# Improving Melodic Similarity In Indian Art Music Using Culture Specific Melodic Characteristics

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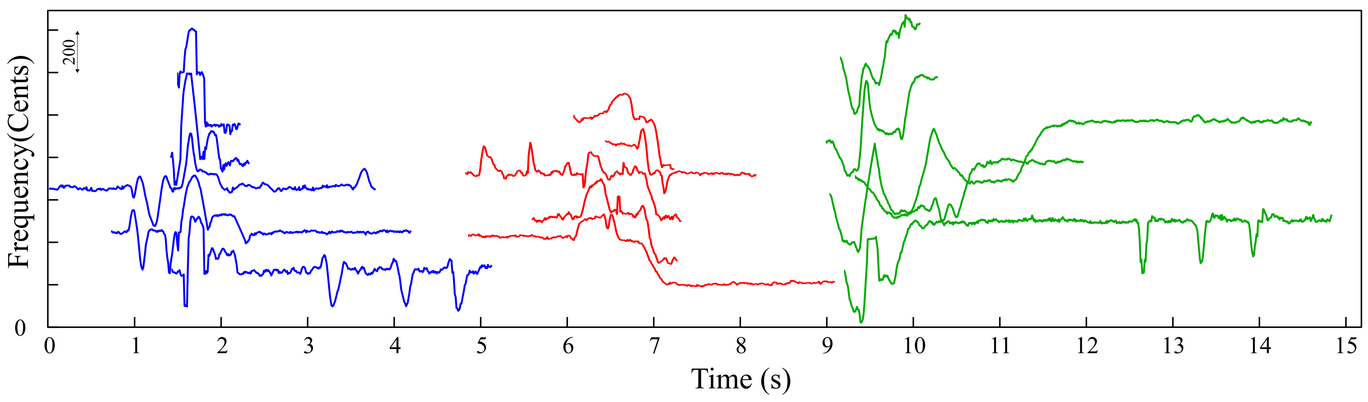
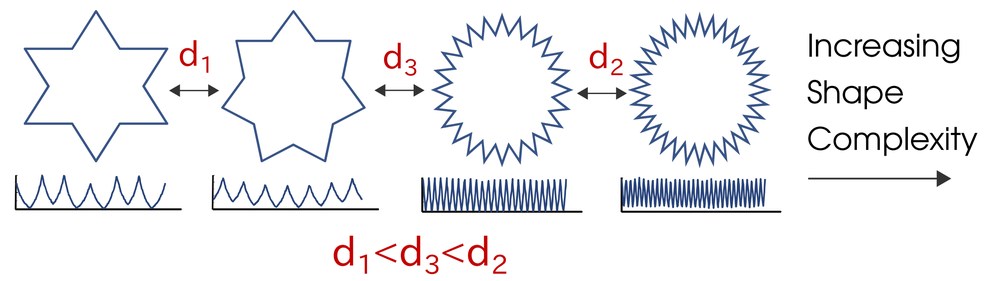
## Indian art Music

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



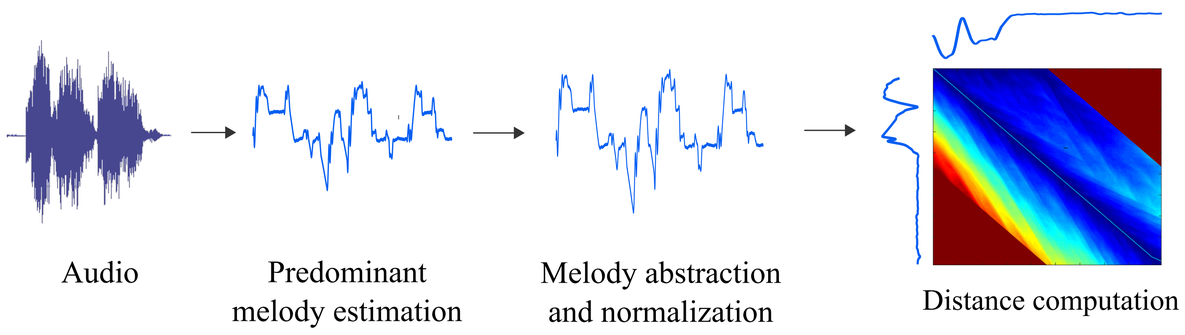

## Goals & Challenges

- Improved computational model for melodic similarity in IAM
- A top-down approach utilizing culture-specific characteristics
- Variability in the overall duration
- Large non-linear timing variations
- Added Melodic ornamentations




"The distance between pairs of complex time series is frequently greater than the distance between pairs of simple timeseries" - Batista et al.

