Unity in Diversity: MIR Tools for Non-Western Music

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https://www.free-largeimages.com/world-map-775/

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/

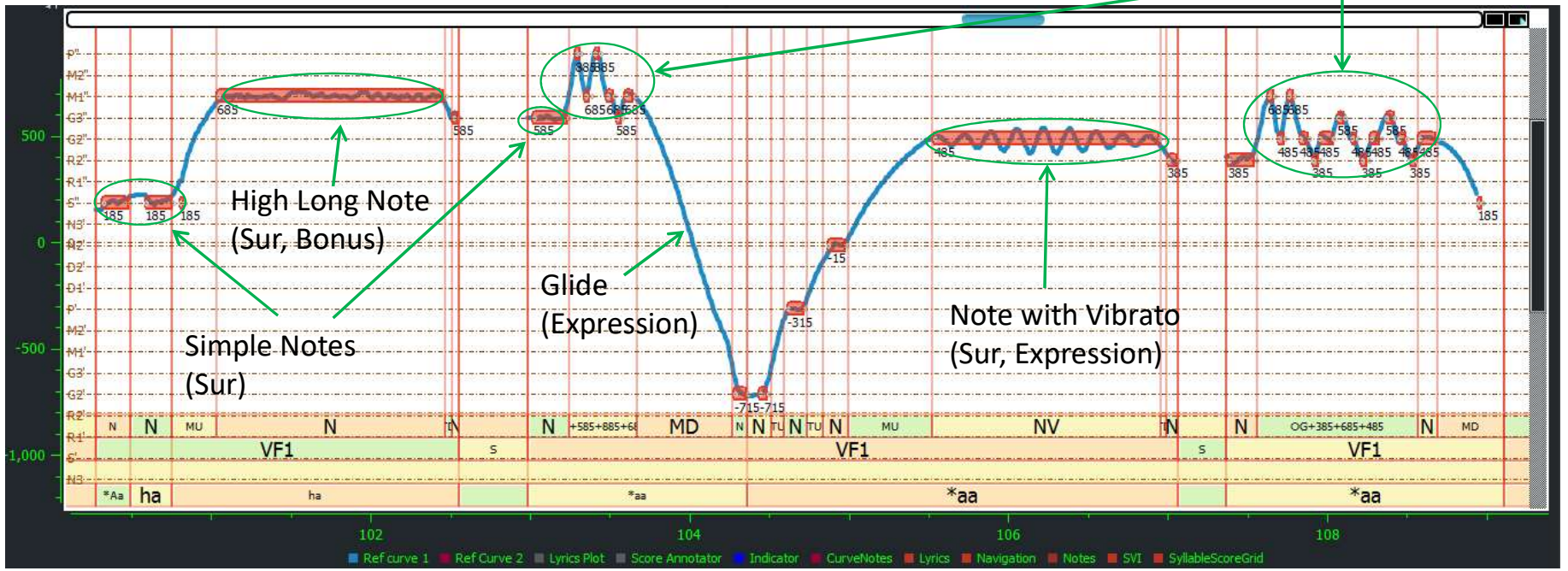
“Predominant melody extraction with presets”

From: US Patent 8575465
(SensiBol Audio Technologies)

