



Introduction to **Audio Content Analysis**

Module 9.6: Downbeat and Bar Length Detection

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introduction

overview

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

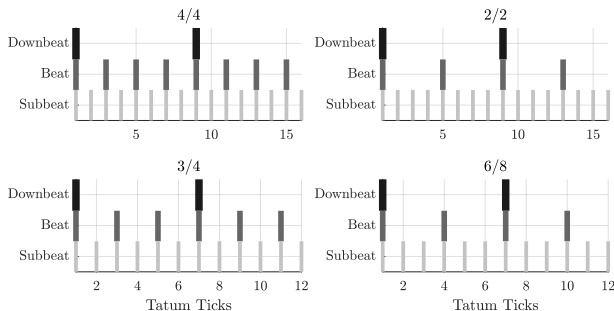
introduction

- 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

meter & downbeat detection

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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

