A Graphical Method for the Analysis of *Swaraprasthara* Patterns in Karnatak Music

ARIJIT MAHALANABIS, NEELA H. YENNAWAR, & HEMANT P. YENNAWAR

Overview

In this paper, we present a graphical method through which we can analyze inherent patterns present in *swaraprastharas* [improvised sequences of notes sung to *swara*, or sol-fa syllables] of Karnatak musicians. This tool can be used to conduct further research into various aspects of the evolution of *kalpanaswara* [in this paper, this term is used interchangeably with *swaraprasthara*] singing. We begin by discussing some assumptions we make in constructing our method. We then present the method itself and provide some example graphs produced using the method. We end the paper by suggesting some hypotheses that can be tested using the technique presented in this paper.

Introduction

One of the most commonly heard topics of conversation among connoisseurs of Karnatak music, in general, seems to be centered around the idea of comparing the styles of the older masters with artists of the present generation. Usually, such comparisions turn out to be highly subjective, with the new generation often bearing the brunt of the attack. While such an approach may not be very productive, the idea of doing a comparative study in an objective manner is a very feasible and desirable one. In this paper we attempt to provide tools that could be used to undertake such an objective analysis of Karnatak music.

We undertake this project with a few constraints. First, we stress that this paper presents work of an extremely preliminary nature. There is much that needs to be done in order to complete such a study. The authors sincerely hope that, as time goes by, others will also join in the effort. Our study, initially, is limited to the analysis of two recordings of musicians belonging to the same *parampara* [tradition, school], namely Maharajapuram. In this paper, we consider pieces by two musicians, both students of the Late Maharajapuram Vishwanatha Iyer: Semmangudi Srinivasa Iyer and the Late Maharajapuram Santhanam. The latter was also his son.

The consideration of only one school here points to possible future work on the analysis of style evolution within one school. That is, the tools presented in this paper could be used to

analyze how *kalpanaswara* rendition has evolved, from a stylistic point of view, within one tradition. We will discuss such work further in the section entitled Future Work.

The two examples, one from Semmangudi's music and the other from Santhanam's, are both based on the same *rag* [melodic mode] and *krithi* [composition]. The *krithi* under consideration here is Thyagaraja's "Dinamani Vamsha" set to Rag Harikambodhi. The scale of this *rag*[1] is given as

S R2 G3 M1 P D2 N2 S

S N2 D2 P M1 G3 R2 S

The first recording, by Semmangudi, is part of a concert given at the Madras Music Academy (no date available) in which the vocalist was accompanied by Lalgudi Jayaraman on the violin and Umayalpuram Sivaraman on the *mridangam*. The second recording, by Maharajapuram Santhanam comes from a concert, given in Philadelphia in 1989, under the auspices of Sruti, an organization for Indian classical music and dance. The accompanying artists were Nagai Muralidharan on the violin and Vellore Ramabhadran on the *mridangam*. In this preliminary paper, we consider the *swaraprastharas* [*?] rendered by the vocalist only. We again, leave for future work, the consideration of *swaraprastharas* by the violinist or other accompanists.

Methodology

Our investigation into kalpanaswaras involved two stages. In stage one, we studied each of the pieces in question and transcribed what we heard into written notation. This involved not only very careful listening, but also repeated listening. This careful study of the recordings gave us raw data, in the form of strings of *swaras* [pitches]. For example, from the Semmangudi recording, we were able to extract the following *kalpanaswara*.

N2 D2 D2 N2 N2 S G3 R2 M1 G3 R2 S N2 S G3 R2 M1 G3 G3 R2 S N2 N2 S G3 R2

S N2 S R2 D2 N2 D2 N2 S N2 D2 P D2 N2 D2 P M1 P D2 P M1 G3 M1 P D2

There is an important point that we must make about the manner in which we extracted this data. We do not show any element of *tala* [rhythm] in our data. That is, we do not show how the data corresponds to the *aksharas* beats or counts] of the *tala* [here, metric cycle], where the *sama* [beat one] occurs, or even the number of swaras being sung per *akshara*. The main motivation for such an approach is that we do not intend to study how rhythm and *swaraprastharas* are intertwined. Instead, our focus is on regular melodic patterns. For

example, a graphical analysis of the *swaras* listed above gives a very steady pattern, especially when the final phrases of the *swaraprasthara* are considered.

