (France)
Talk: Mixité femmes-hommes, on a toutes et tous à y gagner
Associate professor at Grenoble INP and LMGP, President of the Parité Science association, Member of “Femmes & Sciences”

Orphée CUGAT
CNRS & G2Elab, Grenoble, (France)
Talk: Immunology test: one-step differential detection by epifluorescence; Magia Diagnostics
Research Director at CNRS, Grenoble Electrical Engineering Lab (G2Elab)

PROGRAM – Thursday, June 13th 2024

08:30 AM-09:00 AM	*GreEn-ER Reception Hall* Welcoming participants - Handing out badges	
09:00 AM-09:30 AM	*Bergès Amphitheater* Welcome and introductory speeches to the workshop days Organizers: Sébastien BOISSEAU (CEA), Cécile GHOUILA-HOURI (G2ELab), Leticia GIMENO-MONGE (G2ELab) G2ELab & FMNT: Alain SYLVESTRE (Deputy Director G2ELab and Director FMNT) IEEE Sensors France Chapter: Jérôme ROSSIGNOL (President)	

IEEE Sensors Distinguished Lecturer Invited talk (Bergès Amphitheater)

09:30 AM-10:15 AM	**Pantelis GEOURGIOU, Imperial College (UK)**	***Microchip Technology enabling Rapid Diagnostics for Infectious Diseases - From AMR to COVID-19***

Coffee break (Forum Room)

10:15 AM-10:45 AM		Poster Session & Sponsors Exhibition

Session 1: Sensors in biological media and for healthcare applications (Bergès Amphitheater)

10:45 AM-11:00 AM	**Orphée CUGAT, G2ELab (France)**	***Immunology test: one-step differential detection by epifluorescence; Magia Diagnostics***
11:00 AM-11:15 AM	Nabil MOUMANE, SenseBioTek	*Body volatolome: a promising solution for health monitoring*
11:15 AM-11:30 AM	Mohand Salah MOUSSA, IEMN	*Developpement of a photoacoustic cell for breast cancer detection using gas spectroscopy*
11:30 AM-11:45 AM	Pierre TACYNIAK, TIMA	*Modal optimisation of acoustic power transfer systems for medical implants applications*
11:45 AM-12:00 PM	Hana BOUKHAROUBA, C2N	*A multifrequency sensor for contactless radiofrequency characterisation of organic media*
12:00 PM-12:15 PM	Khouloud ARFAOUI, LTM	*Trapping of biological objects on SOI optical photonic crystal micro-resonators*

Lunch (Forum Room)

12:15 PM-01:45 PM

Session 2: Sensors for industrial applications (Bergès Amphitheater)

01:45 PM-02:15 PM	**Aktham ASFOUR, G2ELab (France)**	***Giant Magneto-Impedance (GMI) sensors for electrical current measurement***
02:15 PM-02:30 PM	Othmane MARBOUH, IEMN	*Wireless monitoring of magnetic field and mechanical properties in ferromagnetic steel sheets using SAW sensors*
02:30 PM-02:45 PM	Alexandra BUZDUCEA, MTA	*AI-based classification of transient phenomena in a distribution power grid*

02:45 PM-03:00 PM	Léo SIMON, ICB	*Dielectric oxides by microwave synthesis and development as sensitive material in ammonia microwave gas sensor*
03:00 PM-03:15 PM	Olivier LAVASTRE, CROMA	*New topologic and chemical imaging for industry, based on non contact THz time domain spectroscopy sensor*

Sponsors (Bergès Amphitheater)

03:15 PM-03:20 PM	**Young-Kil KIM**	**Nextron**
03:20 PM-03:25 PM	**Charles-Ambroise KOUAKOU-VASSET**	**Polytec**
03:25 PM-03:30 PM	**Joanna KAISER**	**COMSOL Multiphysics**

Coffee break (Forum Room)

03:30 PM-04:00 PM Posters Session & Sponsors Exhibition

Session 3: Sensors for environmental challenges (Bergès Amphitheater)

04:00 PM-04:30 PM	**Xavier LEFEVRE, CSEM (Suisse)**	***Porous layers for environmental electrochemical sensors***
04:30 PM-04:45 PM	Bérengère LEBENTAL, IMSE	*Carbon nanotubes chemistor arrays for environmental and biological monitoring*
04:45 PM-05:00 PM	Zarina NAZYROVA, C2N	*Zero-power MEMS sensors for trees health monitoring*
05:00 PM-05:15 PM	Marie OLLIVIER, ICB	*Potential of zeolitic materials in capturing VOCs*
05:15 PM-05:30 PM	Sabine VASSAUX, IMT² Nord-Europe	*Ammonia sensor based on polyaniline dispersed in toluene with a remarkably low sensitivity to humidity*
05:30 PM-05:45 PM	Tristan CAROFF, CEA Leti	*Autonomous Piezoelectric Sensor System for Ski Monitoring and Performance Evaluation*
05:45 PM-06:00 PM	Sandrine BERNARDINI, IM2NP MADIREL	*Improving the Sensitivity of Carbon Dioxide Sensors in Humid Environments*

Cocktail (Forum Room)

06:15 PM-20:00 PM

PROGRAM – Friday, June 14th 2024

08:30 AM-09:00 AM	Welcome	*GreEn-ER Reception Hall* Welcoming participants - Handing out badges

