Introduction to Audio Content Analysis

Module 9.6: Downbeat and Bar Length Detection

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introduction
overview

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College of Design

corresponding textbook section

Section 9.6

- **lecture content**
  - quick overview of bar length and downbeat detection

- **learning objectives**
  - discuss systematic differences between tempo & bar length detection
  - discuss systematic differences between beat & downbeat detection

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meter & downbeat detection
problem statement

- **bar length detection**
  - detect periodicity of group of strong and weak musical events/beats
  - length typically between 3–7 beats

- **downbeat detection**:
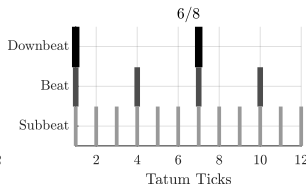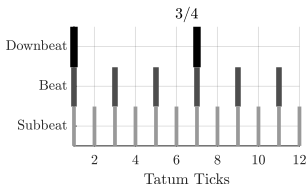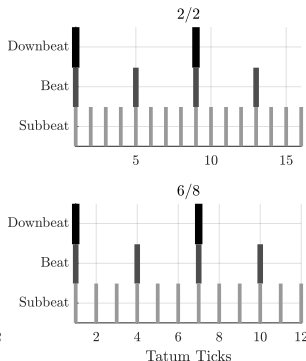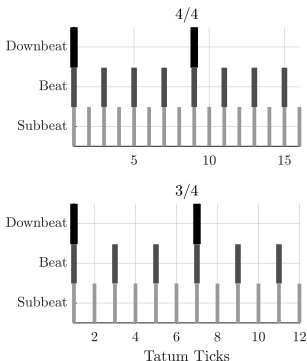 - detect the start location of a bar

meter & downbeat detection
introduction

- relation of *bar length and downbeat* is comparable to relation between *tempo and beat phase*
- meter and downbeat are on a higher hierarchical level

- extraction can be very similar but on *higher hierarchical level*
  1. extraction of novelty function
  2. estimation of bar period
  3. estimation of downbeat

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matlab source: plotBeatHierarchy.m

bar length detection
overview

1 extraction of **novelty function**
- onset probability (see tempo detection)
- downbeat-specific (may be genre-dependent)
  - ▶ bass onset/low frequency energy increase
  - ▶ harmonic change → pitch chroma change
  - ▶ beat and onset match
  - ▶ . . .

2 possible: **quantization to beat or tatum** (downbeat can only be on a beat)

3 **periodicity estimation**
- ACF
- spectral peak analysis
- . . .

bar length detection
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downbeat detection
overview

- assumption: downbeat is most prominent reoccurring peak in the novelty functions
  - ⇒ delta pulse CCF
    - . . .

summary
lecture content

- **bar length detection**
  - same principles as tempo detection
    - ▶ higher hierarchical level (different periodicity freq)
    - ▶ modified or additional novelty functions

- **downbeat detection**
  - same principles as beat detection
    - ▶ higher hierarchical level (different periodicity freq)
    - ▶ modified or additional novelty functions