

Unity in Diversity: MIR Tools for Non-Western Music

Preeti Rao

Rohit M A

I.I.T. Bombay, India



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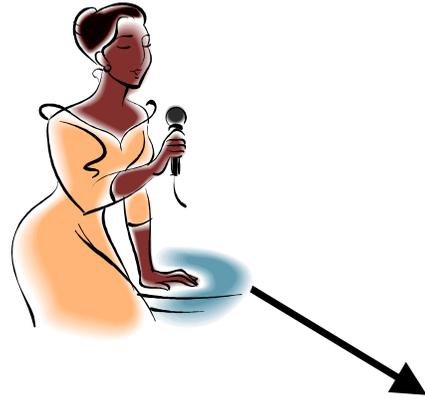
Outline

- A personal journey to MIR research and the experiences that shaped it.
- A presentation, by Rohit, of an example MIR task on audio with music drawn from different genres.
- Rounding it off...

Personal journey

- Undergraduate degree in EE from I.I.T. Bombay
- Ph.D. in Signal Processing from the Univ. of Florida
- Postdoc in Speech & Hearing Sciences at UIUC
- Visiting Researcher, Hitachi Labs in Tokyo, Speech compression
- Academic position in India since 1994
- Got involved in music audio research about 15 years ago, and sometime after, discovered this wonderful community...

Early project ...

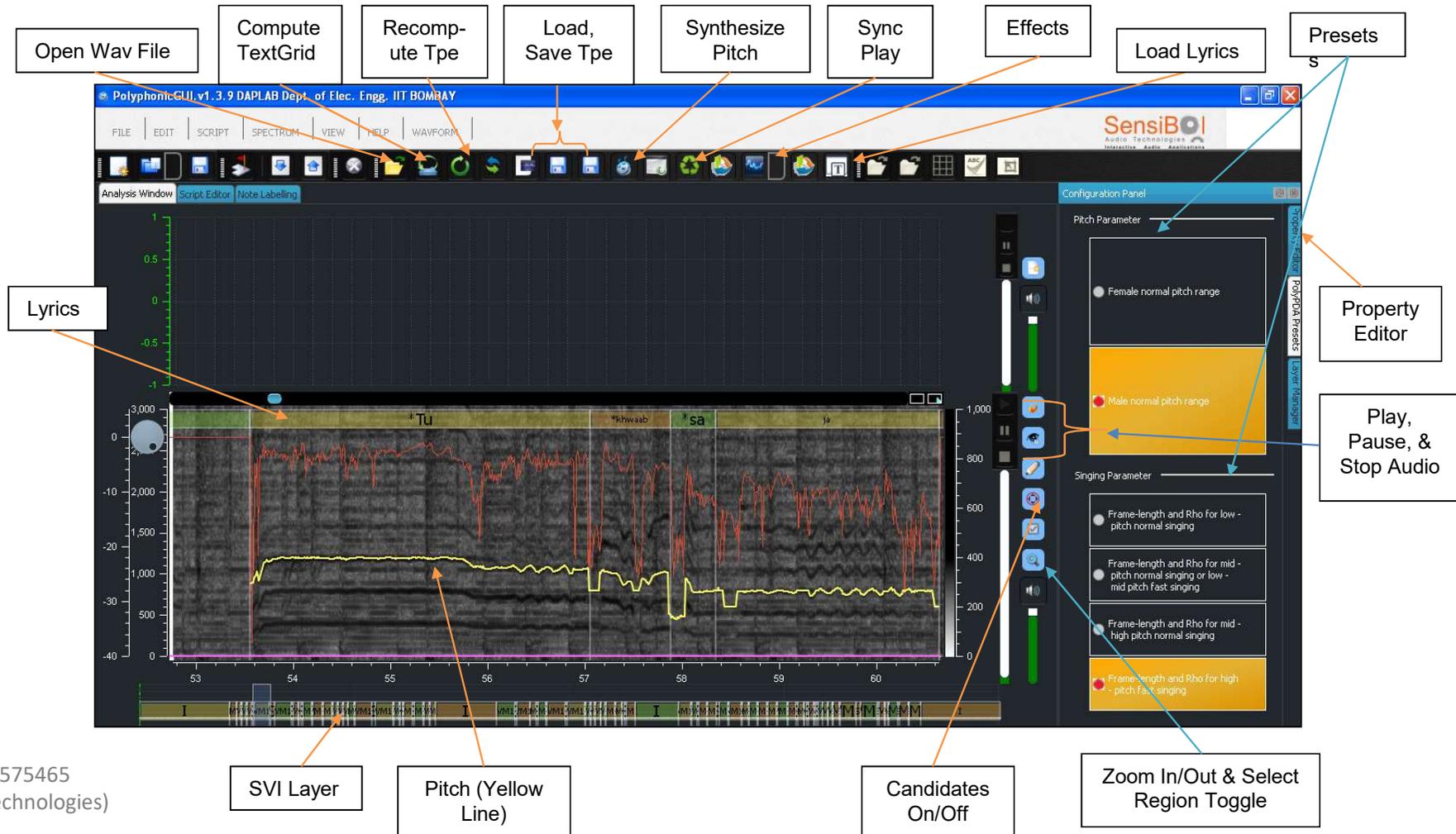


Query by Humming

"Aaj mausam bada beimaan hai"

View the video here: <https://www.ee.iitb.ac.in/student/~daplab/demos/tansen/>

“Predominant melody extraction with presets”



