AUDIO LABS

2nd International Jazzomat Research Workshop
Perspectives for Computational Jazz Studies

Tracking microtiming variations in the course of a jazz performance

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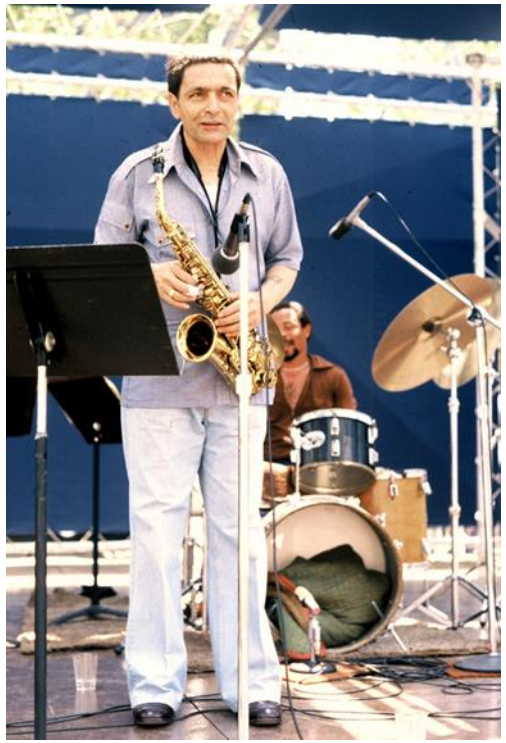
FRIEDRICH-ALEXANDER UNIVERSITÄT ERLANGEN-NÜRNBERG

Fraunhofer IIS

Introduction

- Title: Anthropology
- Album: The Compelete Galaxy Recordings (1979)
- Lineup:
  - Charlie Haden on bass
  - Art Pepper playing solo clarinet
  - Billy Higgins on drums
- Music:
  - B ♭ -Major
  - 4/4 Signature
  - ~219 BPM



Source: wikipedia

Introduction

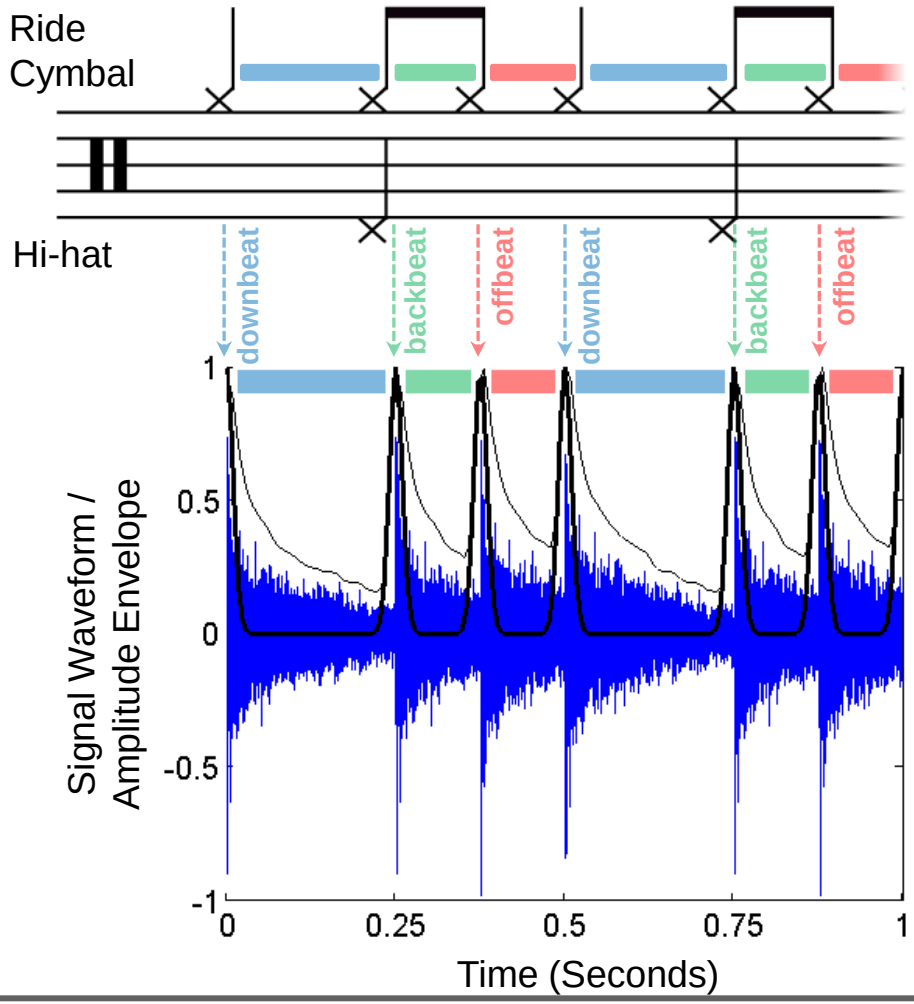
- Typical ride cymbal (RC) pattern
  - Downbeat
    - ⋮
  - Backbeat
  - Offbeat
  - Downbeat
    - ⋮
  - Keep tempo
  - Induce „swing feel“

