



## Digital synthesis to evaluate the role of the cutoff frequency on sound production and radiation

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### Abstract

The cutoff frequency of the input impedance is a well-known characteristic of woodwind instruments. Benade remarks that the frequency at which cutoff occurs is strongly related to the produced sound of a given instrument and that it correlates to the adjectives musicians use to describe the character of a given instrument. However, it is not known how the cutoff frequency contributes to the competition between the energy that contributes to the auto-oscillation of the reed and the energy that is radiated from the resonator. To evaluate the effects on sound production and radiation, simplified resonators with the same first impedance peak frequency, but different cutoff frequencies, are simulated and experimentally verified. It is found that a rigorous geometrical regularity results if a very strong cutoff behavior. Next, digital synthesis is used to simulate the pressure and velocity waveforms within the mouthpiece which are propagated to the external field. Spectral characteristics of the sound both within and outside the resonators can be used to quantify how the cutoff frequency affects sound production and radiation.

Keywords: Musical acoustics, tonehole lattice cutoff frequency, digital sound synthesis, clarinet.

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