

DIFFERENT FREQUENCIES OF TONES WITH A SAME NAME AND THEIR PRACTICAL EXECUTION IN A SELECTED NORTH INDIAN CLASSICAL MUSIC CONTEXT

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Abstract

Two of the world's five major music traditions are related to India. They are, north Indian and south Indian classical music. North Indian classical music is built upon the concept of *raga* which uses a monophonic structure giving importance to each and every individual musical tone in performing. Though the Indian music uses twelve musical tones similarly to the other music traditions such as western music, the tones in Indian classical music are positioned using a concept called *shruti* which has twenty-two intervals for an octave. According to this concept, instead of placing twelve tones on fixed frequencies, their frequency values vary depending on the mood of the *raga*, the fluency of the performer, the musical techniques used and on many other factors. In this research the above fact is studied focusing only on *komal gandhar* by analyzing voice recordings of nine *ragas* which would be taken from reputed university lectures. To measure the frequency of the taken recordings, *Overtone analyzer 5.0.2* software has been used and *Audio speed changer pro portable* software has been used to change the pitch (when necessary) of the original recordings without affecting their speed.

Keywords

North Indian Classical Music, Frequencies, Measurements, Komal Gandhar, Raga Angas

Introduction

In this research, the practical execution and the pitch values of *komal gandhar* used in north Indian classical music studied. Even though the *komal gandhar* can be used in every musical form in the north Indian music repertoire, only the *khayal*¹ music form will be considered in this research to study the pitch values and the practical execution of *komal gandhar*. This study will partly refer to a comparison with musical systems used outside India.

Indian Classical Music

Indian classical music is well-defined by a number of authors and musicians such as *Bharathamuni*² and *Sharangdev*³. Its history goes back to the *Vedic* period of 3000BC (Abeyasundara, 1963: 13). Also, Indian classical music has many different repertoires and systems that evolved during different times and in different geographical areas (Rahut, 2012).

¹ A traditional style of songs from the northern part of the Indian subcontinent, which is having two main speed patterns, performed with an instrumental accompaniment (Tapashi, 2008:10).

² An ancient Indian theatrologist who wrote the book *Natya Shastra*.

³ Indian musicologist in the 13th century who authored the book *Sangit Rathnakar*.

North Indian Classical Music and its Tone Material

During and after the *Moghal* ruling period of the northern part of India around 13th century, classical music was mixed with some past Persian musical concepts (Anon., 2017). Social changes caused by the rapid development of large parts of Indian society enabled musicians and their educational systems to change into a broader movement among middle class and urban settlers (Rahut, 2012). Changing Indian classical music into a more formal way, the fact of using the average tempered scale known from European music ⁴ helped comparing frequencies in the following way:

European tempered scale tone names	Tone names in North Indian classical music
C	<i>Sa</i>
C#	<i>Komal Ri</i>
D	<i>Shudha Ri</i>
E ^b	<i>Komal Ga</i>
E	<i>Shudda Ga</i>
F	<i>Ma</i>
F#	<i>Thivra Ma</i>
G	<i>Pa</i>
A ^b	<i>Komal Dha</i>
A	<i>Shudha Dha</i>
B ^b	<i>Komal Ni</i>
B	<i>Shudha Ni</i>

Figure 1: European tempered scale tone names and tone names in north Indian classical music mutually used to roughly translate approximate frequencies (pitches).

The monophonic structure of most of the north Indian classical music repertoire is focused on their basic tones. On the contrary, frequencies of European classical music depend on harmonic progressions in various structural contexts.

Regarding the mentioned rough translation of tone names and frequencies (figure 1), there have been controversies (Matthew Guerrier., 2017) for the frequencies of tones in European classical music until an international conference on this topic held in London in 1939⁵, which declared the frequency of the tone A being exactly 440Hz. According to that, the middle C has 261.63Hz which is the starting tone of the 4th C major scale from the left side of the grand piano which has seven C major scales altogether in its shape at the time of that conference. One of the major causes of controversy could be the assumption that the tone names used in north Indian classical music were roughly translated as absolute pitches rather than naming the relative intervals with syllables, but not on exact frequencies. Therefore, considering the middle C as having 261.63Hz in north Indian classical music is seen as impractical since female and male singers have a considerable difference in the basic tone of their respective middle C (*Sa*); since most of the performances are solos, the performers themselves decide the basic tone.

If the middle C is wrongly understood as *Sa* in north Indian classical music and wrongly compared to the middle C of European classical music, there is only a considerable similarity in the named frequency between the fourth C (C4) of European classical music and the high C (*Uchcha Sadja*) of north Indian classical music as well as between the third C (C 3rd) of European classical music and the middle C (*Madhya sadja*) of north Indian classical music. This fact is again much proven later through the *Itabla pro*; an Indian classical music software, which states the *Madhya sadja* as C3, with a frequency value of 130.81Hz and *Uchcha sadja* as C4, with a frequency value of 261.63Hz

⁴ Introduced by Werckmeister and executed by J.S.Bach (Lindley, 1987).

⁵ (Sir Jeans, 1968, p. 24)



Figures 2a and b: Mobile phone software *itabla pro*, showing the Hz for C3 and C4.

Therefore, in this research the middle C (*Madhya sadja*) of north Indian classical music is considered as having 130.81Hz which is similar to the third C (C 3rd) of the grand piano. However, it has to be seen in the historical context that the app was developed in times when the grand piano was known to the entire world and the mobility of musicians caused a global unification of pitch levels in all regions with diverse cultures.

Concept of Raga

Raga is an important element of the main concept of Indian classical music, which is derived from earlier musical experiences such as those of the *veda*, *grama*, *murchana* and *jathi* respectively (Nigam 1993: 29). The *raga* concept has specific structures of ascending and descending orders of tones which are sung or played without the boundaries of a semi tonal concept such as that found in European classical music. This causes the idea of *Shruti*.

