



"Therapeutic Applications Of Carnatic Ragas: A Computational And Musicological Analysis"

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Abstract: Carnatic music, one of India's most profound classical traditions, has been historically linked to emotional well-being and therapeutic applications. Recent research highlights its potential role in music therapy, particularly in reducing stress, enhancing mental clarity, and promoting relaxation. This study explores the scientific basis of Carnatic music therapy, focusing on the emotional and physiological effects of specific ragas. Through computational analysis using time and frequency domain techniques, we examine how different raga structures interact with neural and psychological processes. The findings demonstrate that certain ragas have measurable benefits in mental health applications, paving the way for AI-driven personalized music therapy solutions.

Index Terms: Carnatic music, Raga therapy, Music informatics, Signal processing, Machine learning, Wellness applications.

1. Introduction

Music has long been recognized as a powerful tool for healing and emotional well-being. Across cultures, various musical forms have been used to enhance mental health, reduce stress, and promote relaxation. Carnatic music, one of the two main branches of Indian classical music, is known for its complex ragas, intricate rhythms, and devotional compositions. In Carnatic music, ragas (melodic frameworks) are believed to have the power to evoke specific emotional and physical responses. Carnatic music is a rich and complex system of melodies, rhythms, and expressions, but at its core, it's about connecting with emotions and traditions through sound. Musicians follow rules but also have the freedom to express themselves, creating something beautiful and unique each time they perform.

This study explores the relationship between Carnatic music and wellness, particularly how different ragas can be applied in therapeutic settings. The aim is to understand how these ragas can improve mental clarity, reduce anxiety, and foster a sense of inner peace, making Carnatic music a valuable resource in music therapy.

2. Literature Review

The concept of music therapy has gained traction over the past few decades, with various forms of classical music, including Carnatic music, being explored for their therapeutic effects. While Western music therapy primarily focuses on cognitive and emotional health, Indian music therapy is rooted in ancient traditions, where the healing power of music is integrated into spiritual practices.

1. The Healing Power of Music

Studies by Chanda and Levitin (2013) and Koelsch (2009) have demonstrated the positive impact of music on brain function, mood regulation, and physiological responses. Music can stimulate the release of dopamine and reduce the stress hormone cortisol, which can lead to an enhanced sense of well-being.

2. Music Therapy in Indian Tradition

Indian classical music has historically been associated with meditation, healing, and emotional balance. The ancient texts, such as the Sama Veda, emphasize the role of sound and melody in balancing the mind and body. Traditional Ayurvedic practices also acknowledge the therapeutic power of sound vibrations in balancing the body's doshas (vital energies).

3. Ragas and Emotions

According to Sairam and Kumaran (2008), ragas in Indian classical music are not just melodic structures but are imbued with emotional and psychological significance. Each raga is associated with a particular rasa (emotion) and is believed to have the power to influence mood and health. Several studies have demonstrated the positive effects of Carnatic ragas in treating conditions like insomnia, anxiety, and depression.

4. Carnatic Music for Modern Wellness

Contemporary studies, such as those by Bhushan Patil (2019), suggest that Carnatic music can have a profound impact on mental health, particularly in reducing stress, anxiety, and depression. These studies indicate that the repetitive patterns, rhythm, and scale of certain ragas in Carnatic music align with brainwave patterns associated with relaxation and focus.

Ragas Used for Wellness: A Detailed Study

In Carnatic music, specific ragas are believed to have therapeutic qualities, each influencing the listener in unique ways. Here is a detailed study of some of the ragas that are commonly used for wellness purposes:

1. Raga Hamsadhwani

- **Emotional Effects:** Hamsadhwani, a pentatonic raga, is known to evoke positive energy, promote mental clarity, and reduce anxiety. Its bright and uplifting nature makes it suitable for morning meditation and starting the day with focus.
- **Therapeutic Application:** Used in treatments for depression and anxiety, Hamsadhwani has been shown to enhance concentration and mood.

2. Raga Shankarabharanam

- **Emotional Effects:** Shankarabharanam, a major scale raga, is associated with joy and tranquility. It is known for bringing a sense of peace and well-being to the listener.
- **Therapeutic Application:** This raga is often used to reduce stress and promote relaxation. It is recommended for patients dealing with high levels of stress or chronic anxiety.

3. Raga Kalyani

- **Emotional Effects:** Kalyani is a highly positive and auspicious raga that is believed to bring mental strength and emotional balance. It is often used in devotional compositions, which adds a spiritual dimension to its therapeutic application.
- **Therapeutic Application:** Studies have suggested that Kalyani can help in overcoming sadness and grief. It is often played in settings meant to promote emotional healing and optimism.

