INTERNATIONAL AUDIO LABORATORIES ERLANGEN

AUDIO LABS

Tutorial
Automatisierte Methoden der Musikverarbeitung
47. Jahrestagung der Gesellschaft für Informatik

Introduction to MIR

Meinard Müller, Christof Weiss, Stefan Balke

International Audio Laboratories Erlangen
{meinard.mueller, christof.weiss, stefan.balke}@audiolabs-erlangen.de

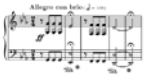
FAU FRIEDRICH-ALEXANDER UNIVERSITÄT ERLANGEN-NÜRNBERG

Fraunhofer IIS

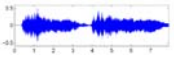
Music

Music Information Retrieval (MIR)

Sheet Music (Image)



CD / MP3 (Audio)



MusicXML (Text)

Dance / Motion (Mocap)

Music

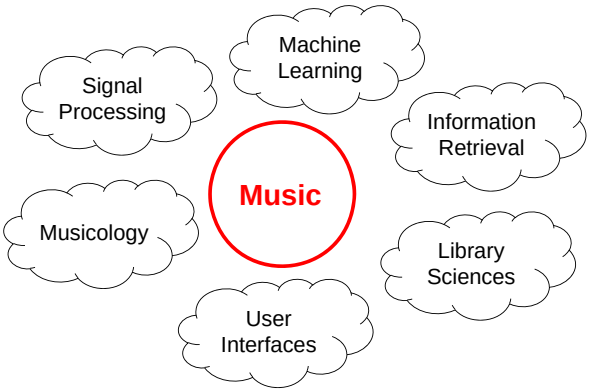
MIDI

Singing / Voice (Audio)

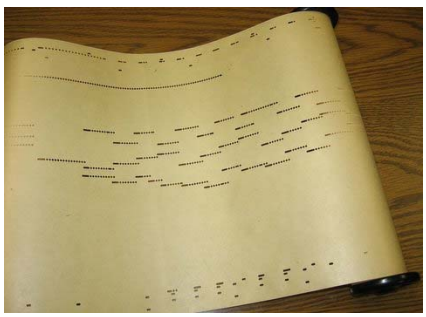
Music Film (Video)

Music Literature (Text)

Music Information Retrieval (MIR)



Piano Roll Representation

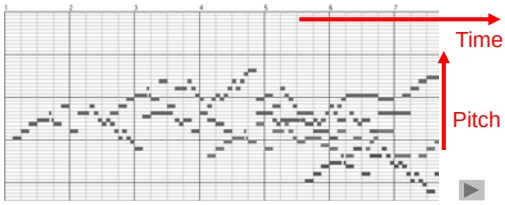


Player Piano (1900)

Piano Roll Representation (MIDI)

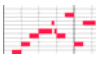
J.S. Bach, C-Major Fuge

(Well Tempered Piano, BWV 846)

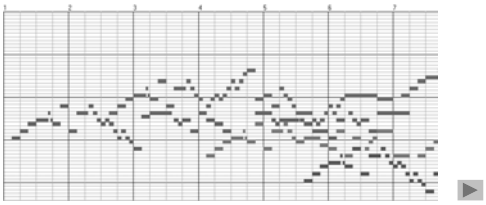


Piano Roll Representation (MIDI)

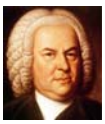
Query:



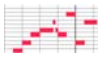
Goal: Find all occurrences of the query



Piano Roll Representation (MIDI)

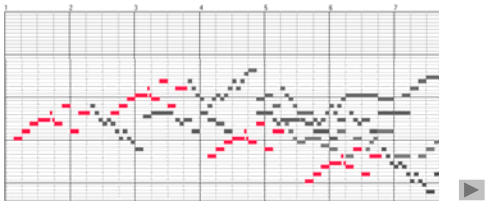


Query:

