

TataTataTakaTaka - Tonguing performance on wind instruments - Visualization and benchmarks

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Background: A tongue motion initiates each note that is played on wind instruments. Visualizations of the complex motion by previous x-ray or MRI studies have been restricted to 4-20 images per second, and do not show a high spatial resolution. Moreover, there are no empirical data, how fast musicians can or should be able to perform 'single tonguing' (TataTata) or 'double tonguing' (TakaTaka).

Purpose was to document the tongue motion with a high-resolution trajectory in slow motion and to reveal benchmarks on maximum tonguing tempi that can be played by musicians of various experience-levels.

Methods: Movement data (250fps) were acquired by means of electromagnetic articulography ('EMA' by Carstens AG501). Cartesian xyz coordinates are gathered of several head and tongue-sensors (transmitter coils), which allow calculating their motions during playing on a trumpet or a clarinet. Another quantitative study (n=206) has been done to evaluate the maximum tempi that can be played on brass instruments. Continuous sixteenth note with 'single tonguing' and 'double tonguing' were recorded to find the absolute maximum tempo for two seconds and the fatigue strength reduction factor over 30 seconds.

Results: Data of the electromagnetic articulography have been visualized and can be seen at 'www.tinyurl.com/Performancevideos'. They show a complex but symmetric 2D trajectory. The range of motion is much smaller for faster notes. The tongue rises with increasing pitch.

The average tempi (median) in BPM (Metronome values) for four 1/16 notes in the first two seconds have been for 'single tonguing' 109 for amateur, 120 for students and 123 BPM for professional players (167 for the fastest player, i.e. 11 notes per second). For 'double tonguing' the averages are 149 for amateurs, 170 for students and 172 BPM for professional players (238 for the fastest player, i.e. 16 notes per second).

Conclusions: The EMA method allowed for the first time a more detailed motion analysis of the tongue. The provided benchmarks values (like BPM 120 for playing 'single tonguing') deliver useful informations for musicians dealing with articulation dysfunction and they can be of potential value for assessing this factor in health clinics.

Key References: Brass Instruments, Tonguing, Tempi, Motion Analysis

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