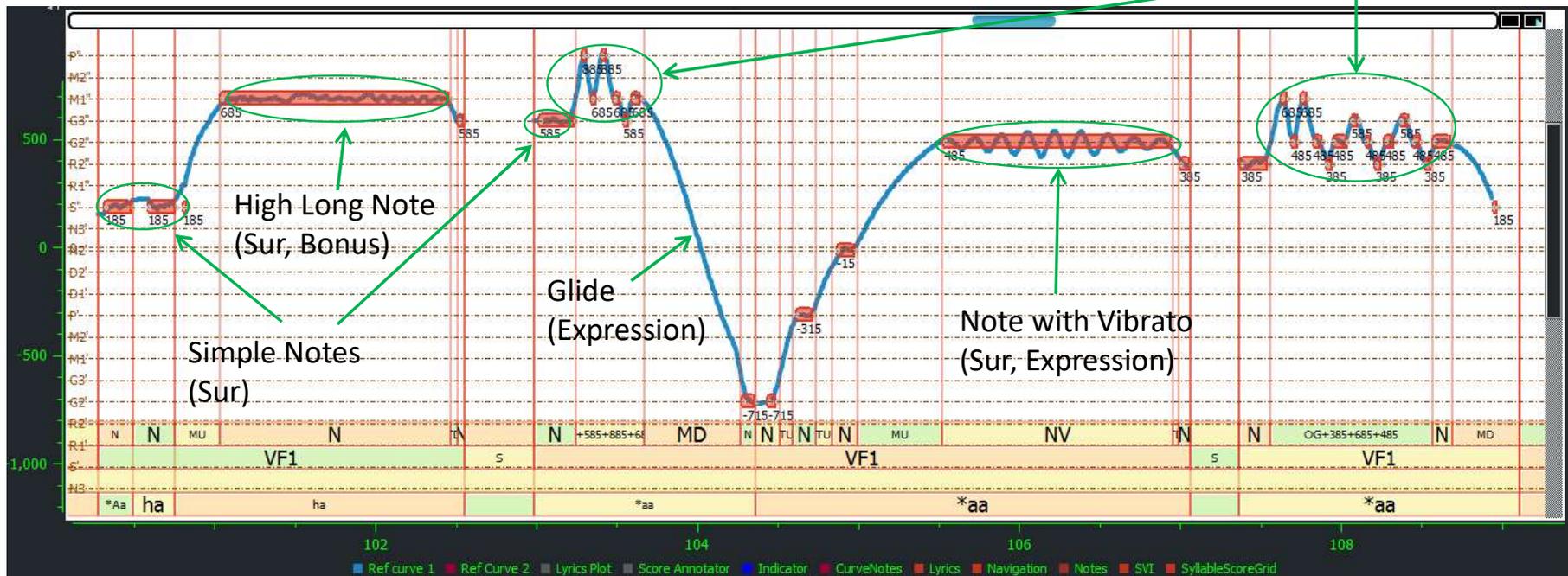
From: US Patent 8575465
(SensiBol Audio Technologies)

Note labeling challenges

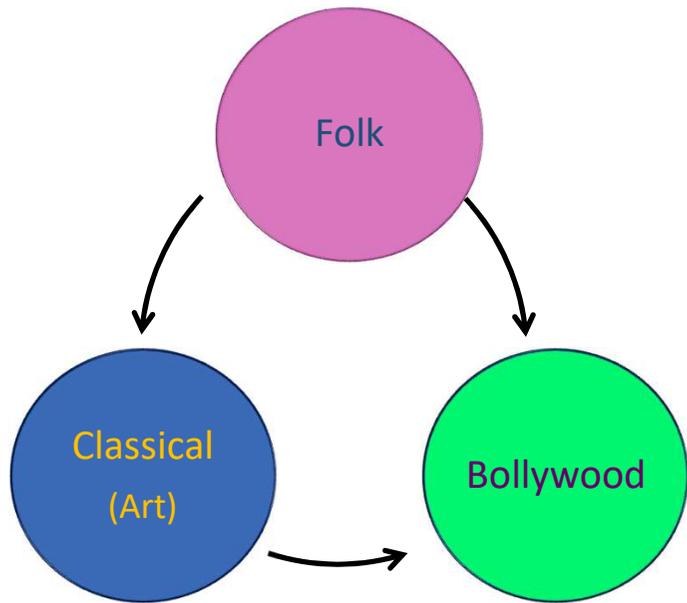
Different musical dimensions

Sur, Expression, Bonus, Taal, **Lyrics**

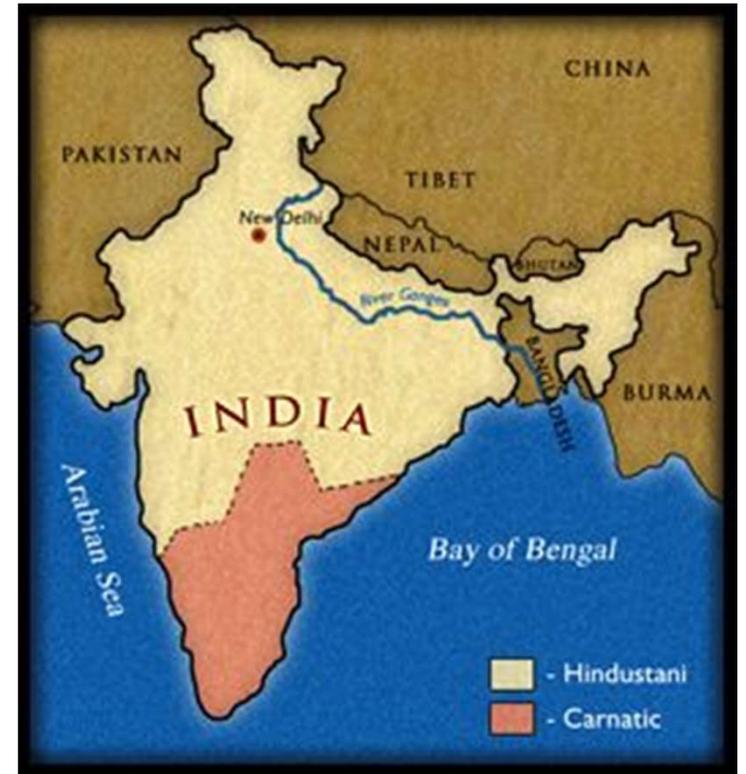
Ornaments
(Sur, Expression)