Session 4: Packaging & Instrumentation (Bergès Amphitheater)

09:00 AM-09:30 AM	**Perceval COUDRAIN, CEA (France)**	***Beyond the component: How advanced packaging drives innovation in microelectronics***
09:30 AM-09:45 AM	Virginie PERROT, GRAPHEAL	*Smart and flexible graphene-based RFID tag sensors for in-field detection*

« Women in Sensors » (Bergès Amphitheater)

09:45 AM-10:15 PM	**Céline TERNON "Femmes & Sciences", LMGP (France)**	***Mixité femmes-hommes, on a toutes et tous à y gagner***

Coffee break (Forum Room)

10:15 AM -10:45 AM		Posters Session & Sponsors Exhibition

Session 5: Sensors for harsh environments (Bergès Amphitheater)

10:45 AM-11:15 AM	**Adriana MORANA, Laboratoire Hubert Curien (France)**	***Optical fiber sensors for harsh radiative environments***
11:15 AM-11:30 AM	Ulrich YOUBI, IJL	*2.45 GHz High Q Wireless SAW Sensors based on the AlN/Sapphire for High-Temperature Applications*
11:30 AM-11:45 AM	Sylvain KERN, IEMN	*SiC micro hot wires for flow measurement in harsh environments*
11:45 AM-12:00 PM	Jean-Marc DUCHAMP, G2ELab	*New microwave sensor for cryogenic liquid*
12:00 PM-12:15 PM	Thomas BRUN, SPINTEC	*Achieving PicoTesla detectivity with magnetic tunnel junctions to monitor magnetic field in space*

Sponsors (Bergès Amphitheater)

12:15 PM-12:20 PM	**Youssef CHRAIBI**	**GreenAlp**
12:20 PM-12:25 PM	**Pierre-Louis NEULET**	**Omicron Technologies**
12:25 PM-12:30 PM	**Daniel SAIAS**	**Asygn**

Lunch (Forum Room)

12:30 PM-02:00 PM

Workshop closing ceremony (Bergès Amphitheater)

02:00 PM -02:30 PM	Sébastien BOISSEAU (CEA), Cécile GHOUILA-HOURI (G2ELab), Leticia GIMENO-MONGE (G2ELab)	Awards ceremony
02:30 PM -04:00 PM	Open discussion are possible in Forum Room	

Posters – Forum Room

N°	*Title*	Speaker
1	*Ammonia sensor based on electrodeposited polyaniline film*	Sophie LAKARD
2	*New Biocaptor for Cancer Cell Detection*	Nour El Houda DADOUCHE
3	*Enhanced Pipe Joint Make-up Evaluation Using Acoustic Sensors*	Esteban CABANILLAS
4	*Followknee Project: Integration Strategies for Instrumented Orthopedic Knee Implants*	Pierre GASNIER
5	*Functionalized gold nanoparticles for colorimetric detection of Arsenic(V) in water*	Eleftheria ZELOU
6	*Joint carbon monoxide and ozone monitoring in environmental conditions using a carbon nanotube sensor array with Bayesian calibration*	Bérengère LEBENTAL
7	*Magnetic Communication Using High Sensitivity Giant Magneto-Impedance Sensor*	Miao XU
8	*NiAl alloy thin films for high temperature SAW sensors : optimization of the electrical resistivity*	Léna Cassandra ABEGUE-MBA
9	*Out-of-equilibrium body potential in Silicon-on-insulator for photodetection applications*	Abbas HAMZEH
10	*Polyaniline Based Flexible Sensors for pH Monitoring*	Boris LAKARD
11	*Polyvinyltriazole-functionalized SWCNT ink for printed Arsenic (III) chemistors for drink water monitoring applications*	Eleftheria ZELOU
12	*Preliminary results of bacterial detection in urine by innovated plasmonic biosensor*	Jovana VITAS
13	*Silicon-Based Thermal Conductivity Detector for Gas Sensing*	Alexandre TEULLE
14	*Towards an integrated multiparametric electroanalytical platform for organ-on-chip monitoring*	Marie-Helene STEGER-POLT
15	*Towards the development of a wearable biocompatible sensor for dialysis monitoring*	Adeleye CHOGOLOU
16	*Biofunctionalized OECT for the Detection of Chlordecone*	Milan TOLEDO

17	*Conversion using GANs Neural Network of Dynamic Full-Field Optical Coherence Tomography Images into Conventional Histology Format*	Nasser DANDANA
18	*Detection of Escherichia coli with planar electrodes, an analysis by EIS and DRT*	Antoine RICO
19	*Dual NanoSensor based on GaN for Drone Engine Monitoring*	Muhammad USMAN
20	*Energy harvesting as a solution for powering sensors in harsh industrial environment*	Dimitri TAINOFF
21	*Evaluation of optical interferometry for thickness control of Parylene HT coating for medical devices based on Titanium*	Sarra RIAHI
22	*Validation of an array of magnetic sensors including smart coordination of measurements*	Zaid JABBAR
23	*Application of USRP and GNU radio for IoT in Healthcare Use case: Heart rate monitoring*	Namarig MOHEMED TAHA ABDELRAHMAN AHMED