Shruti

Shruti is an idea of dividing larger intervals into smaller intervals. (Zatkalik, Medić, and Collins 2013). According to Indian music theorists (Sobhana Nayar 1989:125) there are 22 *Shrutis* between *madhya sadja* which might be translated into middle C, and *uchcha sadja* which might be translated into upper C. They are named respectively as *theevra*, *kumudhni*, *mandha*, *chandhowathi*, *dhayawathi* and others (Gadrey Mukund 2016).

Shrinivas said “*Chathusa chathusa chathusa chaiva –sadjā madhya panchamaa / Dhwe dhwe nishadha gandharo- thishree rishaba dhaiwatho*”⁶

According to the above Sanskrit poem, there are:

- 4 *Shrutis* in each semitone as imagined through knowing the European tempered scale of classical music between *Ni* (B) and *Sa* (C), *Ga* (G) and *Ma* (F), *Ma* (F) and *Pa* (G)⁷
- 2 *Shrutis* in each semitone between *Da* (A) and *Ni* (B), *Ri* (D) and *Ga* (E)⁸
- 3 *Shrutis* in each semitone between *Sa* (C) and *Ri* (D), *Pa* (G) and *Dha* (A)⁹

⁶ (Shrikrishna, 2015)

⁷ (Shrikrishna, 2015)

⁸ (Shrikrishna, 2015)

⁹ (Shrikrishna, 2015)

In this research the space between *Ri* and *Ga* of a specific repertoire in north Indian classical music will be studied for various frequency positions of *komal gandhar*.

Classification Systems of *Ragas*

There are three main classification systems of *ragas* in north Indian classical music (Priya Viswanathan, 2007):

1. *Raga ragini* system
2. *Thata raga* system
3. *Raganga* system

To select *ragas* for this research, both *thata raga* system and the *raganga* system are used. From the ten *thatas* in north Indian classical music, only *kafi*, *asawari*, *thodi* and *bhairavi thatas* have *komal gandhar* directly. Three *ragas* from each of *kafi*, *asawari thatas* and two *ragas* from *thodi thata* (avoiding *bhairavi thata*) are selected here for the study of the *komal ghandhar*.

Selected *ragas* of *kafi thata*:

1. *raga kaafi*
2. *raga miyanki malhaar*
3. *raga bahar*

Selected *ragas* of *asawari thata*:

1. *raga asawari*
2. *raga adana*
3. *raga darbari Kanada*

Selected *ragas* of *thodi thata*:

1. *raga thodi*
2. *raga multhani*

It is also important to consider the specific phrases of tones that include *komal gandhar* in these *ragas*. These specific phrases are often sung or played along with *ragangas*. A *raganga* is a specific pattern formed by a unique tone row. Though there are about thirty *ragangas* being used in north Indian classical music, there are three main *ragangas* with *komal gandhar* which are appropriate with the *ragas* chosen for this study.

- *Kanada anga*
- *thodi anga*
- *bhairavi anga*

Since only the *kafi*, *asawari* and *thodi thatas* are being considered here, *Kanada anga* and *thodi angas* will be used in *alaps*¹⁰ of the above selected *ragas* for this study.

Analysis of *Komal Gandhar* with Different Frequencies

¹⁰ Improvising of a specific raga, usually in a slow manner, with or without a beat. (Gorlinski, 2010).

Voice recordings of *alaps* of selected *ragas* which are taken from three university lecturers teaching vocal students mentioned below, are to be analyzed, measuring the frequency with the overtone analyzer 5.0.2 software.

- Senior lecturer of the University of the Visual and Performing Arts, *Chinthaka Prageeth Meddegoda*
- Senior lecturer of the University of the Visual and Performing Arts, *Nalaka Bandara Sumanasiri*
- Lecturer of the University of the Visual and Performing Arts, *Asith Athapaththu*

Use of *Komal Gandhar* in *Raga Kafi*

The *raga kafi* is the main *raga* of the *kafi thaata* itself, which produces the *kafi angas*, the typical characteristics of *raga kafi*. below is the analysis of the frequency of *komal gandhar* as it appeared in the phrase *Ri, Ga, Ma* sung by Mr. *Asith Athapaththu* respectively on *raga kafi*.

