COMPARISON OF MOUTHPIECE PRESSURE SIGNAL AND REED BENDING SIGNAL ON CLARINET AND SAXOPHONE

Alex Hofmann[1], Christoph Reuter[2]
[1] Institute of Music Acoustics,University of Music and Performing Arts Vienna, Austria
[2] Musicological Institute of the University of Vienna, Austria
hofmann-alex@mdw.ac.at
christoph.reuter@univie.ac.at

ABSTRACT

The clarinet and the saxophone have a similar sound excitation principle. For both instruments, a single reed is mounted to a beak shaped mouthpiece and becomes excited by the player's blowing. Caused by the different shapes of the resonators, the sound of the cylindrical clarinet contains only the odd numbered harmonics, whereas the sound of the conical saxophone contains all members of the harmonic series. Measurements on double reed instruments by Voigt (1975) showed that the closing time of the double reed was constant across all pitches played on the instrument. Consequently, only the offset period was modulated. Characteristic frequency gaps in the spectrum (formants) of an instrument's sound were explained by this specific motion pattern of the oscillator (pulse forming theory, Fricke 1975). Can this theory also be applied to single reed instruments, like the saxophone and the clarinet? For our measurements on a Bb-clarinet and an alto-saxophone, synthetic single-reeds were equipped with strain gauge sensors, to capture the bending of the reed during sound production. A pressure transducer inside the chamber of the mouthpiece tracked the inner mouthpiece pressure. Two professional players performed a chromatic scale over the whole range of the instrument, either on the clarinet or the saxophone. From the reed bending measurements, we calculated the ratio between the opening time and the closing time for each played tone. On the clarinet, this ratio was almost constant for all played tones (M = 0.71, SD = 0.09), whereas on the saxophone these ratios showed larger deviations, but no clear pattern in relation to the played pitch (M = 0.64, SD = 0.44). Closing times for the tones eb', ab' and b' on the saxophone were much shorter than the neighboring pitches. Spectrograms of the reed signal and the mouthpiece pressure signal were calculated for the steady state part of the tones. For the saxophone, both the spectrograms were almost identical, depicting all members of the harmonic series in a decreasing fashion. Against our expectations, we also observed all harmonics in the reed signal of the clarinet, whereas only in the mouthpiece pressure signal merely the odd harmonics appeared. However, these reed bending measurements indicate that the pulse forming theory, which is valid for double reed instruments, can not be transferred to single reed instruments like the clarinet or the saxophone, where the closing time varies with the pitch.