Abstracts

Session 1: Sensors in biological media and for healthcare applications

Talk 1 - Body volatolome: a promising solution for health monitoring
Speaker: Nabil MOUMANE (SenseBioTek)
Abstract: *Our research investigates into body odor analysis, a non-invasive method for health monitoring. We developed SkinVOCs®, a user-friendly sampling system, crucial for obtaining reliable chromatographic analysis results. By identifying volatile biomarkers associated with human diseases, we've have started a clinical investigation for skin cancer detection, signaling potential for early detection of various cancers and chronic diseases.*

Talk 2 - Development of a photoacoustic cell for breast cancer detection using gas spectroscopy
Speaker: Mohand Salah MOUSSA (IEMN)
Abstract: *In this paper, we report the development and use of a photoacoustic cell designed for gas spectroscopy of volatile organic compounds (VOCs) used as biomarkers of breast cancer. The cell, composed of a Plexiglas Helmholtz resonator combined with a TDK membrane microphone. The system was successfully characterized using different concentrations of isopropanol (0.5 to 17 ppm) using tunable MIRCAT QCL laser with wavelength range of 8-11µm.*

Talk 3 - Modal optimization of acoustic power transfer systems for medical implants applications
Speaker: Pierre TACYNIAK (TIMA)
Abstract: *Acoustic Power Transfer (APT) is increasingly used to power medical implants wirelessly, where the acoustic waves have to go through several media (skin, fat, implant's case, …). Amongst these different layers, only the implant's case does not change from one person to another, which intrinsic resonance can then be used as a generic amplifying element. However, identifying this mode can be difficult as the APT system is characterized by multiple coupled resonances. In this article, using both Pspice parametric studies and experimental results, we derive which layers contribute to each mode and determine which is the most appropriate for medical APT.*

Talk 4 - A multifrequency sensor for contactless radiofrequency characterization of organic media
Speaker: Hana BOUKHAROUBA (C2N)
Abstract: *This paper presents the implementation of a newly-developed inductive multifrequency resonator used for the non-contact sensing of dielectric properties of organic matter. The sensor is based on an original arrangement of several passive radiofrequency transmission-line resonators on a single flexible substrate. Coupled to a distant monitoring control probe, the resonator is used as a wireless transmit-and-receive multifrequency sensor. A monolithic 3-frequency resonator is fabricated and experimentally implemented for the dielectric sensing of calibrated solutions. The obtained results are compared to those provided by a coaxial contact probe, in the 80 MHz to 340 MHz range. Then, a 3-frequency resonator is used to monitor the dielectric changes occurring during the ripening process of a kiwifruit. Findings show the viability of the developed multifrequency resonator as a non-invasive tool for dielectric property assessment, with potential application in different fields such as agriculture, food industry, and healthcare.*

Talk 5 - Trapping of biological objects on SOI optical photonic crystal micro-resonators
Speaker: Khouloud ARFAOUI (LTM)
Abstract: *Multidrug-resistant bacteria are spreading rapidly and, in the absence of new approaches, the World Health Organization (WHO) predicts 10 million deaths a year by 2050. This resistance results in part from the intensive use of non-specific antibiotics commonly prescribed to manage bacterial infections. Phage therapy, i.e., the therapeutic use of viruses called bacteriophages, is currently being considered as a promising complementary strategy. However, this approach, reputed to be personalized due to the high specificity of phages, requires precise selection of the bacteriophages to be administered to patients. In this context, we are developing a new interdisciplinary methodology for phage susceptibility testing (PST), based on bio-photonic microsystems. Photonic crystal (PhC) micro-cavities are fabricated on silicon-on-insulator (SOI) substrates. Thanks to the use of highly localized resonances on the chip, nano-objects can be trapped by the electric field gradient in the near field of the resonator. The very high sensitivity of the resonance frequency to the environment allows for the presence, nature (selectivity), residual motion or viability of the trapped object to be monitored in real time in the transmitted optical signal. To ensure the feasibility of this type of measurement in a health diagnostics context, it is essential to control all the forces and interactions existing between the SOI and the trapped biological object. Electrostatic and Van de Waals interactions can modify the initial trapping force due to the electric field gradient. We report here more specifically on some of the important parameters influencing these interactions, such as the surface charges (measurement of Zeta potentials), the resonator surface treatments, the ionic strength of the suspension solution and the presence of surfactants. The aim is to select and define a surface treatment/suspension medium combination that is as universal as possible to effectively trap any bacterium. We will present our state of the art of this project and the methods currently used to study the interactions between SOI and biological objects.*

Session 2: Sensors for industrial applications

Talk 1 - Wireless monitoring of magnetic field and mechanical properties in ferromagnetic steel sheets using SAW sensors
Speaker: Othmane MARBOUH (IEMN)
Abstract: *Ferromagnetic materials, including electrical steels, play a critical role in enhancing energy efficiency and performance in electrical machines. Understanding their magnetic and mechanical properties is vital for optimizing machine design. This study proposes the utilization of a shear surface acoustic wave (SAW) sensor in a delay line configuration, enhanced with a nanostructured magnetic film, integrated directly onto the ferromagnetic steel sheet. This setup enables the measurement of both static and dynamic magnetic fields at the surface of the ferromagnetic steel. Additionally, a novel approach is introduced for characterizing the magnetostrictive behavior of non-oriented ferromagnetic steel sheets using miniaturized SAW resonator sensors. Unlike conventional methods for assessing magnetic fields and mechanical properties, this type off sensors offers inherent advantages such as onboard functionality, resistance to high temperatures (up to 400°C), and remote connectivity. The final objective is to monitor magnetic behavior in electrical machines, aligning with the requirements of Industry 4.0 and predictive maintenance.*