The Music of India



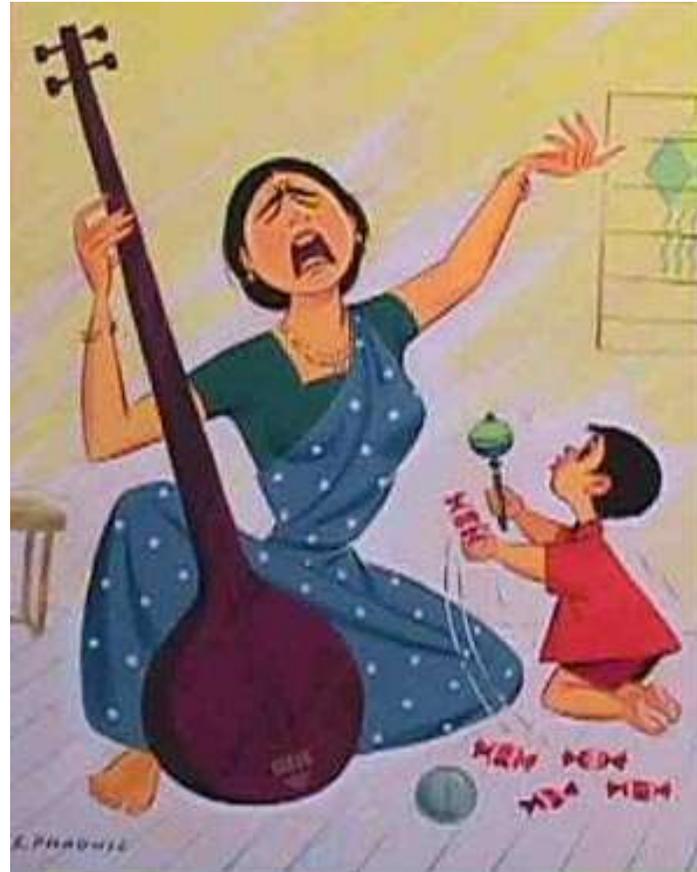
*Unique, highly theorized
oral tradition*



Classical Music Map of India: ESRI

Answering a key question ...

To define meaningful tasks in music retrieval, consider what a musicologist, musician, or what a listener, might look for.



S.D. Phadnis

'Music season' in Chennai



Ramanathan N. Iyer



Ramanathan N. Iyer

Computational research dominated by...

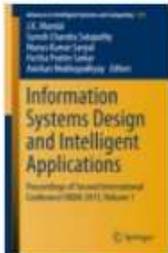


Journal of New Music Research



ISSN: 0929-8215 (Print) 1744-5027 (Online) Journal homepage: <https://www.tandfonline.com/loi/nnmr20>

Rāga Recognition based on Pitch Distribution Methods



[Information Systems Design and Intelligent Applications](#) pp 865-875 | [Cite as](#)

Raga Classification for Carnatic Music

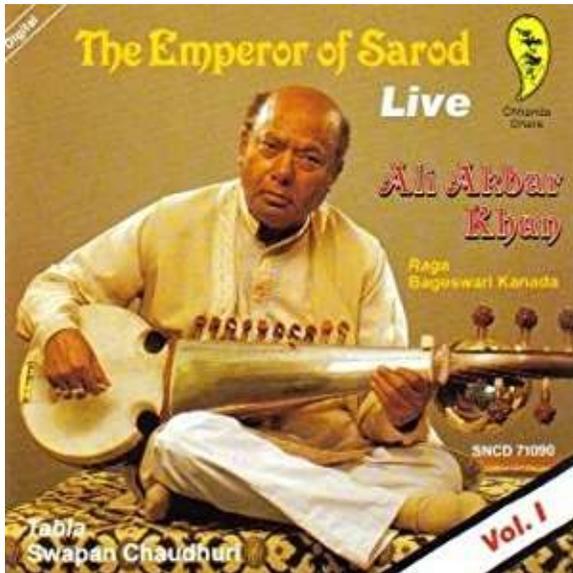


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Volume 4, Issue (6) NCRTCST-2013, ISSN 2249-071X

National Conference on Recent Trends in Computer Science and Technology (NCRTCST)-2013

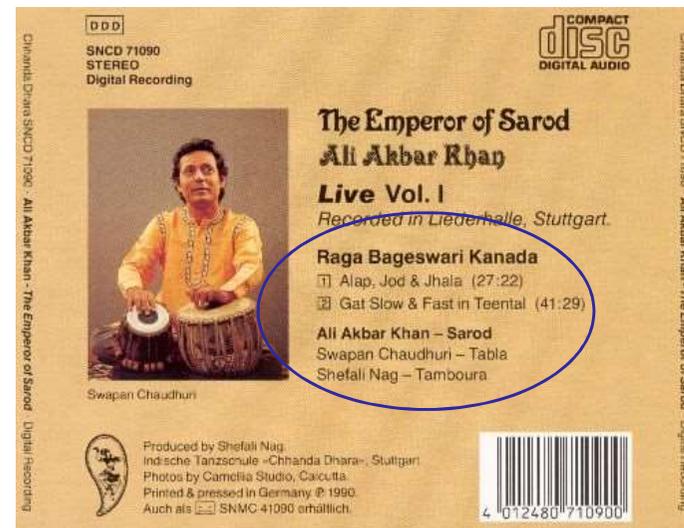
Multiple Techniques for Raga Identification in Indian Classical Music

