

INTERNATIONAL AUDIO LABORATORIES ERLANGEN
A joint institution of Fraunhofer IIS and Universität Erlangen-Nürnberg



Lecture

Music Processing

Course Overview

Meinard Müller

International Audio Laboratories Erlangen
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Meinard Müller



- Mathematics (Diplom/Master, 1997)
Computer Science (PhD, 2001)
Information Retrieval (Habilitation, 2007)
Bonn University
- Combinatorics (Postdoc)
Keio University, Japan
- Senior Researcher (2007-2012)
Max-Planck Institute, Saarland
- Professor Semantic Audio Processing (since 2012)
Erlangen-Nürnberg University



Meinard Müller: Research Group



- Michael Krause



- Simon Schwär



- Yigitcan Özer



- Peter Meier (external)



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- Michael Krause



- Simon Schwär



- Yigitcan Özer



- Peter Meier (external)



International Audio Laboratories Erlangen



- Fraunhofer Institute for Integrated Circuits IIS
- Largest Fraunhofer institute with ≈ 1000 members
- Applied research for sensor, audio, and media technology



- Friedrich-Alexander Universität Erlangen-Nürnberg (FAU)
- One of Germany's largest universities with $\approx 40,000$ students
- Strong Technical Faculty

International Audio Laboratories Erlangen



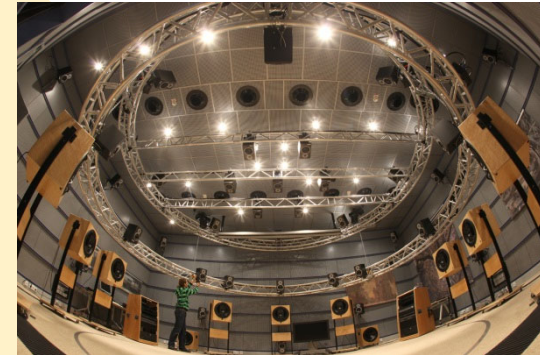
Audio

International Audio Laboratories Erlangen

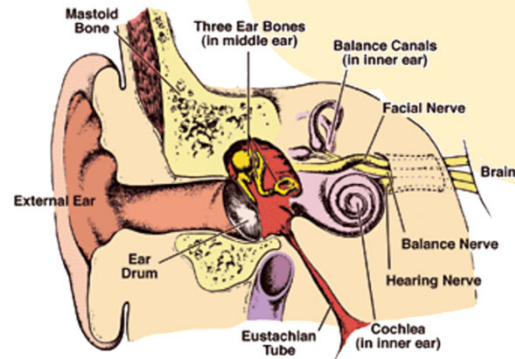
Audio Coding



3D Audio



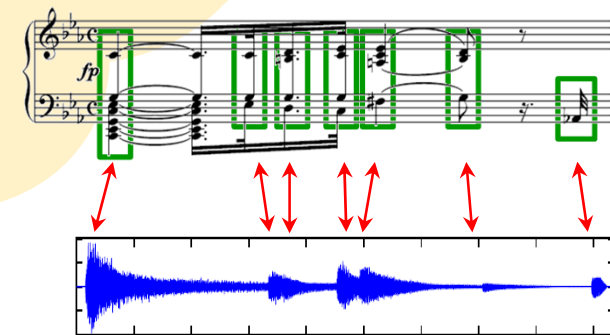
Audio



Psychoacoustics



Internet of Things



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 Habetts
Spatial Audio Signal Processing
- Prof. Dr. Nils Peters
Audio Signal Processing
- Dr. Stefan Turowski
Coordinator AudioLabs-FAU



Related Courses

Audio Processing **Laboratory**

The objective of this lab course is to give students a hands on experience in audio processing.

- Offered every semester
- Short-Time Fourier Transform
- Speech Enhancement
- Statistical Methods
- Speech Analysis
- ...

Registration via StudOn is mandatory!

Audio Processing **Seminar**

Various applications within audio and acoustic signal processing.

- Offered every semester
- Advanced topics
- Require lecture on DSP, audio, ...
- Also music-related topics
- ...

Registration via StudOn is mandatory!



Registration on studOn is mandatory!

