Postdoctoral position:
Nano aerial vehicle based on vibrating wings control

Keywords: Nanotechnology, nano aerial vehicle, vibrations, aero-elasticity, electromagnetic actuator, control, cleanroom fabrication, modelling and simulation

Laboratory: IEMN-CNRS,
Institute of Electronic, Microelectronics and Nanotechnology, France

Laboratory : ENSAM-LISPEN,
Ecole Nationale Supérieure d'Arts et Métiers - Laboratoire des Sciences de l'Information et des Systèmes

Project: NANOFLY
https://anr.fr/Projet-ANR-19-ASTR-0023

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Workplace, contract period and salary:
IEMN-CNRS and ENSAM-LISPEN are seeking for a talented postdoctoral candidate in nano aerial vehicles and nanotechnology research fields. The position should be filled from 01/October/2020 for a period of **24 months**, with a salary of 2269 € /month after taxes.

Environment:
The IEMN-CNRS is spread over sites of Valenciennes and Villeneuve d'Ascq in France, whereas ENSAM-LISPEN is located in Lille. The candidate will work in a state of the art cleanroom environment and will have full access to the micro & nanofabrication platform of the IEMN laboratory (https://www.iemn.fr/plates-formes/cmnf/equipements). She/He will work in close collaboration with experts from nanotechnology and nano aerial vehicles.
The Post-Doc researcher will integrate the MEMS Bioinspired Team. This team has been working for several years on the manufacturing of flying objects that mimic insects [1-3], in close collaboration with the ENSAM-LISPEN Laboratory, which has a solid expertise in design and vibration calculation of non-linear electromechanical systems [4-6].

Objective:
The main objective is the hovering ability demonstration of a nano aerial vibrating wings vehicle operating with an electromagnetic actuator.
The Post-Doc main tasks can be divided into three axis detailed hereafter.

Task1:
The first axis will deal with the design of the nano aerial vehicle structure and the electromagnetic actuator. The goal is to get closer to the performance of flying insects capable of generating large

amplitudes and lifting their weight several times. Therefore, the Post-Doc candidate will have to consider all solutions possible for the reproduction of a kinematics and lift similar to that of insects.

Task2:
The second axis will focus on the manufacturing and testing of nano aerial vehicles prototypes. In particular, the candidate will work on the development of an instrumentation and measurement bench for the control of the nano aerial vehicle hovering as well as on the programming of the closed loop control.

Task3:
The postdoctoral researcher will be responsible of the administrative and scientific aspects of two workpackages in the NANOFLY project: the first one being the design and manufacturing of nano aerial vehicles (Task 1), the second one being its hovering ability demonstration (Task 2). He will also have to ensure a good coordination with the other partners of the project, in particular those who work on the prototypes aero-elastic performances and will assist the team's professors in supervising master and doctoral students.

Candidate profile:
The Post-Doc candidate will be in charge of the three tasks described above. Experience in micro/nano fabrication in a cleanroom environment and in modelling and simulation is mandatory. Skills among the following research fields would be an advantage: micro-nanofabrication processes, mechanical engineering, electrical engineering and control engineering. In addition, experience and strong interest in micro- and nano aerial vehicles will be a plus.

Application:
Please send the following documents:
A complete CV with the list of publications and, when possible, with 2 references letters.
A copy of the doctoral degree and a copy of passport page where your photo is printed.
A copy of your PhD degree if already available.

References:
[1] Dargent, T., Bao, X. Q., Grondel, S., Le Brun, G., Paquet, J. B., Soyer, C., & Cattan, E. (2009). Micromachining of an SU-8 flapping-wing flying micro-electro-mechanical system. *Journal of Micromechanics and Microengineering*, *19*(8), 085028.
[2] Bao, X. Q., Bontemps, A., Grondel, S., & Cattan, E. (2011). Design and fabrication of insect-inspired composite wings for MAV application using MEMS technology. *Journal of Micromechanics and Microengineering*, *21*(12), 125020.
[3] Bontemps, A., Vanneste, T., Paquet, J. B., Dietsch, T., Grondel, S., & Cattan, E. (2012). Design and performance of an insect-inspired nano air vehicle. *Smart materials and Structures*, *22*(1), 014008.
[4] Faux, D., Thomas, O., Cattan, E., & Grondel, S. (2018). Two modes resonant combined motion for insect wings kinematics reproduction and lift generation. *EPL (Europhysics Letters)*, *121*(6), 66001.
[5] Faux, D., Thomas, O., Grondel, S., & Cattan, É. (2019). Dynamic simulation and optimization of artificial insect-sized flapping wings for a bioinspired kinematics using a two resonant vibration modes combination. *Journal of Sound and Vibration*, *460*, 114883.
[6] Colin, M., Thomas, O., Grondel, S., & Cattan, É. (2020). Very large amplitude vibrations of flexible structures: Experimental identification and validation of a quadratic drag damping model. *Journal of Fluids and Structures*, *97*, 103056.