Note labeling challenges

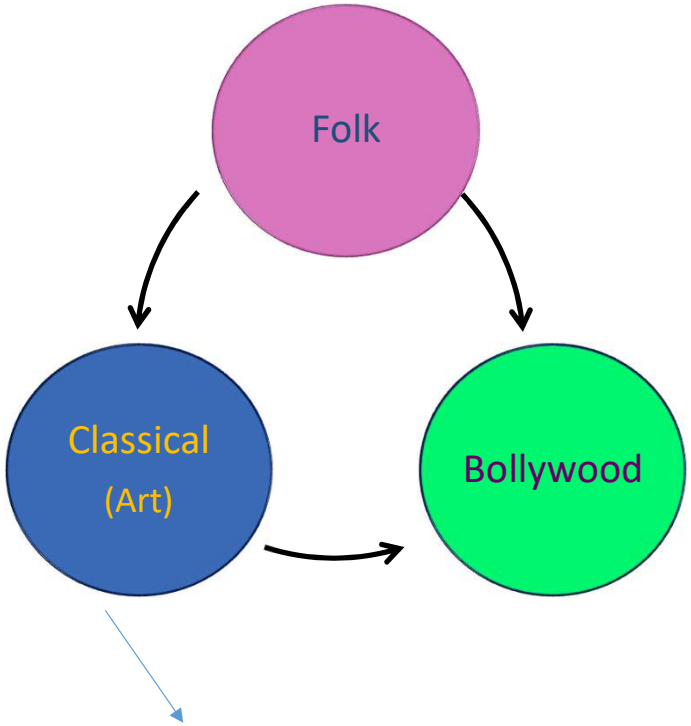
Different musical dimensions

Sur, Expression, Bonus, Taal, Lyrics



From: US Patent 8575465 (SensiBol Audio Technologies)

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

Computational research dominated by…

Journal of New Music Research

Routledge
Taylor & Francis Group

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

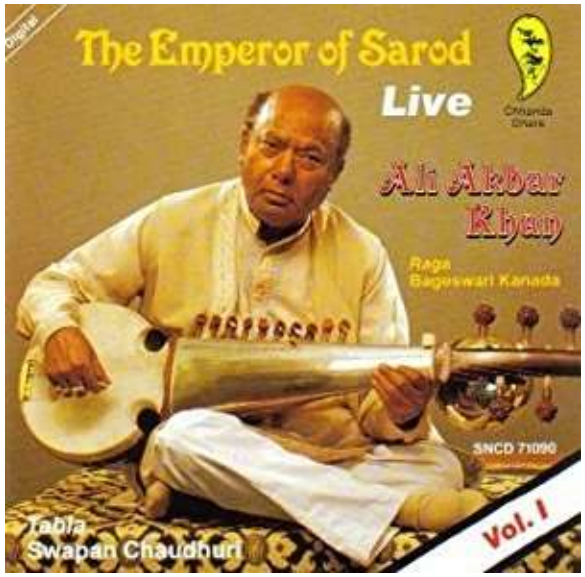
Raga Classification for Carnatic Music

International Journal of Electronics Communication and Computer Engineering
Volume 4, Issue (6) NCRTCST-2013, ISSN 2249–071X

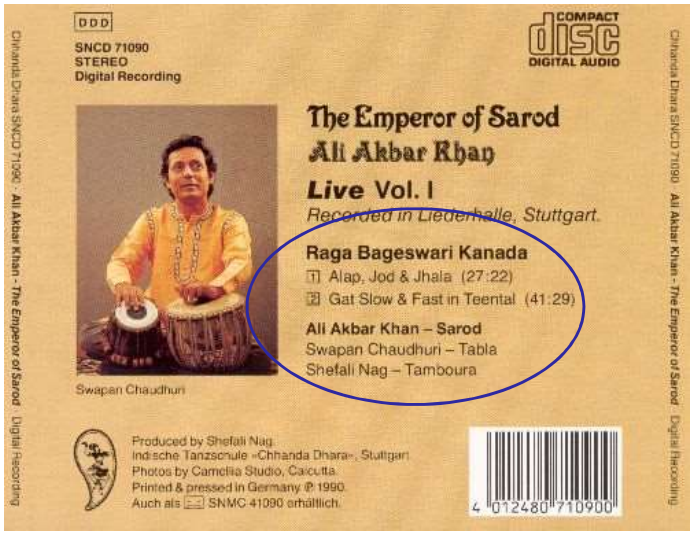
National Conference on Recent Trends in Computer Science and Technology (NCRTCST)-2013

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)