Related Courses

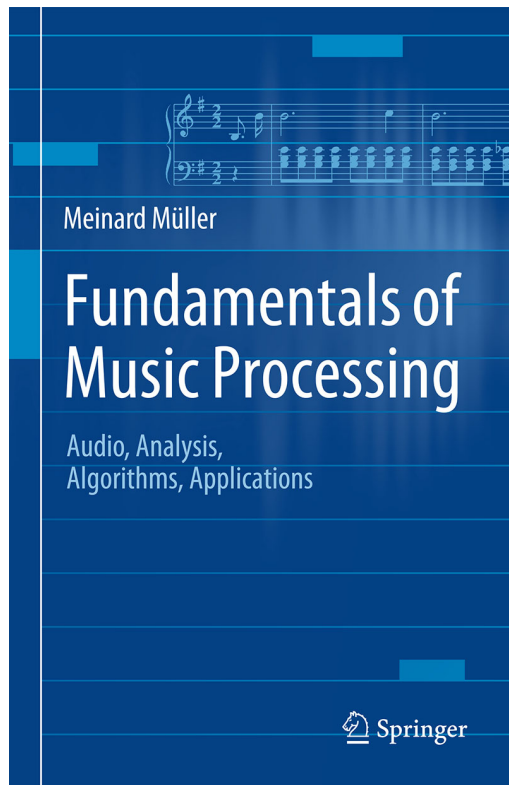
- **Speech Enhancement**
Prof. Dr. Emanuël Habets
AudioLabs
- **Advanced Topics in Perceptual Audio Coding**
Prof. Dr. Jürgen Herre
AudioLabs
- **Music Processing – Synthesis**
Dr. Maximilian Schäfer
Lehrstuhl für Digitale Übertragung (IDC)

Lecture: Music Processing Analysis (MPA)

https://www.audiolabs-erlangen.de/fau/professor/mueller/teaching/2022w_mpa

- Dates, Material, Information ... → **See website!**
- Time (Lecture): Mo 16-18
- Time (Exercise): Mo 14-16
- Mandatory elective for course for EEI, CME, ICT, ASC
Credits: 2,5 ECTS (Module MPA)
- Elective course for CME
Credits: 5 ECTS (Module MPA-LE)
- Course for Computer Science, AI, ...
Credits: 5 ECTS (Module MPA-LE)
- Oral exam for all study programs

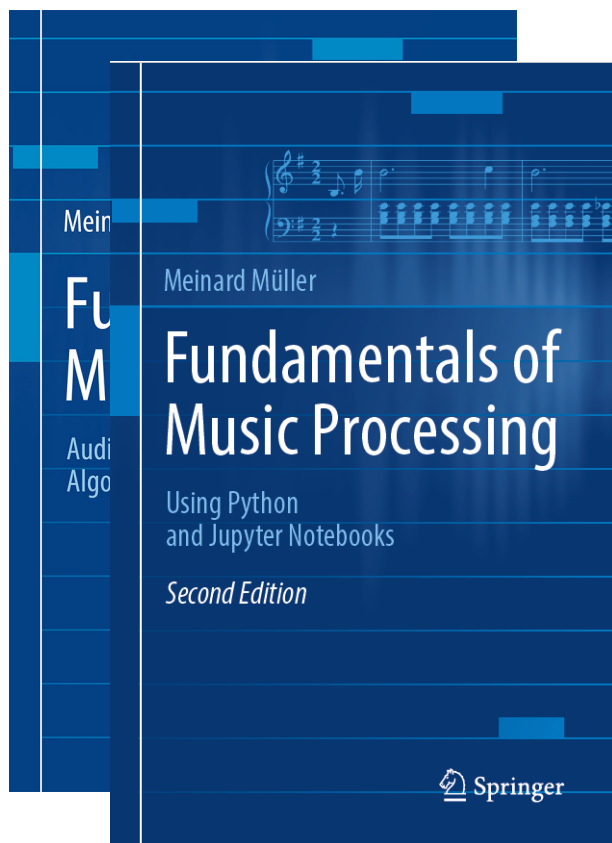
Textbook: Fundamentals of Music Processing (FMP)



Meinard Müller
Fundamentals of Music Processing
Audio, Analysis, Algorithms, Applications
Springer, 2015

Accompanying website:
www.music-processing.de

Textbook: Fundamentals of Music Processing (FMP)

