

- Method of automatic extraction of a rhythmic attribute from percussive music audio signals: the smallest rhythmic pulse, called the "tick".
- Discussion and evaluation of the relevance of use of this feature in the framework of subsequent analyses.

## Context

**Drum tracks:** Percussive music of constant tempo. More precisely, audio signals of restricted polyphonic complexity, containing few sets of timbres, e.g. few seconds-long mixes of acoustic bass drums, snare drums, hi-hats, toms and cymbals.

**Long-term objectives:** Design retrieval and transformation tools for percussive musical signals, anchored in the musical contents of the audio.

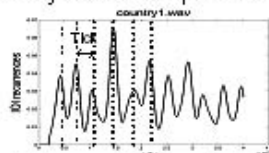
**Goal:** Extract the smallest rhythmic pulse and investigate its relevance as a segmentation step for subsequent analyses

## The 'tick'

Subdivision of the Beat, or tactus (perceptually most prominent pulse). Might *not always* be apparent in the signal as the lowest level of the metric hierarchy, i.e. the shortest inter-onset interval (IOI). *Rather* High-frequency pulse which period most highly coincides with *all* note onsets

## Algorithm

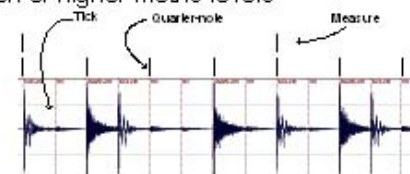
- Onset detection based on short-time energy calculations
- IOIs histogram generation
- Tick gap = IOI (smoothed) histogram harmonic series gap (use of a two-way mismatch procedure on the histogram)



- Phase computation and gap adjustment (use of a two-way mismatch procedure on the signal). (Compromise between precision of the measure and amount of agglomeration of the IOIs.)

## Subsequent analyses

1. Characterization of percussive events in audio drum tracks
2. Determination of higher metric levels



## Evaluation of the tick extraction

Generate audio drum tracks, together with exact scores (tick indexes and instruments occurrences)  
 ⇒ 1000 5-seconds drum tracks: 77.3% good ticks, 11.1% simple rational relation and 11.6% bad.

Subjective evaluation  
 ⇒ 57 drum tracks: 86%, 7%, 7%.  
 ⇒ 112 polyphonic excerpts: 56%, 25%, 19%

## References of first relevance:

- Biles J., *Timing is of the Essence: Perceptual and Computational Techniques for Representing, Learning, and Reproducing Expressive Timing in Percussive Rhythm*. MS Thesis, MIT, (1993).
- Seppänen J., *Tatum grid analysis of musical signals*. IEEE Workshop on Applications of Signal Processing to Audio and Acoustics (2001).