Concert recordings: Album cover information



Raga Name

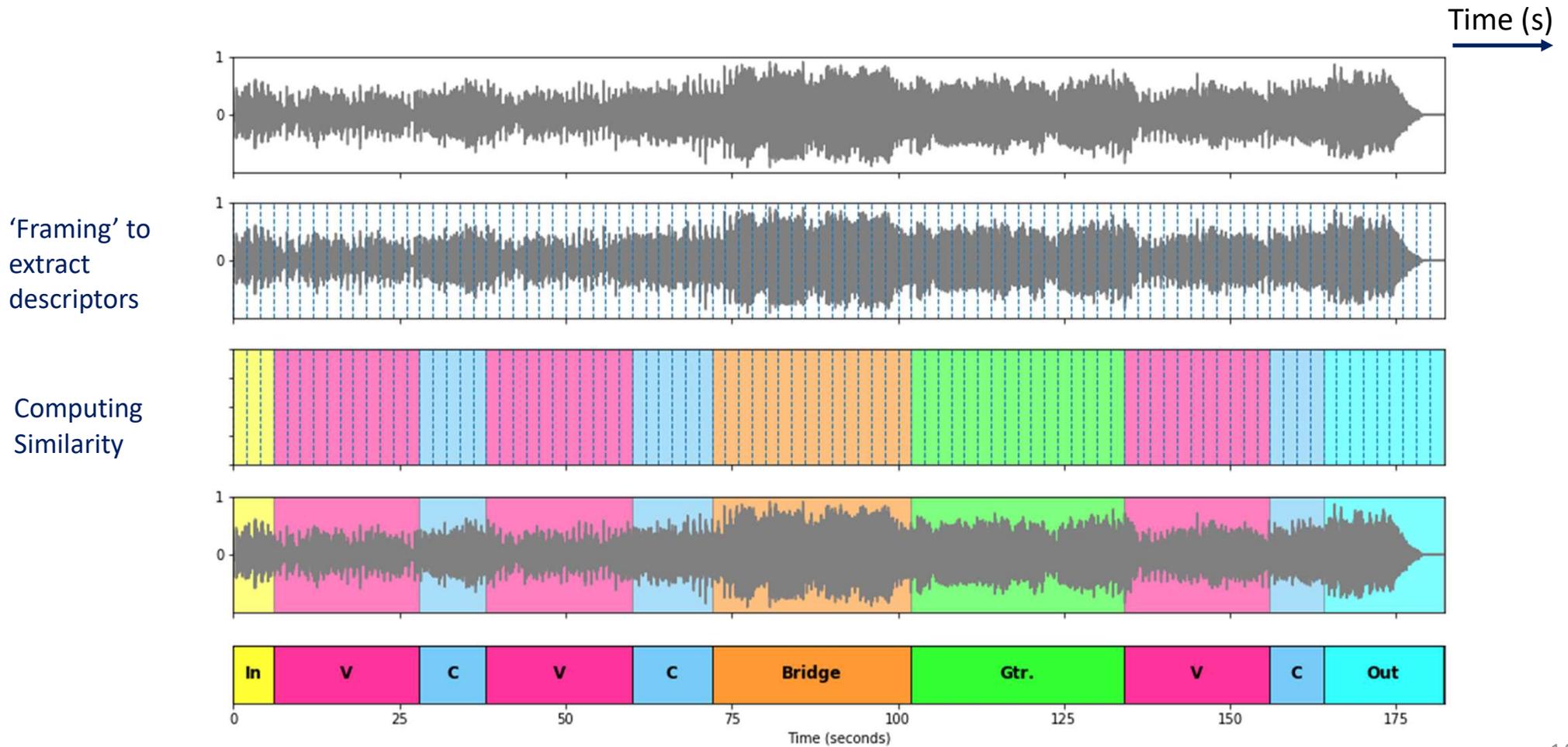
- [1] Alap, Jod, Jhala (28 min)
- [2] Gat (Laya, Tala) (42 min)



