

Workshop HfM Karlsruhe
Music Information Retrieval

Introduction

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International Audio Laboratories Erlangen

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Meinard Müller

- 2007 Habilitation
Bonn University
- 2007 – 2012
Senior Researcher
Saarland University & MPI Informatik
- Since 2012
Professor: Semantic Audio Processing
Erlangen-Nürnberg University



Group Members

- Christof Weiß
- Frank Zalkow
- Sebastian Rosenzweig
- Hendrik Schreiber



Christof Weiß

- 2006 – 2012 Physics Diploma
Würzburg University
- 2006 – 2012 Composition Diploma
Würzburg University of Music
- 2012 – 2015: PhD
Ilmenau, Fraunhofer IDMT
- Since 2015: AudioLabs Erlangen
- Freelancing composer



Frank Zalkow



- 2008 – 2012 Bachelor Musicology/Music Informatics (University of Music Karlsruhe)
- 2012 – 2015 Master Music Informatics (University of Music Karlsruhe)
- 2015 – 2016 Research Fellow in Musicology (Saarland University)
- since 2016 PhD Student, Group Meinard Müller (AudioLabs)



Where are we?



Fraunhofer-Gesellschaft

- Europe's largest organization for applied research
- 18,000 employees worldwide, total budget: 1.5 billion €
- 60 institutes covering a broad range of research areas

Fraunhofer Institute for Integrated Circuits IIS

- Largest Fraunhofer institute
- Staff >700 people
- MP3



Where are we?

Friedrich-Alexander Universität Erlangen-Nürnberg (FAU)

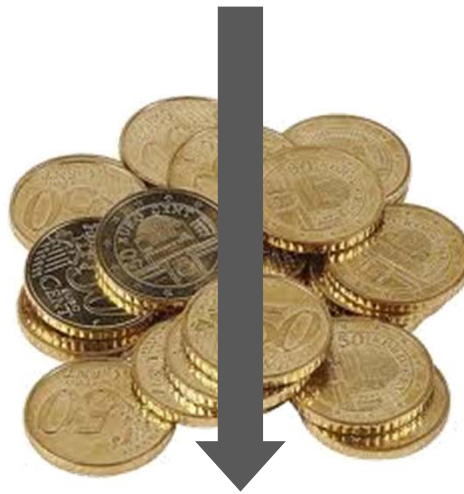
- One of Germany's largest universities
- More than 35,000 students



Collaboration between FAU and Fraunhofer IIS

- Roots of “MP3” audio compression scheme
- Research on audio coding in Erlangen since 1981