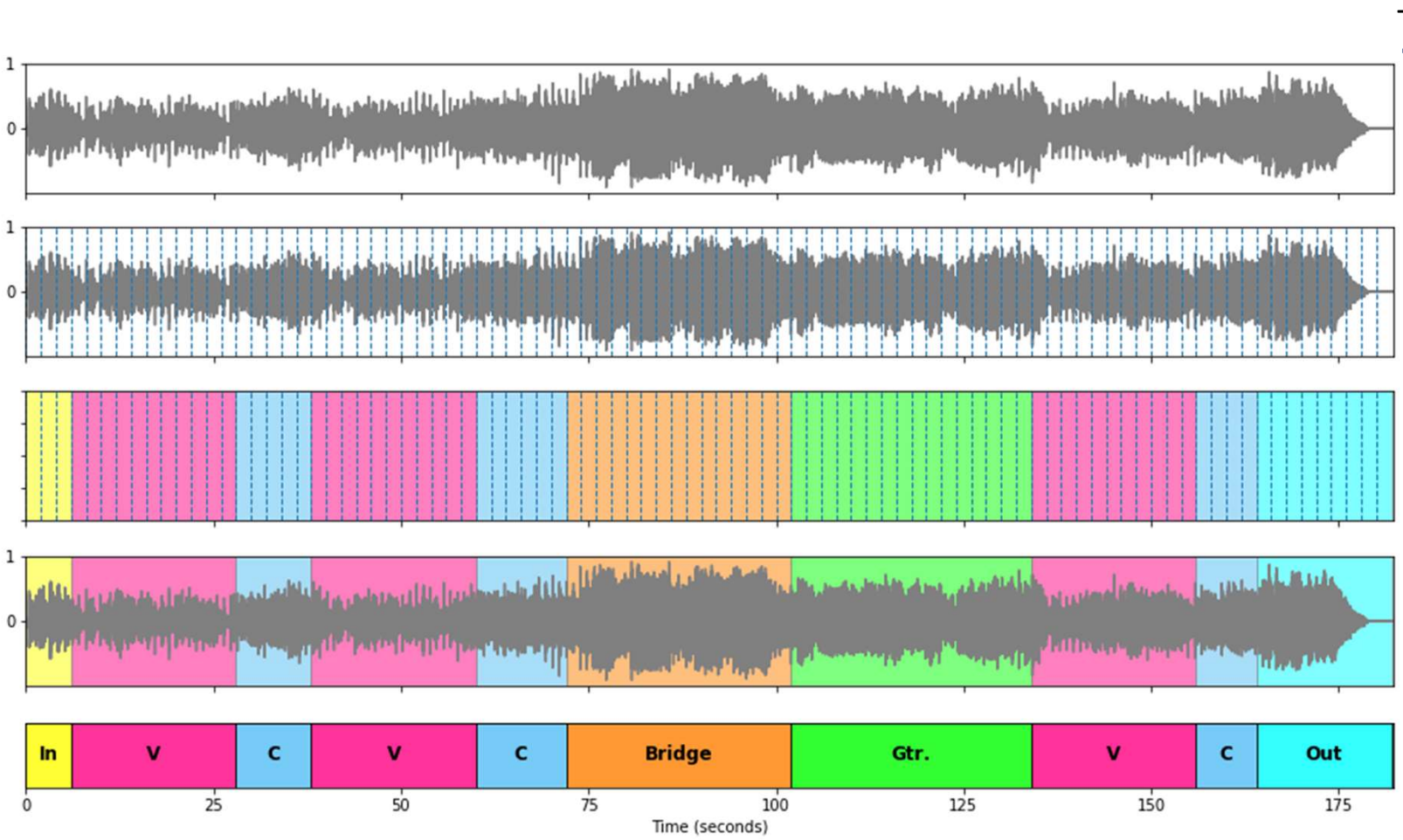
Music Structure Analysis

- 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…

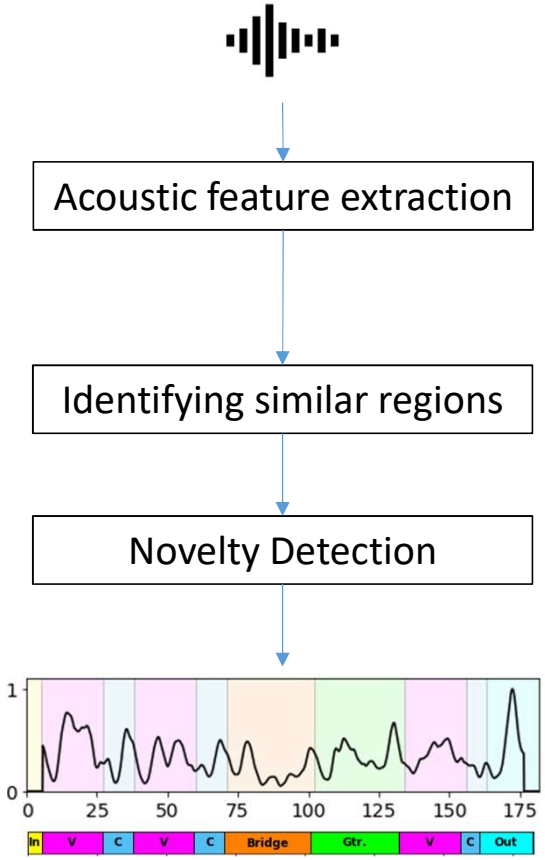
Music Structure Analysis on Audio Recording