Talk 2 - AI-based classification of transient phenomena in a distribution power grid
Speaker: Ioana CORNEL (GIPSA-lab)
Abstract: *The security of power grids is currently an important topic in the context of exponentially increasing electrical power consuming. Given that electrical power grids are a large infrastructure submitted to several random constraints (aging, overload, underground and difficult-to-access), it*

has become critically to understand and control any transient phenomenon which may indicate a fault rising in some power grid parts. The approach proposed in this paper uses a deep learning method of transient classification based on experimental grid harnessing, that can be later used on a larger scale.

Talk 3 - Dielectric oxides by microwave synthesis and development as sensitive material in ammonia microwave gas sensor
Speaker: Léo SIMON (ICB)
Abstract: *Microwave gas sensors need sensitive materials with high dielectric properties and high specific surface area to ensure a great sensitivity. In this study, high dielectric ceramic nanopowders were synthesized using an original microwave process and tested on sensors to detect ammonia and showed an increase of the sensibility of the sensor to detect ammonia.*

Talk 4 - New topologic and chemical imaging for industry, based on non contact THz time domain spectroscopy sensor
Speaker: Olivier LAVASTRE (CROMA)
Abstract: *This paper reports a new method based on THz time domain spectroscopy (THz-TDS) for performing simultaneously a contactless topographic imaging and chemical composition analysis. It represents a new 3D scanning of surfaces in addition to AFM spectroscopy and 3D optical microscope, for non-destructive testing applications in pharmaceutical or food industries. We successfully applied this approach for fast comparison of tablets made of glucose and maltose with different thickness and concentrations.*

Session 3: Sensors for environmental challenges

Talk 1 - Carbon nanotubes chemistor arrays for environmental and biological monitoring
Speaker: Bérengère LEBENTAL (IMSE)
Abstract: *While carbon nanotube sensors and sensor arrays for environmental and biological monitoring have been demonstrated by the research community worldwide for over 20 years, their commercial use in "real life" applications is still extremely limited. While the advantages they offer are clear in theory - small size, high sensitivity, low power consumption, low cost in large volumes... - In practice, there are several critical bottlenecks: reproducible and repeatable manufacturing in small, medium and large series, high measurement quality despite many strong interfering factors (humidity, temperature, pH...), or stable end-to-end integration (including packaging and electronics) suitable for use in harsh environments.*
Through three different case studies, the paper will address these multiple challenges and illustrate how they can be addressed from a scientific and engineering perspective. First, the paper will discuss the case of water quality monitoring using carbon nanotube chemistor arrays for pH, chlorine and arsenic monitoring. This solution has been successfully deployed in a 40m water loop for up to 4.5 months within the EU-India LOTUS project, so the talk will address the lessons learned from this work and briefly discuss the roadmap towards commercialization with the startup Hydroscope. Next, the talk will cover the adaptation of this solution for air quality monitoring, with state-of-the-art results on joint outdoor ozone and carbon monoxide monitoring enabled by a Bayesian calibration methodology. Finally, new developments within the Horizon Europe HS4U project on real-time RNA monitoring for virus detection aboard cruise ships will be detailed.

Talk 2 - Zero-power MEMS sensors for trees health monitoring

Speaker: Zarina NAZYROVA (C2N)

Abstract*: Sensor development plays a crucial role for the industry and especially for precision agriculture development. Climate change provokes longer and stronger heat waves and it is important to monitor plants to prevent early wilting process. The sap inside the plants is moving from the roots to the leaves through the xylem network and during heat waves, the tension in the xylem vessels increases and result in ultrasonic emissions in the range of 100 kHz to 500 kHz. This work represents the early stage of the MEMS sensor designed to passively detect acoustic emissions. Resonating sensors have been designed and fabricated and an electric model has been developed. First result shows a resonance peak at 178.8 kHz in the targeted range.*

Talk 3 - Potential of zeolitic materials in capturing VOCs

Speaker: Marie OLLIVIER (ICB)

Abstract*: Despite advancements in portable sensor development for indoor air quality monitoring, the challenge of detecting and trapping VOCs in ambient air persists due to humidity interference. To solve this, researchers are exploring the use of hydrophobic zeolitic materials as preconcentrators, such as in the micro-analytical prototype developed by Achraf El Mohajir et al., aimed at detecting even trace concentrations of VOCs in indoor environments. The main objective of this work is to evaluate the performance of hydrophobic zeolite materials to capture VOCs.*

Talk 4 - Ammonia sensor based on polyaniline dispersed in toluene with a remarkably low sensitivity to humidity

Speaker: Sabine VASSAUX (IMT Nord-Europe)