Source: wikipedia

Introduction: Swing Ratio

♩ = 240 BPM

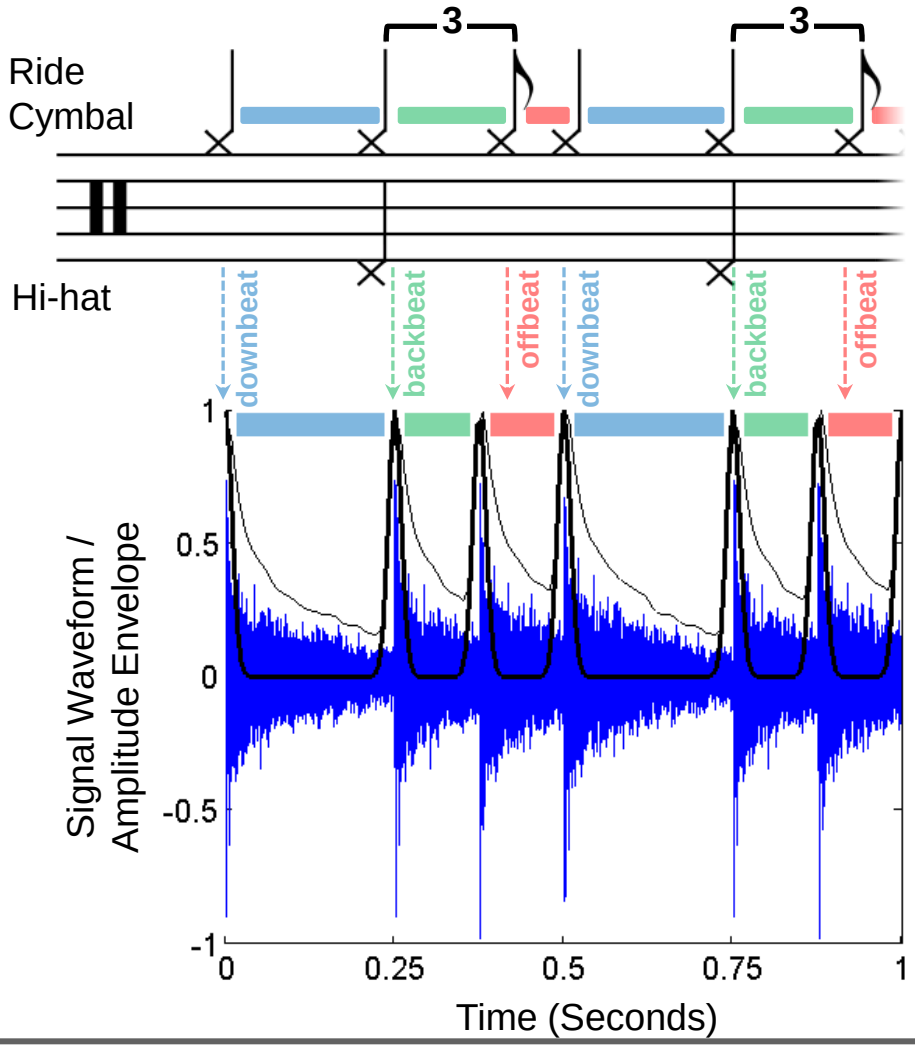
$$s_r = \frac{0.125}{0.125} \approx 1$$



Introduction: Swing Ratio

♩ = 240 BPM

$$s_r = \frac{0.167}{0.083} \approx 2$$



Introduction: Swing Ratio

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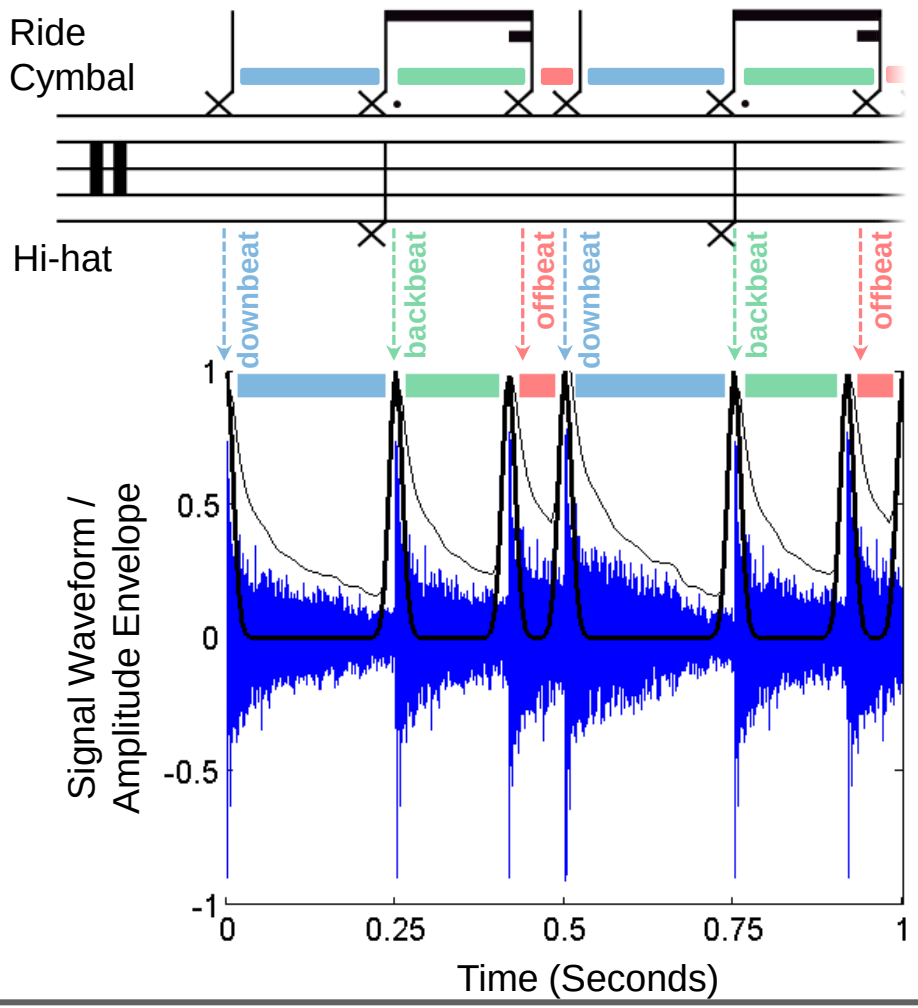

Related Work: Jazz Microtiming Analysis

- Early investigations into swing ratio:
  - Kerschbaumer 1978, Reinholdsson 1987, Rose 1989
  - Manually marked onset times
- Measurements using MIDI-fied instruments:
  - Ellis 1991, Busse 2003
- Negative correlation between tempo and swing ratio:
  - Friberg & Sundström 2002 → inspiration for our work
  - Dittmar et al. 2015 → (semi-) automatic swing ratio estimation
- No strong correlation, preferred swing ratio ~2.0:
  - Honing & de Haas 2008 → focus on jazz drummers
  - Marchand & Peeters 2015 → swing ratio in diverse genres (GTZAN)

Swing Ratio Estimation via Log-Lag ACF

- Tempo-normalized spectral rhythm patterns
  - Peeters 2005
- Scale transform for rhythmic similarity
  - Holzapfel & Stylianou 2009, 2011
  - Marchand & Peeters 2014
  - Prockup et al. 2015
- Log-Lag ACF (LLACF)
  - Gruhne & Dittmar 2009
  - Völkl et al. 2010
  - Dittmar et al. 2015

- Autocorrelation (ACF) computed from onset detection function
- Resampled to logarithmically-spaced lag-axis (resp. tempo-axis)
- Rhythmic patterns → salient peaks at distinct periodicities
- Tempo factors → log-lag offsets

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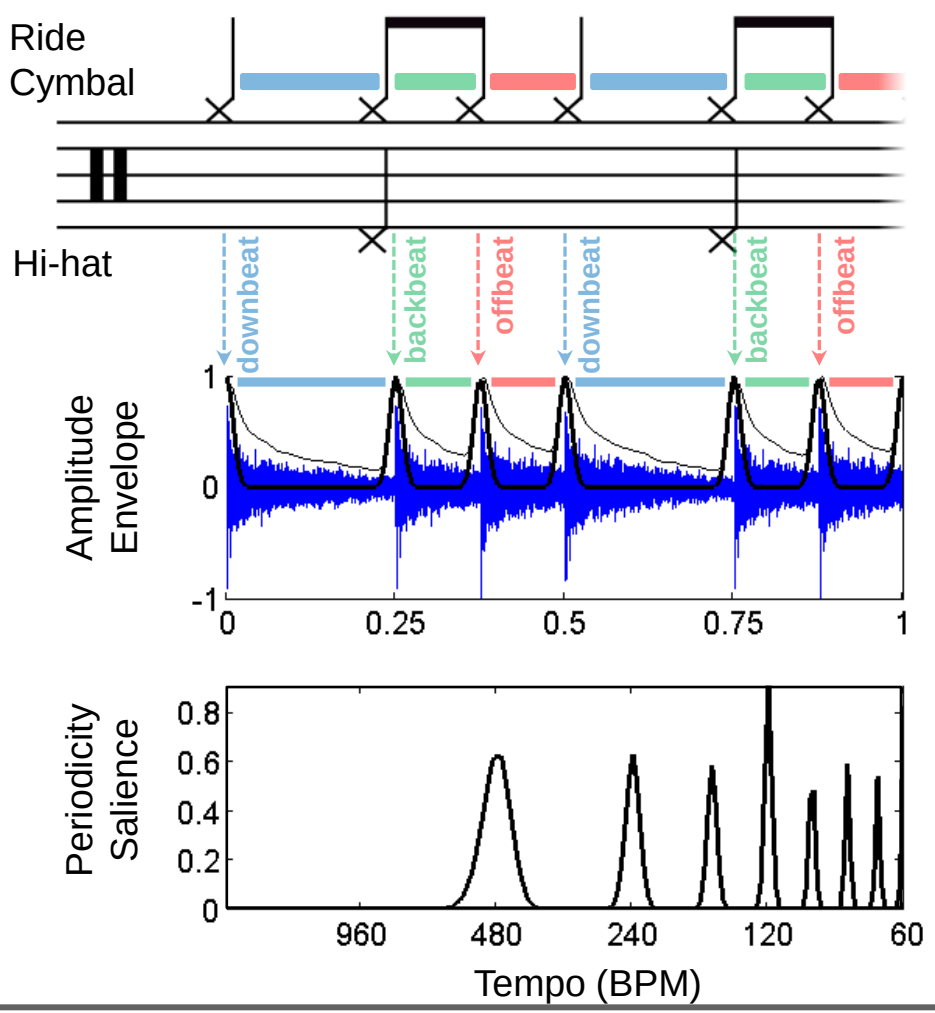