Indeed, producing a graphical display of the data is precisely the second phase of our analysis. For each *swaraprasthara* phrase, we enumerate each of the *swaras* in the *swaraprasthara* by consecutive nonnegative integers, beginning with the first *swara* corresponding to 0, the next corresponding to 1, the third to 2 and so on. We can define a second enumeration, by equating 1 with Sa in the *madhya sthayi* [i.e., Sa in the middle octave], 2 with *madhya* Ri [middle Ri] and so on, with 8 being equated with *taar sthayi* Sa [upper octave Sa], and 0 with *mandra sthayi* Ni [lower octave Ni, i.e., one pitch below middle octave Sa]. To construct the graph, we begin by defining a Cartesian coordinate plane, with the axis denoting the *swara* number in the *swaraprasthara* phrase and the axis corresponding to the enumerated *swara*, as suggested by the second enumeration scheme above.[2]

We stress again, that each of the units on the axis has nothing to do with a fixed time unit, like a *tala akshara*. Rather, each of the units represents a variable quantum of time taken by the artist to render one *swara*.

We do not claim to be the first to attempt a graphical approach to Indian music (see, e.g., Wade 1984). However, we believe that our particular style of constructing the graphs is unique. Further, our strict restrictions on what we show in the graphs allows us to isolate one factor while eliminating other factors that might impact on the study of a particular hypothesis. In the examples we have given here, we have isolated *swara* positions within a round of *kalpanaswaras.* It is certainly possible to follow a similar methodology and isolate some other factor.

Sources of errors

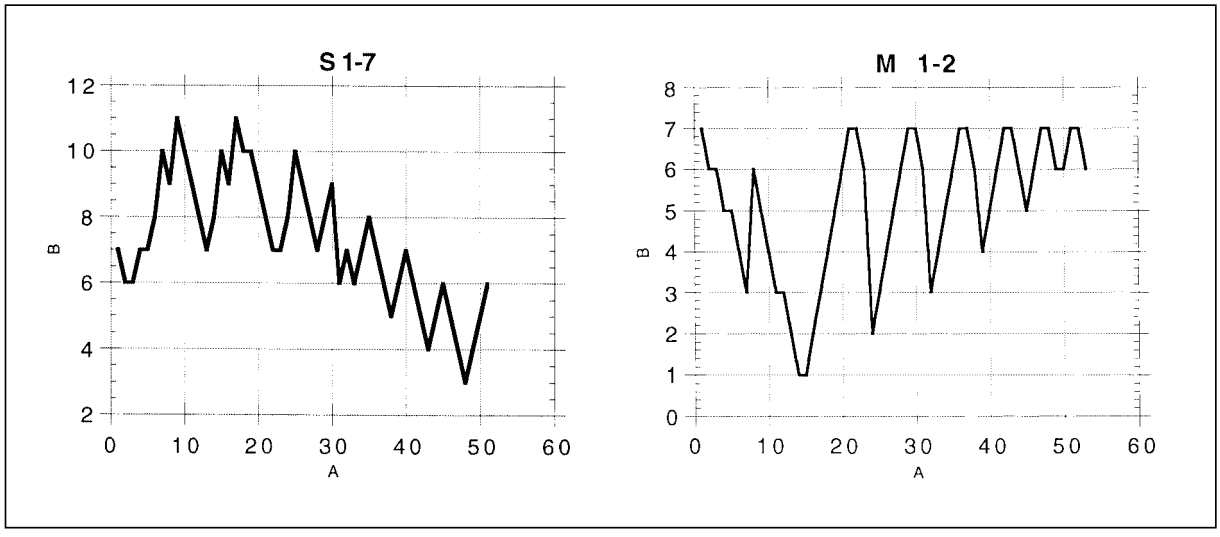
While our approach, in a theoretical sense, appears to be sound, there are several possible sources of error in such an analysis. One obvious source was our own aural inadequacies. Despite careful and repeated listening, it is possible that some errors in transcription occurred which could emerge in our graphs. However, we believe that the risk of such errors is relatively small; even if an isolated error did occur, our aim has been to reflect the big picture. Consequently, any minor errors should not affect any inherent patterns in the *swaraprastharas.*

