

Hochschule für Musik Karlsruhe

Blockvorlesung

Advanced Audio-Based Music Processing

Introduction

Christof Weiß, Frank Zalkow, Meinard Müller

International Audio Laboratories Erlangen

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meinard.mueller@audiolabs-erlangen.de

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

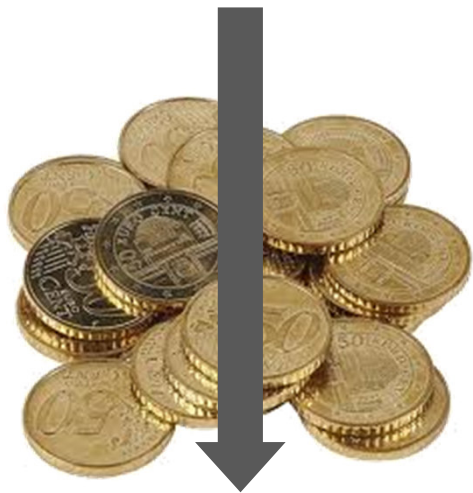
- Roots of “MP3” audio compression scheme
- Research on audio coding in Erlangen since 1981

International Audio Laboratories Erlangen

 **Fraunhofer**
IIS



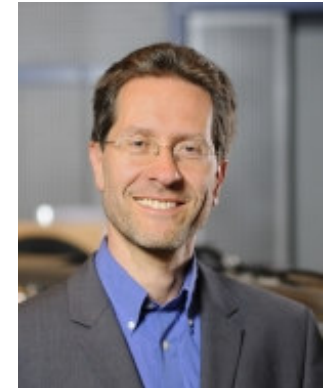
FAU FRIEDRICH-ALEXANDER
UNIVERSITÄT
ERLANGEN-NÜRNBERG



AUDIO
LABS

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



International Audio Laboratories Erlangen



Audio

International Audio Laboratories Erlangen

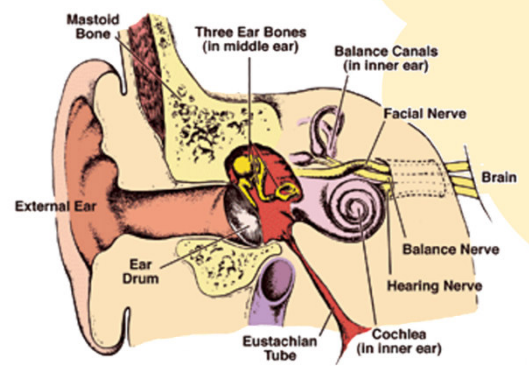
Audio Coding



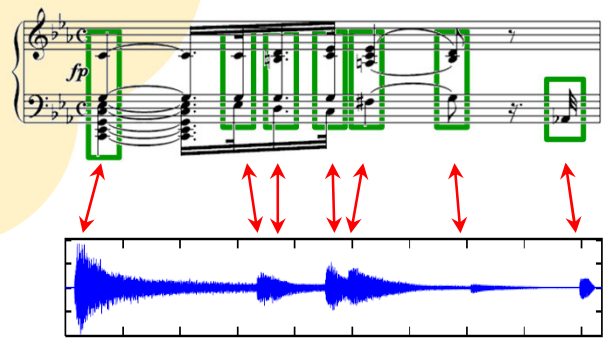
3D Audio



