Computational analysis of melodic mode switching in raga performance
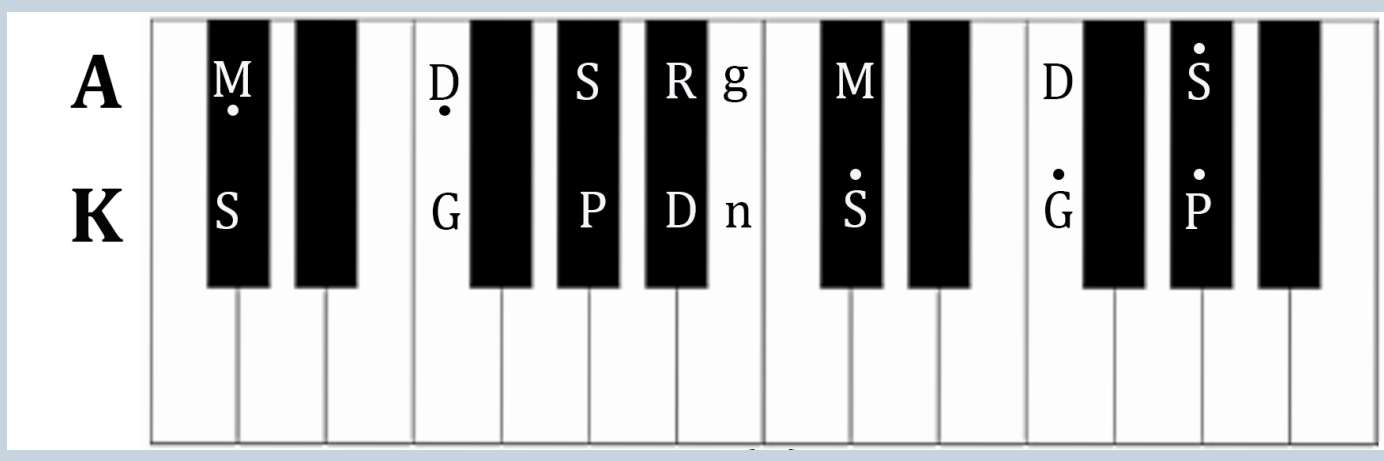
Nithya Shikarpur, Asawari Keskar, Preeti Rao
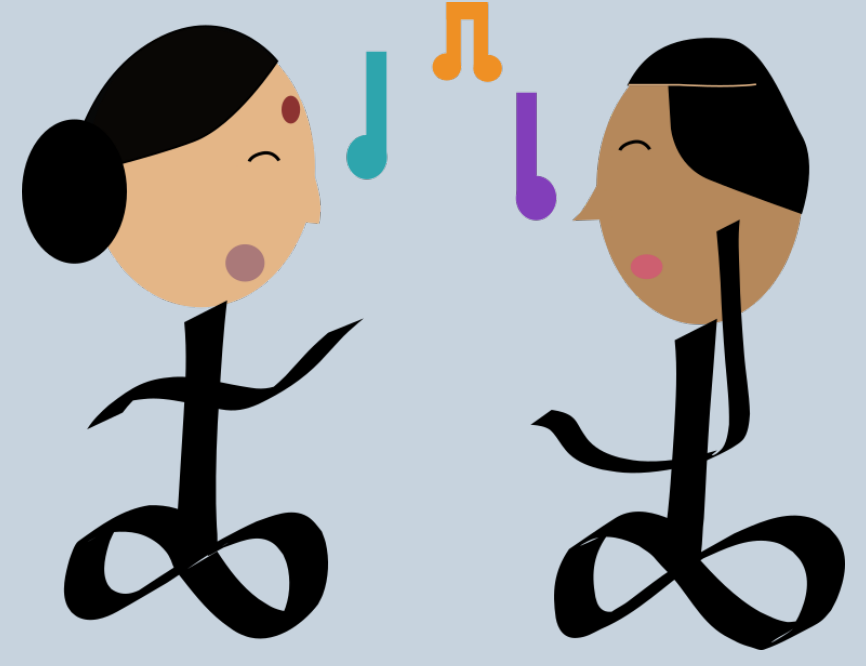{nithyas, prao}@ee.iitb.ac.in

Introduction & Background

Murchana (Modal Shift):
Using the same keyboard notes, it is possible to obtain multiple scales by changing the tonic note.