‘Framing’ to extract descriptors

Computing Similarity



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

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=Icgcgya3qM4)

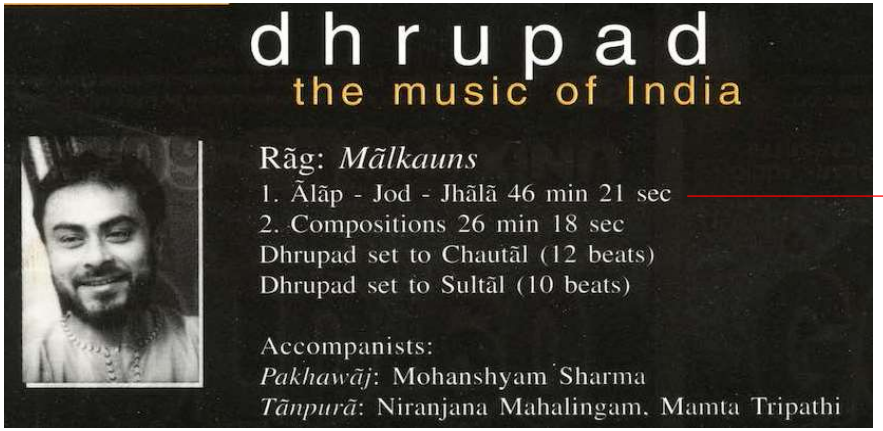
Sitar

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

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

Concert Structure

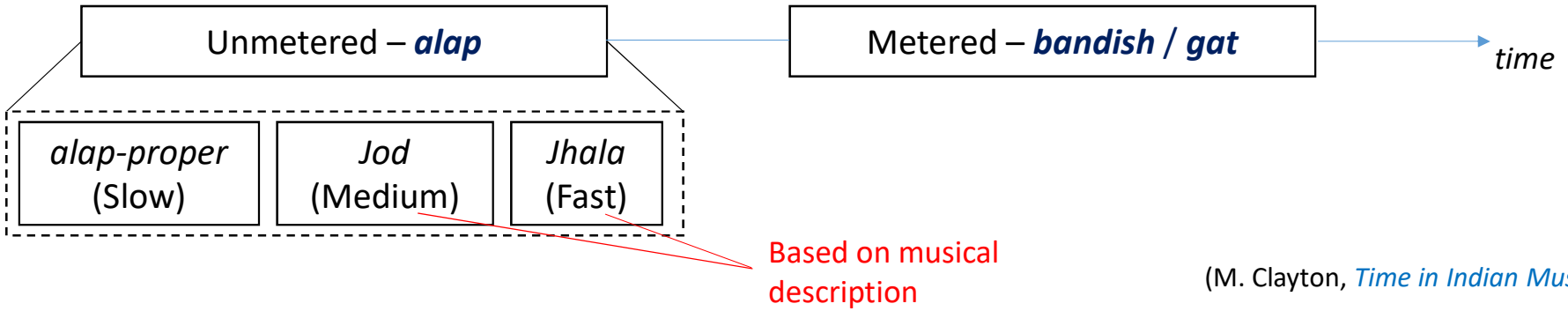
- Typical concert
  - 1.5 hours long
  - Consists of *raga* performances



Section durations missing

(http://www.nirmalyadhrupad.org/media)