Abstract*: To measure ammonia gas, organic sensors constitute a promising technology due to their low cost of production and their ability to work at room temperature. However, the effect of interfering species such as humidity may be detrimental to the measurement reliability of the sensor. In comparison to traditional solvents used to disperse the conductive polymer in solution, doped polyaniline is dispersed in toluene here. The change of solvent leads to an interesting active layer microstructure, composed of microscopic needles, whose sensing performances are little impacted by humidity. The sensitivity of this new material, its limit of detection as well as its stability over 6 months are really promising compared to sensors made in dichloroacetic acid.*

Talk 5 - Autonomous Piezoelectric Sensor System for Ski Monitoring and Performance Evaluation

Speaker: Tristan CAROFF (CEA Leti)

Abstract*: This article presents an innovative batteryless sensor system integrated into skis, which enables ski usage monitoring and skier performance evaluation. The Autonomous Piezoelectric Sensor (ASDS) system utilizes piezoelectric energy harvesting from the ski's deformation and vibrations to power the electronics, eliminating the need for batteries. The system consists of several key components, including piezoelectric transducers, a Power Management Circuit (PMC), a microcontroller unit (MCU) with a Bluetooth transceiver. The ski level of the user is evaluated thanks to data fusion between the measurements from ASDS and the inertial measurement unit (IMU) of a smartphone. For this purpose, several measurement campaigns were carried out to generate the database for the machine learning algorithms for ski level classification. During a public experimentation at the FIS Alpine World Ski Championships at Courchevel-Meribel in 2023, the ASDS technology demonstrated its robustness and reliability, achieving a technological maturity level of TRL 7. The successful demonstration highlighted the potential for widespread adoption in the ski industry, offering benefits to various stakeholders.*

Talk 6 - Improving the Sensitivity of Carbon Dioxide Sensors in Humid Environments
Speaker: Sandrine BERNARDINI (IM2NP MADIREL)
Abstract: *Lanthanum-oxycarbonate powders were prepared by high-energy ball-milling under wet conditions. The active layers were deposited using the drop-casting method, and the performances of the microsensors were evaluated. The study demonstrates that the operating temperature for CO2 detection in humid environment can be decreased to 350°C. The microsensors exhibit detection capabilities over a wide range of relative humidity levels, and their responses remain independent of the relative humidity values. This work can guide the development of more sensitive and reliable CO2 gas sensors for applications in various industries.*

Session 4: Packaging & Instrumentation

Talk 1 - Smart and flexible graphene-based RFID tag sensors for in-field detection
Speaker: Virginie PERROT (GRAPHEAL)
Abstract: *Graphene-based sensors are a promising avenue for multiplex detection of a wide range of molecules and species in both gaseous and aqueous media. Our technology is based on CVD monolayer graphene-on-polymer sensing film, produced by roll-to-roll coupled with printed electronics, a system-on-chip and an antenna, enabling battery-less connectivity in the field. Graphene acts as a field-effect-transistor and can be made to target specific biomarkers through functionalization of specific receptors. Moreover, a set of instruments and tools have been developed to characterize these sensors, demonstrating their suitability in a multitude of applications.*

Session 5: Sensors for harsh environments

Talk 1 - 2.45 GHz High Q Wireless SAW Sensors based on the AlN/Sapphire for High-Temperature Applications
Speaker: Ulrich YOUBI (IJL)
Abstract: *SAW sensors are of great interest for high-temperature applications because of their ability to operate without batteries and wirelessly. In this work, we study a wireless SAW sensor of Al/AlN/Sapphire structure operating at 2.45GHz for high-temperature applications. Experimental characterization was carried out using a SAW Components wireless interrogator between RT and 500°C. Frequency variation with temperature showed good stability, with a measured TCF of -41 ppm/°C. Wireless interrogation of the sensor was possible up to 3m.*

Talk 2 - SiC micro hot wires for flow measurement in harsh environments
Speaker: Sylvain KERN (IEMN)
Abstract: *This study introduces a silicon carbide-based micromachined device for measuring turbulent airflow in harsh environments, and the fabrication techniques involving SiC etching and silicon substrate under-etching to create the MEMS structure. First characterizations reveal intriguing thermal sensitivity compared to traditional metal and semiconductor-based sensors.*

Talk 3 - New microwave sensor for cryogenic liquid
Speaker: Jean-Marc DUCHAMP (G2ELab)
Abstract: *A novel method for measuring cryogenic liquid level inside the storage tank is proposed. A CPW sensor is fabricated on an FR-4 substrate and is immersed in the target liquid tank to monitor the reflection parameters at different liquid levels. By developing a precise experimental setup, it is possible to experiment on several liquids with various relative permittivity and derive a relation between the relative permittivity of the substrate and the liquid with the liquid height.*

Talk 4 - Achieving PicoTesla detectivity with magnetic tunnel junctions to monitor magnetic field in space

Speaker: Thomas BRUN (SPINTEC)

Abstract: *Current technologies for magnetic field detection in space include flux gates and search coils magnetometers. The main drawback of those sensors is their bulkiness, thus they are not compatible with integration into small satellites (i.ex. cubesat (1dm3)). The goal of the MAROT project is to realize a magnetic field sensor with an excellent detectivity and low footprint (~1cm3). We combine magnetic tunnel junction technology and an elaborated microfabrication process to reach the desired performances.*