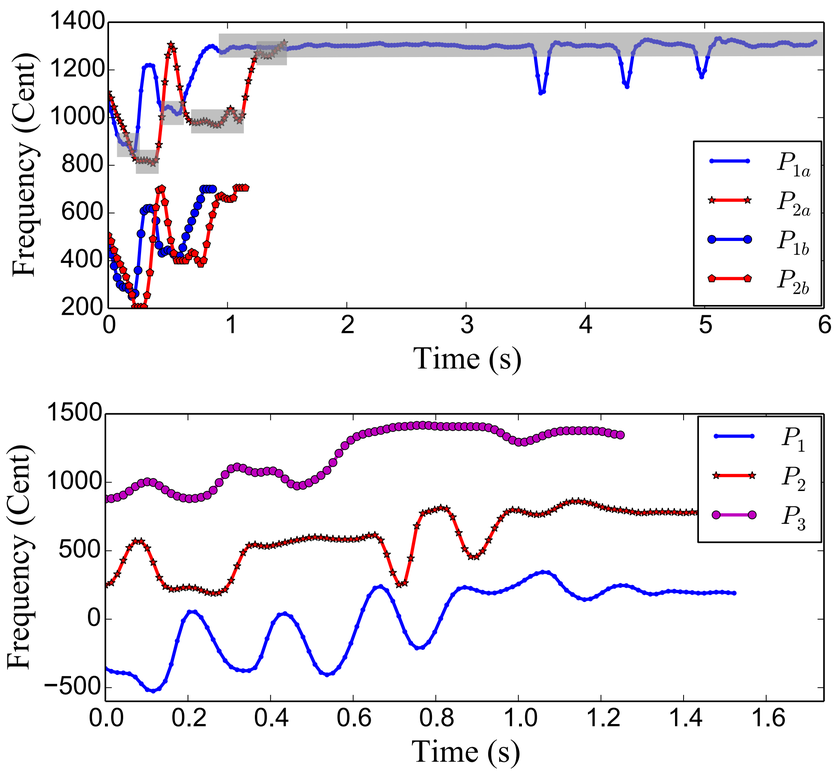
## Methodology



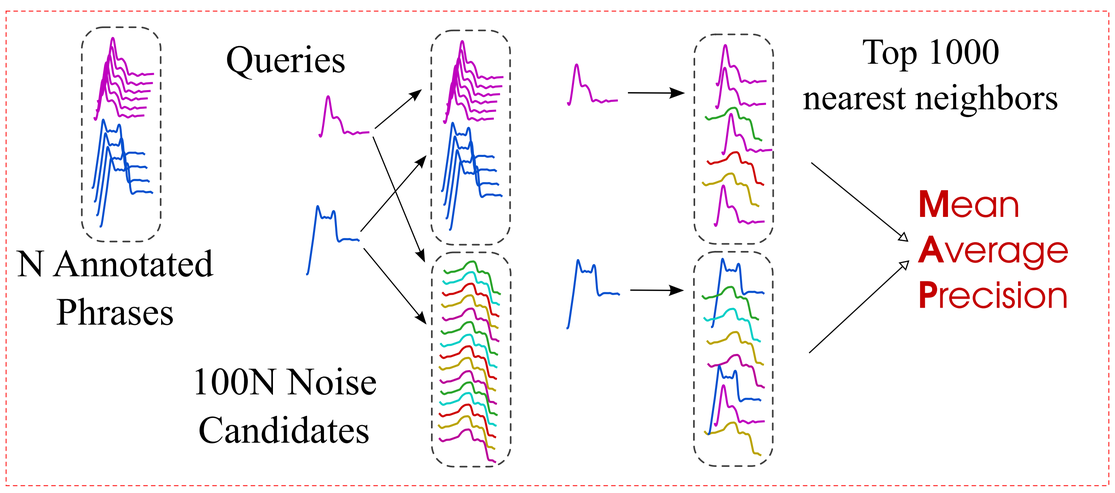

## Proposed approach

- Partial transcription -> duration truncation ($M_{DT}$)
- Complexity Weighting ($M_{CW}$): $D_{final} = \alpha D_{DTW}$
- Tetrachord normalization ($N_{tetra}$)

$$\alpha = \frac{\max(C_i, C_j)}{\min(C_i, C_j)}; \qquad C_i = \sqrt{\sum_{i=1}^{N-1} (p_i - p_{i+1})^2}$$