- Typical *raga* performance

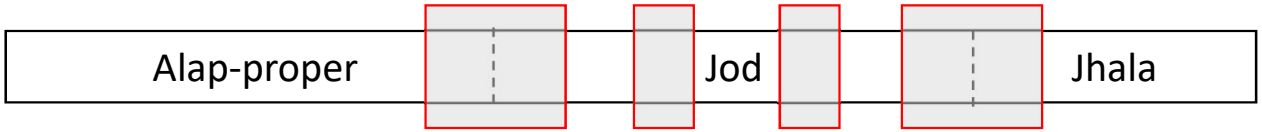


(M. Clayton, *Time in Indian Music*, 2000)

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



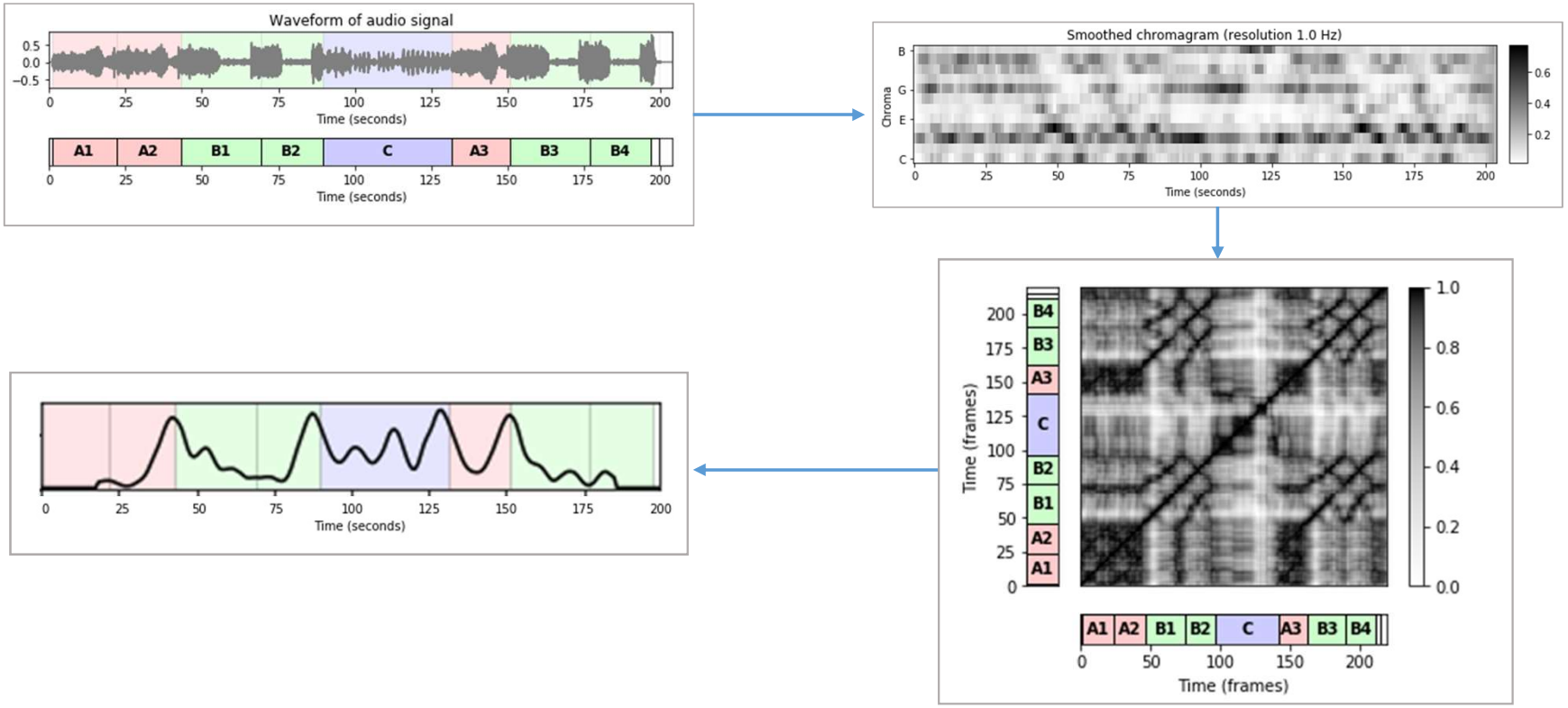
Demo using the FMP Notebooks..