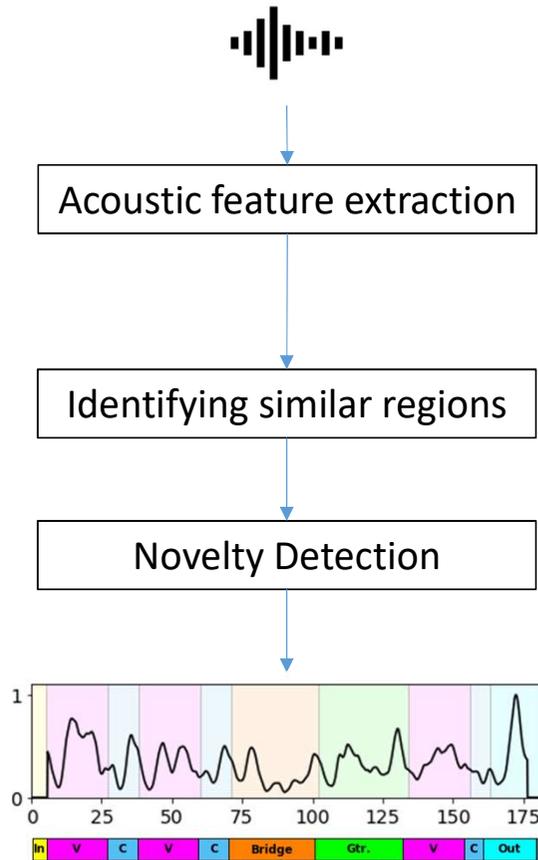
Music Structure Analysis

- Distinguishing an ordinary sound sequence and a musical piece is the intricate hierarchical structure (*genre-specific*).
- Repetitions or patterns can exist in any of the musical dimensions - melody, harmony, rhythm and timbre.
- A listener can 'parse' the music once the structure is understood.
- Applications: concert summaries, navigation, guided listening...

Music Structure Analysis on Audio Recording



An Approach to Automatic Segmentation



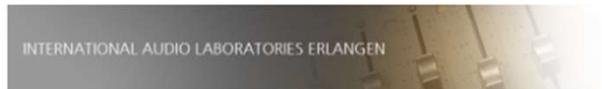
Features should

- Be homogenous within a section
- Change abruptly at section boundaries

Using, e.g., dot product of feature vectors

Identifying points of change

Existing MIR Tool for Segmentation – The FMP Notebooks



FMP Notebooks

Python Notebooks for Fundamentals of Music Processing



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 and the main contributors.

<https://www.audiolabs-erlangen.de/resources/MIR/FMP/C0/C0.html>

Dhrupad and Instrumental Hindustani Music

Dhrupad vocal

- Lead - Vocals
- Accompaniment - *Pakhawaj*
- *Tanpura*, supporting vocals



(<https://www.youtube.com/watch?v=lcggya3qM4>)

Sitar

- Lead - Sitar
- Accompaniment - *Tabla*
- *Tanpura*



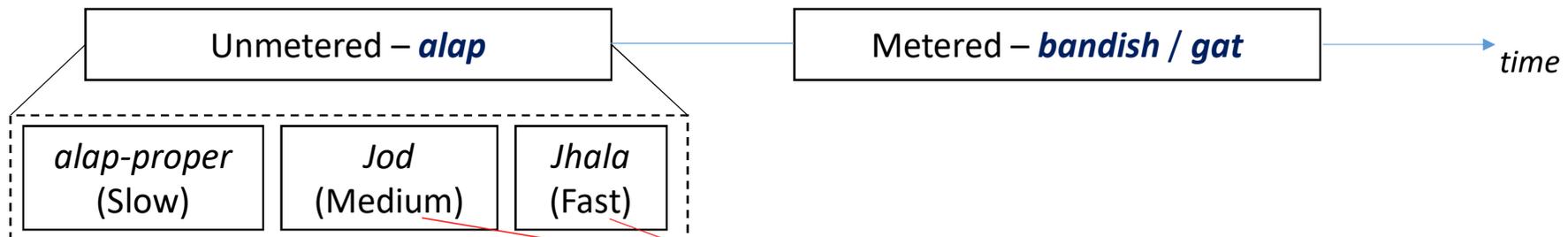
(<https://www.youtube.com/watch?v=FnP1x5FuEqU>)

Concert Structure

- Typical concert
 - 1.5 hours long
 - Consists of *raga* performances

Section durations missing

- Typical *raga* performance

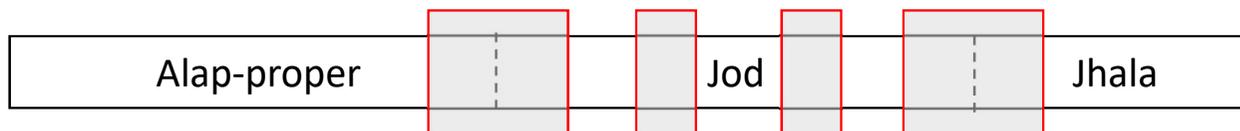


Based on musical description

(M. Clayton, *Time in Indian Music*, 2000)

Segmentation Using the FMP Notebook

- Notebooks work best with short audios
- But alap portions are usually 30-40 minutes long
- We look at short, constructed snippets of alap recordings
 - Regions immediately around each boundary, and between the two



Demo using the FMP Notebooks..