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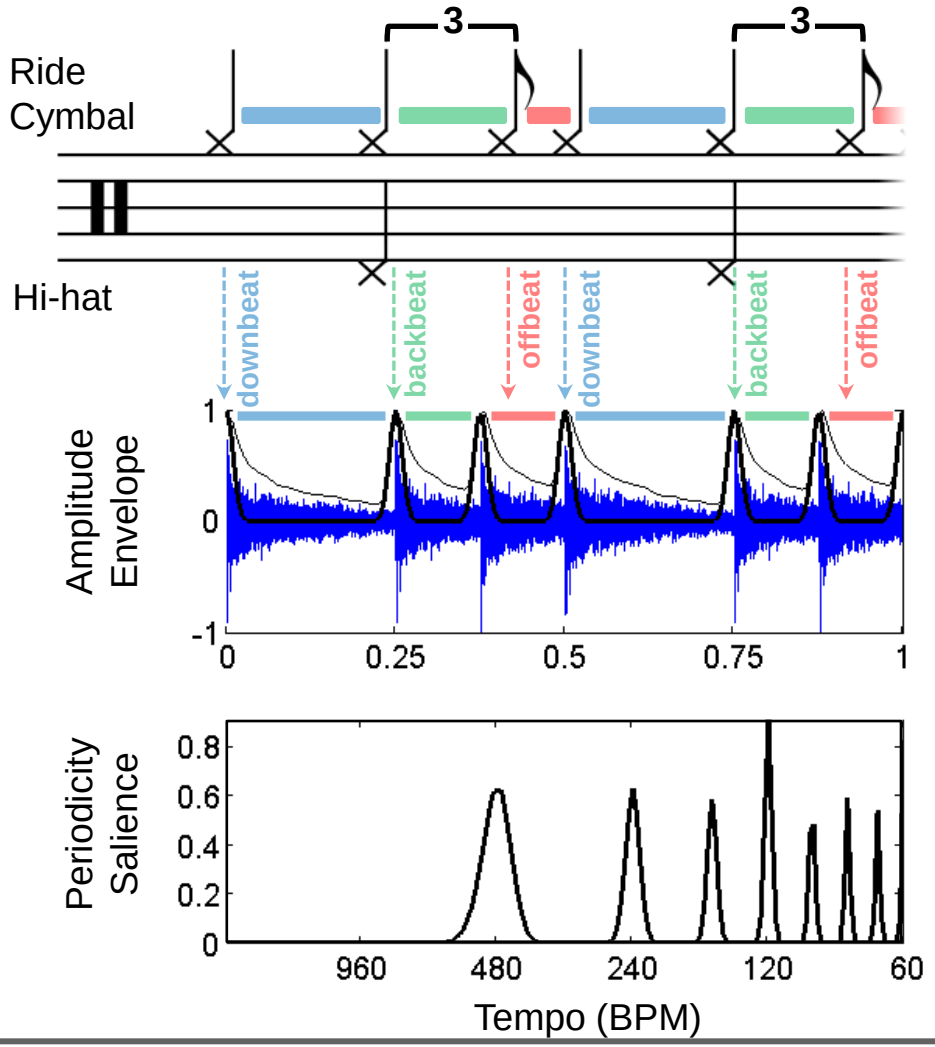

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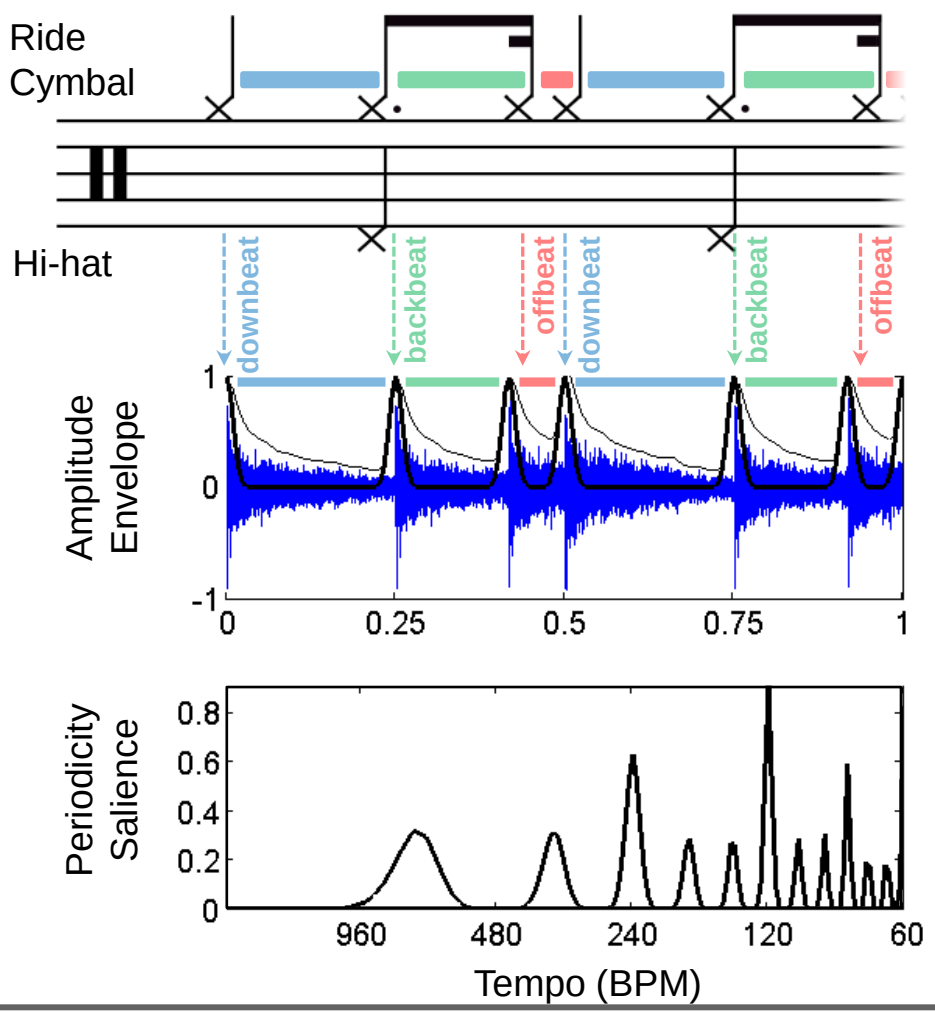
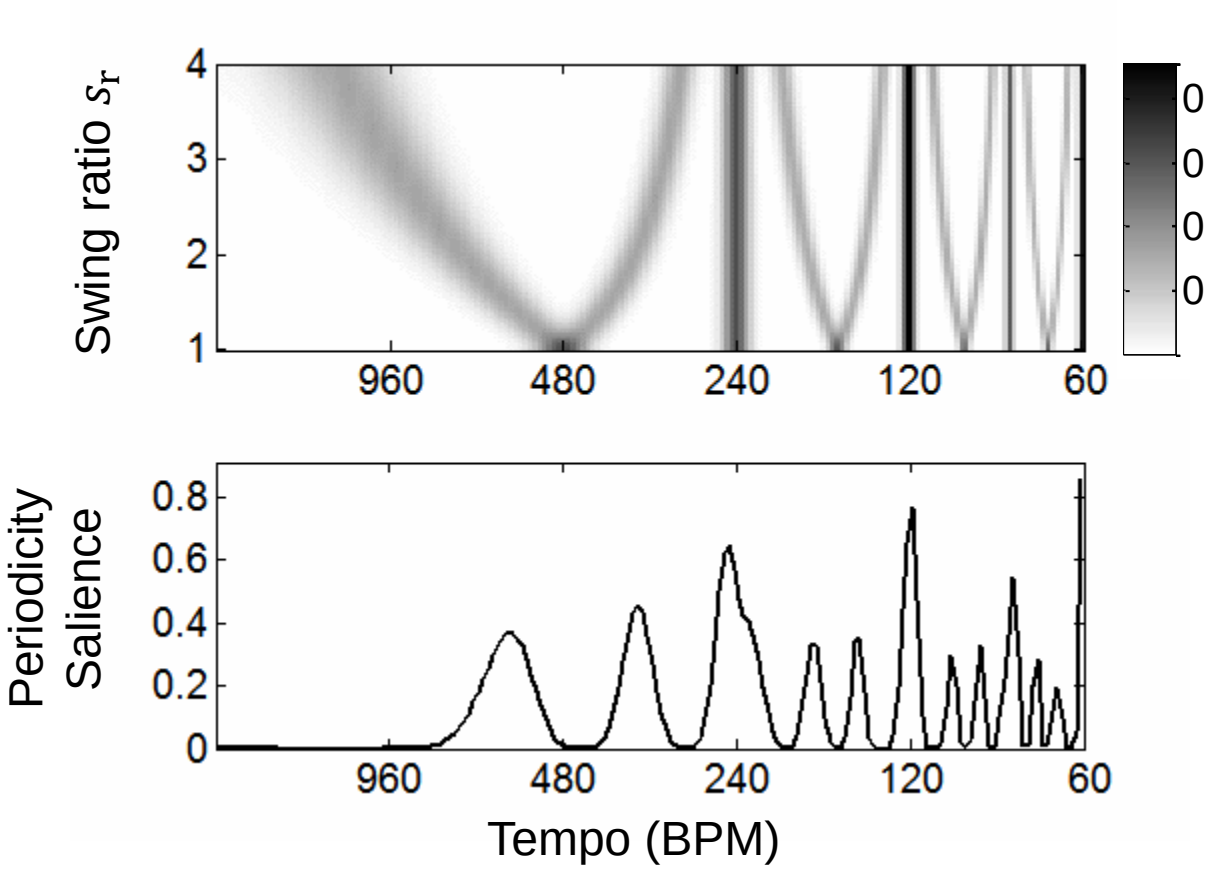