Audio examples:

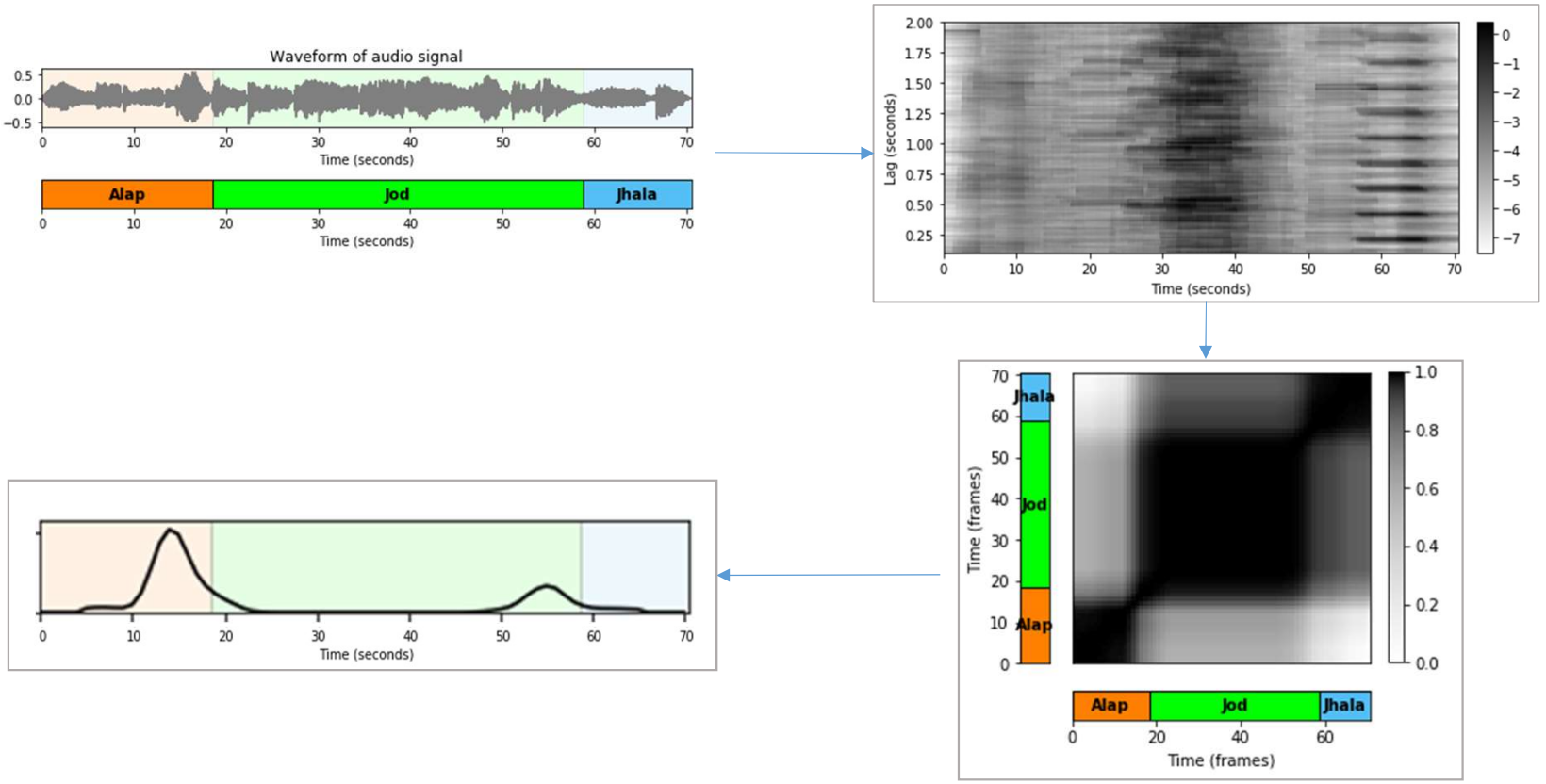
1. Hungarian Dance No. 5 by Johannes Brahms
2. Dhrupad Alap in Raag Bhimpalasi by Gundecha Brothers (Link)
3. Sitar Alap in Raag Patdeep by Nayan Ghosh (Link)