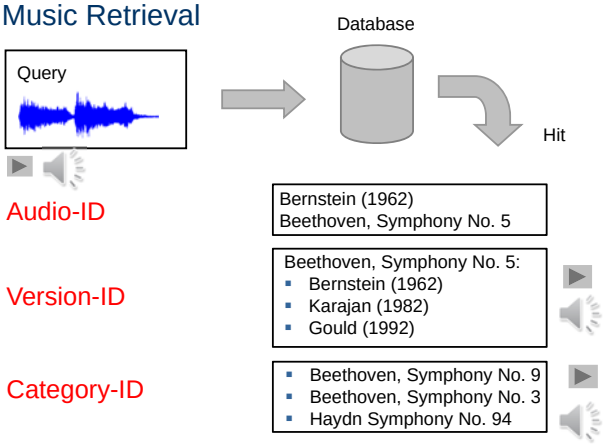


Goal: Find all occurrences of the query

Matches:

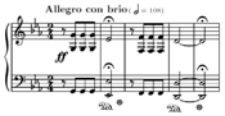


Music Retrieval



Music Synchronization: Audio-Audio

Beethoven's Fifth



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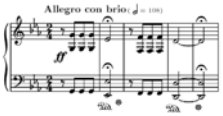
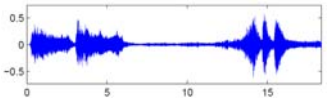
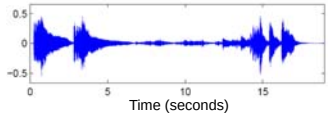


Orchester (Karajan)



Piano (Scherbakov)



Music Synchronization: Audio-Audio

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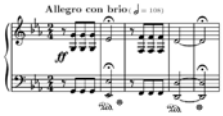
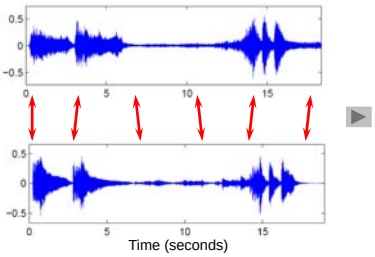


Orchester (Karajan)

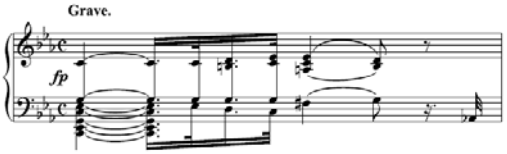
Piano (Scherbakov)



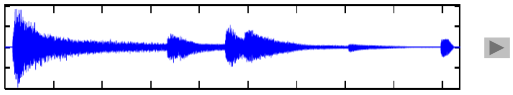
Application: Interpretation Switcher

Music Synchronization: Image-Audio

Image

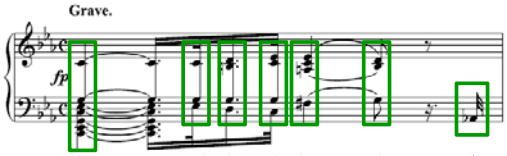


Audio

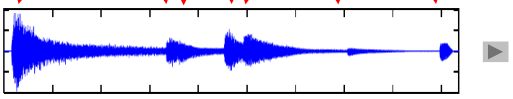


Music Synchronization: Image-Audio

Image

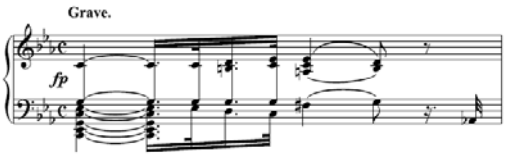


Audio



How to make the data comparable?

Image



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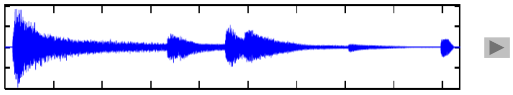
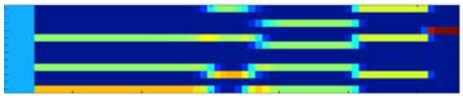


How to make the data comparable?

