

Vibro-Acoustic investigations of accordion free-reeds

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Project Description

The sound mechanism of a blown-closed free reed is quite particular and it could be found in musical instruments like the accordion, harmonica and bandoneon. The interest at the present project, is focused on the accordion reeds and their vibro-acoustic coupling with their boundaries (support plate, reed block, acoustic cavities, materials, etc.) [4]. The objective of this research is the better understanding of the sound mechanism and the general investigation of the sound's timbre according to a set of parameters, which are the material, the shape and the vibro-acoustic coupling. There have been studies of free reeds in general but only few researchers have focused on the accordion reeds and the whole structure. To address these issues, experimental, analytical and numerical studies will be done after a literature review:

Experimentally: Built up an experimental set up suitable for flow and acoustic measurements. Dynamic measurements of reed vibration will be performed measuring simultaneously the motion (displacement) and frequency of the reeds

Analytically: An analytical tool has been developed, simulating the sound generation of a blown-closed valve (reed) [3]. The understanding of the physical modelling and the validation between the analytical and experimental results will derive a good tool for a future analytical extension.

Numerically: Study on the Fluid-Structure Interaction (FSI) problem, define boundary and initial conditions and create 2D and 3D models in a commercial software using Finite Elements Method (FEM). Calculate the velocity and pressure at the near-field and apply FW-H equation for extracting the acoustic field [5].

The master student will work at ECL laboratories or at a partner's laboratory using one or combining partially more than one methods. The experimental approach is the primal interest for this work providing with input and validation data the other methods as a second step.

References

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- [3] Denis Ricot, René Caussé and Nicolas Misdariis, "Aerodynamic excitation and sound production of blown-closed free reeds without acoustic coupling: The example of the accordion reed, J. Acoust Soc. Am. 117/4, 2279 (2005); <https://doi.org/10.1121/1.1852546>
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