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

TISMIR

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

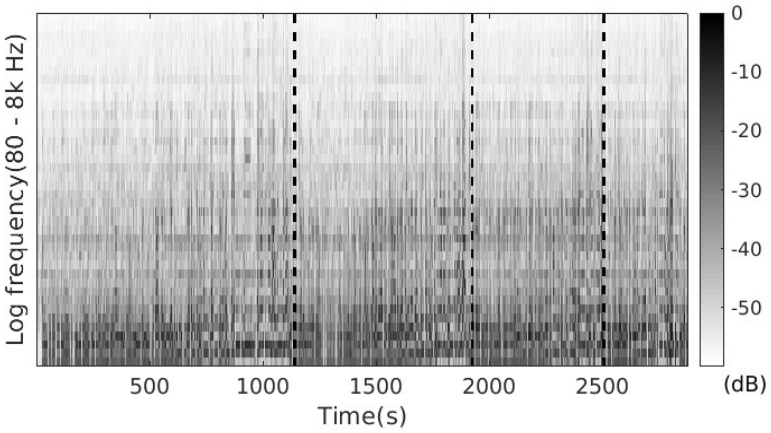
Dhrupad vocal concerts exhibit a temporal evolution through a sequence of homogeneous sections marked by shared rhythmic characteristics. In this work, we address the segmentation of a concert audio's unmetered improvisatory section into musically meaningful segments at the highest time scale. Motivated 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/

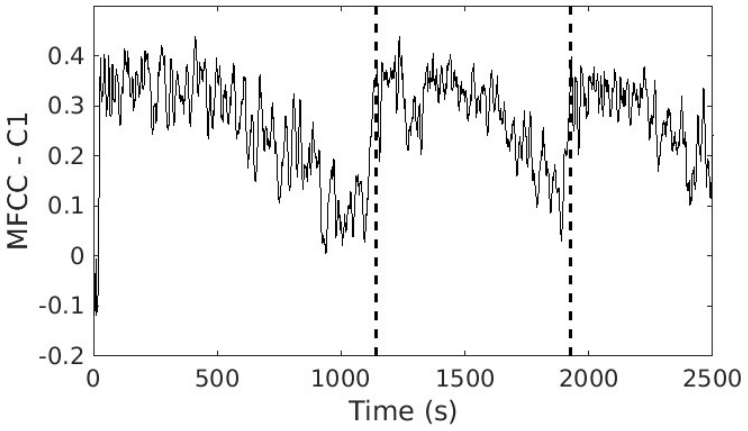
More features that signal boundaries ...

