INHARMONICITY OF A TRUMPET WITH A VARIABLE DEPTH MOUTHPIECE

Robin Tournemenne[1], Jean-François Petiot[1] and Joël Gilbert[2]

[1] Institut de Recherche en Communications et Cybernètique de Nantes, France
[2] Laboratoire d'Acoustique de l'Université du Maine, France
robin.tournemenne@irccyn.ec-nantes.fr
jean-francois.petiot@irccyn.ec-nantes.fr
joel.gilbert@univ-lemans.fr

ABSTRACT

This study focuses on the agreement between harmonicity criteria of the trumpet, calculated using either the resonance frequencies of the input impedances, or the playing frequencies of sounds produced by physical modeling (simulated sounds) or played by a musician (real sounds). In order to create different trumpets with different acoustical behavior, a variable depth mouthpiece was developed whose depth can be easily and continuously adjusted from "deep" to "shallow". After a measurement of the input impedance of the trumpet with different mouthpiece depths, simulations by physical modeling were produced on different notes with the harmonic balance technique and the impedance as input. A musician also played the trumpets on different notes. Four fingerings were considered in the study. The influence of the depth of the mouthpiece on the trumpet harmonicity was investigated using different estimators based on the Equivalent Fundamental Pitch (EFP). For a given reference frequency (resonance for the impedance, or tuning note for the sounds), and a given fingering, the EFP calculates the difference in cents between the multiples of this reference and the resonances of the impedance (or the playable notes). Different criteria are proposed to aggregate all these EFP over the regimes and/or fingerings in order to provide an estimator of the trumpet harmonicity. For different mouthpiece depths, a comparison of the harmonicity criteria obtained with the impedance, the simulations, or the played notes by a musician, is proposed. The results show that the simulations by physical modeling can be a relevant alternative to the input impedance measurements to predict certain qualities of the instrument, opening the door to virtual acoustics for instrument makers.