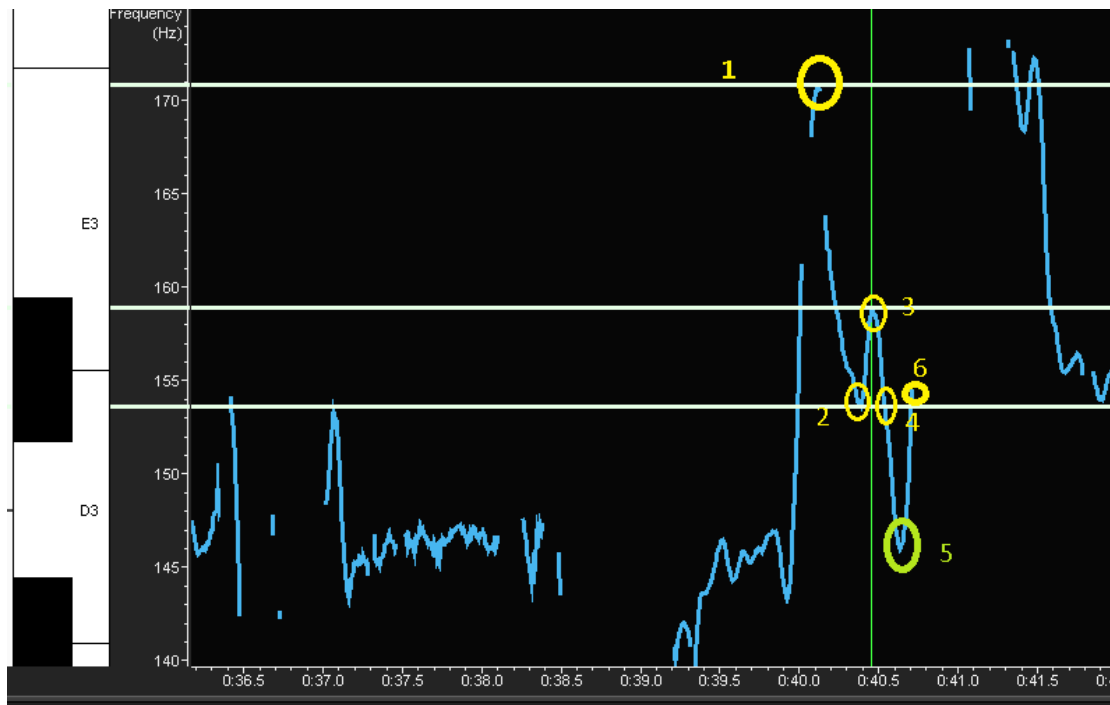


Figure 3: *komal gandhar* as it appeared in the phrase *Ri, Ga, Ma* sung by Mr *Asith Athapaththu* respectively on *raga kafi*, spectrogram taken from *overtone analyzer*. Available at: <https://youtu.be/aolL4u0Dd2w>.¹¹

According to the above picture, there are three parts of *komal gandhar* sung in this specific phrase.

- Starting part: started from position one having 171Hz frequency which is nearly *shudhdha madhyam* (F)
- Actual *komal gandhar*: position two,three and four
- Ending part: position five and six

¹¹ (Athapaththu, 2018).

The starting tone is a *kan swar*¹² which is not a *komal ghandhar*. From the above marked positions, only the two, three, four and six can be considered as frequencies of *komal ghandharas* sung in this phrase.

Two - 154Hz

Three - 159Hz

Four - 154Hz

Six - 155Hz

Therefore, according the above picture, frequency value of *komal ghandhar* of the *raga kafi* has varied between 154Hz – 159 Hz.

Use of *Komal Gandhar* in *Raga Miyanki Malhar*

Below is the analysis of the frequency of *komal ghandhar* that appears in the phrase *Ga Ma Ri Sa* sung by *Nalaka Bandara Sumanasiri* respectively on *raga miyanki malhar*.

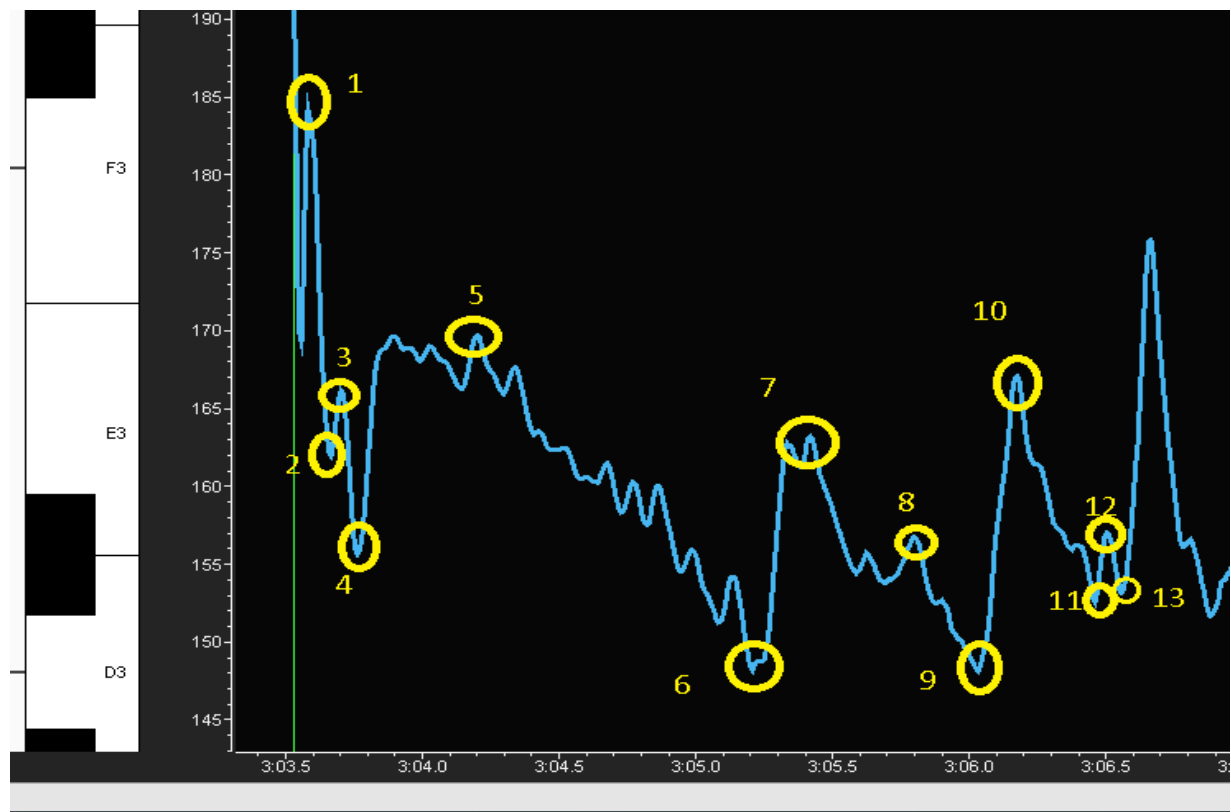


Figure 4: *Ga Ma Ri Sa* sung by Mr.Nalaka Bandara Sumanasiri respectively on *raga miyanki malhar*, spectrogram taken from overtone analyzer. Available at: <https://youtu.be/0qBgKJI0iek>.¹³

Since this particular *raga* has a *kanada anga* which is *Ga, Ma, Ri, Sa* with an oscillation in *komal ghandhar*, finding the frequency similar to E flat is even more complicated. The above wave form can be divided into three parts, since in the recording *komal ghandhar* can be heard with an oscillation of three times. They are;

First oscillation- number one to number six

¹² (A different tone which is slightly touched when singing or playing a longer and stronger tone)

¹³ (Sumanasiri, 2018)

The *komal gandhar* started with a frequency of 185Hz using *madhyam* (F) as a touched tone (*kan swar*). Then position numbers two to six respectively with frequencies of 162Hz, 166Hz, 156Hz, 169Hz, 148Hz have been used in the first oscillation.