- "*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

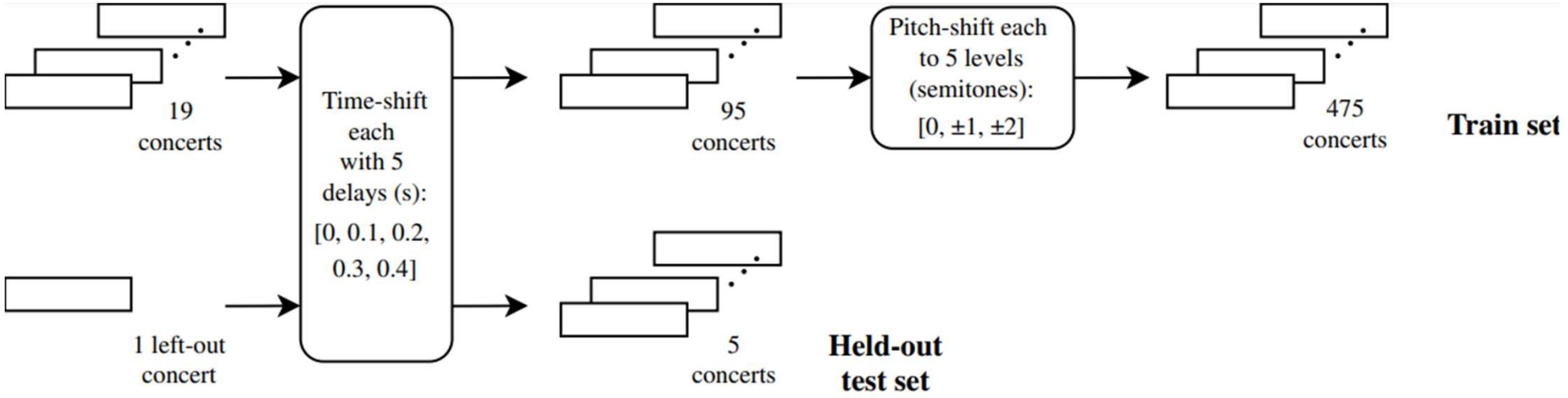
Challenges

- 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

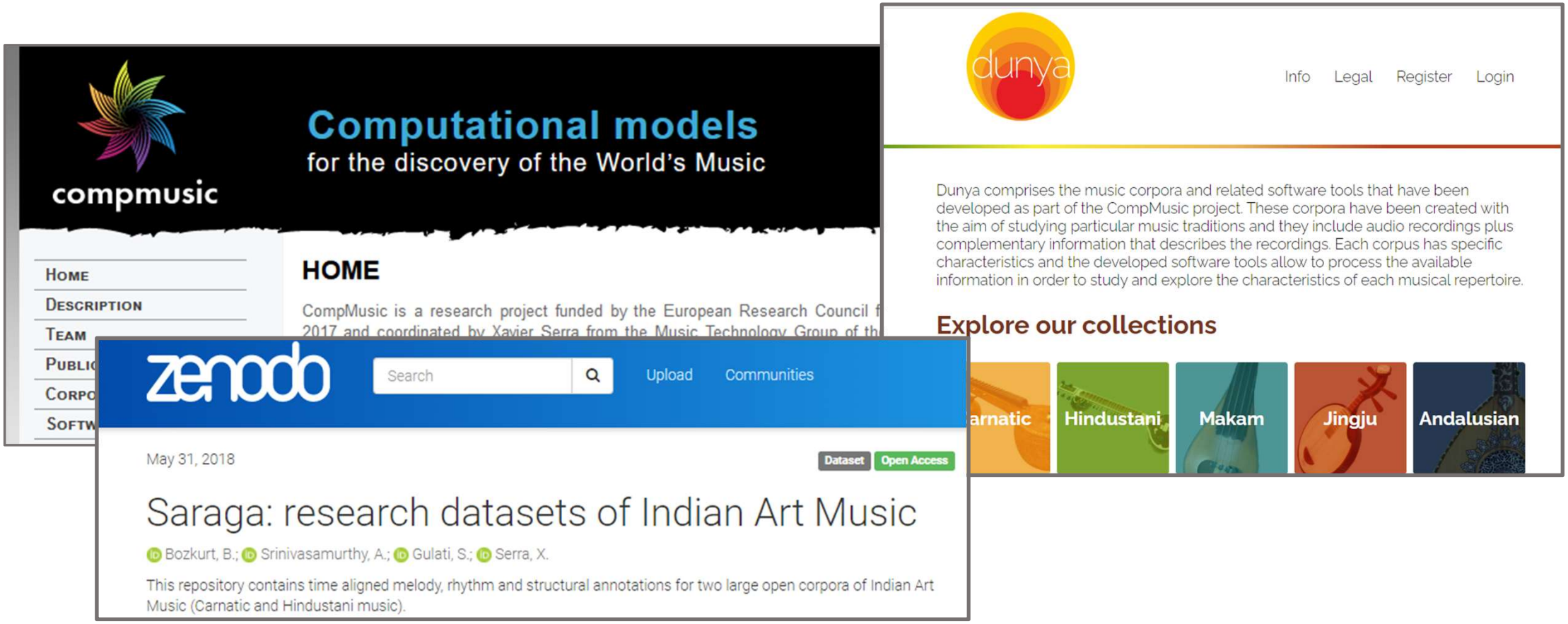
* Boundaries from each feature fused together using majority rule

\# Classifier trained on vector with all features

Method	Features	Precision	Recall
Unsupervised SSM-Novelty*	Tempo MFCC Short-time energy S.t. spectral centroid	0.72	0.66
Random Forest Classifier #		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/)



Available Resources

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

Software Tools

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

- 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

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