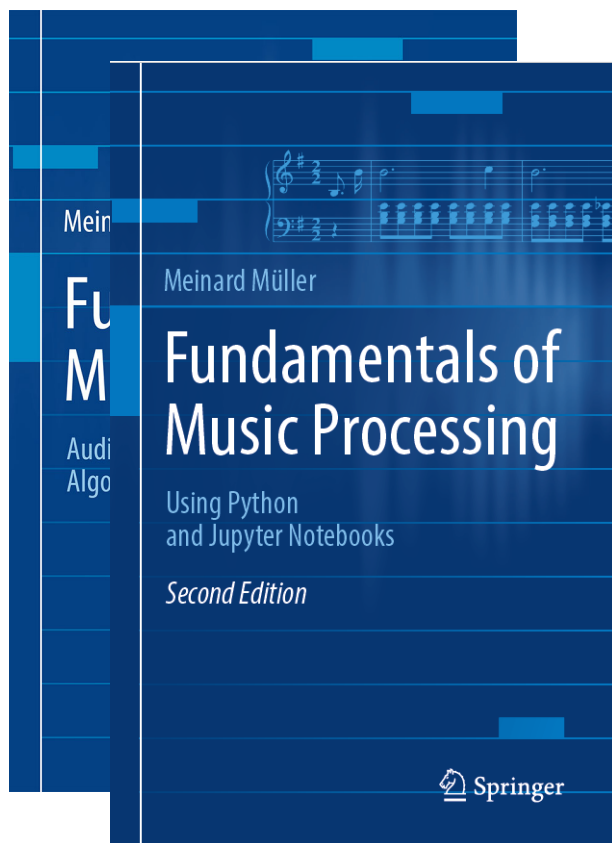


Meinard Müller
Fundamentals of Music Processing
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2nd edition
Meinard Müller
Fundamentals of Music Processing
Using Python and Jupyter Notebooks
Springer, 2021

Textbook: Fundamentals of Music Processing (FMP)



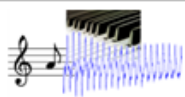

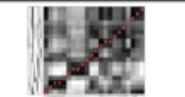
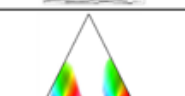

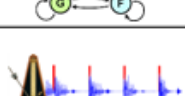


Meinard Müller
Fundamentals of Music Processing
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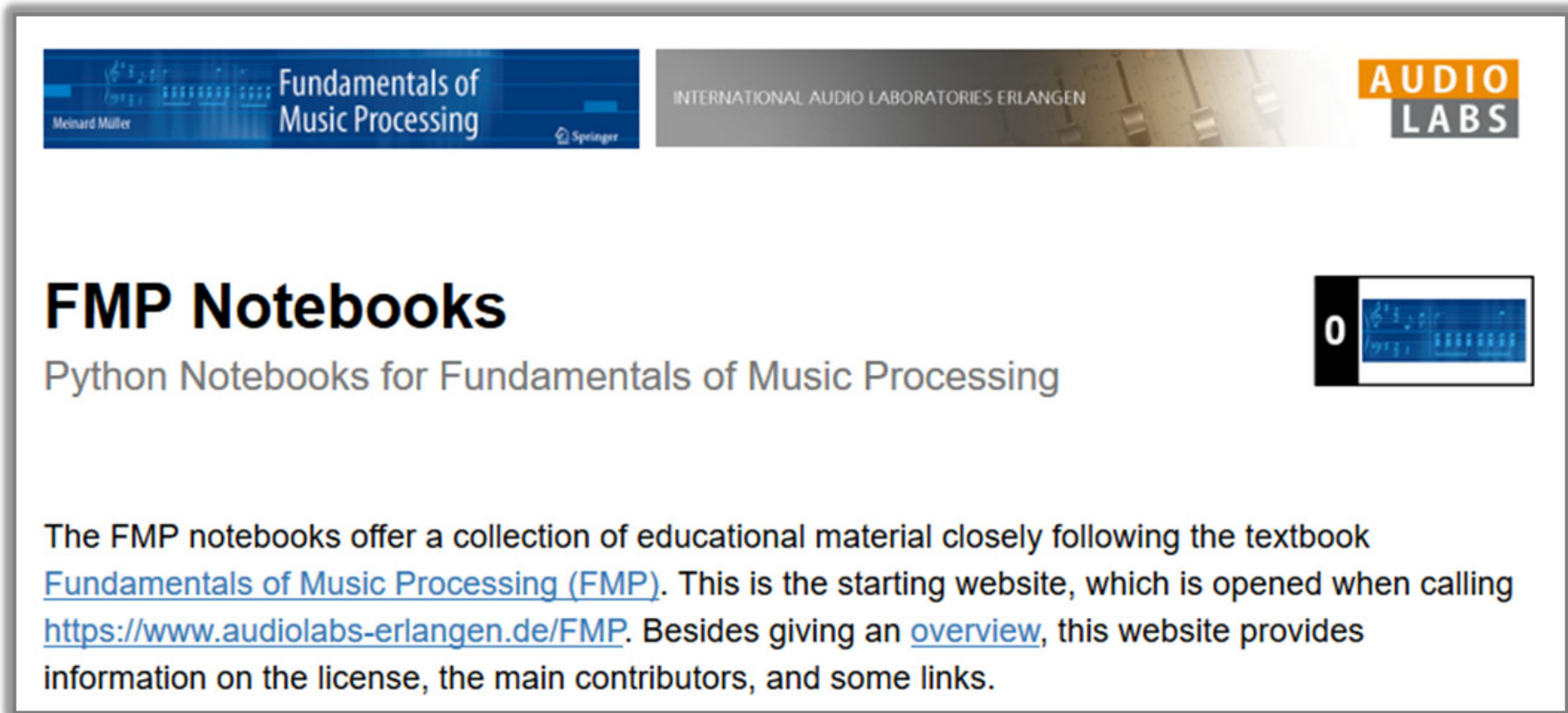
Chapter	Music Processing Scenario
1 	Music Representations
2 	Fourier Analysis of Signals
3 	Music Synchronization
4 	Music Structure Analysis
5 	Chord Recognition
6 	Tempo and Beat Tracking
7 	Content-Based Audio Retrieval
8 	Musically Informed Audio Decomposition

