MSP2018 Assignment #2

Jakob Georg Ruderer

Reading:

de Cheveigné, A. 2005. Pitch perception models. In Pitch: Neural Coding and

Perception, ed. C. J. Plack, A. J. Oxenham , R. R. Fay and N. A. Popper, 169–233.

New York, NY: Springer.

1. definition of pitch

The definition of pitch is complicated and has different aspects to it. It is one dimensional only when it comes to pure tones, then it could be described as a sounding sensation that can be ordered from low to high depending on how small or great the frequency is, which stands in correlation with pitch.

When it comes to the real-life auditory sensations, such as voices, “noises” etc., it is more complex to define pitch. It is multidimensional with several frequency parameters with multiple pitch like dimensions. There might be a focus on one of the pitches in the mix that a listener perceives as the main one, which means pitch has more than one layer.

The pitch that might function as formant signal could lead to a pitch related to flocus, the spectral pitch, while the pitch is related to F0, the periodicity pitch. The latter only exists in a limited region of parameter space. Spectrum and time are closely related to pitch.
Pitch is invariant to other dimensions.

2. place theory (with a brief synopsis of its history and its relationship to signal processing methods)

The first record of relating ratios of string lengths on the monochord to musical intervals dates back to the 6th century B.C., to Pythagoras. Two centuries later, Aristoxenos describes interval and pitch. Safi al-Din defined a musical note, which can be compared to the modern definition of pitch much later, the 13th century “a sound for which one can measure the excess of gravity or acuity with respect to another sound”.

Later on, after the qualitative dependency of pitch and frequency was already established by the Greeks, in the 17th century Mersenne and Galilei discovered the quantitative relationship. Mersenne proved that the frequency of a string varies inversely proportionally to the square root of its tension, and inversely the square root of its weight per unit length.

By halving the string lengths, after stretching them long enough so that he can count the vibrations, he created frequencies of every note in the scale.

In the early 18th century, Sauveur found out that a string can vibrate simultaneously at different harmonics, which led to the terms of fundamental and harmonic. The concept of linearity, established by Euler, drew the conclution to the principle of superposition. A vibration can show a sum of vibrations that are related by periods at integer submultibles of the fundamental period, having the same period as the fundamental period with the same or a different shape. Adding sinusoidal partials cause variegated shapes according to their phases and amplitudes.

Later that same century, Du Verney came up with his resonance theory, looking at the spiral lamina as a resonator in order to send auditory signals to the brain, which marks the beginning of the tonotopic projection to the brain. More accurate studies of anatomical aspects were conducted after.

3. time theory (with a brief synopsis of its history and its relationship to signal processing methods)
The measurement of sound early on, for example at the Pythagorean school was concerned with the ratio of pulse counts. This later on, for Mersenne or Descartes for instance became the ratios of frequency in spectral theorie:
Vibration rate determines pitch, speed of propagation is independent of pitch.
The listeners perception in this matters is subject of time theory as well, such as the question if one's ears and brain count vibrations or if there are calibrated resonatores/nerves. And where exactly does this measurement happen?
Different theories were developed, so for example internal air theory, which were disregarded because proven wrong.
Later on with measuring within fibers of the auditory system it was proven that the fibers firing is stochastic. So, time structure can be carried, being able to measuring up to 3 to 5 kHz for cats.

MSP2018 Assignment #3

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Reading:

Bello, J. P., et al. (2005). “A tutorial on onset detection in music signals.” IEEE

TRANSACTIONS ON SPEECH AND AUDIO 13(5): 1035–1047.

Briefly answer the following questions:

i. What is the difference between an attack and an onset?
The attack is the a time interval during which a sound's amplitude level increases.
The onset on the other hand is a moment which marks the beginning of a transient, an event that significantly changes a signal, such as an attack.

ii. Why is preprocessing typically done to the signal?
It usually serves as a transformation in order to enhance or reduce a number of factors of a signal in order to the aim of the signal processing at hand.

iii. What is the purpose of reduction?
The reduction is a process that turnes an audio signal into a detection function which serves as indicator for events, such as onsets and their subsequent transients. It basically magnifies every occurrence of transients.

iv. What is the role of peak picking?
In an according to the task curated detection function, noise in the signal, created by factors such as actual noise, vibrato etc. might disguised as local maxima, the peaks which represent the features extracted for the detection function. So, in order to estimate the onset times of the actual events, a peak-picking algorithm is necessary.