Audio



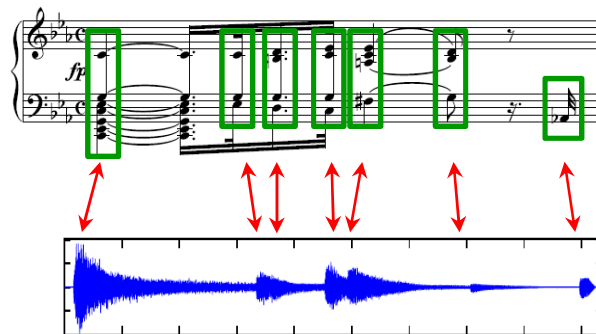
Psychoacoustics



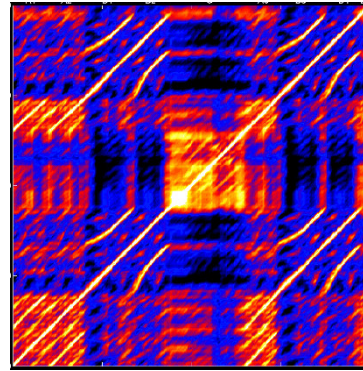
Music Processing

Music Processing / Music Information Retrieval

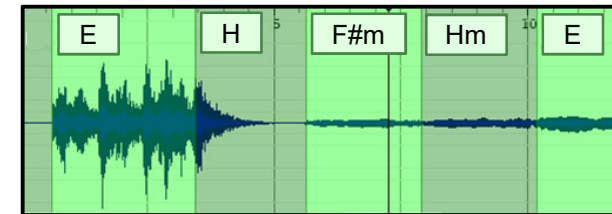
Musiksynchronisierung



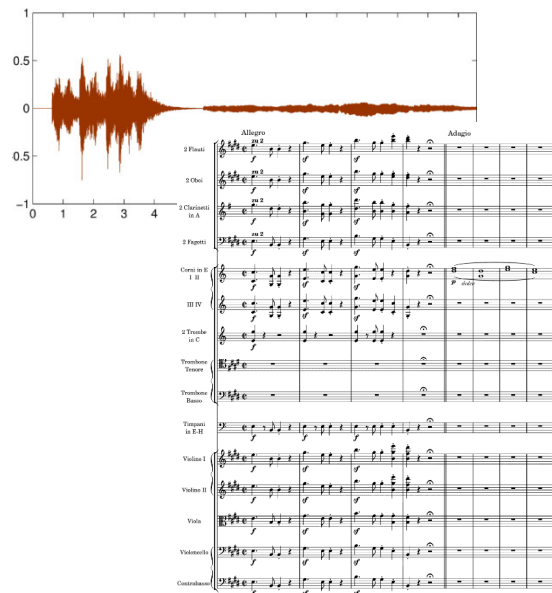
Strukturanalyse



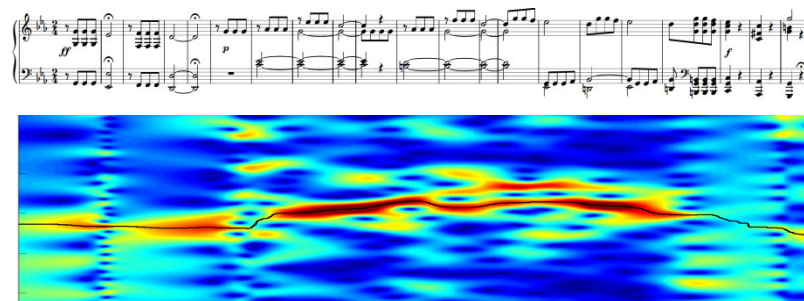
Harmonieanalyse



Automatische Transkription



Temposchätzung und Beat Tracking



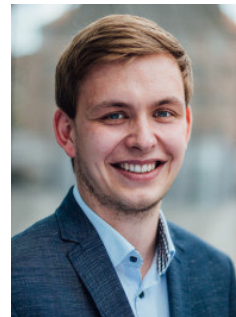
Meinard Müller

- 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
- Michael Krause



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
- 2018: KlarText Preis für
Wissenschaftskommunikation
- Freelancing composer



Christof Weiß

- 2006 – 2012: Physics Diploma
Würzburg University
- 2006 – 2012: Composition Diploma
Würzburg University of Music



Hochschule
für Musik
Würzburg
university of music



Saitengesang (2013)