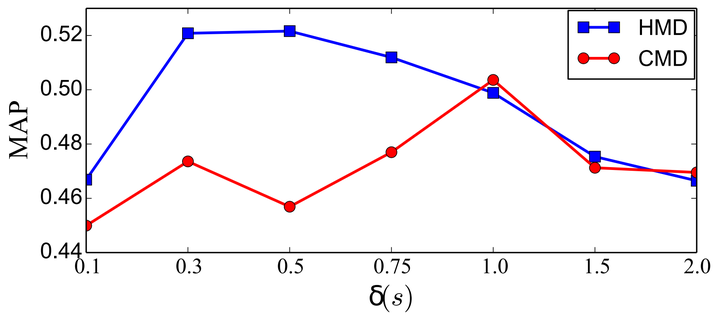


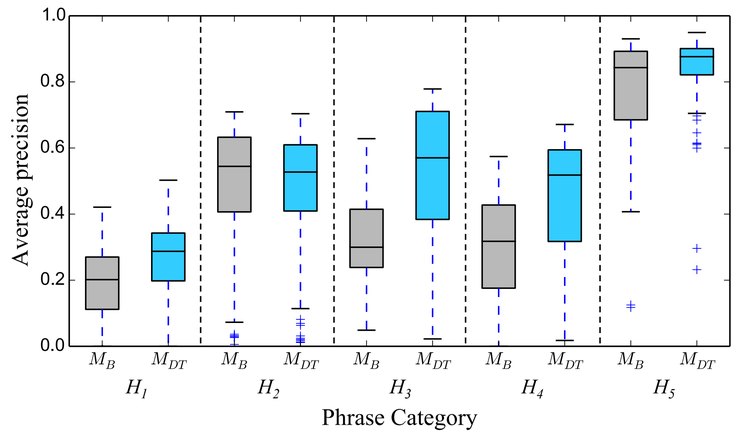

## Experimental setup

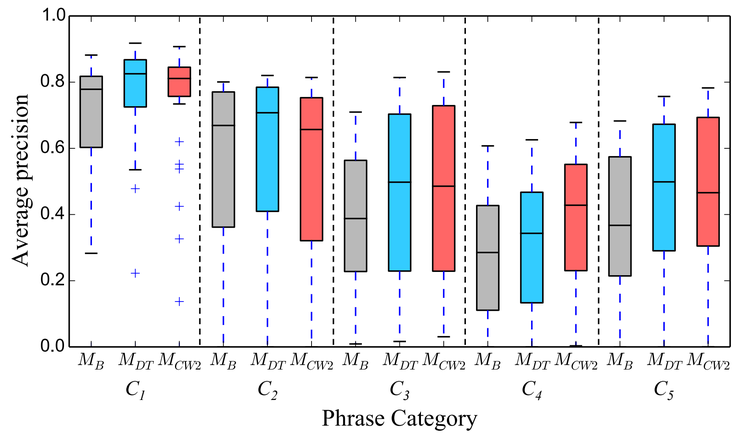



## Results

| HMD | | | | |
|---|---|---|---|---|
| Norm | $M_B$ | $M_{DT}$ | $M_{CW1}$ | $M_{CW2}$ |
| $N_{tonic}$ | **0.45 (0.25)** | **0.52 (0.24)** | - | - |
| $N_{mean}$ | 0.25 (0.20) | 0.31 (0.23) | - | - |
| $N_{tetra}$ | 0.40 (0.23) | 0.47 (0.23) | - | - |
| **CMD** | | | | |
| Norm | $M_B$ | $M_{DT}$ | $M_{CW1}$ | $M_{CW2}$ |
| $N_{tonic}$ | 0.39 (0.29) | 0.42 (0.29) | 0.41 (0.28) | 0.41 (0.29) |
| $N_{mean}$ | 0.39 (0.26) | 0.45 (0.28) | 0.43 (0.27) | 0.45 (0.27) |
| $N_{tetra}$ | **0.45 (0.26)** | **0.50 (0.27)** | **0.49 (0.28)** | **0.51 (0.27)** |




## Music collection

- Over 5 hours of polyphonic recordings, 23 Carnatic (CMD), 9 Hindustani (HMD)
- 625 phrases instances,10 Phrase categories, 6 rāgas, 21 artists and different forms
- Annotations: two performing musicians with over 15 years of music training

## Conclusions

- Duration truncation of steady melodic regions significantly improves melodic similarity in IAM
- Complexity weighting considering inflection points improves melodic similarity in Carnatic music
- Tetra-chord normalization improves retrieval accuracy in Carnatic music.

## References

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G. E. Batista, X. Wang, and E. J Keogh. "A complexity- invariant distance measure for time series", in SDM, volume 11, pp. 699–710, 2011