International Audio Laboratories Erlangen



International Audio Laboratories Erlangen



Audio

International Audio Laboratories Erlangen

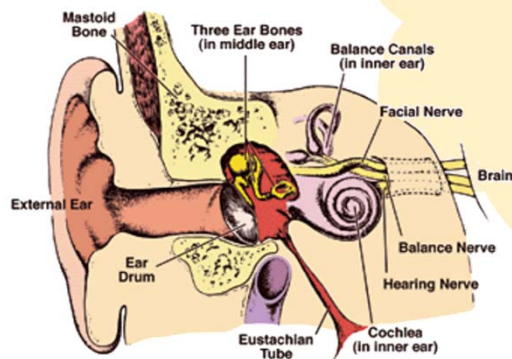
Audio Coding



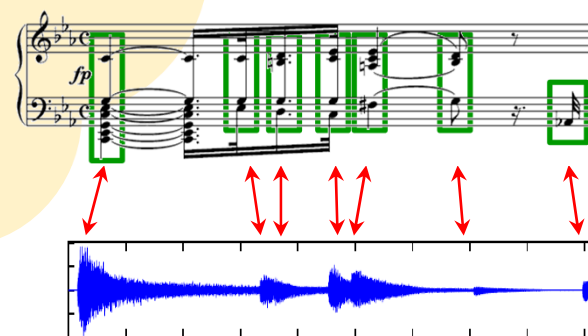
3D Audio



Audio



Psychoacoustics



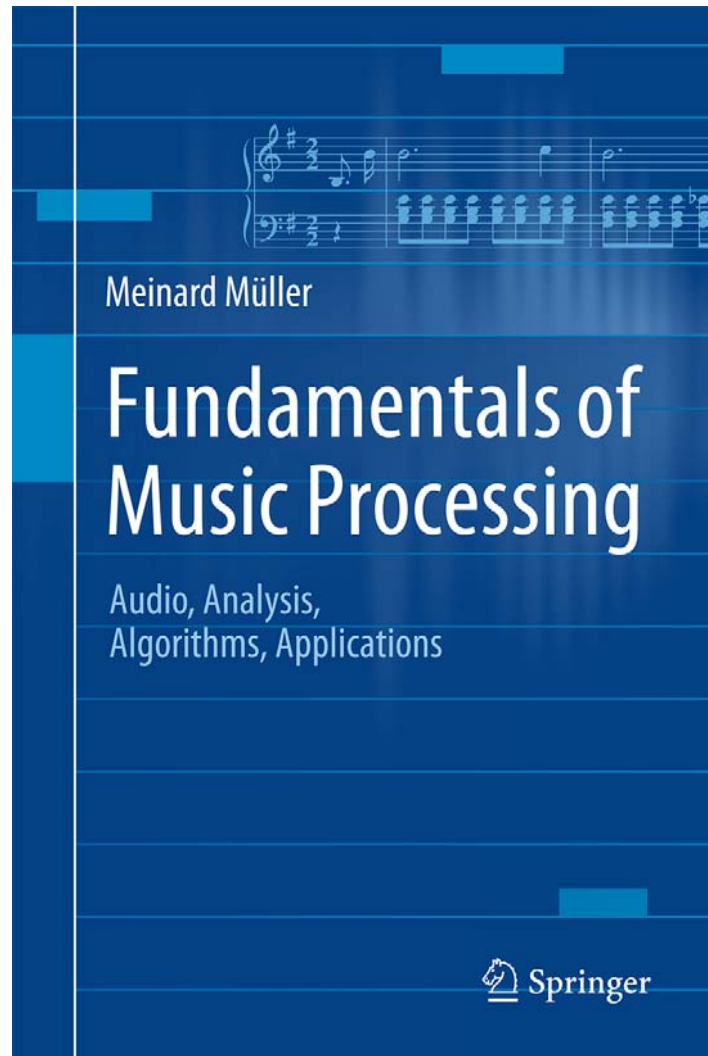
Music Processing

AudioLabs – FAU

- Prof. Dr. Jürgen Herre
Audio Coding
- Prof. Dr. Bernd Edler
Audio Signal Analysis
- Prof. Dr. Meinard Müller
Semantic Audio Processing
- Prof. Dr. Emanuël Habets
Spatial Audio Signal Processing
- Prof. Dr. Frank Wefers
Spatial Audio Signal Processing
- Dr. Stefan Turowski
Coordinator AudioLabs-FAU



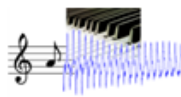
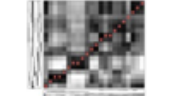
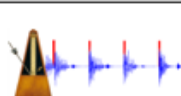
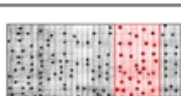
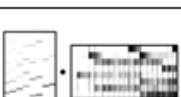
Book: Fundamentals of Music Processing



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 Representations
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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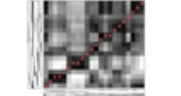
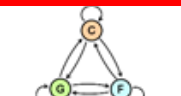
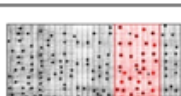
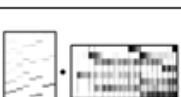
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Book: Fundamentals of Music Processing

- Accompanying Code: Jupyter Notebooks (Python)



Python Notebooks for Fundamentals of Music Processing



This site offers a collection of Python code examples along with additional explanations and instructions that illustrate, implement, and extend many concepts explained in the book [Fundamentals of Music Processing](#). All pages are authored using [Jupyter notebooks](#). The site is maintained by [Meinard Müller](#). For questions, please email meinard.mueller@audiolabs-erlangen.de. I am grateful for any feedback and suggestions.

License

The code, text, and figures of these notebooks are licensed under a [Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License](#). As for the audio material, the respective original licenses apply. This site contains material (text passages, figures) from the book [Fundamentals of Music Processing](#). If you use code or material from this site, please give reference to this book (e.g. Figure 1.1 from [\[Müller, FMP, Springer 2015\]](#)). If you publish results obtained or using these Python notebooks, please cite:



Meinard Müller
Fundamentals of Music Processing
Springer Verlag, 2015. [BibTeX](#)



Overview

The collection of notebooks is organized along the eight chapters of the textbook [\[Müller, FMP, Springer 2015\]](#). The following table gives an overview of these chapters and provides links. Furthermore, we provide some basic information on Python programming language and the Jupyter framework underlying these notebooks.

Chapter	Title	Notions, Techniques & Algorithms	HTML
	Basics	Basic information on the Python programming language, the Jupyter notebook and other topics including the Anaconda package management system, Python environments, and Git	[html]
	Overview	Overview of the notebooks (this website)	[html]
	Music Representations	Music notation, MIDI, audio signal, waveform, pitch, loudness, timbre	[html]
	Fourier Analysis of Signals	Discrete/analogue signal, sinusoid, exponential, Fourier transform, Fourier representation, DFT, FFT, STFT	[html]
	Music Synchronization	Chroma feature, dynamic programming, dynamic time warping (DTW), alignment, user interface	[html]

www.audiolabs-erlangen.de/FMP

Workshop MIR

Dienstag (MUT 206)

14:00 – 16:00 **Lecture:** Introduction + Music Representations

16:00 – 18:00 **Lecture:** Audio Features

Mittwoch

10:00 – 12:00 **Lecture:** Harmony Analysis (MUT 206)

13:00 – 15:00 **Programming Exercise:** Short Time Fourier Transform (MUT 207)

15:00 – 17:00 **Programming Exercise:** Chroma Features and Harmony Analysis

Donnerstag

10:00 – 11:00 **Lecture:** Music Synchronization (MUT 207)

11:00 – 12:00 **Lecture:** Music Classification (MUT 207)

13:00 – 17:00 **Programming Exercise:** Harmonic–Percussive Separation (MUT 206)

Freitag (MUT 207)

10:00 – 12:00 **Student Mini-Projects / Further Exercises**

13:00 – 16:00 **Student Mini-Projects / Further Exercises**

Course material:

www.audiolabs-erlangen.de/resources/MIR/2019_CourseMIR_HfM-Karlsruhe