Jonas Palm, Violoncello
Philipp Heiß, Klavier

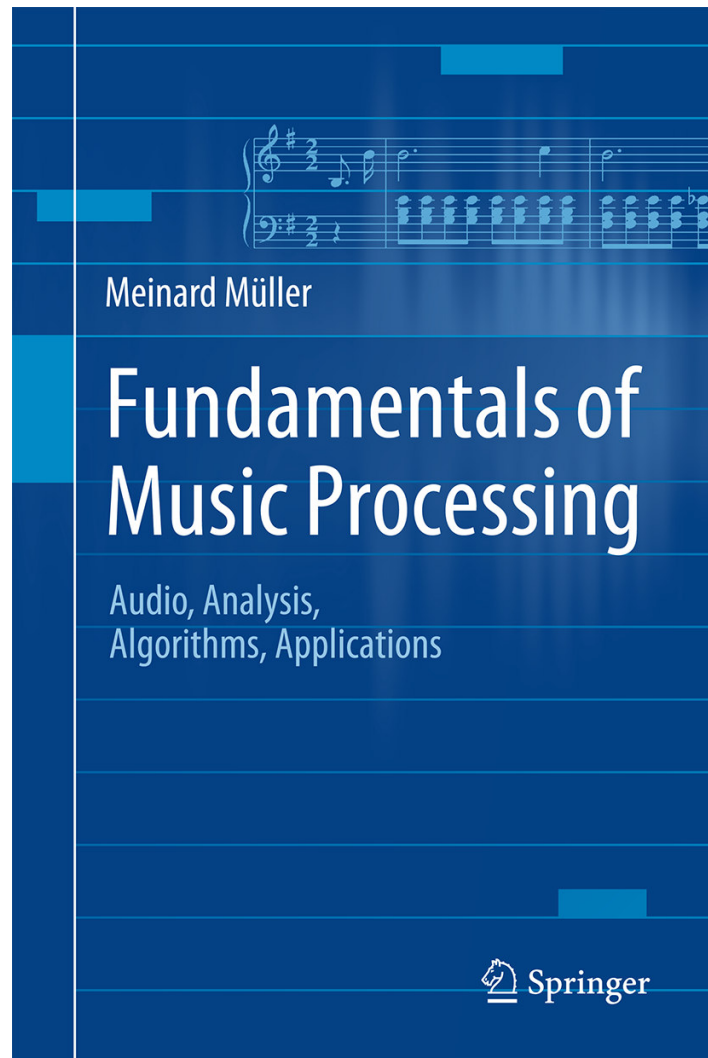
The header of the website for Christof Johannes Weiß, featuring a portrait of him on the left and the text 'Christof Johannes Weiß Komponist · Wissenschaftler' on the right. Below the header is a navigation menu with links: HOME, BIO, WERK, FOTOS, IRIS TRIO 2018, FORSCHUNG, IMPRESSUM. Below the navigation menu is a large image of musical notation for 'Saitengesang (2013)'.

Christof Johannes Weiß
Komponist · Wissenschaftler

HOME BIO WERK FOTOS IRIS TRIO 2018 FORSCHUNG IMPRESSUM

www.christofweiss.de



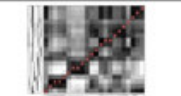
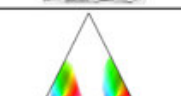

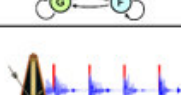


Book: Fundamentals of Music Processing



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

Meinard Müller

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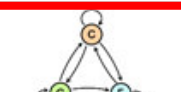
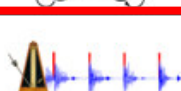


