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LINKING PROTOTYPICAL, STOCK KNOWLEDGE WITH THE CREATIVE MUSICIANSHIP DISPLAYED IN RAGA PERFORMANCE

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Abstract- *Indian classical music is an oral tradition where training is imparted principally through demonstration. There exist text resources however that provide theoretical constructs relating to the raga and tala frameworks. For example, raga grammar is considered to provide the technical boundaries of a raga in the face of the seemingly high flexibility available to the artist in performance. In this work, we consider the computational analyses of audio recordings of raga performances by eminent Hindustani vocal artistes in the context of what is considered the mandatory raga grammar. Our analyses of performance audio use computational models to achieve an understanding of: (i) how the mandatory grammar is satisfied in performance, (ii) whether there are other consistent practices observed for a raga apart from what is specified by the grammar, and (iii) how the artist improvises i.e. uses the stock knowledge of the raga lexicon/grammar in "new" ways.*

Keywords- Raga-characteristic phrase, acoustic measurements, raga grammar, improvisation.

1. Introduction

A raga performance by a virtuoso is marked by considerable creativity while also strongly maintaining the identity of the raga in the ears of the listener. Raga grammar is typically presented in terms of the allowed svara (tonal material) and the relative importance of the svaras, and the svara sequences (aroh, avroh and the characteristic phrases). The intonations and durations of selected svaras may be specified too. We note that the raga grammar, defined in terms of both distributional as well as structural aspects, is skeletal in terms of leaving much room for creative improvisation. In view of the stated requirement of maintaining the raga identity in performance, the transgression of raga grammar may be considered to occur when the performer "treads" on another raga [1]. Such a situation of blurring raga identity is more likely to involve allied ragas (rather than completely unrelated ragas) due to their close similarity on several dimensions [1,2]. For example, the pentatonic ragas Deshkar and Bhupali have the same set of svaras (S; R; G; P; D corresponding to 0, 200, 400, 700, and 900 cents respectively) and common phrases in terms of svara sequences. Learners are typically introduced to the two ragas together and warned against confusing them [3,4,5].

The above observation encouraged us to propose and tune computational models for the distributional and structural properties of a raga as those that maximally discriminate allied ragas in the context of concert performance [6]. Audio recordings of performances by eminent artistes serve as perfect examples of heightened creativity coupled with adherence to the underlying raga grammar. The computational models, further, help us to achieve an understanding of: (i) how the mandatory grammar is satisfied in performance, (ii) whether there are other consistent practices observed for a raga apart from what is specified by the grammar, and (iii) how the artist improvises i.e. uses the stock knowledge of the raga lexicon/grammar in "new" ways.

In the present paper, we summarize the computational methods and some of the results of [6] together with new observations suggestive of performance practices that lie beyond the scope of raga grammar.

2. Computational methods

For the goals introduced in the previous section, we need computational representations that robustly capture particular melodic characteristics of the raga in a performance while being sensitive enough to the differences between allied ragas. The detection of the pitch of the singing voice forms the bases for higher order representations such as tonal distribution and melodic shapes of phrases. A tonic normalized pitch contour is computed across the audio recording by applying a predominant pitch detection algorithm [7] followed by tonic detection [8].

The permissible svaras and their prescribed relative saliences constitute the tonal hierarchy of the given raga. There are several options before us for a computational representation of the tonal hierarchy which can be considered to be a first-order pitch distribution. These include: (i) using the continuous pitch contour sampled at 10 ms intervals to construct a finely-binned continuous distribution, (ii) detecting stable pitch intervals and building a histogram by one of either counting alone or duration-based accounting methods. Decisions such as bin width and definition of stable svara (pitch interval) are expected to influence the final representation.

Experiments on the discrimination of performances belonging to different members of allied raga pairs demonstrated the superiority of svara-salience histograms where svara duration was accounted for [6]. As distance measures comparing the histogram representations, both correlation and KL divergence distance measures worked well. The melodic shapes of characteristic phrases is obtained by semi-automatic segmentation of the phrase followed by a computation of the uniformly sampled pitch contour.

3. Experimental observations on a selected raga pair

We consider the allied raga pair of Bhupali-Deshkar. Table 1 presents a comparison of the melodic attributes corresponding to the grammars as compiled from musicology texts [4,9,10,11]. The audio recordings used in this study are drawn from the Hindustani music corpus from 'Dunya' [1] compiled as a representative set of the vocal performances in the genre [12] augmented with concerts from personal collections. The editorial metadata for each audio recording is publicly available on the metadata repository MusicBrainz [2]. The Dunya corpus for raga Deshkar comprises 5 concerts of which 4 are selected for the current study, omitting the drut (fast tempo) concert due to the distinctly different style of realizing phrases associated with such tempi [3]. Similarly, we selected 5 concerts for the Bhupali test set.