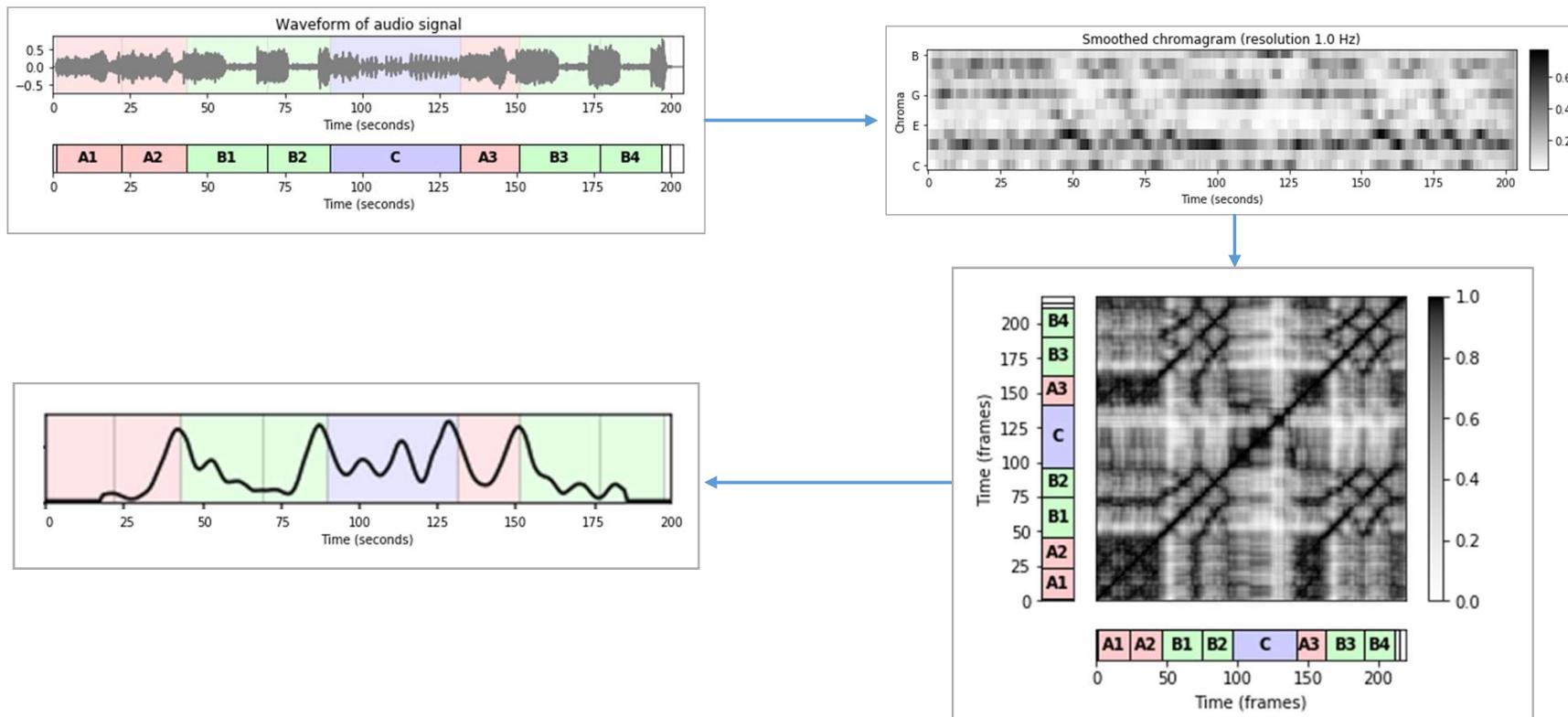
Audio examples:

1. Hungarian Dance No. 5 by Johannes Brahms
2. Dhrupad Alap in Raag Bhimpalasi by Gundecha Brothers ([Link](#))
3. Sitar Alap in Raag Patdeep by Nayan Ghosh ([Link](#))

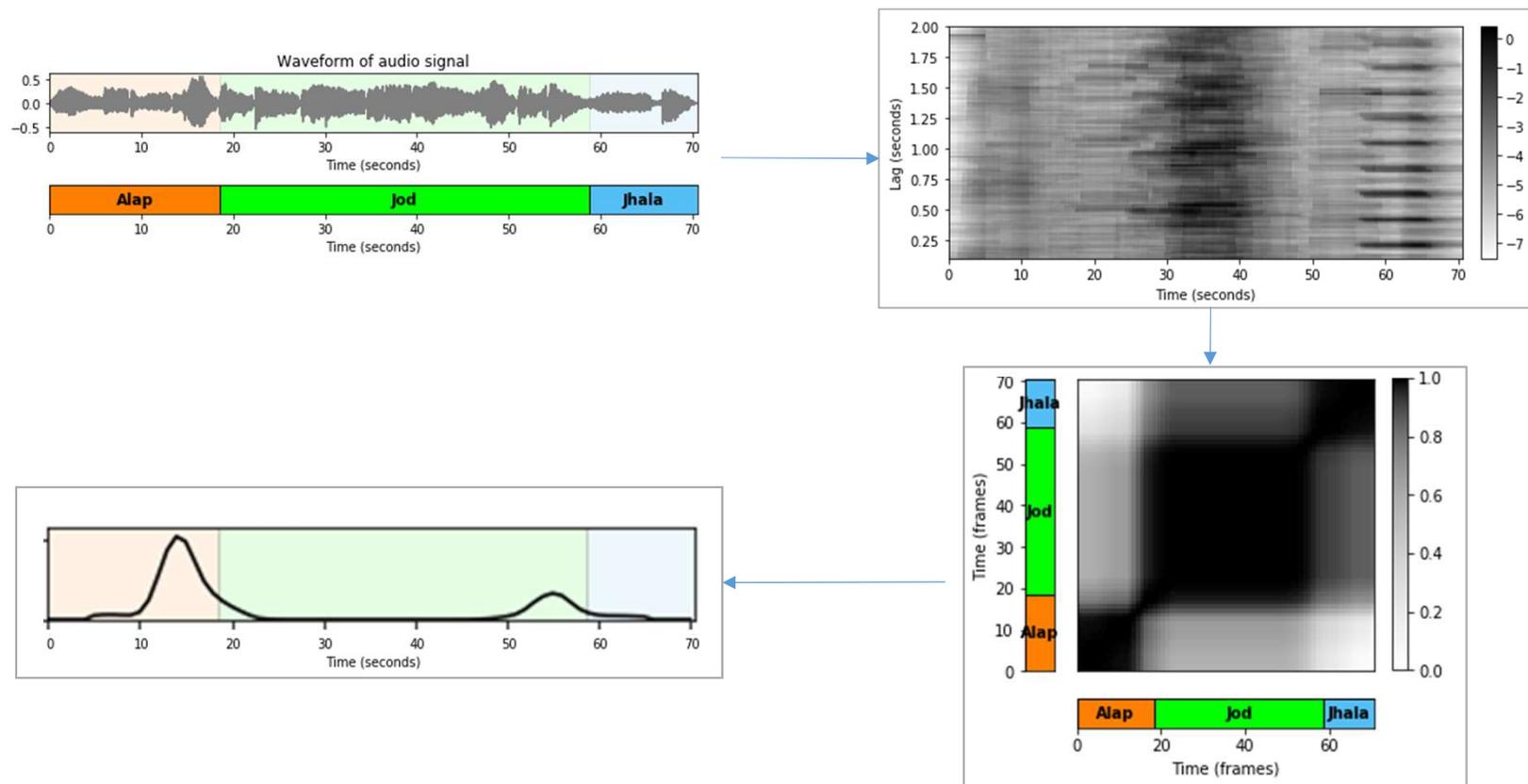
A video recording of the demo can be found

