Postdoctoral position in acoustic holography at the Laboratory of Mechanics and Acoustics (LMA, Marseille, France)

Employer : Aix-Marseille University
Duration : 20 months
Start date: January / February 2020
Gross salary: 2 450 €/month to 2800 €/month depending on qualification and experience, with a seniority bonus on the second year of contract
Location: Laboratory of Mechanics and Acoustics of Marseille UMR7031, Aix-Marseille University

The laboratory of Mechanics and Acoustics of Marseille, CNRS, Aix-Marseille University, France is looking for a post-doctoral fellow in the area of acoustic holography starting February 1st for a period of 20 months (the position is funded by AMIDEX, Aix-Marseille University).

Background and Research context
This research project in collaboration with researchers from the Laboratory of Mechanics and Acoustics (UMR 7031)/AMU Marseille, the Marine Physical Laboratory, University of California San Diego (USA) and the Naval Research Laboratory, Washington DC (USA) aims at developing acoustic methods for defect localization or complex structures characterization based on innovative holography acoustic devices.
A scientific challenge toward that objective comes first from the complexity of the inspected structure that has many degrees of freedom as opposed to the limited information provided by the few sensors that gives access to only a limited number of degrees of freedom of the structure. Secondly, another major limitation for characterizing elastic structure from acoustic data comes from structure interactions with the surrounding environment that impacts the data and makes it difficult to decorrelate/separate intrinsic elastic object response/signature from surrounding environment contribution (sensor holder, fluctuation of the environment, boundaries, mechanical properties, …).
One approach was developed recently for addressing those two challenges for estimating the intrinsic or *in vacuo* response (= structural impedance/admittance) of an elastic target based on the impedance matrices formalism [1] and on the noise correlation method [2] for getting pressure and velocity information. In the frequency range of few kHz [1 kHz -10 kHz], the approach was demonstrated numerically on a 2 D cylinder immersed in water [3] and experimentally on a spherical shell in air in a non-anechoic environment with microphones and accelerometers at the surface [4]. In order to minimize coupling effect between sensors and the elastic target, a versatile dual array of mems microphone is under development at MPL [5]. In order to assess the actual pressure and normal velocity at the target surface to get structural impedance/admittance with that contactless set-up, recent developments based on field separation techniques and backpropagation are applied on these contactless data.

Research objectives/Plan of work
In collaboration with researchers from LMA, MPL and NRL, tasks of the successful candidate are to further develop and apply the latter approach to more complex shape targets in a complex environment (random and/or bounded) using this newly developed experimental set-up.
More specifically, the goal will be to estimate the intrinsic object elastic response (structural admittance/impedance), apply it in a reverberant environment and develop the method for

localizing a change in the target structure based on the previously developed approach. The developed method will be tested on numerical data and experimental data from experiments conducted at the LMA facilities as well as with experimental data from experiments conducted at the partnered laboratories.
The post-doc activities will then be focused on the following items in partnership with researchers from LMA, MPL and NRL:

- Setting-up of the acoustic mems holographic array experiment at the LMA,
- Further developments on the matrix's impedance/admittance estimation for characterization purposes and for localization purpose with the latter set-up and in reverberant environment,
- Test and implementation of the developed approach from acoustic measurements in the anechoic room of the AMU/LMA for getting an experimental baseline response and from measurement in the source room from AMU/LMA.

Requirements

- Candidates must hold a Ph.D. in mechanics, acoustics or related field.
- Essentials skills: Structural acoustics, Signal and array processing and Strong experimental skills/interests
- Knowledge of Matlab or Python required
- Skills in electronics (FPGA) and Knowledge of Comsol Multiphysics would be also appreciated
- High proficiency in English
- Ability for team work and initiative

Applications

Please send your application including a CV with a list of publications, a cover letter and the names/contact information of 1-2 referees who can provide a detailed account of your accomplishments and abilities to:
Dr. Sandrine Rakotonarivo: sandrine.rakotonarivo@univ-amu.fr

The position will be open until filled.

[1] Yu. I. Bobrovnitskii, "Impedance theory of sound scattering: General relations," Acoust. Phys. 52(5), 513–517 (2006).
[2] O. I. Lobkis, R. L. Weaver, "On the emergence of the Green's function in the correlations of a diffuse field", Journal of Acoustical Society of America, vol. 110, 3011 – 3017 (2001)
[3] S. T. Rakotonarivo, W. A. Kuperman and E. Williams, « Prediction of a Body's Structural Impedance and Scattering Properties using Correlation of Random Noise », Journal of Acoustical Society of America, vol. 134, 4401 – 4411 (2013)
[4] E. Williams, J. D. Tippmann, S. T. Rakotonarivo, W. Kuperman, Z. Waters, P. Roux, « Experimental estimation of in vacuo structural admittance using random sources in a non-anechoic room », Journal of Acoustical Society of America, vol. 142, 103 – 109 (2017)
[5] Jit Sarkar, Sandrine T. Rakotonarivo , Simone Sternini, Alexis Bottero, Earl G. Williams, Jeffrey Dwayne Tippmann, and William A. Kuperman, "Holographic array for determining structural acoustic properties", UACE Crete, (2019)