Second oscillation- number seven to number nine

This oscillation is shorter in duration than the first oscillation and uses the frequencies of 161Hz, 157Hz, and 148Hz respectively.

Third oscillation- number ten to number thirteen

This concluding oscillation is shorter than the first and the second oscillations in duration. It has used 167Hz, 153Hz, 157Hz, 153Hz frequencies respectively for the *komal gandhar*. Therefore, according to the above picture, *komal gandhar* in *raga miyanki malhar* has oscillated between 167Hz and 148Hz {*Ga* (E) and *Ri* (D)} having no sustaining frequency.

Use of *Komal Gandhar* in *Raga Bahar*

Below is the analysis of the frequency of *komal gandhar* appearing in the phrase *Ma, Pa, Ga*, sung by *Chinthaka Prageeth Maddegoda* respectively on *raga bahar*.

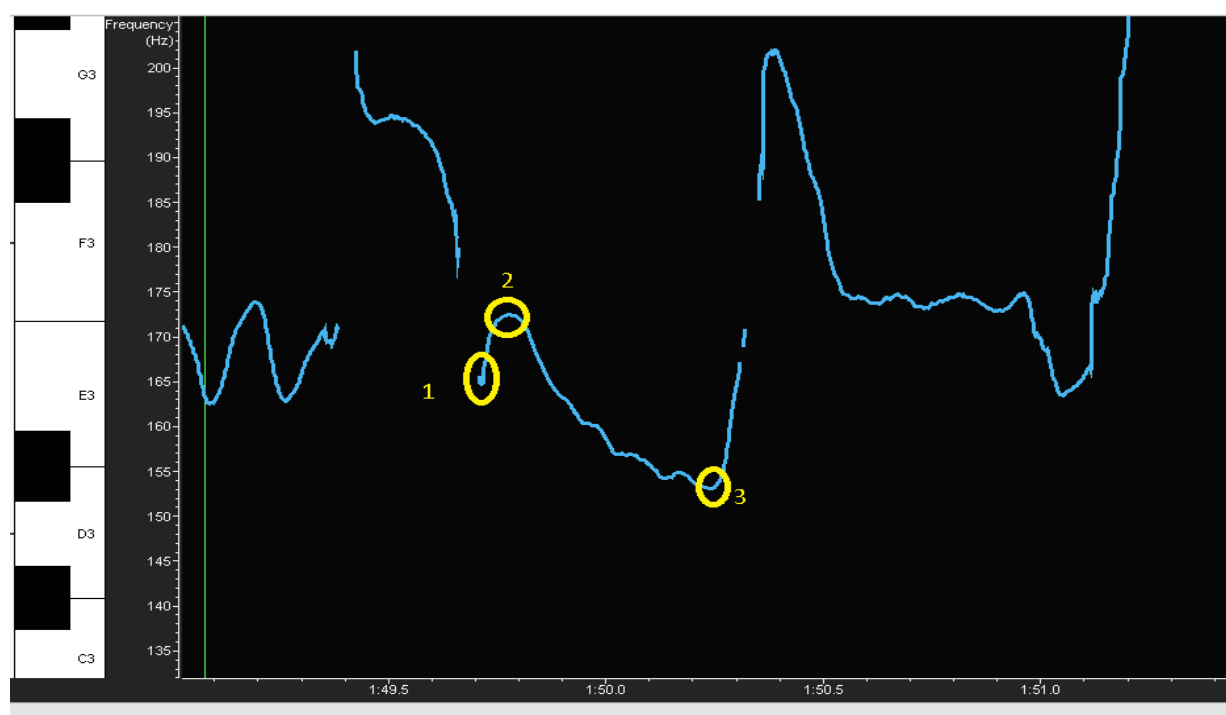


Figure 5: *Pa, Ga, Ma* sung by Chinthaka Prageeth Maddegoda respectively on *raga bahar*, spectrogram taken from over tone analyzer. Available at: https://youtu.be/P_rWcFF2FW8.¹⁴

Here also the phrase *Ga Ma Ri Sa* that appears as a *kanada anga*, yet slightly oscillated less than in *raga miyanki malhar* as seen in above picture. The *komal gandhar* has oscillated only once, starting from position one with a frequency of 166Hz, then to position two which has a frequency of 173Hz and ended in position three with a frequency of 153Hz. Though the actual *komal gandhar* of this oscillation appeared to be position three since it is the only position within the range of *komal gandhar*, yet it is difficult to state that the *komal gandhar* in this

¹⁴ (Meddegoda, 2018).

phrase has a frequency of 153Hz since it has been oscillated all the way from a *shudhdha gandhar* of 173Hz.

Use of Komal Gandhar in Raga Asawari

The *raga asawari* being the main *raga* of the *asawari thata* uses *komal gandhar* using *kanada angas*. Below is the analysis of the frequency of *komal gandhar* appearing in the phrase *Ma, Pa, Ga* sung by *Nalaka Bandara Sumanasiri* respectively on *raga asawari*.