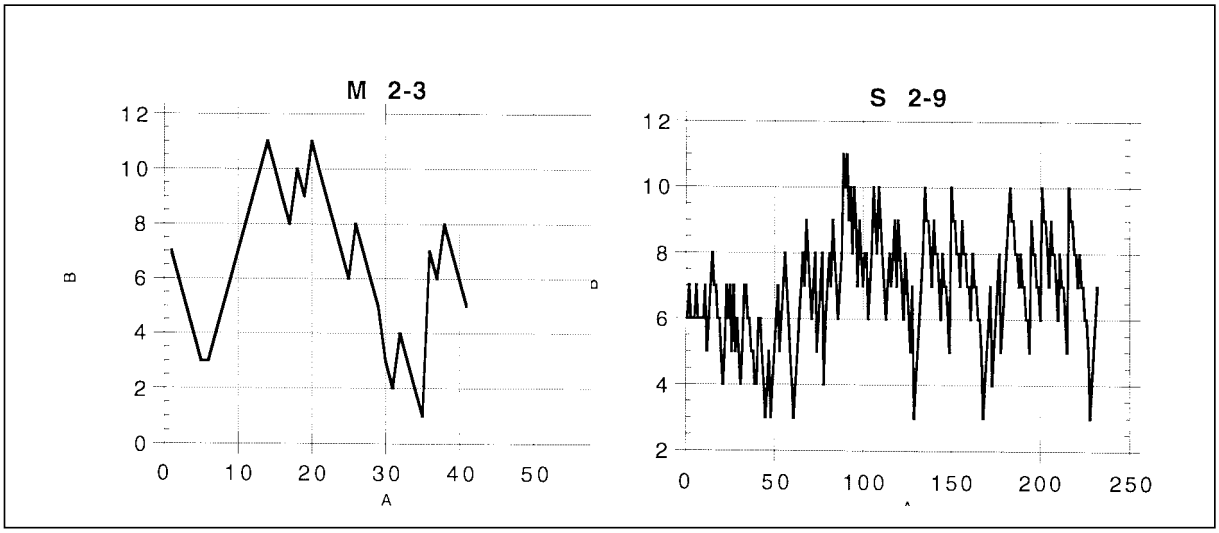
Another source that we must consider is recording quality. While both recordings are clear, there are a few places where a couple of distortions are present. Some are because of the

recording equipment itself, while others are due to other factors. For example, in the Semmangudi recording, at one point, the volume of the <mridangam> drowns out the voice of the vocalist. In such cases, when repeated listening failed to reveal the actual notes sung, we had to guess what notes were rendered, based on what the violinist echoed, and what was rendered before and after the distortion. Here, the probability of error is about the same as the human error factor described previously. However, again, we do not believe this affects the overall picture.

Examples

Let us now provide some example graphs to illustrate the effectiveness of the method described in this paper. Consider the transcription of the *swaraprasthara* given in the Methodology section of the paper, above. This is illustrated in the graph labelled S 1-7. This label indicates that the corresponding *swaraprasthara* was taken from the Semmangudi recording (S), that it was sung in the first *kala* (1) [i.e., the first, or slow, tempo] and was the seventh *kalpanaswara* sung in the first *kala* round (7). Initially, no clear pattern seems to emerge from the graph. The *kalpanaswara* goes through several peaks and valleys without giving any indication of regularity. Right after *swara* 30, a W-shaped section emerges, which is then followed by a strikingly regular pattern. Starting with the rising right arm of the W, we have a series of three inverted V shapes, each descending lower and lower on the Cartesian plane. The arms of each of the V shapes are parallel to the corresponding arms of every other V shape. This regular pattern is broken at Ga, from where the artist rises linearly to Dha to end the *kalpanaswara*. This graph would seem to indicate that regularly patterned