Posters

Poster 1 - Ammonia sensor based on electrodeposited polyaniline film

Speaker: Sophie LAKARD

Abstract: *In the present work, polyaniline porous films are electrodeposited on flexible interdigitated sensors to detect ammonia gas in the range of 50 to 200 ppb. A solution of aniline with camphorsulfonic acid (CSA) and fluoral-p is used. The resulting polyaniline-based sensor device exhibits high sensitivity to ammonia, good repeatability, and reversible response in a wide range of relative humidity.*

Poster 2 - Cancer Cell Detection: A Simulation Study

Speaker: Nour El Houda DADOUCHE

Abstract: *This study focuses on the development of a novel patch antenna sensor with dimensions of 20X22 mm, integrated with metamaterial, in order to enable early detection of various types of cancer cells (HS578-T, MCF-7, MDA-MB-213) based on their dielectric properties. The sensor operates across multiple resonance frequencies, and through simulation, significant shifts in resonance frequencies were observed. These findings suggest the potential of the sensor for accurately estimating different types of cancer cells, thus offering promising prospects for early cancer detection.*

Poster 3 - Enhanced Pipe Joint Make-up Evaluation Using Acoustic Sensors

Speaker: Esteban CABANILLAS

Abstract: *Cost-effective handling, ease of deployment, and reliable leak-proof installation are crucial factors for hydrocarbon casing and tubing assembly. We propose a new method using acoustic sensors to evaluate joint tightness. By analyzing wideband impedance of a piezoelectric transducer placed on the accessible side, our system detects metal-to-metal seals across thick barriers, offering simple, yet effective technology for sensor acoustic reading through metal walls.*

Poster 4 - Followknee Project : Integration Strategies for Instrumented Orthopedic Knee Implants

Speaker: Pierre GASNIER

Abstract: *Total knee arthroplasty (TKA) is a common orthopedic procedure, projected to increase significantly by 2030 due to factors like an aging population and rising obesity rates. To address the need for technological advancements and reduce revision surgeries, the ANR FollowKnee project was launched. This initiative focuses on three key areas: customized implants using 3D metal printing, augmented reality for surgical precision, and sensor integration for postoperative monitoring. CEA-Leti led the development of a sensor system embedded within knee prostheses, featuring pH and temperature sensors for infection detection, accelerometers for flexion angle measurement, and RFID technology for power/data transmission. Collaborative efforts with clinicians and project*

partners were instrumental in designing, testing, and validating the prototype, with initial experiments conducted on cadaveric specimens.

Poster 5 - Functionalized gold nanoparticles for colorimetric detection of Arsenic(V) in water
Speaker: Eleftheria ZELOU
Abstract*: Arsenic is a notorious poison and one of the world's greatest environmental hazards. The presence of arsenic in the environment poses substantial health risks to humans and threats the ecosystem balance. Therefore, developing efficient and sensitive sensing techniques for arsenic detection is crucial. In this context, a novel approach utilizing a glutathione (GSH), dithiothreitol (DTT) and cysteine (Cys)-modified gold nanoparticle-based assay is reported. These functionalized gold nanoparticles (AuNPs) provide a label-free selective detection of arsenate (As+5 or As(V)) in water samples, with the current achieved limit of detection (LOD) of 3ppm.*

Poster 6 - Joint carbon monoxide and ozone monitoring in environmental conditions using a carbon nanotube sensor array with Bayesian calibration
Speaker: Bérengère LEBENTAL
Abstract*: The calibration of non-specific multisensory systems deployed in an uncontrolled environment is a challenging task, particularly due to the presence of unknown interferents that can impact the sensor and measurement noise. This **Abstract** presents a method that addresses these difficulties and has been tested in particular on a carbon nanotube-based sensor predicting ozone and carbon monoxide in outdoor conditions.*

Poster 7 - Magnetic Communication Using High Sensitivity Giant Magneto-Impedance Sensor
Speaker: Miao XU
Abstract*: A proof of concept of using high sensitivity Magneto-Impedance (GMI) sensors for magnetic communication systems is presented. In this system, the receiving coil of a conventional magnetic communication system is replaced by a new receiver based on a GMI sensor and its associated digital signal processing. This processing, implemented in real-time, include two amplitude-demodulations to recover the binary sequence of the transmitted message modulated by On-Off-Keying (OOK) method. The whole architecture of the receiver is described. A demonstration of the reliable functioning of the system is presented. The first measured performances are given.*

Poster 8 - NiAl alloy thin films for high temperature SAW sensors : optimization of the electrical resistivity
Speaker: Léna Cassandra ABEGUE-MBA
Abstract: *Developing stable surface acoustic waves (SAW) devices for extreme environments operating in the 2.45 GHz ISM bands requires conductive lightweight thin film electrodes able to withstand such harsh conditions. In this perspective, Ni/Al multilayers are deposited by electron beam evaporation and annealed subsequently to form the NiAl phase and optimize the electrical properties. First results are very promising since resistivity values as low as 22.7 µOhms.cm were found for the post-annealed thin films while X-Ray diffraction shows the extinction of the Ni and Al reflexes during annealing, together with the apparition of a new phase, likely NiAl.*

Poster 9 - Out-of-equilibrium body potential in Silicon-on-insulator for photodetection applications
Speaker: Abbas HAMZEH
Abstract*: In this paper we show how an out-of-equilibrium phenomenon in simple SOI (silicon-on-insulator) back gated metal-oxide semiconductor field effect transistors (MOSFET) can be used for photodetection applications. The phenomenon exploited is the out-of-equilibrium body potential,*

due to the instantaneous lack of carriers at a fast scan of the back gate and it is strongly influenced by light because of generation mechanism. The effect of the position of a laser beam on the device, as well as the intensity are studied. The sensor could be adapted for different types of applications, including biochemical and environmental ones.