Example of ragas Abhogi (A) and Kalavati (K), generated with same keyboard notes using different tonic (S) notes

Jasrangi Jugalbandi (JJ)
A development in North Indian Classical music allowing singers (a male and female) with incompatible vocal ranges to sing together using the concept of murchana (mode-shifted ragas)[1]

Challenges
(Identified by discussions with singers)

Research Questions

1. Preserving Raga-specific characteristics ┄┄┄▶ **1. Analyse the extent to which individual raga characteristics are preserved in the context of a JJ song**

2. Meaningfully linking phrases during singer interaction ┄┄┄▶ **2. Analyse the interaction between 2 singers**
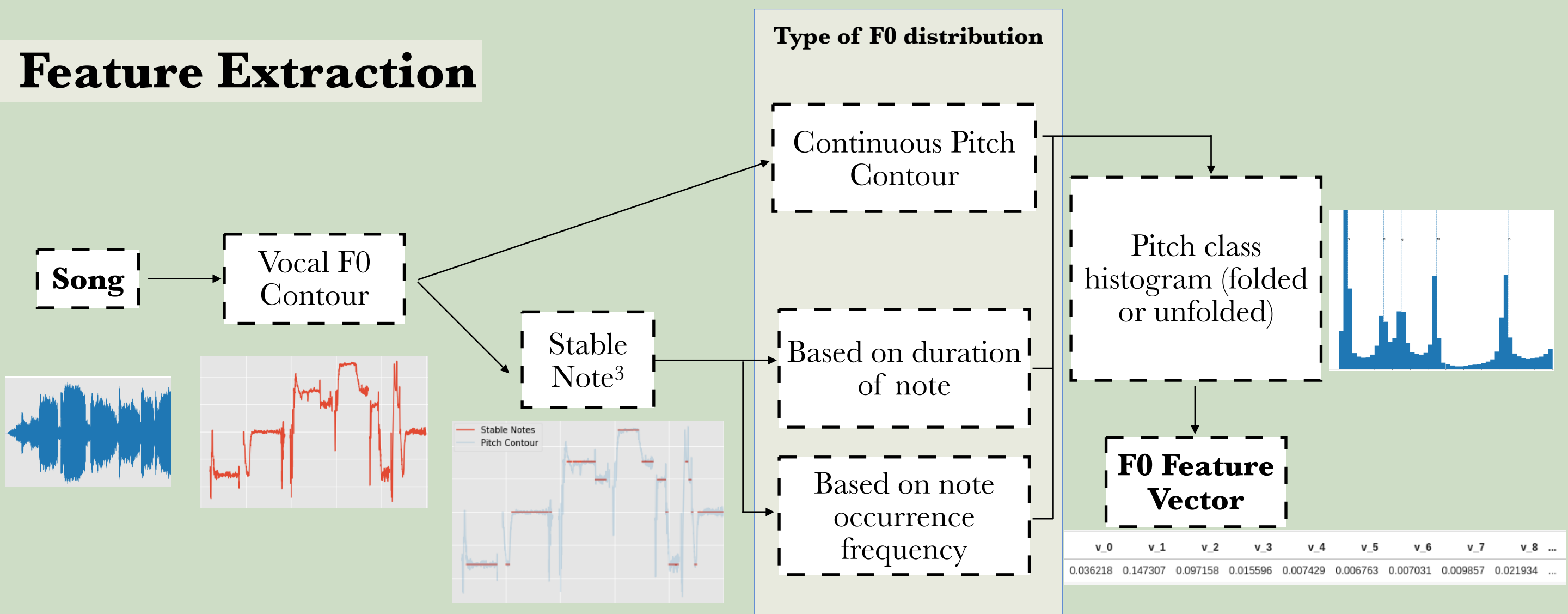
Dataset

Sources:
1. Hindustani Raga Recognition Dataset[2]
2. Commercial Recordings
3. YouTube

Raga Pairs
1. Abhogi-Kalavati
2. Chandrakauns-Madhukauns
(Dataset includes individual raga-specific songs and JJ songs)