Swing Ratio Estimation via Log-Lag ACF

Pattern matching against prototype LLACFs



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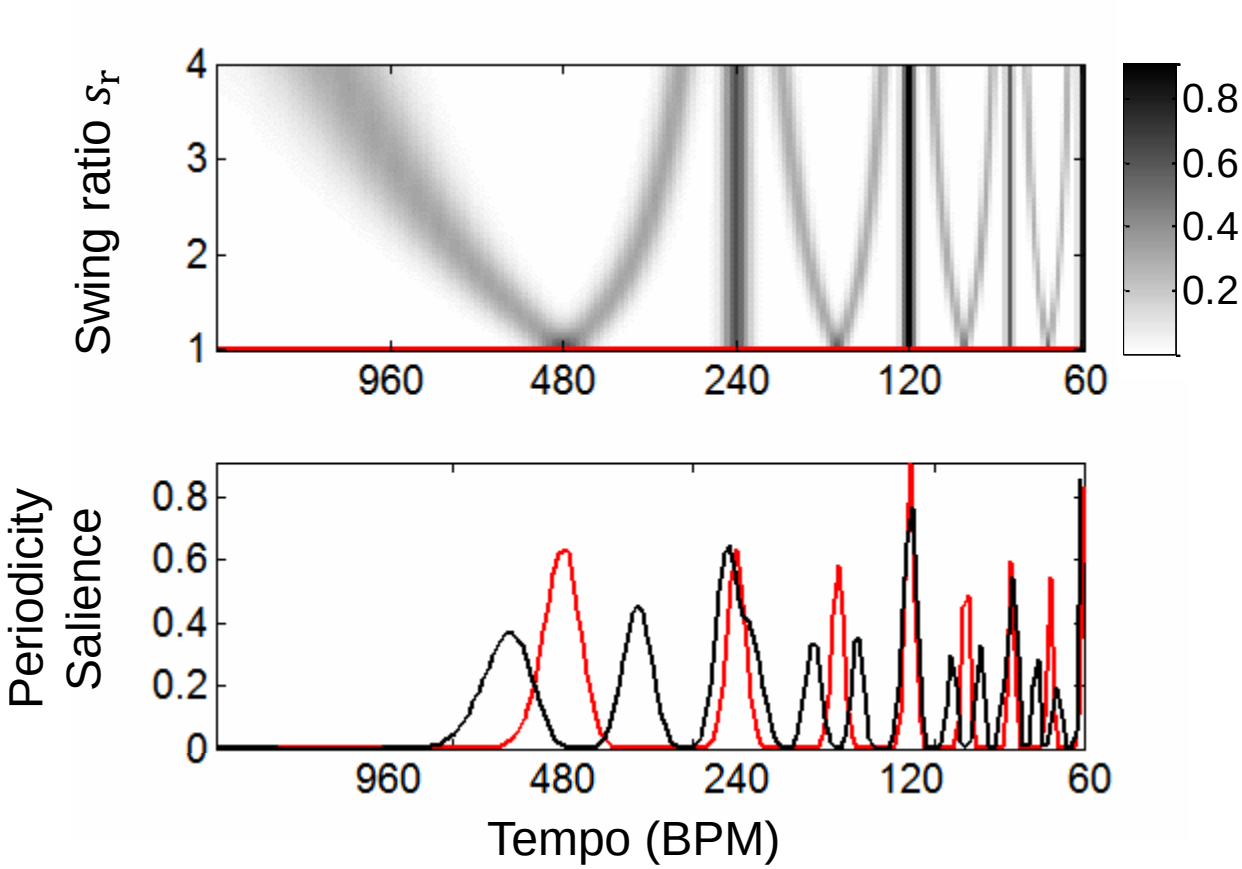