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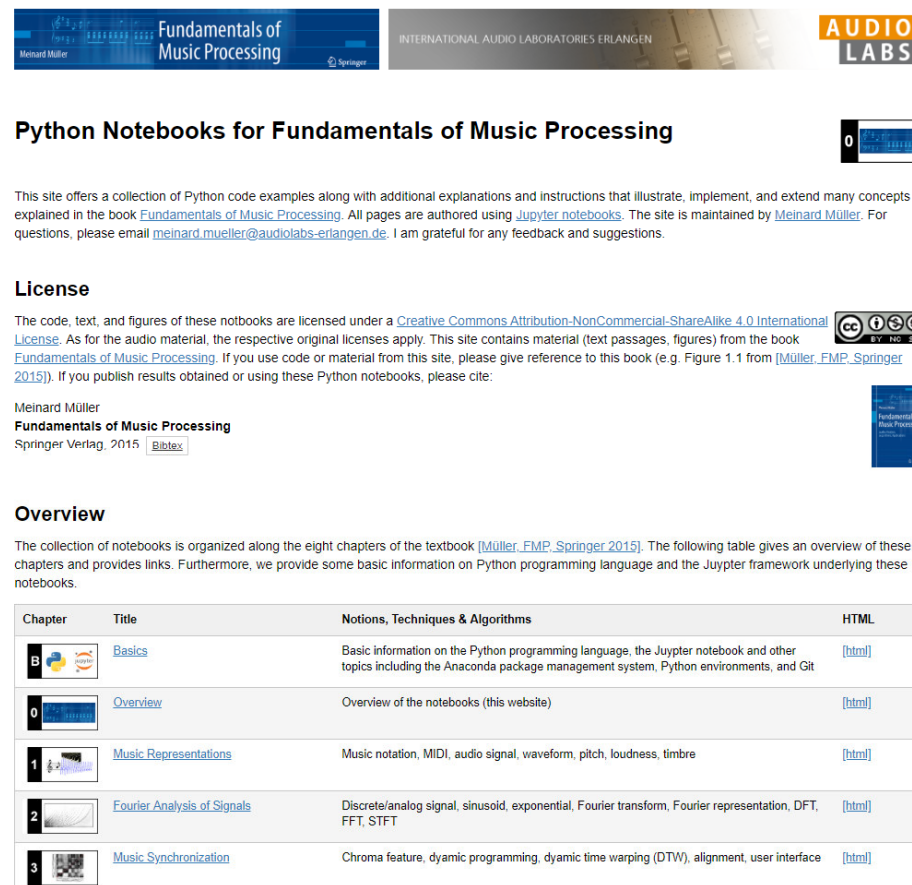
Springer, 2015

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Book: Fundamentals of Music Processing

- Accompanying Code: Jupyter Notebooks (Python)



The screenshot shows the website for 'Python Notebooks for Fundamentals of Music Processing'. At the top, there are logos for 'Fundamentals of Music Processing' by Meinard Müller (Springer) and 'AUDIO LABS' from 'INTERNATIONAL AUDIO LABORATORIES ERLANGEN'. The main heading is 'Python Notebooks for Fundamentals of Music Processing'. Below this, a paragraph states: '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
 B	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]
 0	Overview	Overview of the notebooks (this website)	[html]
 1	Music Representations	Music notation, MIDI, audio signal, waveform, pitch, loudness, timbre	[html]
 2	Fourier Analysis of Signals	Discrete/analogue signal, sinusoid, exponential, Fourier transform, Fourier representation, DFT, FFT, STFT	[html]
 3	Music Synchronization	Chroma feature, dynamic programming, dynamic time warping (DTW), alignment, user interface	[html]

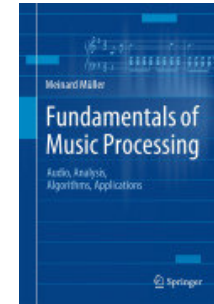
www.audiolabs-erlangen.de/FMP

Organization

- Presence days
 - Friday, 8.5.2020
 - Friday, 29.5.2020
 - Friday, 19.6.2020
 - Friday, 10.7.2020
- Format
 - Presence phases mainly for discussion and questions
 - „Inverted classroom“: videos and reading assignments
 - Programming exercises in python & jupyter notebooks
 - Tools: ZOOM and Nextcloud
- Grading (Master Music Informatics):
 - Exercises
 - Mini-project / Hausarbeit (together with Daniel Höpfner's course)

Material

- M. Müller (2017), **Fundamentals of Music Processing**
 - Kapitel 1, 2, 3, 5
 - Library, Springer, eBook Download Springer Link
 - <https://link.springer.com/book/10.1007%2F978-3-319-21945-5>
- C. Weiß (2017), **Computational Methods for Tonality-Based Style Analysis of Classical Music Audio Recordings**, PhD Thesis, TU Ilmenau
 - Selected chapters and passages
 - http://www.db-thueringen.de/servlets/MCRFileNodeServlet/dbt_derivate_00039054/ilm1-2017000293.pdf
- AudioLabs Erlangen, **Python Notebooks for Fundamentals of Music Processing**
 - Basis for practical exercises
 - Close to the book *Fundamentals of Music Processing*



Contact

- Phone: +49 9131 85 - 20 542
- E-mail: christof.weiss@audiolabs-erlangen.de
- Web: <https://www.audiolabs-erlangen.de/fau/assistant/weiss>