



Postdoctoral Position in Microphone Design

1-year fellowship in TIMA Laboratory, Grenoble

Project Title:

MEMS-based microphones for aeronautics

Keywords:

MEMS, Electroacoustic transducer, Microphone, Acoustics, FEA modeling.

Working Place:

TIMA Laboratory, 46 Avenue Félix Viallet, Grenoble, France,
(<http://www-tima.imag.fr>)

Introduction:

In the last decades, MEMS-based microphones have reached the maturity and became a part of many mobile devices. There was also announced a measuring MEMS-based microphone having a good uniformity on sensitivity and frequency response and reaching the noise level of 23 dB(A), which is 7 dB lower than state-of-the-art 1/4-inch measurement microphones. The best MEMS-based capacitive microphones currently available on market reach the acoustic overload point (AOP) levels of 135dB and there are indications showing that new concepts of microphones using the piezoelectric effect can be used for levels above 150dB. Most of these devices cover entirely or partially the audible frequency range.

Industries such as aeronautics, supersonic aviation, defense, high-speed train, and fans production demand a development of advanced aero-acoustic microphones with a wide frequency band and a large dynamic range. Such novel microphones are needed to perform advanced aeroacoustics measurements being mandatory for state-of-the-art development processes.

Tasks:

The aim of the project is to design a MEMS-based microphone satisfying specifications of a wide frequency band (500Hz to 50kHz) and the acoustic overload point reaching at least the level of 150dB. Both capacitive and piezoelectric microphone principle can be considered to reach the main goals of the project. The main work load will be devoted to the development of a new microphone structures based on the piezoelectric principle.

The candidate will accomplish a detailed modeling of the mechanical behavior of the microphone structure considering effects of acoustic elements introduced to the system to damp its resonance. He will estimate the microphone sensitivity, the frequency range, and other main characteristics. He will optimize the structure dimensions to achieve the best solution and to present the sensor design. A realistic fabrication steps will be proposed for at least two microphone cases based on the piezoelectric transduction principle. The proposed fabrication process will be completely identified in terms of required technical parameters.

Working Context:

The proposed project is based on the collaboration with the teams of the Acoustics Department of the Airbus Operations, S.A.S. and the Acoustic Centre from the Laboratory of Fluid Transfer and Acoustics (LMFA) of Ecole Centrale, Lyon. The candidate will work at the TIMA Laboratory / CDSI Group and will communicate with members of the LMFA on the validation of the design of the device.

Prerequisites: (Desired but not required)

- Basic knowledge of microelectronic and microsystems technology.
- Basic knowledge of mechanical vibrations, elasticity, and acoustics.
- Experience with ANSYS FEA software.

Project Advisors:

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Submission of the applications

Please send Curriculum Vitae, summary of research expertise, list of the publications, list of three or more references and your questions to both advisors.

The position is available starting from September 1, 2021. The selection procedure will last until the position is filled.

Literature:

- [1] VM2020, High Dynamic Range Bottom Port Piezoelectric MEMS Microphone with Differential Output, Vesper, Preliminary Datasheet, 22 Feb. 2019, 9 pp.
- [2] Littrell, R. J., High performance piezoelectric MEMS microphones, Ph.D. dissertation, Univ. Michigan, Ann Arbor, MI, 2010.
- [3] Williams, M.D., Griffin, B.A., Reagan, T.N., Underbrink, J.R., and Sheplak, M., An AlN MEMS Piezoelectric Microphone for Aeroacoustic Applications, J. of Microelectromechanical Systems, Vol. 21, No. 2, April 2012, pp. 270-283.
- [4] Zhou, Z., Rufer, L., Wong, M., Damped Aero-Acoustic Microphone with Improved High-Frequency Characteristics, IEEE Microelectromechanical Systems, Vol. 23, No. 5, 2014, pp. 1094-1100.
- [5] Zhou, Z., Rufer, L., Salze, E., Yuldashev, P., Ollivier, S., Wong, M., Bulk micro-machined wide-band aero-acoustic microphone and its application to acoustic ranging, J. Micromech. Microeng., Vol. 23, No. 10, 2013, pp. 1094-1100.
- [6] Esteves, J., Rufer, L., Ekeom, D., Basrour, S., Lumped-parameters equivalent circuit for condenser microphones modelling, J. Acoust. Soc. Am., Vol. 142, No. 4, Oct. 2017, pp. 2121- 2132.