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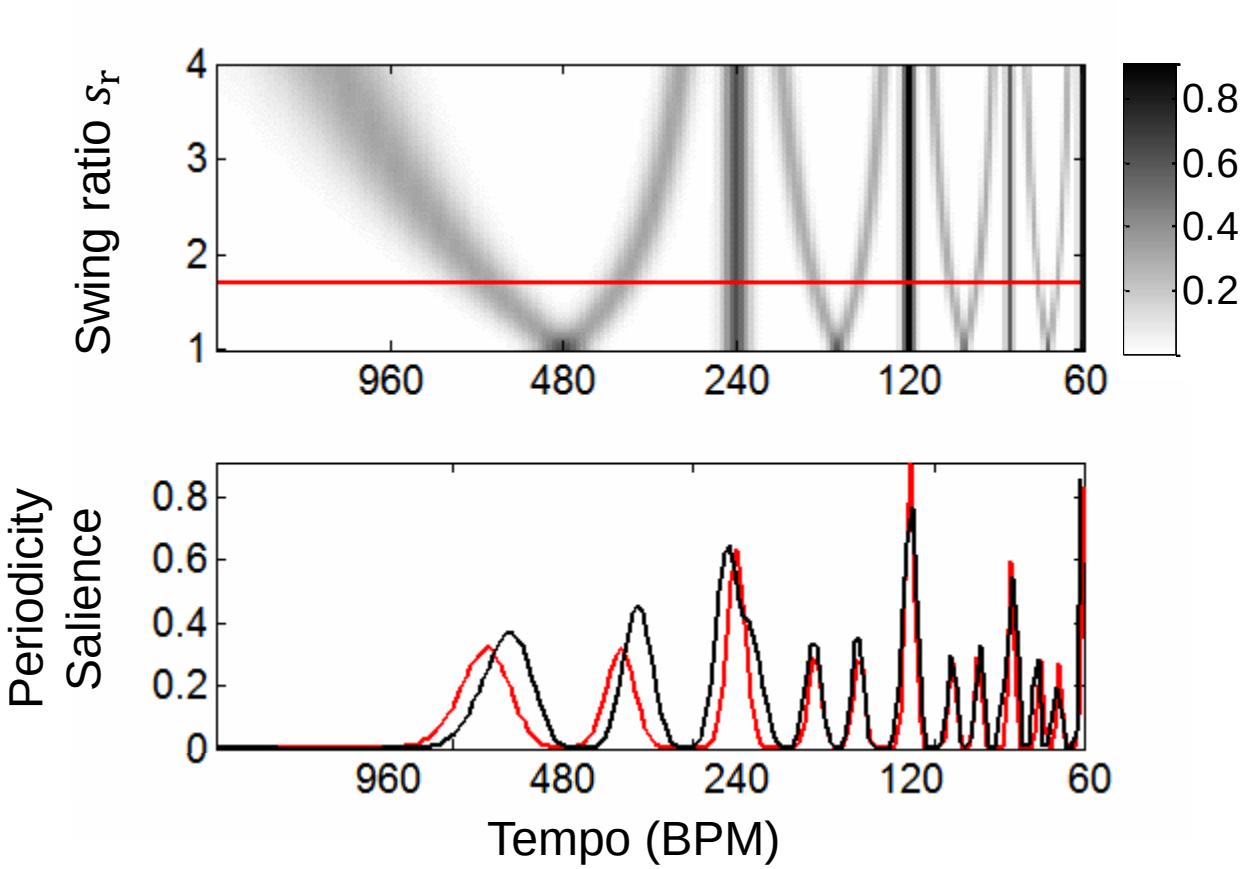
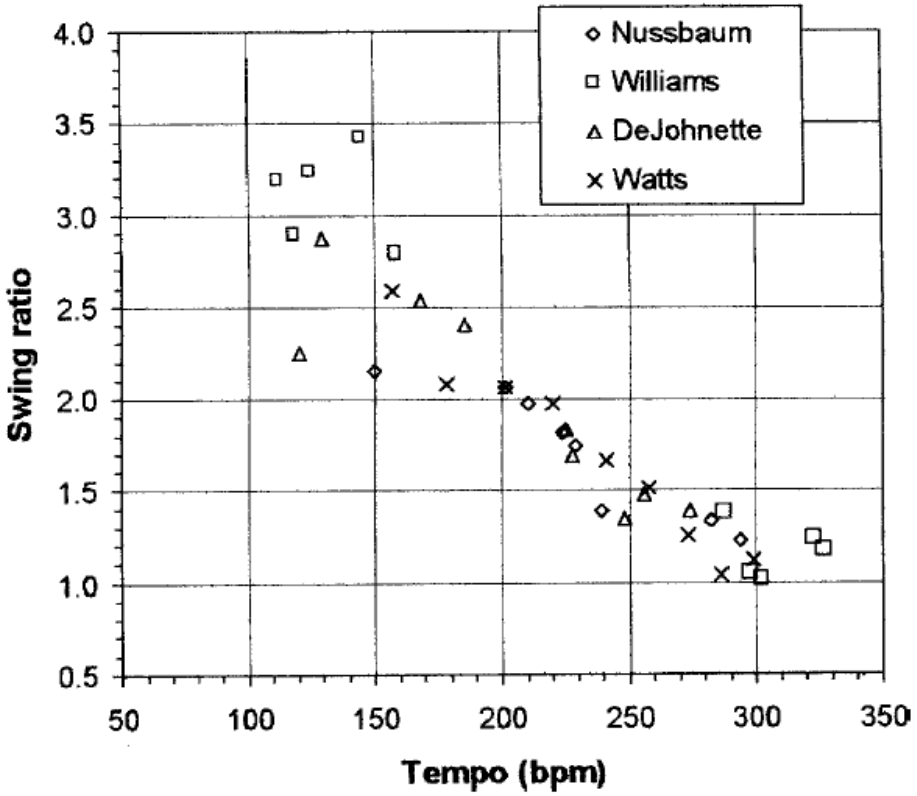
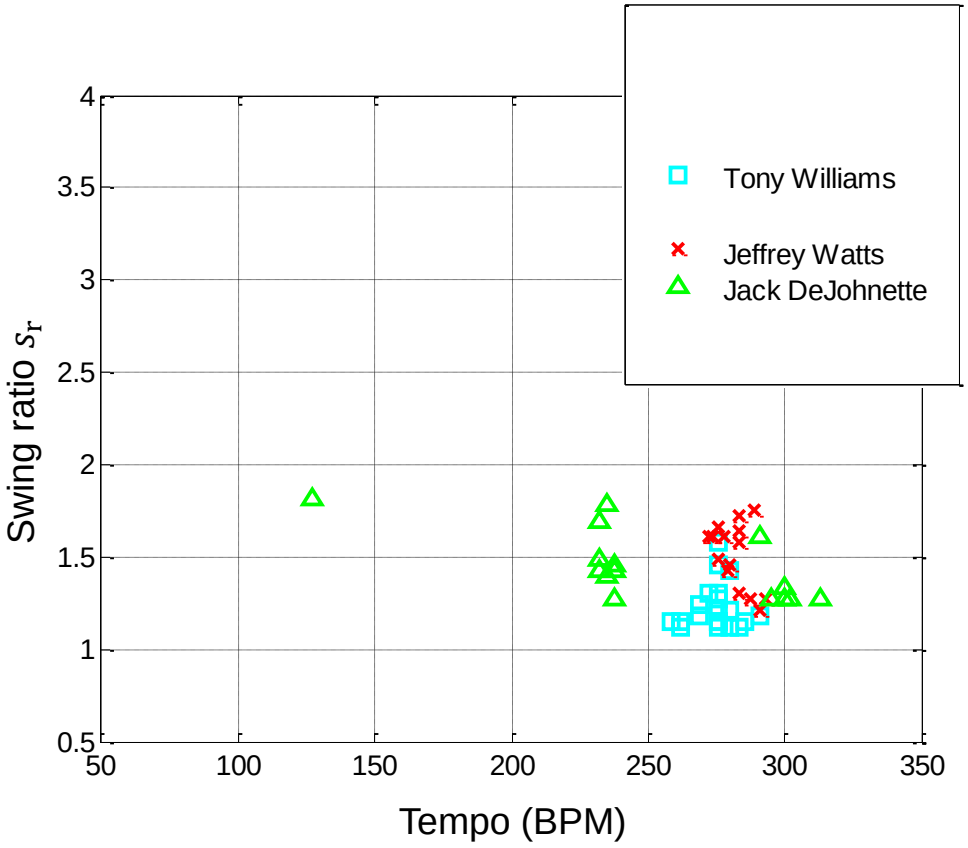


Swing Ratio Estimation via Log-Lag ACF:

Friberg & Sundström 2002:



Dittmar et al. 2015:



