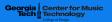


Introduction to Audio Content Analysis

module 9.6: downbeat and bar length detection

alexander lerch



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



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



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

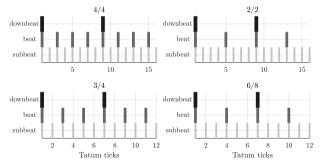


- relation of *bar length and downbeat* is comparable to relation between *tempo and beat phase*
- meter and downbeat are on a higher hierarchical level
- extraction can be very similar but on higher hierarchical level
 - 1 extraction of novelty function
 - 2 estimation of bar period
 - 3 estimation of downbeat

meter & downbeat detection introduction



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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
 - lacktriangle harmonic change ightarrow pitch chroma change
 - beat and onset match
 - ▶ ...
- possible: quantization to beat or tatum (downbeat can only be on a beat)
- **3** periodicity estimation
 - ACF
 - spectral peak analysis
 - . .

bar length detection overview



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bar length detection overview

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downbeat detection overview



assumption: downbeat is most prominent reoccurring peak in the novelty functions

 \Rightarrow delta pulse CCF

• ...

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

