Giving Ragas the Time of Day:
Pitch Structures in North Indian Classical Music

1. Research Team

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2. Statement of Project Goals

This research centers on two projects in North Indian Classical Music (NICM):

- Mapping the structures of parent classes in NICM on the Harmonic Network used in Western Classical Music to explore relations between structures, musical content with respect to the mood conveyed, and the performance times of the parent classes.

- Generation of melodies in NICM on fixed pitch sets (*raga)*, guided by certain rules and pitch patterns characteristic to the *raga*.

3. Project Role in Support of IMSC Strategic Plan

This research supports IMSC's research in user centered sciences through the modeling of music perception in the context of North Indian Classical Music (NICM). The research uses knowledge-based methods to model parent classes and synthesize melodic improvisation in ragas. This interdisciplinary and cross-cultural project expands IMSC's use of creative technologies to computer modeling of music perception and improvisation in the music of South Asia.

4. Discussion of Methodology Used

The Harmonic Network used in Western Classical Music, is being used as the basic medium of representation of NICM. We mapped the ten basic parent classes in NICM on the Harmonic Network used in Western Classical music. The Harmonic Network is shown in Figure 1, and the mappings of the ten parent classes in Figures 2.1-2.10.

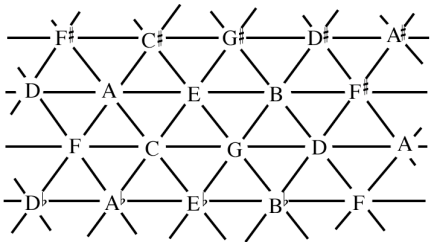

Figure 1: The Harmonic Network

Based on the ten structures obtained from the mapping, we analyzed the symmetry and weight distribution of the structures. The symmetry structures helped to explain the choice of those ten parent classes, while the pitch distribution could be linked directly to the emotional content of the *ragas*. The mapping is shown below in Figure 2.