Image Processing: Optical Music Recognition

Image



Audio

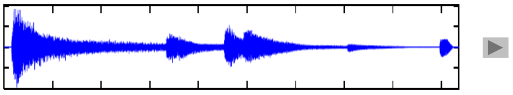


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Image Processing: Optical Music Recognition

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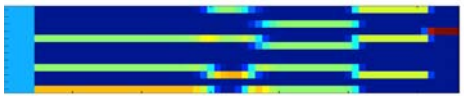
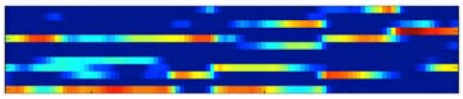


Audio

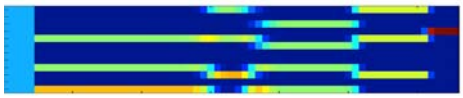


Audio Processing: Fourier Analyse

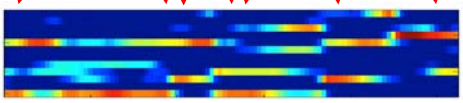
How to make the data comparable?

Image Processing: Optical Music Recognition

Image

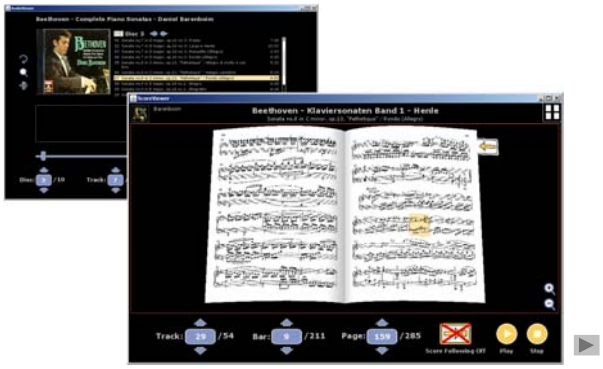


Audio



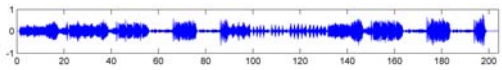
Audio Processing: Fourier Analyse

Application: Score Viewer



Music Structure Analysis

Example: Brahms Hungarian Dance No. 5 (Ormandy)



Music Structure Analysis

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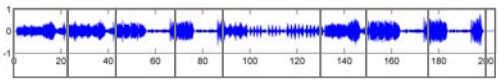

Music Structure Analysis

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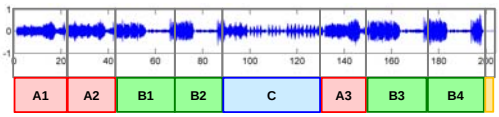
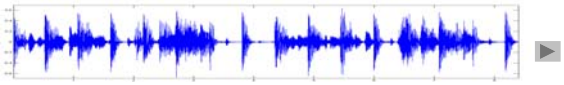


Tempo Estimation and Beat Tracking

Basic task: “Tapping the foot when listening to music”

Example: Queen – Another One Bites The Dust

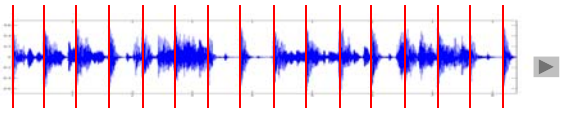


Time (seconds)

Tempo Estimation and Beat Tracking

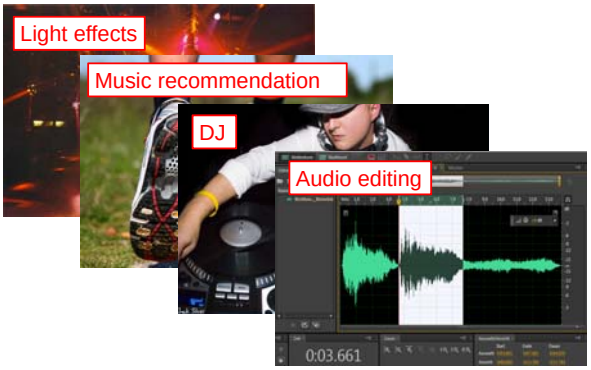
Basic task: “Tapping the foot when listening to music”

Example: Queen – Another One Bites The Dust



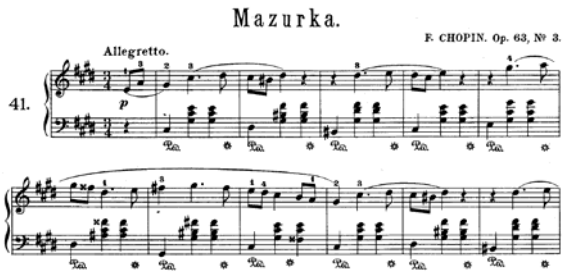
Time (seconds)

Tempo Estimation and Beat Tracking



Why is Music Processing Challenging?