Tracking Swing Ratio Variations

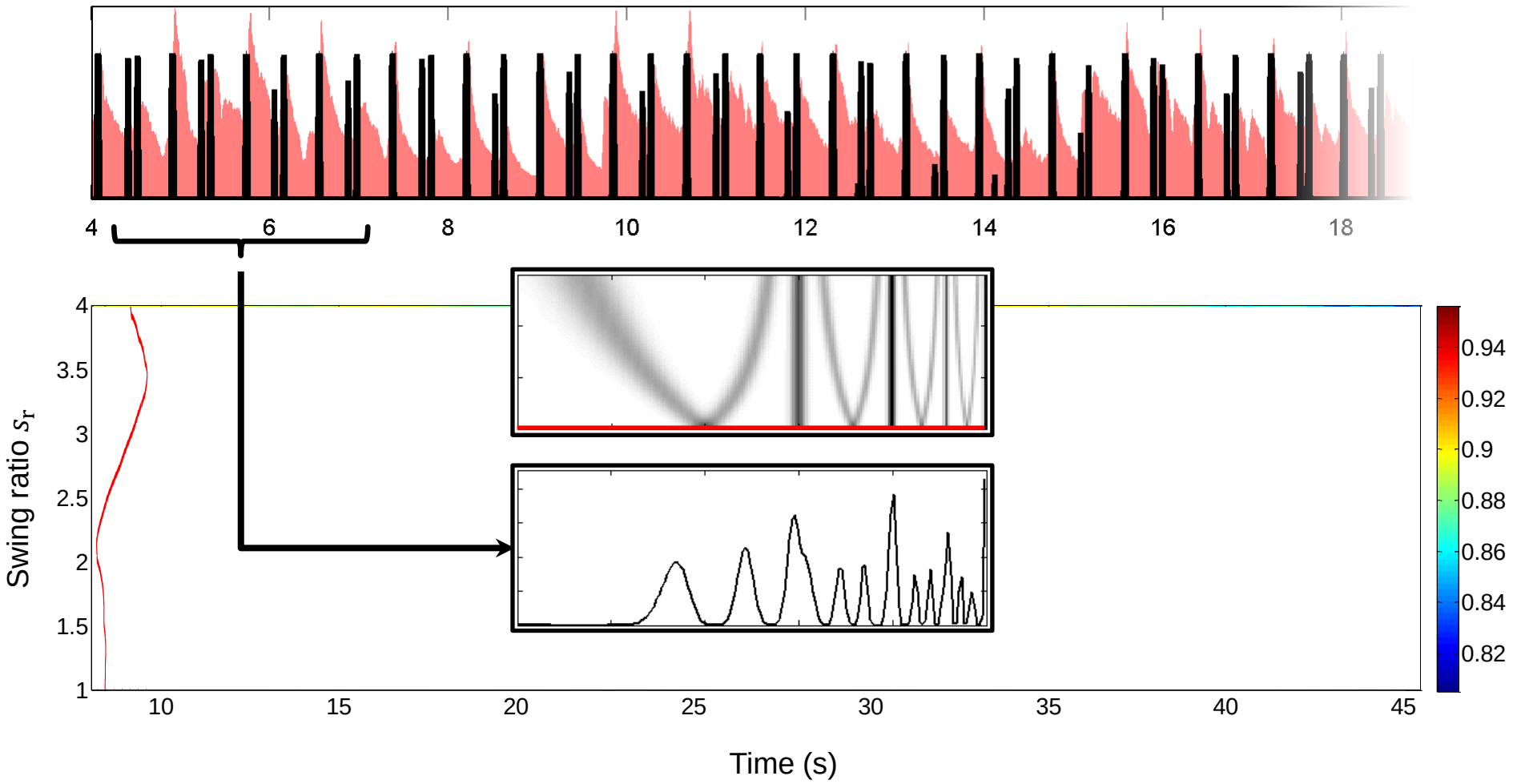
Weimar Jazz Database:

- Soloist swing ratio implicitely given via tone onsets
- Automatically estimated swing ratios of RC patterns
- Investigations into the interactive art of improvising together

New idea:

- Compute segment-wise LLACF accross complete solo
- Store matching score for all swing ratios per segment

Tracking Swing Ratio Variations



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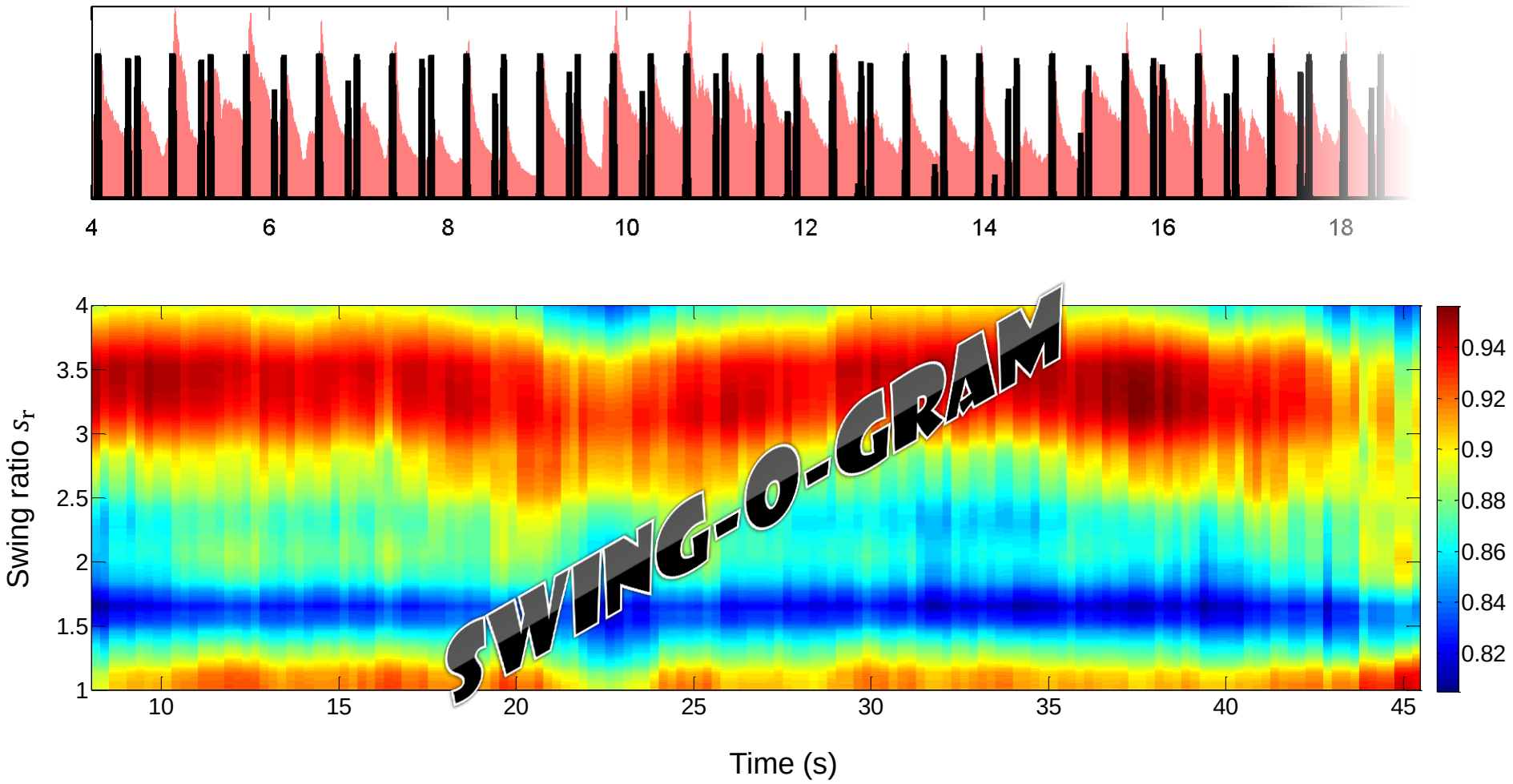
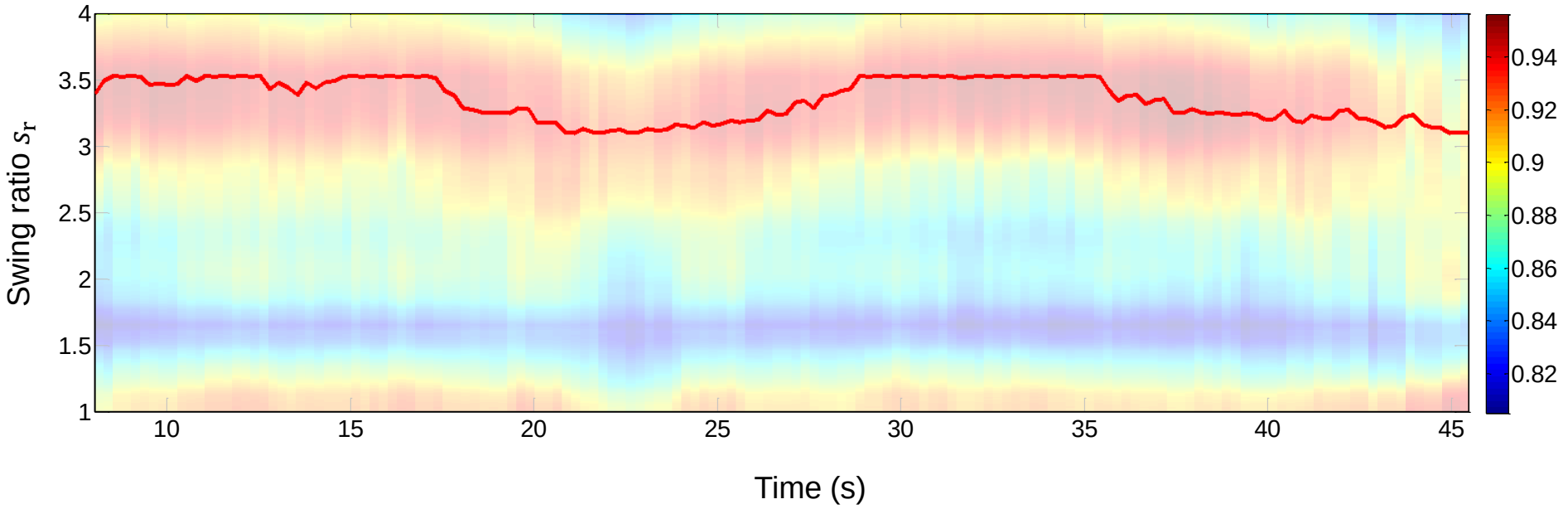


