An Evaluation of Methodologies for Melodic Similarity in Audio Recordings of Indian Art Music

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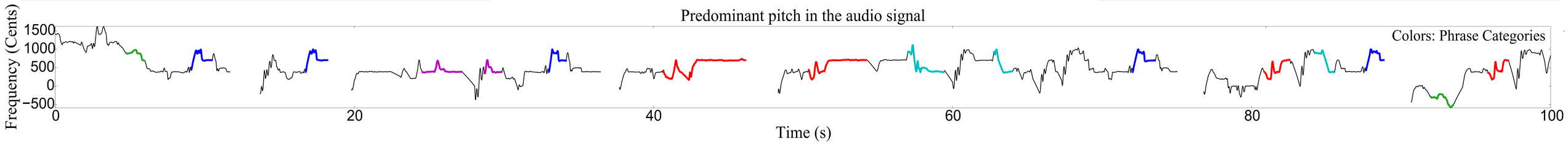
Indian art Music

- Hindustani (North-Indian), Carnatic (South-Indian) music.
- Rāg melody framework, Tāl rhythm framework
- Rāg: Svaras, Aroh-Avroh, **Characteristic phrases**
- Oral pedagogy, essentially audio music repertoire
- Practically no written music (descriptive) scores

Goals

- Detect the occurrences of phrases of a rāg
- Optimal methodology: approach and parameter values
- Evaluation of 560 combinations: sampling rates (5), normalization techniques (8), time-scaling (2) and distance measures (7)



Challenges

- Variability in the overall duration
- Large non-linear timing variations
- Added Melodic ornamentations

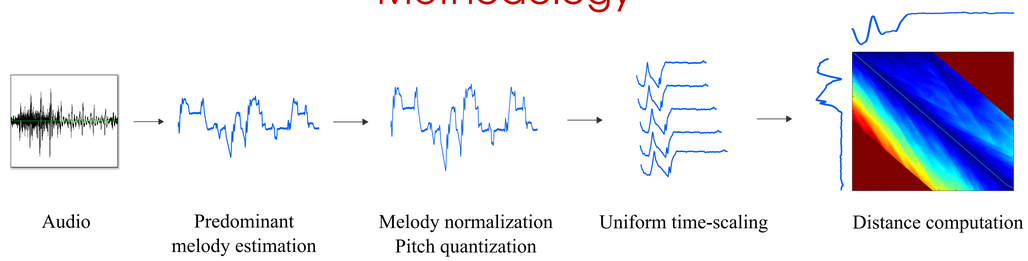
Music collection

- 5 hours of polyphonic audio recordings
- 23 Carnatic (CMD), 9 Hindustani (HMD)
- 10 Phrase categories, 6 rāgs, 21 artists
- Mean duration 1.15 (CMD), 1.5 (HMD)
- Annotations: 2 performing musicians

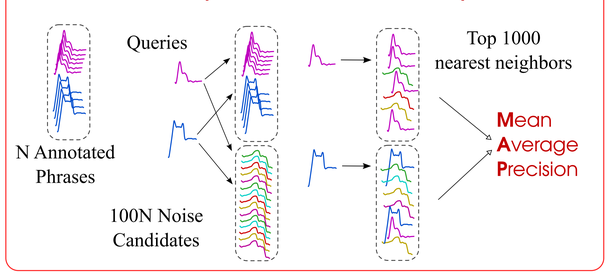
Evaluation

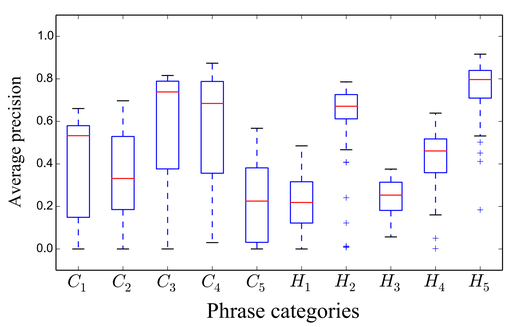
- Select top 1000 nearest neighbors
- Mean Average Precision (MAP)
- Wilcoxon signed rank-test ($p < 0.01$)
- Holm-Bonferroni adjustment

Methodology



Experimental setup



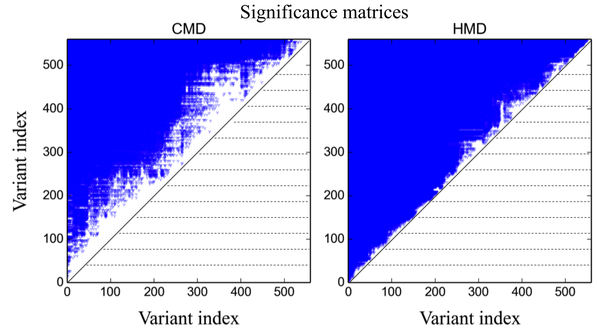


Results

Best performing variants

Dataset	MAP	Sample Rate (Hz)	Normalization	Time-Scaling	Distance
CMD	0.413	67	Mean	Off	$D_{DTW\_L1\_G90}$
	0.412	67	Mean	On	$D_{DTW\_L1\_G10}$
	0.411	100	Mean	Off	$D_{DTW\_L1\_G90}$
HMD	0.552	100	Tonic	Off	$D_{DTW\_L0\_G90}$
	0.551	67	Tonic	Off	$D_{DTW\_L0\_G90}$
	0.547	50	Tonic	Off	$D_{DTW\_L0\_G90}$

Significance matrices



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Conclusions

- DTW-based distance preferred over Euclidean
- Local constraint (DTW) improves the performance
- Time-scaling is beneficial for constrained DTW
- Carnatic melodies need higher sampling rate
- Mean normalization is beneficial in Carnatic music
- Tonic normalization is beneficial in Hindustani music