here: https://www.ee.iitb.ac.in/student/~daplab/resources/fmp_demo_wimir20.html

On Western Music – Chroma worked well



On Hindustani Music – Tempo worked well



Reporting Performance on a Dataset



Rao, P., Vinutha, T. P., & Rohit, M. A. (2020). Structural Segmentation of Alap in Dhrupad Vocal Concerts. *Transactions of the International Society for Music Information Retrieval*, 3(1), pp. 137–152. DOI: <https://doi.org/10.5334/tismir.64>

RESEARCH

Structural Segmentation of Alap in Dhrupad Vocal Concerts

Preeti Rao, Thallam Prasad Vinutha and Mattur Ananthanarayana Rohit

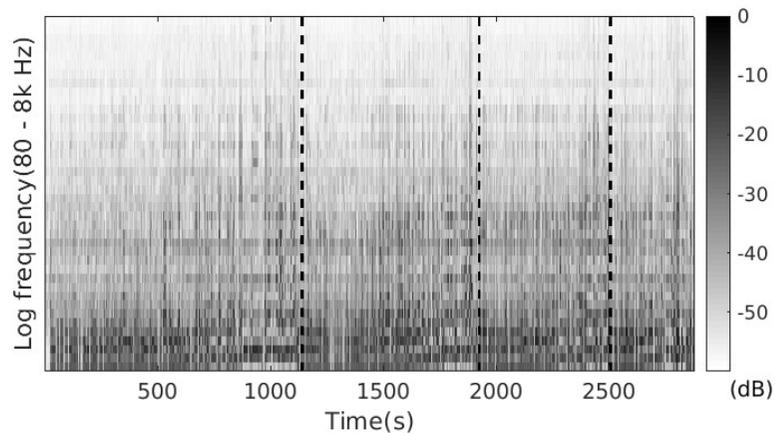
Dhrupad vocal concerts exhibit a temporal evolution through a sequence of homogeneous sections marked by shared rhythmic characteristics. In this work, we address the segmentation of a concert audio's unmeasured improvisatory section into musically meaningful segments at the highest time scale. Motivated by the distinct musical properties of the sections and their corresponding acoustic correlates, we compute a number of features for the segment boundary detection task. Both supervised and unsupervised

<https://transactions.ismir.net/articles/10.5334/tismir.64/>

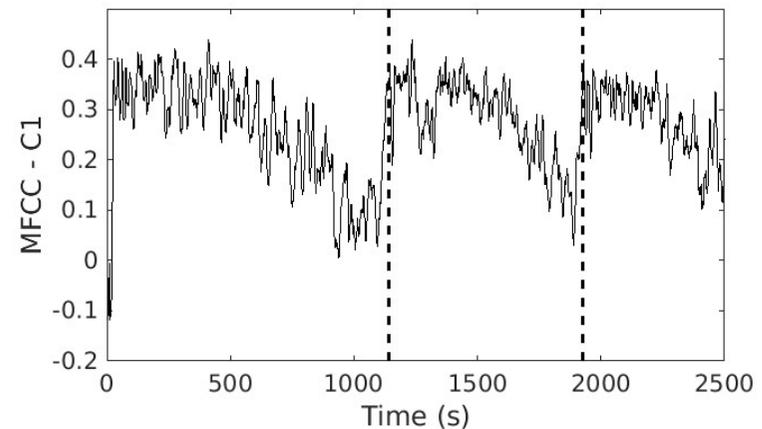
More features that signal boundaries ...

- *"Sections are characterized by gradual, progressive melodic ascent"* - B. C. Wade ([Music in India](#), 2001)

Raga Ahir Bhairav by Uday Bhawalkar



Log-mel-spectrogram shows energy moving to higher bins towards section-end



MFCC C1, measuring spectral tilt, shows decrease

Challenges

- Scarcity of annotated data
 - 30-40 minutes of concert audio has only 2-3 boundaries
 - Publicly available recordings are not always of good quality
 - Requires trained annotators
- Necessity of domain knowledge
 - Choice of features
 - System parameter values
e.g. Kernel width, evaluation tolerance