Poster 10 - Polyaniline Based Flexible Sensors for pH Monitoring

Speaker: Boris LAKARD

Abstract*: A potentiometric flexible sensor using a polyaniline film electrodeposited on a Cu/Ni/Au stack as the pH-sensitive material was developed. The pH sensor exhibited interesting detection performances in aqueous solution, leading to sensitive (73.4 mV per unit pH) and reproducible responses for pH values going from 3 to 8. However, these sensors were ineffective in solutions containing oxidizing hypochlorite ions, which made it necessary to incorporate Tritonx100 surfactant during the electrodeposition of the polyaniline film to make the sensitive material more stable in an oxidizing environment. The pH sensors based on polyaniline and Tritonx100 surfactant were then proved to be sensitive (62.3 mV per pH unit) and reproducible in aqueous solutions containing hypochlorite ions.*

Poster 11 - Polyvinyltriazole-functionalized SWCNT ink for printed Arsenic (III) chemistors for drink water monitoring applications

Speaker: Eleftheria ZELOU

Abstract*: Arsenic contamination in drinking water, which results from both natural sources and human activities, poses a significant global health risk. Simple field-deployable detection methods are crucial for monitoring water sources. We present a promising, novel chemiresistive transduction method for Arsenic III that uses Polyvinyltriazole (PVT)-functionalized single-walled carbon nanotubes (SWCNT). PVT-functionalized SWCNT sensors offer better sensitivity than pristine SWCNT sensors (0.77%/ppb instead of 0.33%/ppb). Further research aims to improve sensitivity by better understanding the interaction between PVT and SWCNTs. And PVT and Arsenic. Specifically, extensive stoichiometry studies suggested a ratio of 1.2:1 PVT: SWCNT for monolayer adsorption according to a Langmuir mode. Such a ratio could be used in further studies to enhance the sensitivity*

Poster 12 - Preliminary results of bacterial detection in urine by innovated plasmonic biosensor

Speaker: Jovana VITAS

Abstract*: Urinary infections are the most common bacterial infections mostly affecting women. Clinical symptoms and the dipstick test allow the doctor to establish an adequate treatment. Unfortunately, the latter can result as false positive or false negative. In order to increase the reliability of the diagnosis, our aim is to develop a new test (biosensor) enabling both specific identification and quantification of the pathogen present in the patient's urine. The test combines advanced plasmonic technique with improved resolution and antibodies as a biorecognition element.*

Poster 13 - Silicon-Based Thermal Conductivity Detector for Gas Sensing

Speaker: Alexandre TEULLE

Abstract*: We present a novel Thermal Conductivity Detector (TCD) for gas sensing without the use of a chromatography column. Its original architecture is based on a suspended membrane on top of which are deposited a heating element and a separated sensing element made of amorphous silicon. These sensors are micro-fabricated and tested in a climatic chamber. They reach a theoretical detection limit (3 sigma) of 13 ppm for carbon dioxide in air and exhibit a signal-to-noise ratio 4 times higher than conventional platinum TCDs.*

Poster 14 - Towards an integrated multiparametric electroanalytical platform for organ-on-chip monitoring

Speaker: Marie-Helene STEGER-POLT

Abstract*: Sensor integration in Organ-on-Chip (OOC) devices presents a challenging task. Sensors used in this context have to stay operational and reliable under complex conditions, while at the same time granting biocompatibility for keeping the biological tissues intact. Further, it is not yet fully understood how the close proximity and the layout of the electrodes influences measurements. To address this demand, we propose the development of an integrated multiparametric electroanalytical platform for the monitoring of an organ-on chip device. Special focus is laid on the optimization of the electrode design for our impedance measurements using numerical simulations (via COMSOL Multiphysics®).*

Poster 15 - Towards the development of a wearable biocompatible sensor for dialysis monitoring

Speaker: Adeleye CHOGOLOU

Abstract*: Improving patients' monitoring between dialysis treatment sessions is highly desirable to adjust the therapy and offer a better quality of life for patients suffering from kidney failure. Relevant biomarkers such as potassium could be quantified in a minimally invasive way in the interstitial fluid (ISF) through the use of wearable devices coupling microneedles for ISF uptake and potentiometric ion-selective electrodes (ISEs) as electrochemical sensors. The development of ion-sensitive layers based on safe and biocompatible materials is presented here to develop this approach.*

Poster 16 - Biofunctionalized OECT for the Detection of Chlordecone

Speaker: Milan TOLEDO

Abstract*: CLD (Chlordecone) is a persistent organic pollutant (POP) of great concerns due to its toxicity and its environmental persistence. To this end, we study organic electrochemical transistors (OECT) featuring biological probes to detect CLD. Here, we report a strategy for immobilizing a VHH-Glypoo102-His6-Tag receptor (D09), which detects CLD-biot in water (D09 and CLD synthesized in-house). WCA (Water Contact Angle), AFM, XPS, FTIR and CV confirm the successful immobilization of D09 on a surface operating as gate electrode sensitive to the presence of CLD-biot in the transfer characteristic.*