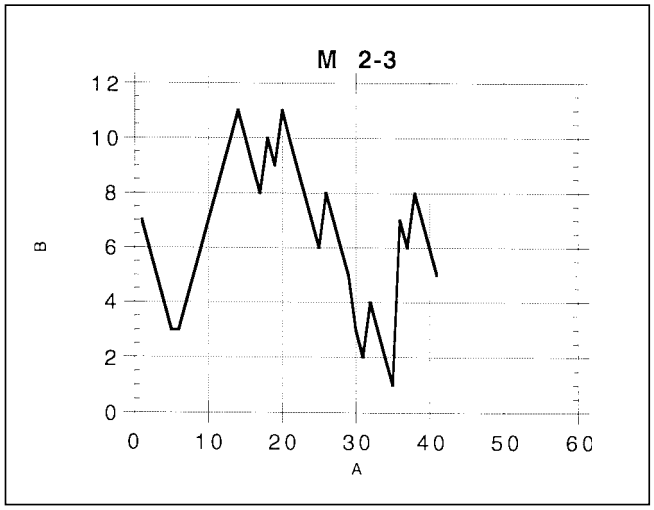




endings are not exclusively dependent on rhythm. Instead regular melodic patterns also seem to play a role in the endings of *kalpanaswara.*

Let us now look at another *kalpanaswara,* this time from the Santhanam recording. This graph is labelled M 1-2. Unlike S 1-7, where the pattern becomes evident only at the very end of the *kalpanaswara*, we can see a much more elaborate pattern forming well before the ending of M 1-2. From the beginning, we see a very structured descent from Ni to Ma. This small pattern seems to indicate that symmetry can be present not only in the very end of the *kalpanaswara*, but also at the beginning. However, the truly striking feature of this graph begins somewhere around *swara* 15. From that point on, the artist ascends repeatedly, in a regular manner, to Ni, descends back a *swara* less than the ascent distance, and repeats the process several times, causing an asymptotic feature to form along the Ni line. While the concept is relatively simple, the extremely structured melodic nature of the *swaraprasthara* is brought out by this graph.

As may be expected, the second *kala swaras* [i.e., patterns faster tempo] are considerably less structured than the first *kala swaras*, in the case of both artists. For example, M 2-3 shows no detectable pattern at all. However, some elements of structure can still be detected in certain other second *kala kalpanaswaras*. For example, in M 2-5, we see around *swara* 60, a pattern of W figures emerging, with two such figures appearing in succession. The next structure, however, is a V strucuture, breaking the expected pattern of another W. However, we note that the right arm of the V is bent, suggesting that, perhaps at a slower pace, the third structure might also have become a W. We note also that the final descent, from around <swara> 80, is again very regular, consisting of two inverted W figures followed



by a short linear ascent to Dha.

We finally consider the last of Semmangudi's second *kala swaras*, labelled S 2-9. First, we note that in comparision to Santhanam's final *kalpanaswara*, given in M 2-5, Semmangudi's *kalpanaswara* is considerably longer (over twice as long). In such a massive string, it is more appropriate to consider overall structure rather than inspecting every peak and valley. If we do this, we find the beginnings of a regular pattern forming right after *swara* 100. The artist rises to *tar sthayi* Ga (G3) [i.e. Ga in the upper octave]; he then descends and jumps back up to G3 twice more. The final repetition ends around *swara* 160. This is then followed by a very regular ascent back up to G3, using a series of V structures. Around *swara* 180, the entire sequence is repeated three times, once again with the descents and upward leaps to G3. At the end of the second round of patterns the artist executes a simple linear ascent before ending the *kalpanaswara* at Ni. The patterns in this *kalpanaswara* are not nearly as clearly defined as in the first <kala kalpanaswaras>. However, we do see a regular melodic pattern, over the span of the entire *swaraprasthara.*

Future Work

The methods discussed in this paper, together with the examples of the last section, seem to indicate that various possibilities for future research exist in this area. First, we again emphasize that we have not really attempted to prove anything here, but have simply provided evidence to suggest that patterns not associated with rhythm, exist within the strucuture of most *kalpanaswaras*. These patterns arise from the melodic aspects of the rendition. However, one could always argue that such patterns may be attributed to these particular musicians, and as such, are not a phenomenon of Karnatak music. To either prove or disprove this statement, a considerable amount of research on artists arising from many different educational backgrounds must be conducted. Such a project would entail consistent data collection over a long period of time.

As suggested in this paper, we may also be interested in restricting our attention to one school of musicians. Analysis of *swaraprastharas* across several generations would indicate

a possible movement towards more or less strucutured *swaraprastharas*. A related hypothesis, worth testing, would be to establish the number of generations of musicians needed to define a distinct style or school of music. For Hindustani music, Deshpande (1987) talks of three as being the defining number of generations required to accomplish the creation of a *gharana* [tradition, school] style. Does a similar statement hold for Karnatak music? Analysis of *swaraprastharas* may lead to an answer to this question.