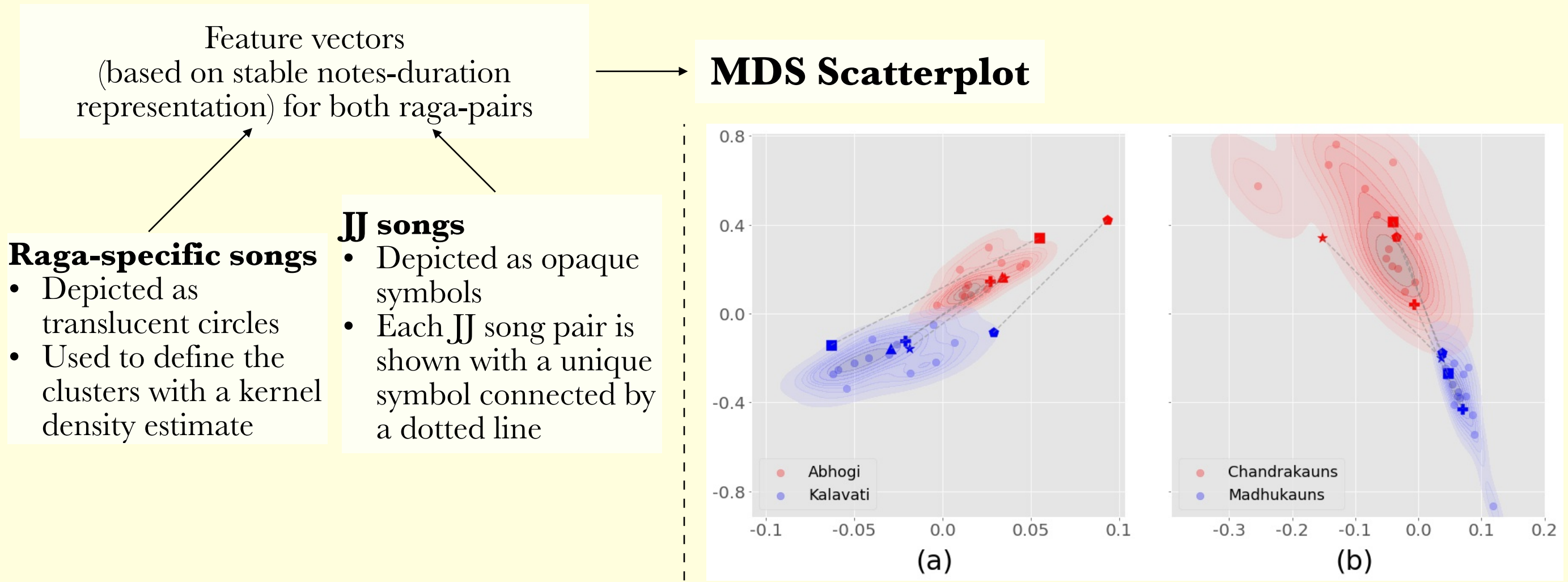| Raga Pair	Number of songs (minutes)		
	Raga 1	Raga 2	JJ
A-K	12 (185)	12 (227)	5 (89)
C-M	13 (214)	14 (171)	4 (69)

Number of songs and duration (in minutes) in our dataset for each raga pair

Feature Extraction

Analysis #1: Preservation of Raga-specific characteristics

Feature vectors (based on stable notes-duration representation) for both raga-pairs → **MDS Scatterplot**

Raga-specific songs
- Depicted as translucent circles
- Used to define the clusters with a kernel density estimate

JJ songs
- Depicted as opaque symbols
- Each JJ song pair is shown with a unique symbol connected by a dotted line

(a) Abhogi / Kalavati

(b) Chandrakauns / Madhukauns

Observation: JJ song raga components are well separated and cluster well with their respective raga-specific songs

Analysis #2: Interaction between 2 singers

- Each JJ song is split into alternating 'turns' between the 2 singers
- Melodic features are extracted for each singer's turn. The 'interaction' between the singers is captured by the computed correlation between the corresponding turns of the two singers.
- We calculate a baseline value by taking the correlation between randomly paired turns of the two singers.

Raga Pairs	No. Of Turn Pairs	Duration (s)	No. Of Notes	Pitch Range (Cents)
A-K	83	0.52 (0.02)	0.61 (0.02)	0.47 (0.04)
C-M	80	0.81 (0.02)	0.64 (0.03)	0.55 (0)

Results of correlation between singer turns. Value in brackets is the baseline.

Observation: Melodic features of turns between singers are well correlated. Implies similarity between melodic contour of corresponding turns.

Types of 'call and response' interactions between singers

2 types of interactions were observed
(a) Same keyboard notes being sung, hence different solfege transcription
(b) Same solfege transcription, hence different keyboard notes

The figure here depicts the pitch contours along with solfege transcriptions of the singers singing raga Madhukauns - M (by the male) and raga Chandrakauns - C (by the female) for both types of interaction.