Deshkar	Bhupali
Tonal material: SRGPD	Tonal material: SRGPD
Ar: SGPD, SPDS *Av*: S, PDGP, DPG(R)S	*Ar*: SRG, PDS *Av*: SDP, GDP, GRS
Vadi: D, *Samvadi*: G	*Vadi*: G, *Samvadi*: D
Phrases: SG, G(P)DPD, P(D)SP, DGP, DPG(R)S	Phrases: RDS, RPG, PDS, SDP, GDP, GRS
Higher shrutis of R, G, D	Natural shrutis of R, G, D

Table 1. Specification of raga grammar for the two allied ragas Deshkar and Bhupali under study.

We computed the tonal hierarchy representations for each of the concerts as described in the previous section. We also selected and annotated a single phrase GRS common to the two ragas, and measured the duration and intonation of each landmark event comprising it. Our main findings were that the ragas are clearly discriminated at the level of the full concert by the chosen tonal hierarchy representation. The

[1] https://dunya.compmusic.upf.edu/Hindustani

[2] https://musicbrainz.org

prominent difference between the tonal distributions is the svara R which is relatively low in strength in raga Deshkar. This aspect is not explicitly stated in the mandatory raga grammar (Table 1); however it is an aspect well known to musicians in that R is touched but not held in raga Deshkar, while it is not particularly constrained in raga Bhupali. The distribution of the different measurements carried out of the individual events (svaras and glides) of the GRS phrase are shown in Figure 1 for each of the two ragas across 12 concerts. We again note the sharp contrast in the distributions of the svara R, as well as in the durations of the transitions to and from R. This suggests that there is considerable flexibility in the durations (possibly constrained only by the local context) of all the notes except for R which is carefully realized in a specified absolute duration in different concerts by different artists.

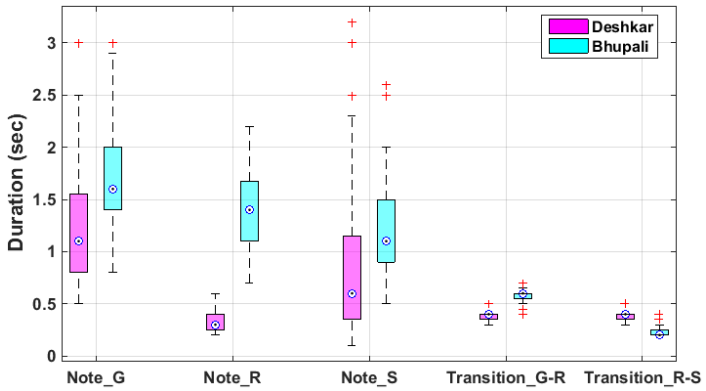

Figure 1. Distributions of 'event' *Duration*s across the annotated GRS phrase instances in the six concerts each in the two ragas Deshkar and Bhupali.