Poster 17 - Conversion using GANs Neural Network of Dynamic Full-Field Optical Coherence Tomography Images into Conventional Histology Format

Speaker: Nasser DANDANA

Abstract*: Dynamic Full-Field Optical Coherence Tomography (D-FF-OCT) is an advanced imaging method known for its high resolution and fast acquisition speeds, initially used for detailed ophthalmic examination of macula. It has since expanded to various fields, including kidney pathology. A major challenge remains the interpretation of D-FF-OCT images by pathologists accustomed to conventional color histology. This project uses UVCGAN, a CycleGAN-based architecture, to convert D-FF-OCT images into traditional histology format, improving their interpretability for pathologists. Initial results are positive and promising for future experiments.*

Poster 18 - Detection of Escherichia coli with planar electrodes, an analysis by EIS and DRT

Speaker: Antoine RICO

Abstract*: An impedance sensor is introduced, consisting of two rectangular, opposing electrodes fabricated from a copper-tin alloy. Biocompatibility within the experience parameters was tested for these electrodes. Electrochemical impedance spectroscopy (EIS) was used to differentiate bacterial*

population counts. Furthermore, Distribution of Relaxation Times (DRT) analysis is performed in order to discriminate between viable and non-viable bacterial populations.

Poster 19 - Dual NanoSensor based on GaN for Drone Engine Monitoring
Speaker: Muhammad USMAN
Abstract*: The recent IoT advancements significantly impact industries like healthcare, automotive, and smart homes. Wireless Sensor Networks (WSNs) in IoT applications often rely on bulky batteries, contributing to cost variations and complexity. Energy-autonomous WSNs, leveraging piezoelectric transducers converting ambient mechanical energy, provide a promising solution [1]. This paper aims to study and model piezoelectric and photovoltaic (PV) sensors, optimizing SPICE circuits for maximum power which would be received by a microcontroller like STM32, then sent via BLE to base station (BS) for monitoring the working of flying drone. Combining PEH with PV cells creates a dual nanogenerator for drone monitoring. Despite deployment challenges, GaN's piezoelectric properties could enhance efficiency in the proposed scheme.*

Poster 20 - Energy harvesting as a solution for powering sensors in harsh industrial environment
Speaker: Dimitri TAINOFF
Abstract: *Implementing new sensors in harsh industrial environments can be complicated by the sensor power supply. Wiring is very costly, if not impossible in some places. An alternative is to use wireless sensors powered by batteries. Unfortunately, this option has its limits, as the energy embedded in the battery is limited, making it necessary to change it. In other hand, batteries often use material like lithium that can be prohibited in industrial environment. To avoid this, one option is to harvest energy from the sensor's environment. We will be presenting our self-powered industrial measurement nodes based on thermal energy harvesting technology. These nodes have been designed and implemented in harsh industrial environments, as a few use cases will illustrate.*

Poster 21 - Evaluation of optical interferometry for thickness control of Parylene HT coating for medical devices based on Titanium
Speaker: Sarra RIAHI
Abstract*: This paper addresses the challenge of accurately measuring the thickness of parylene HT coatings using White Light Scanning Interferometry (WLSI), a non-destructive technique. Our results indicate a significant correlation between WLSI and mechanical profilometry measurements affirming the reliability of WLSI for thickness control.*

Poster 22 - Validation of an array of magnetic sensors including smart coordination of measurements
Speaker: Zaid JABBAR
Abstract*: This study proposes a validation approach for a magnetometer grid system integrated with a smart switch for multi-bandwidth magnetic sensor applications. Magnetometers are essential tools for measuring magnetic fields in various scientific and industrial applications. However, existing magnetometer systems often lack the capability to adapt to different bandwidth requirements, limiting their flexibility and applicability. To address this limitation, we present a novel approach that combines a magnetometer grid system with a smart switch mechanism to dynamically adjust the bandwidth of the magnetic sensors based on the requirements of the application.*

Poster 23 - Application of USRP and GNU radio for IoT in Healthcare Use case: Heart rate monitoring

Speaker: Namarig MOHEMED TAHA ABDELRAHMAN AHMED

Abstract: *Conventional, significant techniques for monitoring vital signs necessitate physical contact and constant manual supervision, resulting in patient discomfort and burdening healthcare personnel. Furthermore, these methods are susceptible to errors caused by human mistakes and the drawbacks of sporadic data collection.*

WBANs play a vital role in healthcare, typically comprising a sensor node, a microcontroller, and a communication module. These sensors can sense real-time events and transmit sensor data to a base station through wireless transmission. Consequently, a dependable communication system is critical for delivering an appropriate base station without error. One of the primary concerns for receiving a signal at its destination is the modulator's reliability and accuracy. This poster introduces an innovative method that showcases the practicality of utilizing the QPSK modulator through GNU Radio and USRP for real-time vital sign monitoring. The goal is to create a precise and efficient platform that captures and analyzes critical sign data.

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The organizing committee