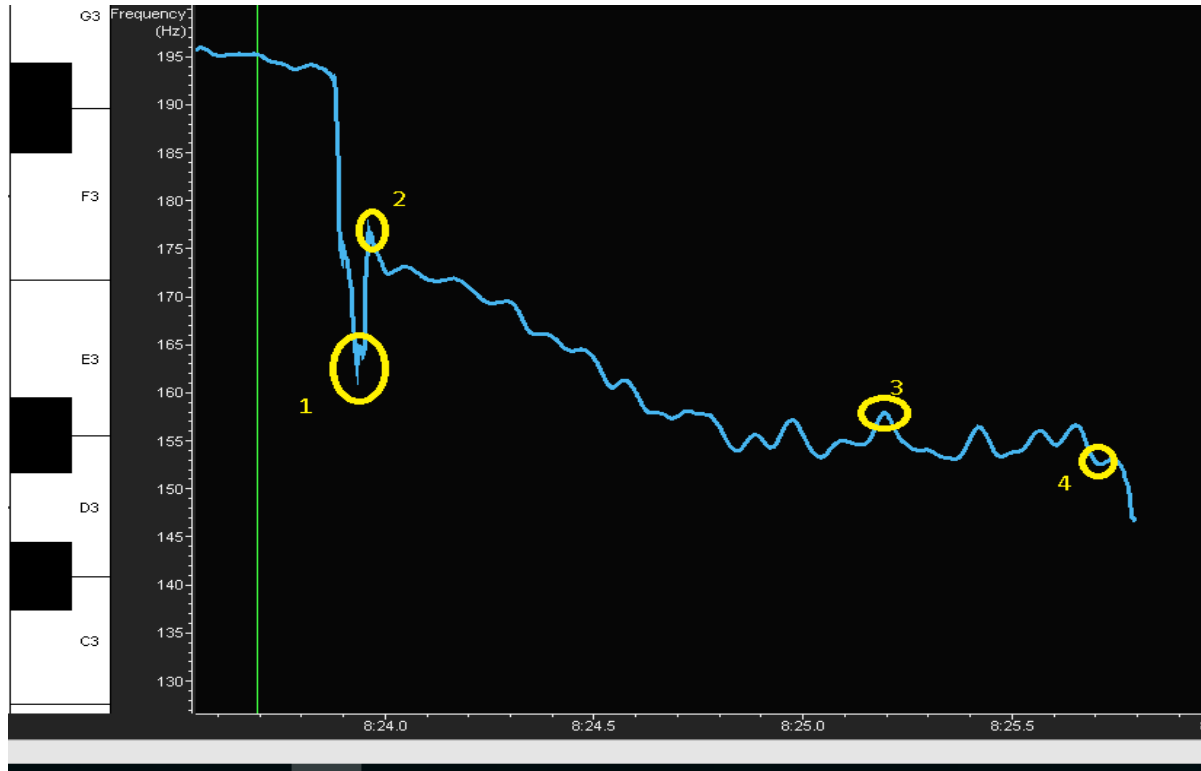


Figure 6: *Ma, Pa, Ga* sung by Mr Nalaka Bandara Sumanasiri respectively on *raga asawari*, spectrogram taken from over tone analyzer. Available at: <https://youtu.be/frXqra7-vHQ>.¹⁵

Here also, the *komal gandhar* is oscillated. It started from position number one which is a *shudhdha Ga* with a frequency of 164Hz, then fluctuated to a *madhyam* with a frequency of 178 which is position two in the above picture. From position two, the frequency has descended into the range of *komal gandhar* and has oscillated to position three with a 158Hz and ended in position four with a 153Hz. Therefore, the actual *komal gandhar* here is between position three and four since they are within the range of E flat. The frequency of *komal gandhar* of *raga asawari* is between 158Hz-153Hz according to above test, yet it is difficult to state the frequency approximately.

Use of Komal Gandhar in Raga Adana

The *raga adana*, being a somewhat controversial *raga* since there are two methods of singing, translated into European classical tone names: one with B flat in ascending and other with natural B in ascending. For this study, only the method of using the natural B is considered. In *raga adana* also, *komal gandhar* comes in *kanada anga*. Below is the analysis of the frequency

¹⁵ (Sumanasiri, 2018)

of *komal gandhar* appearing in the phrase *Ma, Pa, Ga* sung by Mr. Asith Athapaththu respectively on *raga adana*.