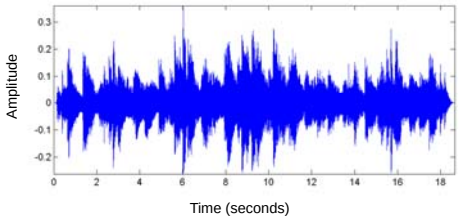
Example: Chopin, Mazurka Op. 63 No. 3



Why is Music Processing Challenging?

Example: Chopin, Mazurka Op. 63 No. 3

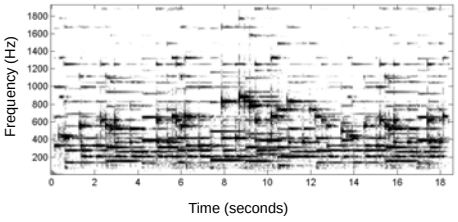
- Waveform



Why is Music Processing Challenging?

Example: Chopin, Mazurka Op. 63 No. 3

- Waveform / Spectrogram



Why is Music Processing Challenging?

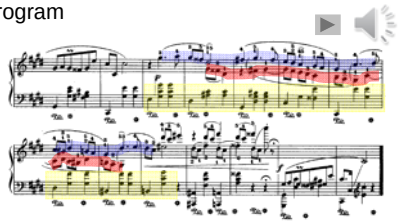
Example: Chopin, Mazurka Op. 63 No. 3

- Waveform / Spectrogram
- Performance
  - Tempo
  - Dynamics
  - Note deviations
  - Sustain pedal

Why is Music Processing Challenging?

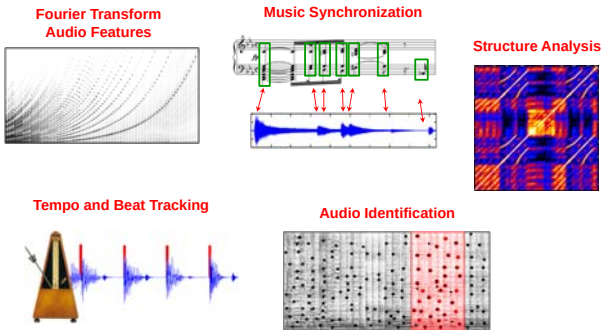
Example: Chopin, Mazurka Op. 63 No. 3

- Waveform / Spectrogram
- Performance
  - Tempo
  - Dynamics
  - Note deviations
  - Sustain pedal
- Polyphony

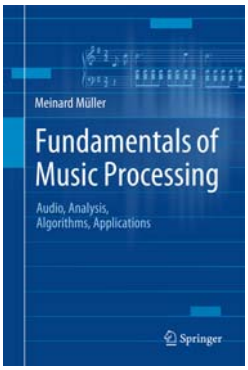


Main Melody
Additional melody line
Accompaniment

Music Processing



Book: Fundamentals of Music Processing



Meinard Müller
Fundamentals of Music Processing
Audio, Analysis, Algorithms, Applications
483 p., 249 illus., hardcover
ISBN: 978-3-319-21944-8
Springer, 2015

Accompanying website:
www.music-processing.de

Book: Fundamentals of Music Processing

Chapter	Music Processing Scenario
1	Music Represenations
2	Fourier Analysis of Signals
3	Music Synchronization
4	Music Structure Analysis
5	Chord Recognition
6	Tempo and Beat Tracking
7	Content-Based Audio Retrieval
8	Musically Informed Audio Decomposition

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