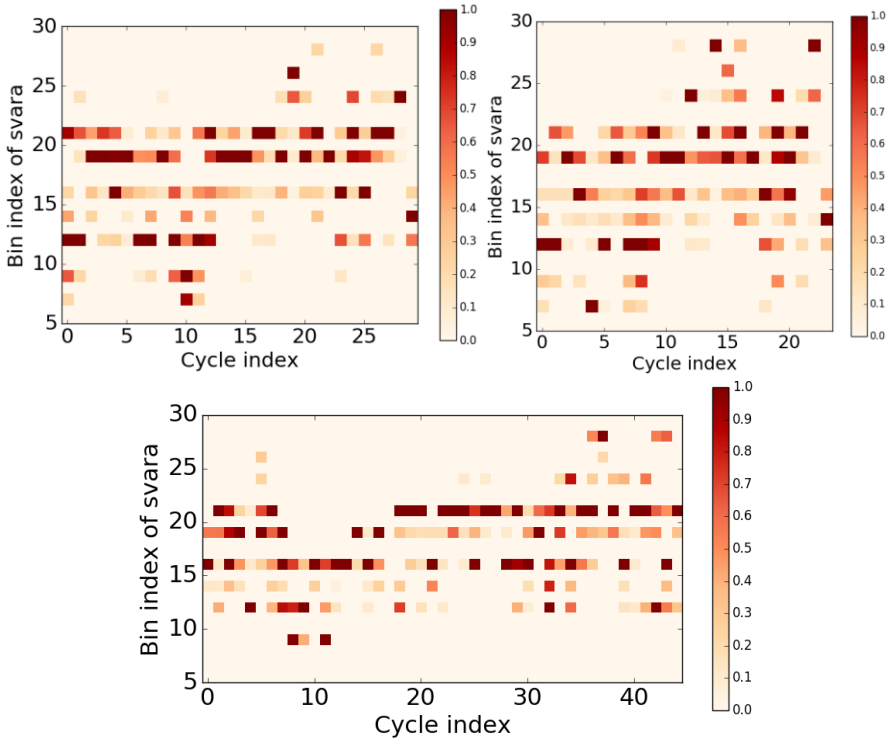

Figure 2. Melody evolution histograms (svara salience histograms per tala cycle) in raga Deshkar for two concerts by Ajoy Chakrabarty (top) and a third concert by Kishori Amonkar (bottom).

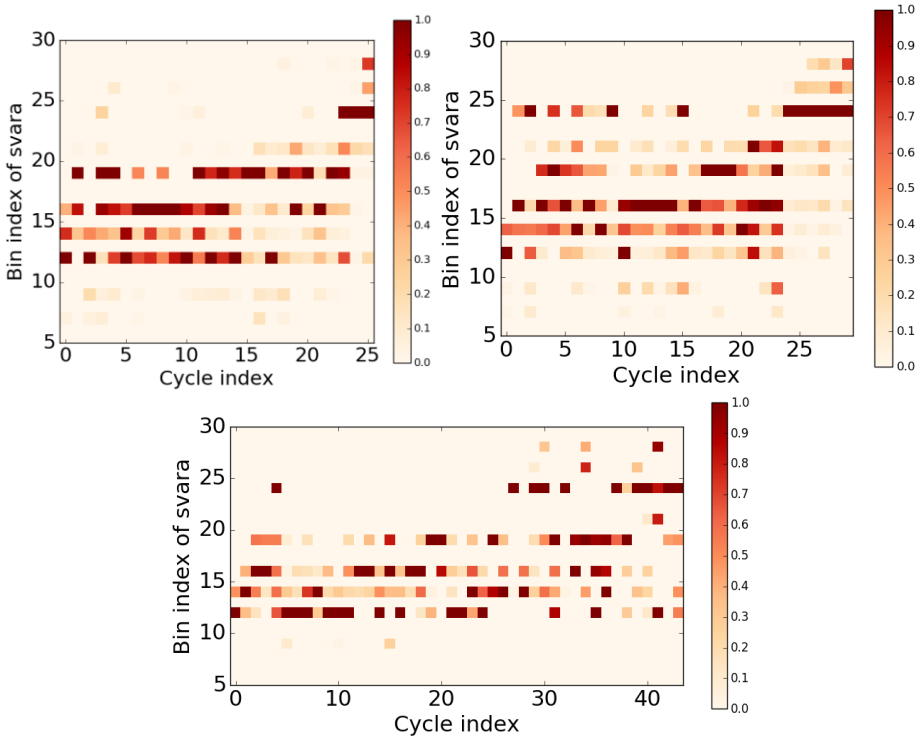

Figure 3. Melody evolution histograms (svara salience histograms per tala cycle) in raga Bhupali for two concerts by Ajoy Chakrabarty (top) and a third concert by Rashid Khan (bottom).

Finally, we present the local distribution of svara saliences in terms of tala cycle index across the concert for each of 3 concerts of each raga in Figures 3 and 4. We observe that the distribution of the svaras changes from cycle to cycle. This is expected from the known musical practice in performance of evolving tonal centre as the performance progresses (also noted in [13]). What is more interesting is the pattern of the evolution across the concert. We see a high degree similarity in the 3 Deshkar concerts as opposed to the behavior across the Bhupali concerts. In the latter, the same artist on two different occasions adopts distinctly different strategies bringing to each concert his particular creative disposition at the time. The Deshkar raga, on the other hand, is performed with relatively little flexibility even by different artists.

4. Conclusion

Computational methods can give us rare insights into performance practice that is potentially valuable for musicological, cultural, and historical studies. Validation of the mandated raga grammar as well as the study of systematic as well spontaneous variation in its interpretation are possible via audio analyses in terms of carefully selected representations of tonal distribution and phrase shape. Larger datasets with more allied raga pairs are likely to strengthen the outcomes of this study while raising new issues.

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