Tracking Swing Ratio Variations

Track salient trajectory:

- Dynamic Programming (DP) → finds optimal paths
- Can be parametrized to prevent unreasonable jumps



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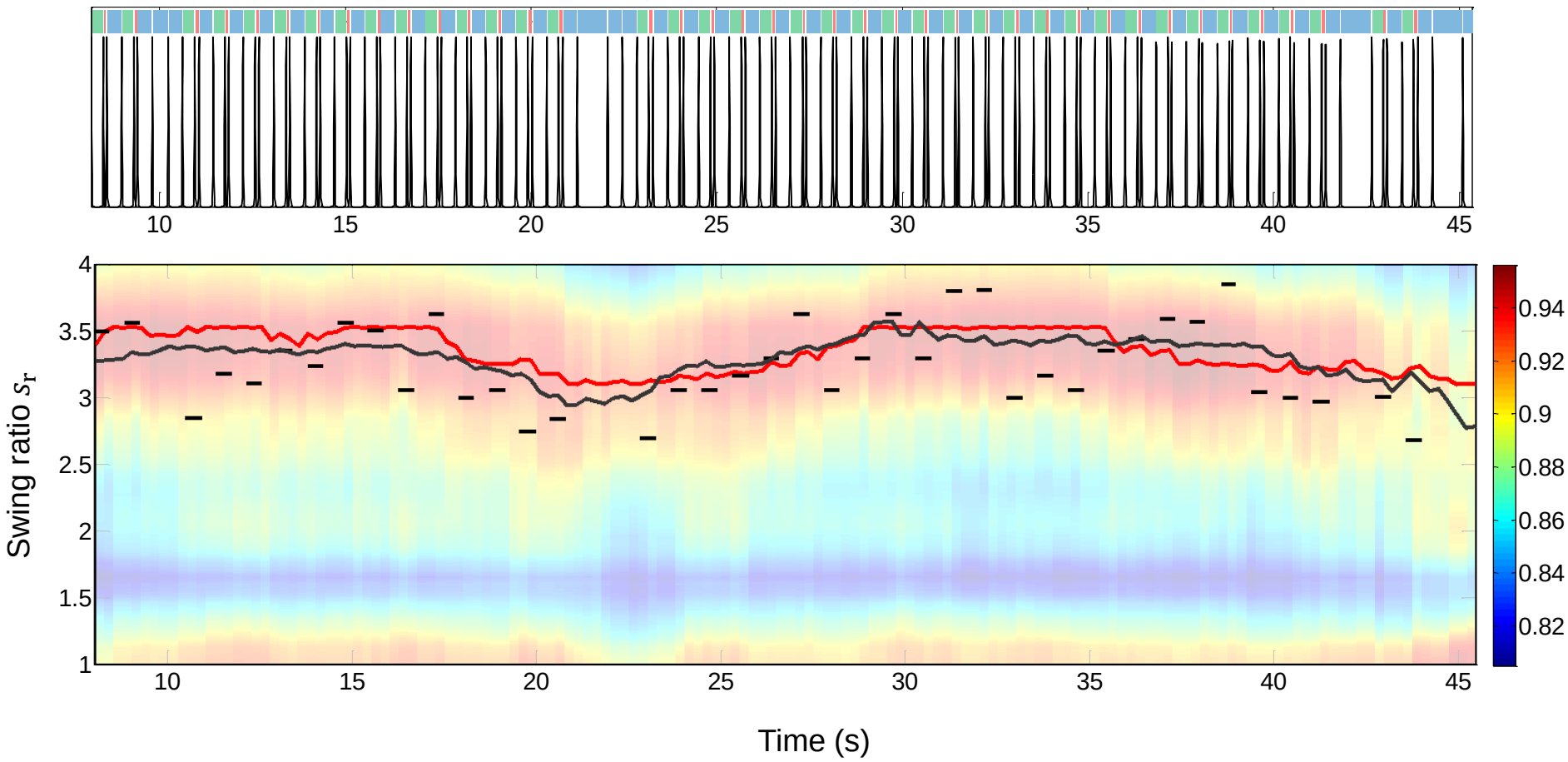