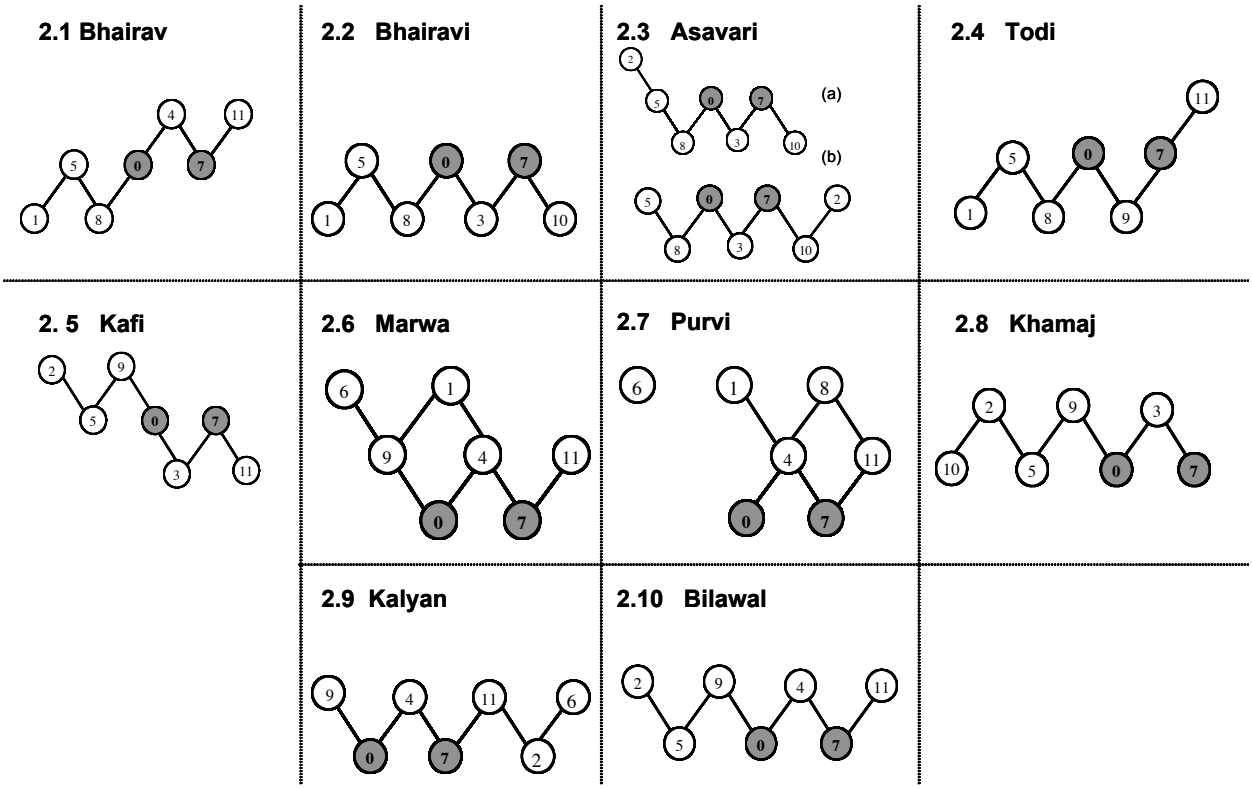

Figure 2: Mapping the parent classes (*thaats*) to the Harmonic Network.

The 5 – 0 – 7 axis is the prime axis as it represents the stable pitches. Symmetries and weight distribution of pitches are referenced with respect to this axis. Based on these structures, we posit that the top-heavy structures are associated with joyful ragas, and bottom-heavy structures are associated with ragas with a solemn mood.

Another conclusion derived from these mappings was the relation between the performance time associated with each raga and the top-heavy and bottom-heavy structures. Ragas that are performed during the day (late morning, afternoon and early evening) have a top-heavy structure, and ragas that are performed between late night and early morning have a bottom-heavy structure.

One could infer the emotional content of any raga, its performance time by studying its mapping on the Harmonic Network.

5. Short Description of Achievements in Previous Years

N/A

5a. Detail of Accomplishments During the Past Year

NICM consists of improvisations on a fixed set of pitch classes, known as *ragas*. We were able to conclude from our study that the Harmonic Network can be an appropriate representation of pitch relations in *ragas* and their parent classes in NICM, and that the relation between each *raga* and its associated emotion is elucidated by its spatial configuration on the Harmonic Network.

This basic research led to the following publication and presentation for the International Conference on Music Perception and Cognition in August, 2004:

> Yardi, Shivani and Chew, Elaine. "Giving Ragas the Time of Day: Linking structure, emotion and performance time in North Indian Classical Music using the Harmonic Network." To appear in the Proceedings of the International Conference on Music Perception and Cognition, Chicago, IL, August 2004.

6. Other Relevant Work Being Conducted and How this Project is Different

Very little work is conducted and published in Europe and the Americas on Indian Classical Music. The rare exceptions include experiments to determine the psychological reality of pitch hierarchies in North Indian Classical Music [1] (NICM) and signal processing approaches to extract pitch information from South Indian Classical Music [2]. This research constitutes a critical first step into mathematical modeling of tonal pitch structures in NICM and its implications for understanding the function and form of the music.

7. Plan for the Next Year

Our attention will turn from analysis to synthesis of NICM in the coming year. Generation of melodies in NICM on fixed pitch sets (*raga)*, guided by certain rules and pitch patterns characteristic to the *raga.*

8. Expected Milestones and Deliverables

A self-generating algorithm that generates musically correct melodic patterns in a few chosen *ragas* will be completed by May, 2004.

9. Member Company Benefits

Basic research in the analysis and synthesis of North Indian Classical Music.

10. References

[1] Bharucha. J, Castellano. M, Krumhansl Carol (1984). "*Tonal Hierarchies in the Music of North India*", Journal of Experimental Psychology, Vol 113, No. 3, 394-412.
[2] Krishnaswamy, Arvindh (2003). "Application of Pitch Tracking to South Indian Classical Music," *Proceedings of the IEEE International Conference on Multimedia and Expo*, Baltimore, MD, July 1999.