(a) M: S g m g S / C: M d N d M
(b) M: S g m P n Ś / C: S-S g M d N Ś
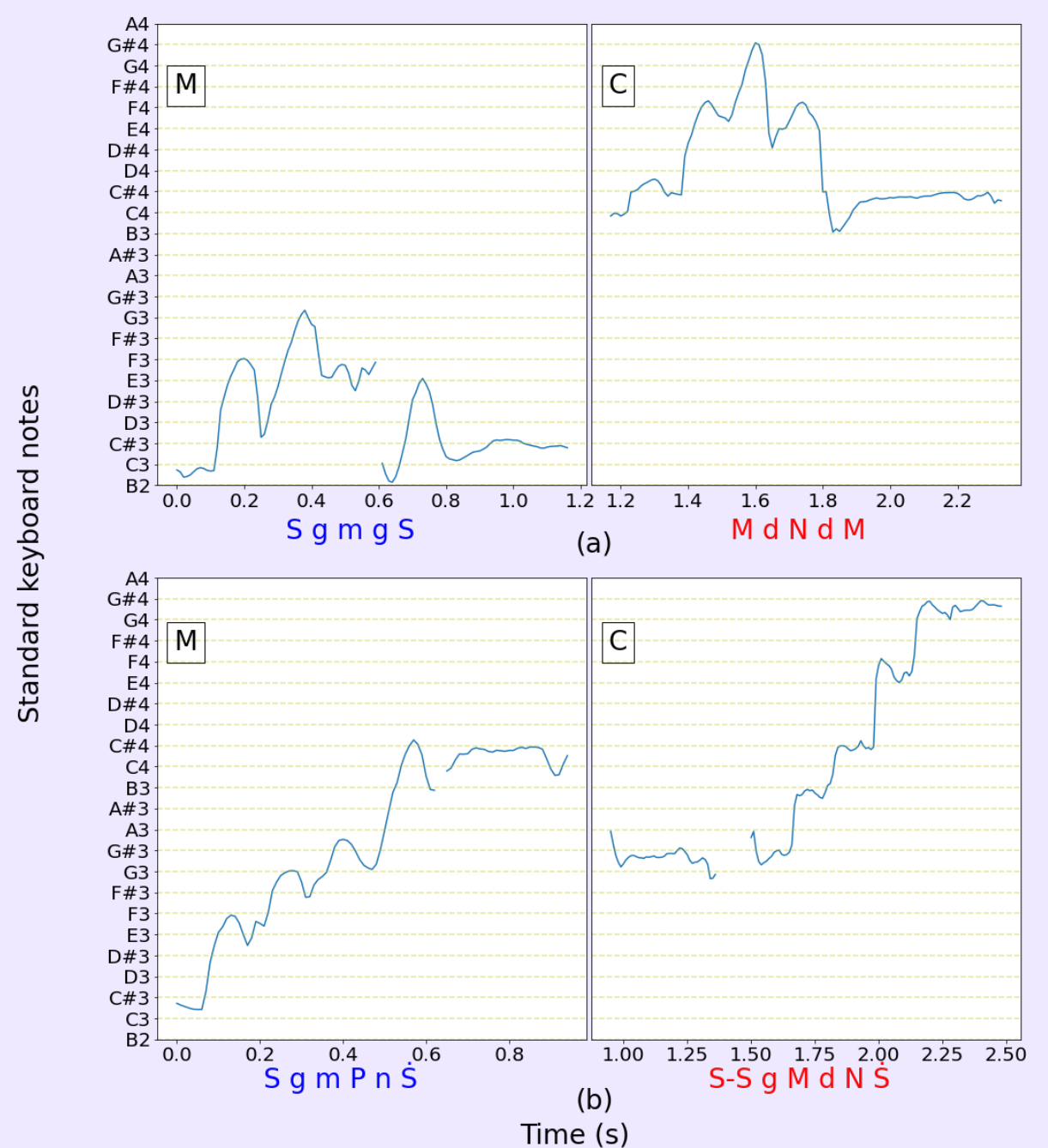
Summary

- JJ singers adhere to the raga characteristic tonal hierarchy to the same extent as in the corresponding individually performed ragas
- Observed interesting 'call and response' patterns where raga phrases are shown to correspond by way of melodic features

Applications

- Insights obtained could be used to identify new raga pairs that could potentially fit the JJ concert format

Supplementary material containing data sources and audio examples can be found here.

[1] M. Desai, "Jasrangi jugalbandi: A wondrous show of musical acumen," https://creativeyatra.com/reviews/jasrangi-jugalbandi-a-wondrous-show-of-musical-acumen/, 2018.
[2] S. Gulati, J. Serrà, K. K. Ganguli, , S. Sentürk, &X. Serra, "Time-delayed melody surfaces for raga recognition", in Proc. of the 17th Int. Soc. for Music Information Retrieval Conference, 2016.
[3] K. K. Ganguli and P. Rao, "Towards computational modeling of the ungrammatical in a raga performance," in Proc. of the 18th Int. Soc. for Music Information Retrieval Conference, Suzhou, China, 2017.