Postdoctoral position offer :

Optimization and miniaturization of an electromagnetic and microfluidic system for immunological detection using magnetic nanoparticles

Sorbonne University, GeePs laboratory, Campus Pierre and Marie Curie, Paris, France

Duration: 1 year with possible extension of 6 months, starting date: **April 1st, 2020**
Salary: Depending on the experiences of the candidate after her or his PhD

Summary:
The objective of this project is the development of an innovative portable electromagnetic microsystem for immunological detection using magnetic nanoparticles (MNP) in a microfluidic lab-on-chip (LoC). MNP associated to the target antigen are used as biological markers in a "sandwich" configuration. A novel method for MNP detection and characterization based on the frequency mixing technique has been developed and tested by our German partner [1-3] in a macroscopic system using cylindrical excitation and detection coils with different immunoassays validations in a sample tube. In order to enhance the performance of this technique (portability, reagent volume, sensitivity, response time, limit of detection and cost), the device has been downsized using planar PCB multilayer excitation and detection coils incorporating with a microfluidic serpentine structure [4-5]. Following the development of analytical and multiphysics simulations tools for optimization of planar coils, first multilayered printed circuit board prototypes have been designed and realized. These prototypes have been characterized with respect to their performance for limit of detection (LoD) of MNP, linear response and validation of theoretical concepts. Using the frequency mixing magnetic detection technique, a LoD of 15ng/µL for 20 nm core sized MNP has been achieved with a sample volume of 14 µL corresponding to a drop of blood. The surface functionalization of MNP and microfluidic sample holders are in progress to achieve biological validation of the LoC device using C-reactive protein (CRP) for proof of concept.

Job description:
In collaboration with partners from different laboratories at Sorbonne Université in Paris involved in this project, and partners at Institute of Bioelectronics (Forschungszentrum Jülich, Germany), the candidate will be in charge of the optimization of the multilayer PCB coils, the development of a portable integrated electronic reader for the whole immunoassay system and the biological validations. This miniaturized electronic readout will consist of different analog and digital modules such as signal generator and digital demodulation module for magnetic excitation and detection, display and microfluidic control modules. The big advantage of a fully digital demodulation electronics as compared to the previously used analog readout electronics incorporating two-stage lock-in demodulation is that all frequency mixing components that are generated by the magnetic nanoparticles can be measured at the same time. The final electronic reader should integrate all components and techniques to achieve a sensitive detection platform as a LoC demonstrator.
We're looking for a candidate with a PhD in electrical engineering, electronics, sensors or other related disciplines, who is open-minded and highly motivated to work on a multi-disciplinary topic related to biological analysis in a LoC. Experience in miniaturized magnetic sensors, multiphysics simulations and realizations, low noise electronic circuits and signal processing, system integration and man-machine interface for biomedical devices will be highly appreciated.

How to apply:
Please send **before January 31, 2020** your application, including a detailed CV and a cover letter, along with the contact information of at least two references to Prof. Hamid Kokabi, hamid.kokabi@sorbonne-universite.fr

References
[1] H.-J. KRAUSE, N. WOLTERS, Y. ZHANG, A. OFFENHÄUSSER *et al.*, *J. Magn. Magn. Mater.* 311, 436 (2007).
[2] S. RETTCHER, F. JUNGK, C. KÜHN, H.-J. KRAUSE *et al.*, *Appl. Environ. Microbiol.* 81, 3039 (2015).
[3] H.B. HONG, H.-J. KRAUSE, I.H. NAM, C.J. CHO, S.W. SHIN, *Anal. Meth.* 6, 8055 (2014).
[4] H. KOKABI, H.-J. KRAUSE, K.A. NGO, A. RABEHI, Electromagnetic sensing device for detecting magnetic nanoparticles, European Patent, EP17306381.9, 28466/004EP1, priority: 12.10.2017, issued: 13.06.2019.
[5] A. RABEHI, B. GARLAN, S. ACHTSNICHT, H.-J. KRAUSE, A. OFFENHÄUSSER, K. NGO, S. NEVEU, S. GRAFF-DUBOIS and H. KOKABI, "Magnetic Detection Structure for Lab-on-Chip Applications Based on the Frequency Mixing Technique", Sensors 2018, 18(6), 1747; https://doi.org/10.3390/s18061747, 2018.