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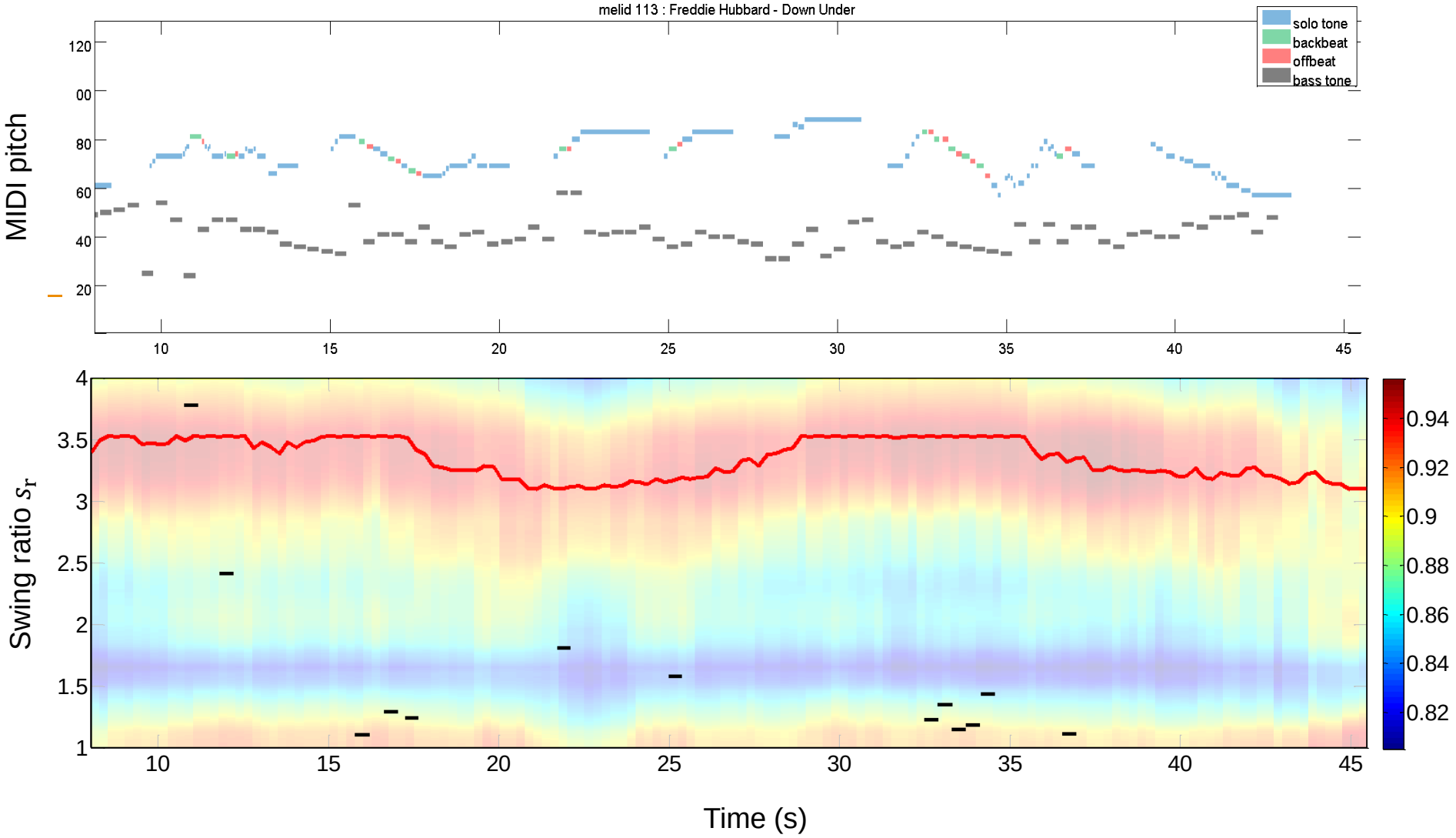


Conclusions

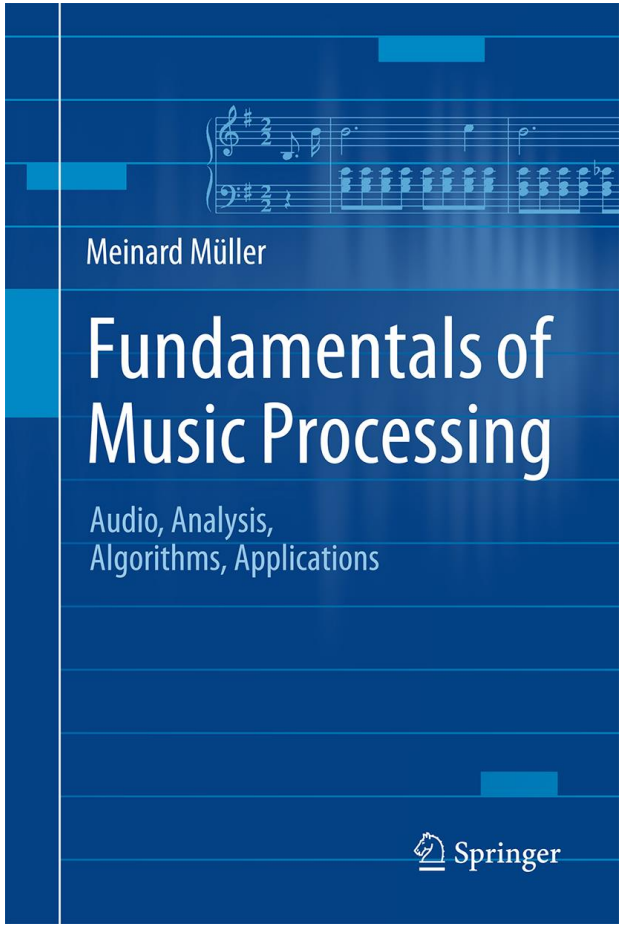
Proposed new method to track swing ratio variations

- Qualitatively similar results as provided by ground truth
- Comparison to soloist swing ratio still has open issues

Next steps?

- Which structures are interesting?
- Relation to phrases?

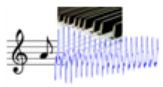
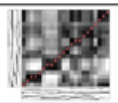
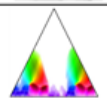
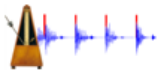
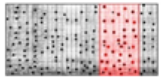
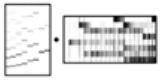
Book: Fundamentals of Music Processing



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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AES Conference: Semantic Audio 2017

Paper deadline: 22.01.2017

AUDIO ENGINEERING SOCIETY
CALL for CONTRIBUTIONS
2017 INTERNATIONAL CONFERENCE ON SEMANTIC AUDIO
ERLANGEN, GERMANY
JUNE 22–24, 2017
http://www.aes.org/conferences/2017/semantic/

Chairs: Christian Uhle and Meinard Müller. Email: **2017semantic_chairs@aes.org**
Papers chairs: Christian Dittmar and Jakob Abeßer. Email: **2017semantic_papers@aes.org**
Technical Coordination and PR: Stefan Turowski, Sascha Disch, and Matthias Rose.

Semantic Audio is concerned with the extraction of meaning from audio signals and with the development of applications that use this information to support the user in identifying, organizing, and exploring audio signals, and interacting with them. These applications include music information retrieval, semantic web technologies, audio production, sound reproduction, education, and gaming. Semantic technology involves some kind of understanding of the meaning of the information it deals with and to this end may incorporate machine learning, digital signal processing, speech processing, source separation, perceptual models of hearing, musicological knowledge, metadata, and ontologies. This conference will be the third AES conference on the topic and will provide the opportunity to present and discuss the latest advancements in the field.

PROPOSED TOPICS

Semantic audio processing
Content-based audio recommendation and retrieval
Music web services and semantic web for music
Blind and informed source separation
Automatic music transcription
Audio classification and segmentation
Musical similarity and structure analysis
Semantic audio coding
Intelligent audio effects and editing
Musical education and instrument tuition
Musical performance analysis
Broadcast monitoring
Digital archiving and libraries
Computational Auditory Scene Analysis

SUBMISSION INFORMATION

The organizing committee invites the submission of full papers of between 4 and 8 pages by January 22, 2017 at www.aes.org/2017semantic_authors. An author's kit describing the paper format will also be available at that site. All submitted papers will be peer-reviewed before selection. Acceptance of papers will be determined by the conference review committee, and authors will be informed of the decision by March 22, 2017. Final versions of papers following any revisions guided by the committee's review must be submitted by April 8, 2017.

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Registration: At least one author of each contribution must pay to register for the conference, and attend to present, or the contribution will not be included in the proceedings. Any author wishing to attend the conference must pay the registration fee.

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Open Access
Authors will have the option of submitting Open Access papers.

AES Conference: Semantic Audio 2017

Ready my carriage! I shall journey to AES in Erlangen!

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