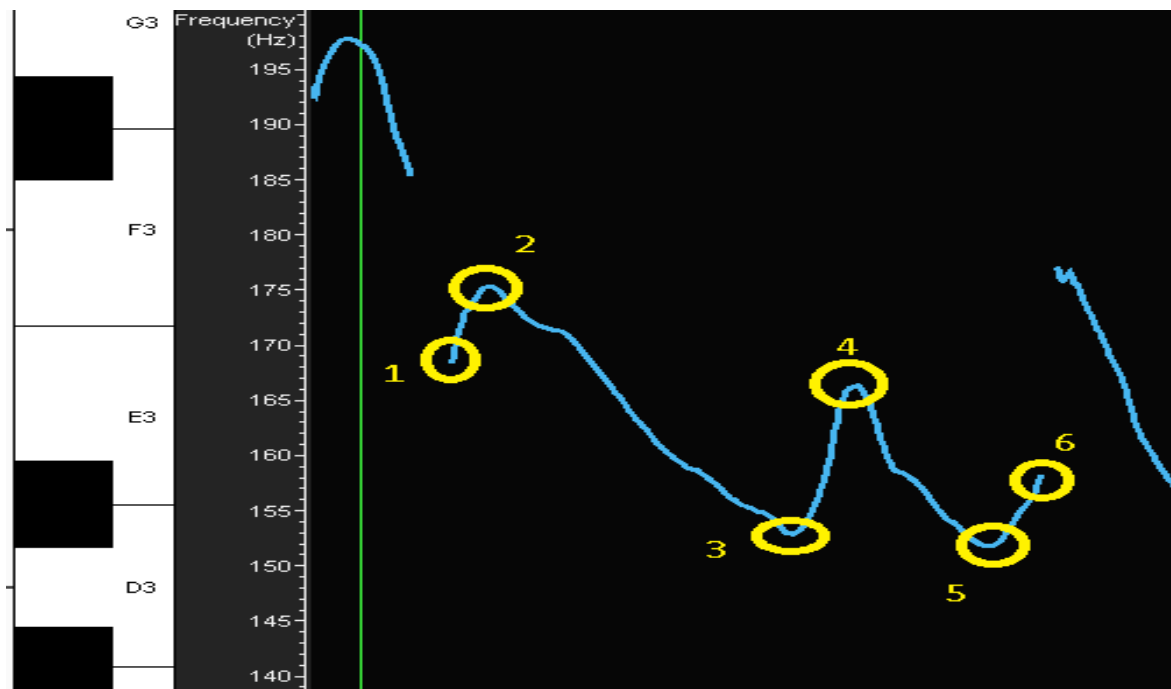


Figure 7: phrase *Ma, Pa, Ga* sung by Mr Asith Athapaththu respectively on *raga adana*, spectrogram taken from overtone analyzer. Available at: <https://youtu.be/QU1iXR7ikZg>.¹⁶

It can be seen in the picture that the *komal gandhar* has been oscillated twice. First oscillation has started from position one which is a *Shudhdha gandhar* with a frequency of 168Hz, then to number two which is a *Shudhdha madhyam* with a frequency of 175Hz and concluded in position number three, a *komal gandhar* with a frequency of 153Hz. Second oscillation consists of position numbers four, five and six which are *Shudhdha gandhar* of 165Hz, *Shudhdha rishab* of 152Hz and *komal gandhar* of 158Hz respectively.

In these brief oscillations there can be seen two different *komal gandharas*. One with a 153Hz, which is close to *Shudhdha rishab* and other one with a 158Hz, close to *Shudhdha gandhar*. Therefore, instead of having a stable frequency, the *komal gandhar* in *raga adana* has fluctuated its frequency within 153Hz and 158Hz.

Use of *Komal Gandhar* in *Raga Darbari Kanada*

Darbari Kanada, being the major *raga* among the *kanada anga ragas* has a manner of a very slow tempo with deep emotions. It is considered that this *raga* is a difficult one to sing without proper knowledge and good practice. *komal gandhar* in *raga darbari Kanada* is taken as a *kanada anga* and oscillated many times in slow tempo which is a unique characteristic of this *raga*. There are two ways of singing *komal gandhar* in *raga darbari Kanada*. One is by oscillating *komal gandhar* multiple times in a slow manner, and the other way is raising the *shudhdha rishab* gradually to *komal gandhar*, touching all the possible *Shrutis* within them. For this study only the first way is considered.

Below is the analysis of the frequency of *komal gandhar* appeared in the phrase *Ni, Sa, Ri, Ga* sung by Asith Athapaththu respectively on *raga darbari Kanada*.

¹⁶ (Athapaththu, 2018)

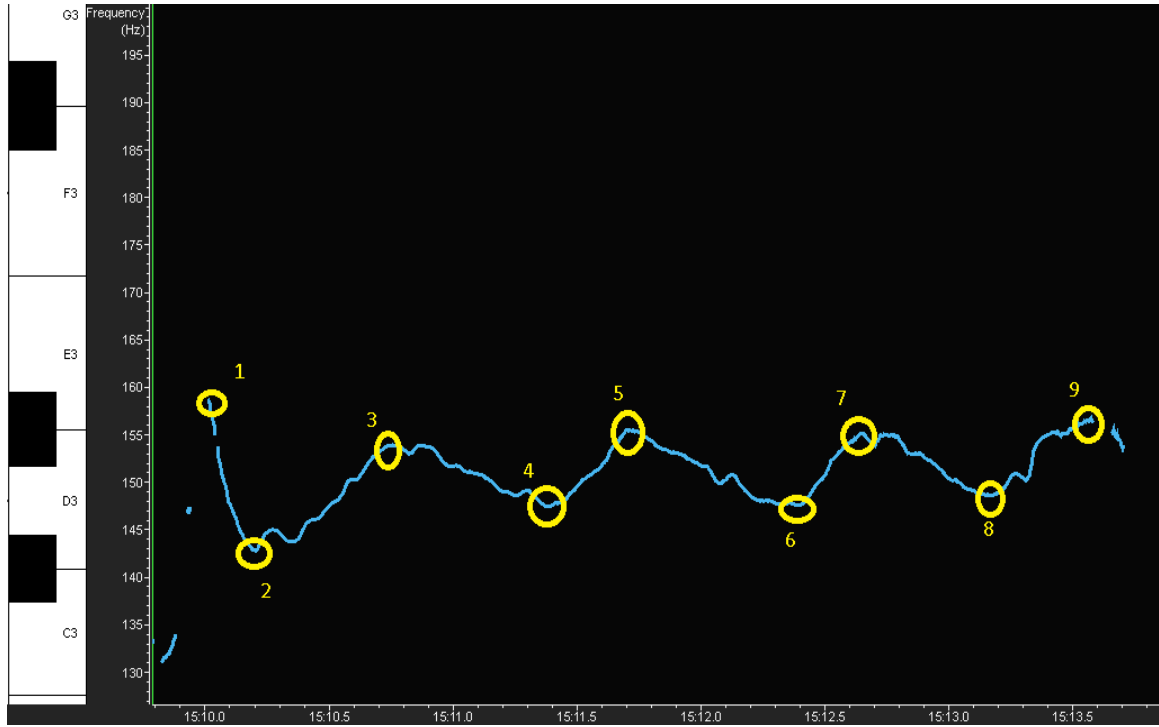


Figure 8: *Ni,Sa,Ri,Ga* sung by Mr Asith Athapaththu respectively on raga darbari Kanada, spectrogram taken from overtone analyzer. Available at: <https://youtu.be/DV-HB8LaIpA>.¹⁷

This oscillation of *komal gandhar* has taken approximately three and half seconds (15:10-15:13.5) being oscillated four times.