Another possible avenue of research in this area is to test the role of rhythm in *kalpanaswara* rendition. Have rhythmic patterns become much more prominent over time? At least one *mridangam vidwan* [master of the mridangam], Palaghat Mani Iyer, seemed to think so (Anon 1978). If we modify the graphical method in this paper by standardizing the units across the axis to reflect a fixed quantum of time, the resulting graphs will immediately be able to tell us whether rhythm has indeed become an overriding factor in *kalpanaswara* rendition.

There are indeed many other possible research projects that can be undertaken using the graphical approach. We hope that we have been able to suggest just some of the possibilities to the reader. Whatever the outcome of these projects, we want to encourage the reader to take a more objective approach to Indian music. Let us end this paper, then, by noting that anyone can form a subjective, hypothetical statement. However, it is necessary to test the hypothesis and discover its validity before applying it to music. Any completely subjective judgement of music, in the end, cannot be proved; thus, it is of little use to the advancement of the theory of the foundations of the music. If indeed, we are truly interested in preserving our systems of music, perhaps the time has come to study music with a more objective, impartial eye.

Acknowledgements

The authors would like to express their thanks to Dr Krishnaswami Alladi and Mr Suryavamshi N. Murthy for providing the recordings which are discussed in this paper.

Notes

1 The convention for transcribing pitches may be unfamiliar to many people, and might best be understood by comparing resultant scales to a Western framework starting on the note C. Sa and Pa are unmovable and therefore have only one position (C and G). Ma has two positions (F and F sharp), thus M1 and M2. Ri, Ga, Dha, and Ni each have three positions: R1 (D flat), R2 (D), and R3 (D sharp); G1 (E double flat), G2 (E flat), and G3 (E); D1 (A flat), D2 (A), and D3 (A sharp); N1 (B double flat), N2 (B flat), and N3 (B). The ascending/descending scales of Rag Harikambodhi would therefore read:

C D E F G A Bflat C

C Bflat A G F E D C

or in the Hindustani system(s) of transliteration:

S R G M P D %N% S (alternatively S R G m P D n S)

S %N% D P M G R S (alternatively S n D P m G R S)

Note that dots above notes signify upper octave (and dots below signify the lower octave).

2 We stress again that each of the units on the X axis has nothing to do with the fixed time unit, like a *tala akshara*. Rather, each of the units represents a variable quantum of time taken by the artist to render one *swara.*

References

Anon. 1978. "An Interview with Palghat Mani Iyer." *The Hindu*. January 22.

Deshpande, Vamanrao H. 1987. *Indian Musical Traditions: An Aesthetic Study of the Gharanas in Hindustani Music.* Bombay: Popular Prakashan.

Wade, Bonnie C. 1985. *Khyal, Creativity within North India's Classical Music Tradition.* New York: Cambridge University Press.

Recordings used

Iyer, Semmangudi S., Lalgudi Jayaraman, and Umayalpuram K. Sivaraman. Undated. "Dinamani Vamsha." Excerpt from concert at the Madras Music Academy.

Santhanam, Maharajapuram, Nagai Muralidharan and Vellore Ramabhadran. 1989. "Dinamani Vamsha." Excerpt from concert in Philadelphia under the auspices of Sruti.

Arijit Mahalanabis *is a self-taught Hindustani vocalist, and has been studying Hindustani music since the age of 9. His research interests in Indian music theory include the theory of <murchana> transforms, comparative study of Hindustani and Karnatak music, and mathematical models and properties of Indian music. He has just completed his bachelors degree in Mathematics and Computer Science at the Pennsylvania State University, and is now in the Computer Science masters program at the same university.*

Neela H. Yennawar *is a scientist working in the area of Structural Biology. She is also a Karnatak vocalist, and has studied the art form with Bagalur Krishnamurthy and Vidwan M. Shankaramurthy.*

Hemant P. Yennawar *is currently a postdoctoral fellow at the Pennsylvania State University in the department of Chemistry. He has had some elementary training in the art of harmonium accompaniment from Shri K.P. Shenoy of Bangalore.*