



Microsensors Research Laboratory creating a new generation of water sensors and smart sensor systems

Dr. Fabien Josse is a professor of electrical and computer engineering at Marquette University. He is also the director of the university's Microsensors Research Laboratory. His research focuses on solid state and acoustic wave device sensors, micro-electro-mechanical systems (MEMS) devices (microcantilevers) for liquid-phase chemical and biochemical sensor applications, investigation of novel chemical and biochemical sensor platforms, and smart sensor systems. The team's work places equal emphasis on three areas:

1. The development and modeling of new sensor technologies (platforms), and expanding the lab's existing strength in piezoelectric sensors, RF-based sensors and microcantilevers to include other solid state, Micro-electro-mechanical systems (MEMs) and nano-electro-mechanical systems (NEMs) sensors.
2. The analysis of sensor signals by continuing to exploit use of novel signal processing and non-linear estimation theory to allow the extraction of clean, consistent features from noisy, contaminated sensor responses for reproducibility, high probability of detection and low failure rate.
3. Sensor system integration, particularly through the implementation of sensor system arrays – both homogeneous and heterogeneous arrays.



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Dr. Josse's Microsensors Research Laboratory

Dr. Josse's Microsensor Research Laboratory performs both theoretical and experimental work in acoustic wave, solid-state devices and Optical waveguides gas- and liquid-phase chemical and bio-sensors. The laboratory has state-of-the-art equipment for the design, characterization, and evaluation of these sensors and extensive computation facilities for theoretical modeling, analysis, and data processing.

His team has developed micro-electro-mechanical systems (MEMS) and solid state sensors, including microacoustic wave-based sensor systems and microcantilevers to develop onsite detection systems for waterborne pathogenic viruses and bacteria. The team uses the same type of devices to detect fuel and oil contamination and locate organophosphate pesticides, which are used in agricultural production and can be harmful

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when inhaled, ingested or absorbed through the skin. Their sensor system could dramatically reduce the time and cost of the collection and analysis of water samples; provide a more systematic approach to automated monitoring of water sources for biochemical contamination; and contribute to the prevention of virus related outbreaks of disease.

Representative journal publications:

1. Dufour, I., Josse, F., Heinrich, S.M., Lucat, C., Ayela, C., M n l, F., and Brand, O., "Unconventional Uses of Microcantilevers as Chemical Sensors in Gas and Liquid Media," *Sensors and Actuators B: Chemical*, Vol. 170, pp. 115-121, 2012.
2. Beardslee, L.A., Josse, F., Heinrich, S.M., Dufour, I., and Brand, O., "Geometrical Considerations for the Design of Liquid-Phase BioChemical Sensors Using a Cantilever's Fundamental In-Plane Mode," *Sensors and Actuators B: Chemical*, Vol. 164, No. 1, pp. 7-14, 2012.
3. Cox, R.; Josse, F.; Heinrich, S.M.; Brand, O.; Dufour, I.; "Characteristics of laterally vibrating resonant microcantilevers in viscous liquid media", *Journal of Applied Physics*, 111, 014907 (1-14) (2012) (Also in *Virtual Journal of Nanoscale Science & Technology* (Vol. 25, Issue No. 4, Jan. 2012).
4. Mensah-Brown, A.K.; Mlambo, D.; Josse, F.; Schneider, S.; "Analysis of the Detection of organophosphates Pesticides in Aqueous Solutions Using Hydrogen-Bond Acidic Coating on SH-SAW Devices", *IEEE Sensors Journal*, Vol. 12, No.5, pp. 893-903, 2012.
5. Wenzel, M.J.; Mensah-Brown, A.; Josse, F.; Yaz, E.E.; "Online Drift Compensation for Chemical Sensors Using Estimation Theory" *IEEE Sensors Journal*, Vol. 11, No.1, pp. 225-232, 2011.

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