- The first oscillation has started from position one which is a *komal gandhar* with a frequency of 159Hz. Then to position two, *komal rishab* with a frequency of 143Hz and to position three, *komal gandhar* with a frequency of 154Hz.
- The second oscillation starts from mentioned position three, then to position four which is a *Shudhdha rishab* with a frequency of 148Hz, and to position five, a *komal gandhar* with a frequency of 156Hz.
- Third oscillation starting from mentioned position five, then to position six, a *Shudhdha rishab* with a frequency of 148Hz and to position seven, a *komal gandhar* with a frequency of 155Hz.
- Fourth oscillation starting from mentioned position seven, then to position eight, a *Shudhdha rishab* with a frequency of 148Hz and concluded in position nine which is a *komal gandhar* with a frequency of 156Hz.

According to the above analysis, there are 5 different *komal gandharas*, varying the value of frequencies. They are:

- position number one - frequency 159Hz
- position number three - frequency 154Hz
- position number five - frequency 156Hz
- position number seven - frequency 155Hz
- position number nine - frequency 156Hz

¹⁷ (Athapaththu, 2018)

Use of Komal Gandhar in Raga Thodi

Thodi is the *ashraya raga*¹⁸ of *thodi thata*. *Thodi anga* is also inspired by this specific raga. There are various types of *thodi ragas* yet the name *thodi* is referred to *raga miyanki thodi*. In *raga thodi*, *komal gandhar* takes in *thodi anga*¹⁹. Below is the analysis of the frequency of *komal gandhar* which appears in the phrase Ri,Ga,Ri,Sa sung by Mr. *Chinthaka Prageeth Meddegoda* respectively on *raga miyanki thodi*.

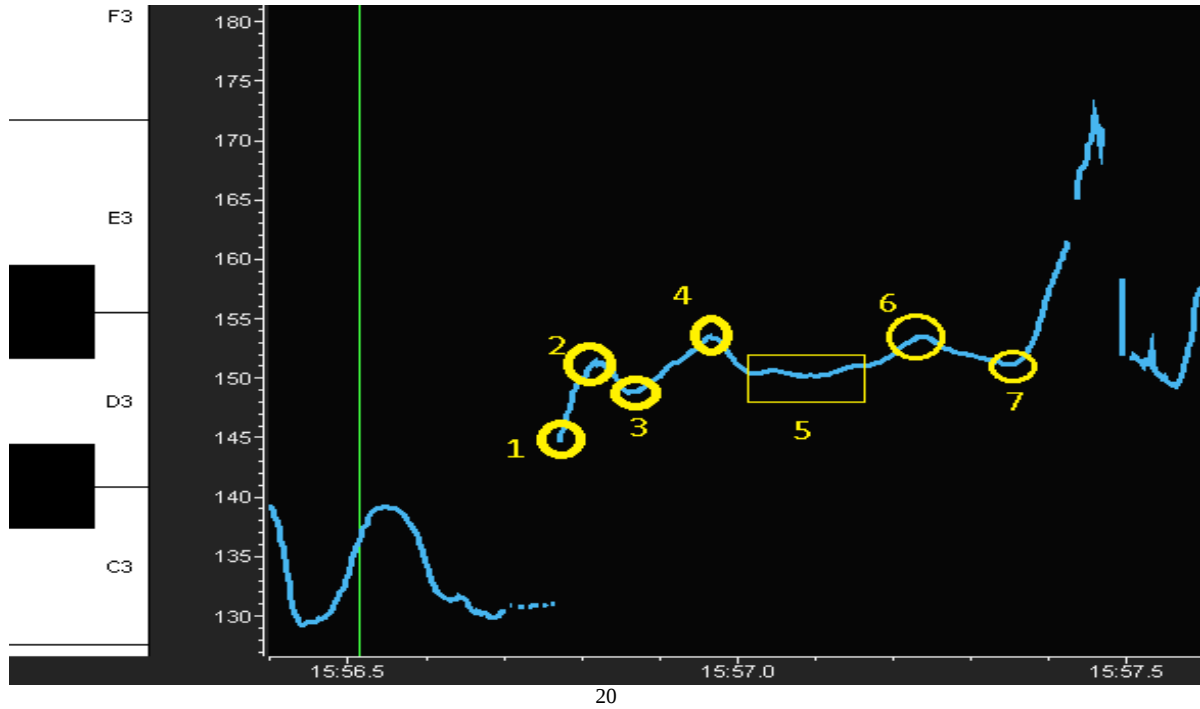


Figure 9: Ri,Ga,Ri,Sa sung by *Chinthaka Prageeth Meddegoda* respectively on *raga miyanki thodi*, spectrogram taken from overtone analyzer. Available at: <https://youtu.be/Po5oe8PzEk>.

Since this *komal gandhar* is sung in *thodi anga*, it has started from *komal rishab* with a frequency of 145Hz (position number one) and has swiftly oscillated through position number two to seven. In this quick oscillation position two, four, five and six are in the range of *komal gandhar*. They have frequency values thus

- position two 152Hz
- position four 153 Hz
- position five 150 Hz
- position six 151Hz

Use of Komal Gandhar in Raga Multhani

Though the *raga multahani* uses the same tones of *raga thodi*, the mood of *multhani* is far more different than the *thodi*. In *multhani*, *pancham* is a prominent note while it is weak in *thodi*.