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Springer, 2021

FMP Notebooks: Education & Research



The screenshot shows the header of the FMP Notebooks website. On the left, there is a blue banner for the textbook 'Fundamentals of Music Processing' by Meinard Müller, published by Springer. To the right of this banner is the text 'INTERNATIONAL AUDIO LABORATORIES ERLANGEN' and the 'AUDIO LABS' logo. Below the header, the main content area features the title 'FMP Notebooks' in a large, bold, black font, followed by the subtitle 'Python Notebooks for Fundamentals of Music Processing' in a smaller, grey font. To the right of the subtitle is a small thumbnail image of a notebook page with a black bar on the left containing the number '0'. Below the title and subtitle, there is a paragraph of text: 'The FMP notebooks offer a collection of educational material closely following the textbook [Fundamentals of Music Processing \(FMP\)](#). This is the starting website, which is opened when calling <https://www.audiolabs-erlangen.de/FMP>. Besides giving an [overview](#), this website provides information on the license, the main contributors, and some links.'

<https://www.audiolabs-erlangen.de/FMP>

Course Requirements

- Strong background in
 - Mathematics
 - Signal processing
 - Algorithms & data structures
 - Pattern recognition
- Python programming skills
- Strong interest in music
- Deep learning not required
- **High motivation!!!**

Our Offer

- Material
 - Textbook
 - FMP Notebooks
 - Website
 - Exam questions
- Lecture & Exercise
- Individualized supervision
- Playground for deep learning
- **High motivation!!!**

This specialized course is demanding!

References (FMP Notebooks)

- Meinard Müller: Fundamentals of Music Processing – Using Python and Jupyter Notebooks. 2nd Edition, Springer, 2021.
<https://www.springer.com/gp/book/9783030698072>
- Meinard Müller and Frank Zalkow: libfmp: A Python Package for Fundamentals of Music Processing. Journal of Open Source Software (JOSS), 6(63): 1–5, 2021.
<https://joss.theoj.org/papers/10.21105/joss.03326>
- Meinard Müller: An Educational Guide Through the FMP Notebooks for Teaching and Learning Fundamentals of Music Processing. Signals, 2(2): 245–285, 2021.
<https://www.mdpi.com/2624-6120/2/2/18>
- Meinard Müller and Frank Zalkow: FMP Notebooks: Educational Material for Teaching and Learning Fundamentals of Music Processing. Proc. International Society for Music Information Retrieval Conference (ISMIR): 573–580, 2019.
<https://zenodo.org/record/3527872#.YOhEQOgzaUk>
- Meinard Müller, Brian McFee, and Katherine Kinnaird: Interactive Learning of Signal Processing Through Music: Making Fourier Analysis Concrete for Students. IEEE Signal Processing Magazine, 38(3): 73–84, 2021.
<https://ieeexplore.ieee.org/document/9418542>

Resources (Group Meinard Müller)

- FMP Notebooks:

<https://www.audiolabs-erlangen.de/FMP>

- libfmp:

<https://github.com/meinardmueller/libfmp>

- synctoolbox:

<https://github.com/meinardmueller/synctoolbox>

- libtsm:

<https://github.com/meinardmueller/libtsm>

- Preparation Course Python (PCP) Notebooks:

<https://www.audiolabs-erlangen.de/resources/MIR/PCP/PCP.html>

<https://github.com/meinardmueller/PCP>