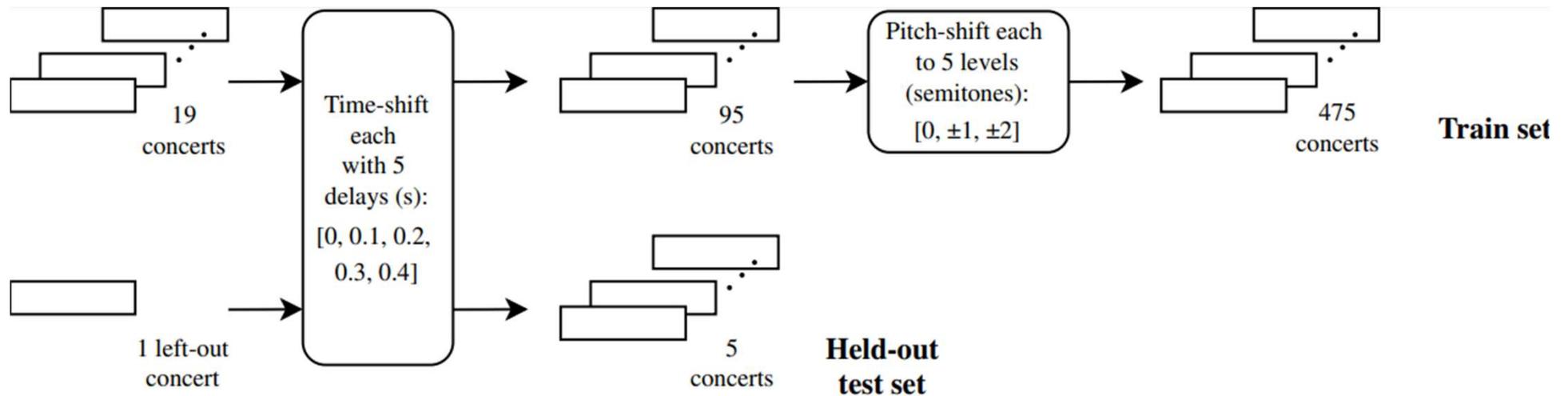
Data Augmentation

- Available Data

- 20 concerts – 53 boundaries

- Augmentation method

- Time and pitch-shifting



Some Results on Dhrupad Alap Segmentation

- Evaluation

- Boundary-hit tolerance: ± 15 seconds
- Leave one concert out cross-validation for supervised methods

* Boundaries from each feature fused together using majority rule

Classifier trained on vector with all features

Method	Features	Precision	Recall
Unsupervised SSM- Novelty*	Tempo MFCC	0.72	0.66
Random Forest Classifier #	Short-time energy S.t. spectral centroid	0.90	0.81
Convolutional Neural Network	Log-mel spectrogram	0.92	0.81

Available Resources (non-Western genres)

- CompMusic Project (<https://compmusic.upf.edu/>)



**Computational models
for the discovery of the World's Music**

HOME

CompMusic is a research project funded by the European Research Council f
2017 and coordinated by Xavier Serra from the Music Technology Group of th

HOME
DESCRIPTION
TEAM
PUBLIC
CORPO
SOFTW



Info Legal Register Login

Dunya comprises the music corpora and related software tools that have been developed as part of the CompMusic project. These corpora have been created with the aim of studying particular music traditions and they include audio recordings plus complementary information that describes the recordings. Each corpus has specific characteristics and the developed software tools allow to process the available information in order to study and explore the characteristics of each musical repertoire.

Explore our collections

Carnatic Hindustani Makam Jingju Andalusian



Search Upload Communities

May 31, 2018 Dataset Open Access

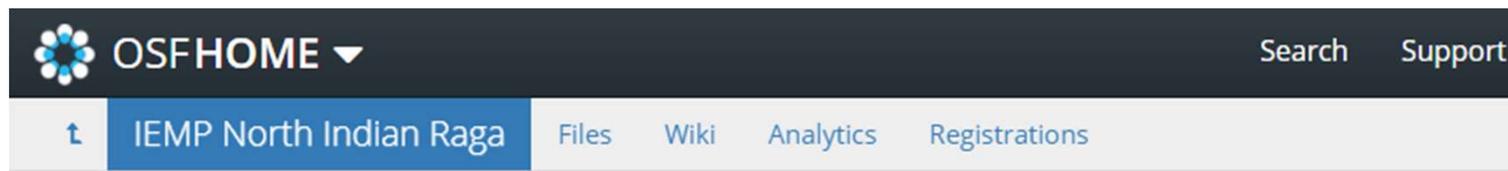
Saraga: research datasets of Indian Art Music

 Bozkurt, B.;  Srinivasamurthy, A.;  Gulati, S.;  Serra, X.

This repository contains time aligned melody, rhythm and structural annotations for two large open corpora of Indian Art Music (Carnatic and Hindustani music).

Available Resources

- IEMP North Indian Raga (<https://osf.io/ks325/>)
 - Multi-track concert recordings, annotations



Interpersonal Entrainment in Music Performance /

IEMP North Indian Raga

Contributors: [Martin Clayton](#), [Laura Leante](#), [Simone Tarsitani](#)

Date created: 2018-07-14 11:17 PM | Last Updated: 2020-05-20 03:59 PM

Identifier: DOI 10.17605/OSF.IO/KS325

Category:  Data

Description: A collection of audiovisual recordings of North Indian (Hindustani) Raga performances, with detailed annotations.

License: Other 

Software Tools

- Librosa – audio processing library for python
(<https://librosa.org/doc/latest/index.html>)



0.8.0

- Rubber Band – command-line utility for pitch-shifting, time-stretching
(<https://breakfastquay.com/rubberband/>)



Ongoing Project

Computational Musicology and Musical Instruments Modeling for Indian Music



I.I.T. Bombay



Govt. of India



I.I.T. Dharwad

Collaborators

Xavier Serra

MTG, UPF Barcelona

Martin Clayton

Dept. of Music, Durham Univ.

Gary Scavone

Schulich School of Music, McGill Univ.

For more information: <https://www.ee.iitb.ac.in/student/~daplab/>