¹⁸ Main rag of a *thata* itself

¹⁹ *Ga*Ri, *Sa*Ga, *Ga*Ri, *Sa* (*Ri* is taken from *komal Ga* and *komal Ga* is taken from *Sa*)

²⁰ (Meddegoda, 2018)

Komal gandhar in *multhani* is not taken in *kanada anga*. It is taken as *Ni Sa Ga*, *komal gandhar* slightly touching *thivra madhyam* as a *kan swar*.

Below is the analysis of the frequency of *komal gandhar* appeared in the phrase *Ni,Sa,Ga* sung by Mr. Nalaka Bandara Sumanasiri respectively on raga *multhani*.

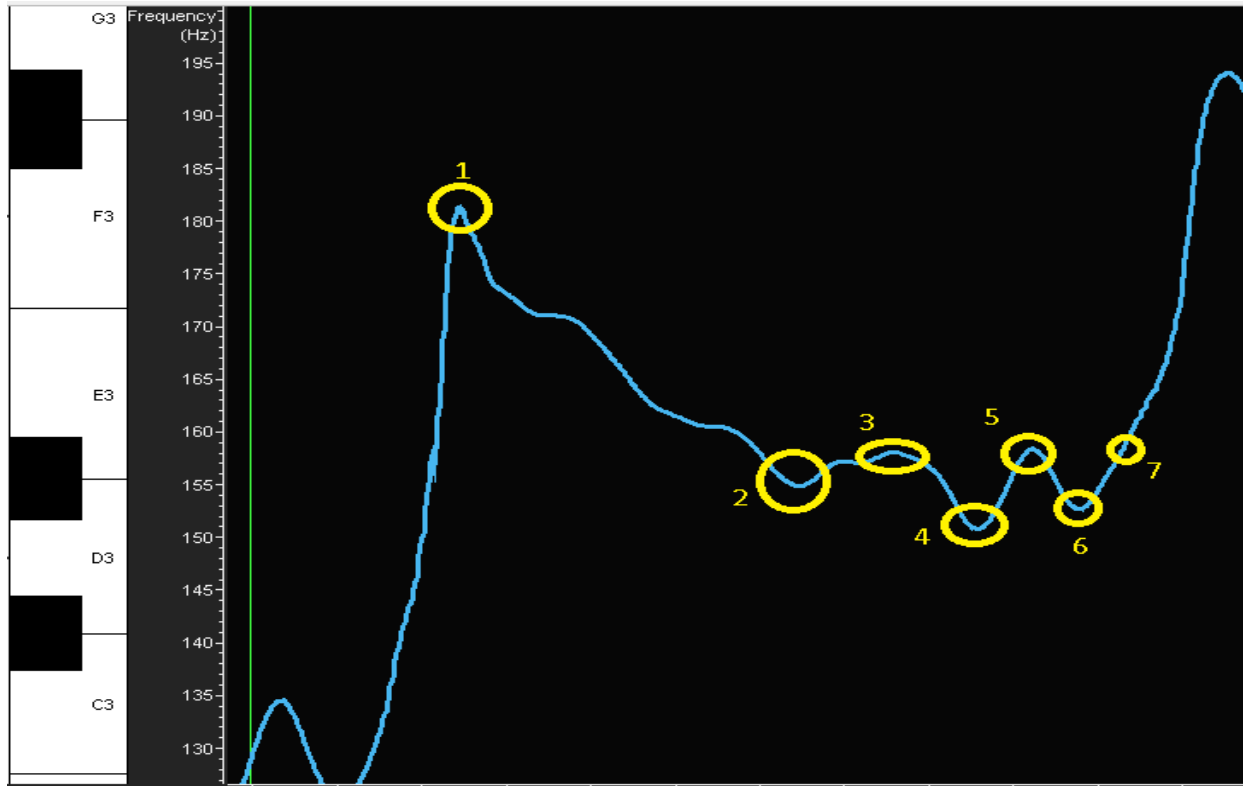


Figure 10: *Ni,Sa,Ga* sung by Mr Nalaka Bandara Sumanasiri respectively on raga *multhani*, spectrogram taken from overtone analyzer. Available at: <https://youtu.be/hcW491g-zu8>.²¹

According to the above picture the *komal gandhar* has twice been oscillated.

- First oscillation

It has started from a *madhyam* (position one), then to *komal mandhar* with a frequency of 155Hz (position two), a *komal gandhar* with a frequency of 158Hz (position three), *Shudhdha rishab* with a frequency of 151Hz (position four) which is very close to a *komal gandhar*.

- Second oscillation

Position five (a *komal gandhar* with a frequency of 158Hz), position six (a *komal gandhar* with a 153Hz frequency) and position seven (a *komal gandhar* with a 158Hz).

There appear to be three frequency values of *komal gandhar* in raga *multhani* according to the above test thus, *komal gandhar*, with a frequency of 155Hz, *komal gandhar* with a frequency of 158Hz and *komal gandhar* with a 153Hz frequency.

Conclusion

The *komal gandhar* of the above selected *ragas* did not have an approximate sustaining frequency. It varied in regard to its *thata*, used *ragangas*, techniques such as *kan swar* and

²¹ (Sumanasiri, 2018)

*andholan*²², the mood of the *raga* and the performer himself. Most of the tested ragas had their *komal gandhar* oscillated with the use of tones surrounding an approximate frequency which characterizes the use of *komal gandhar* in the respective *raga* and can clearly not be translated as E flat.

Unlike in European classical music, especially its tempered scale system, North Indian classical music uses a variety of tone spaces. Therefore, a tone named similarly in North Indian classical music can appear in different frequencies and is far more different in its meaning than the names of tones of any European classical music.

Many thanks go to: Prof. Dr. Gisa Jähnichen, Dr. Chinthaka Prageeth Meddegoda, and Dr. Ruwin Rangeeth Dias for their guidance through critical remarks.

²² A tone which is gently oscillated in a slow manner. (Manorma, 2006)

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