AN ONLINE PLATFORM FOR INPUT IMPEDANCE COMPUTATION OF WIND INSTRUMENTS

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Supporting instrument makers on an innovation strategy, the innovation hub of the Institut Technologique Européen des Métiers de la Musique (Itemm) develops tools to predict the acoustical behavior of wind instruments. From the entire internal bore profile including holes and pistons, the PAFI online platform provides features such as the input impedance or the acoustic pressure or velocity along the bore. The input impedance provides the resonance frequencies which are linked to the playing frequencies (with a musician). The difference between the two is partly due to the coupling between the musician and the mouthpiece. In order to determine this difference a series of measurements carried out on different instruments such as flutes or brass instruments are made. Comparisons between played frequencies and measured resonance frequencies are presented on those different instruments types. Comparisons between measured resonance frequencies and calculated resonances frequencies from the bore profile of the instruments are also presented. This information is intended to help instrument makers to estimate playable frequencies from measured or calculated resonance frequencies.

Keywords: wind, musical instrument, PAFI, impedance, instrument making

The behavior of wind instruments in playing situation results from the coupling between the musician and the instrument, excitation mechanism (musician, mouthpiece) and the resonator (air column inside the instrument). Playable notes within the standard technique (not including notes such as multiphonics, pedal notes, etc) of most modern wind instruments (especially Boehm instruments), are directly linked to the resonance frequencies of the air column. The knowledge of these resonance frequencies helps to estimate the playable note of such instruments.

The “Plateforme d’Aide à la Facture Instrumentale” PAFI that is dedicated to wind instruments offers several analysis and calculation features regarding the input impedance of wind instruments air columns. The platform offers an accessible and secure database allowing collaborative work between users.

This platform has grown out of a research project supported by the French “Agence Nationale de la
Recherche - ANR” between 2009 and 2014, in which were involved several research laboratories, a professional association and the Itemm.

The innovation hub of the Itemm supports instrument manufacturing companies and individual makers in their theoretical approaches in the conception of new instruments through training sessions either on the PAFI platform or through other specific studies.

Over the past few years, several french wind instrument makers got involved in this approach. The relationship between the frequencies of the playable notes and the measured or calculated resonance frequencies of the air column were studied for different kind of instruments such as trumpets, flutes, recorders or uillean pipes. This kind of study requires:

- the entire geometry (figure 1),
- fingering knowledge,
- impedance measurements (figure 2) and calculations for the selected fingerings,
- recordings of played notes for the selected fingerings.

Figure 1: Fingerings of playable notes of a studied flute from the B3 to the C7.
Figure 2: Some impedance measurements of the studied flute.

REFERENCES