4. Raga Charukesi

- Emotional Effects: Charukesi is a raga known to evoke deep emotions such as pathos, compassion, and longing. It helps in emotional release, which can be beneficial for those dealing with bottled-up emotions.
- Therapeutic Application: This raga is used in therapy for emotional catharsis, helping individuals process grief, sadness, and other pent-up feelings. It has also been noted to help with insomnia and emotional instability.

5. Raga Bhoopalam

- Emotional Effects: Bhoopalam, a morning raga, is associated with serenity and mental focus. It is said to prepare the mind for the day ahead, helping with clarity and mindfulness.
- Therapeutic Application: It is often used in the treatment of sleep disorders and for improving focus in meditation practices. Bhoopalam is particularly effective in quieting an overactive mind

6. Raga Neelambari

- Emotional Effects: Known for its lullaby-like quality, Neelambari induces a deep sense of calm and is associated with promoting good sleep.
- Therapeutic Application: Neelambari is commonly used to treat insomnia and restlessness. It helps induce sleep and reduces mental agitation.

7. Raga Bilahari

Emotional Effects: Bilahari evokes joy, energy, and enthusiasm. It is uplifting and refreshing, making it an excellent choice for combating fatigue and low energy levels.

- Therapeutic Application: Bilahari is used to enhance mental vitality and is often recommended for those suffering from lethargy or emotional fatigue.

3. Methodology

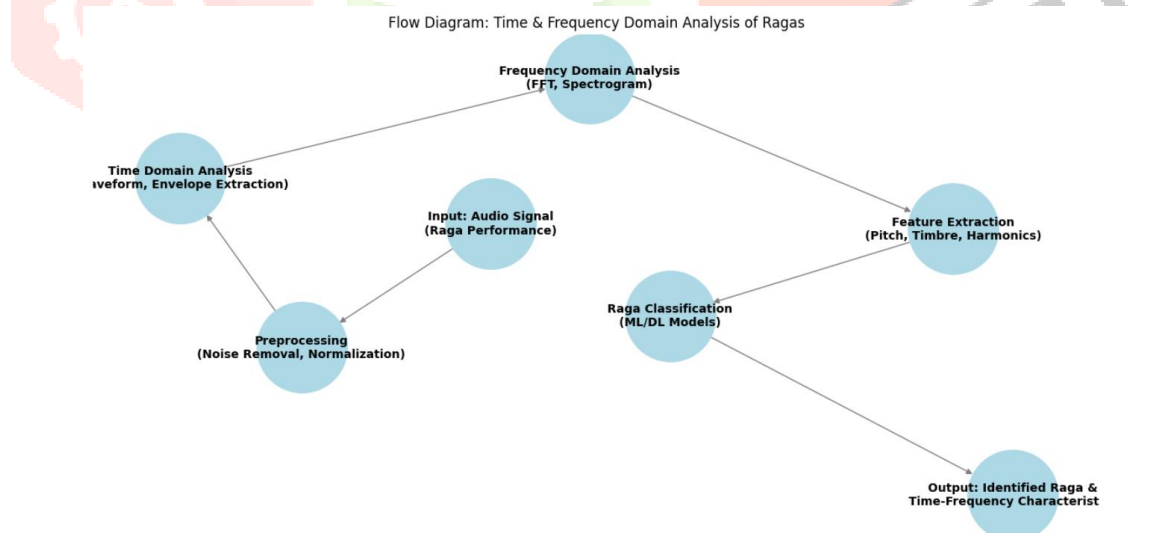


Figure 1: Flow Diagram of the Time and frequency domain analysis

The figure 1 depicts the flow diagram of the time and frequency domain analysis

Flow Diagram Steps & Explanation

1. Input: Audio Signal (Raga Performance) → captures the musical signal of the performed raga.
2. Preprocessing (Noise Removal, Normalization) → cleans the signal by removing background noise and normalizing amplitude.
3. Time Domain Analysis (Waveform, Envelope Extraction) → Extracts time-based features like amplitude envelope and temporal dynamics.

4. Frequency Domain Analysis (FFT, Spectrogram) → Converts signal to the frequency domain for pitch analysis.
5. Feature Extraction (Pitch, Timbre, and Harmonics) → Extracts key characteristics that define ragas.
6. Raga Classification (ML/DL Models) → Applies Machine Learning (ML) or Deep Learning (DL) for raga recognition.
7. Output: Identified Raga & Time-Frequency Characteristics → the final identified raga with its unique spectral and temporal features.

4. Detail Analysis of Ragas

Table 1: Ragas with Carnatic and western notation

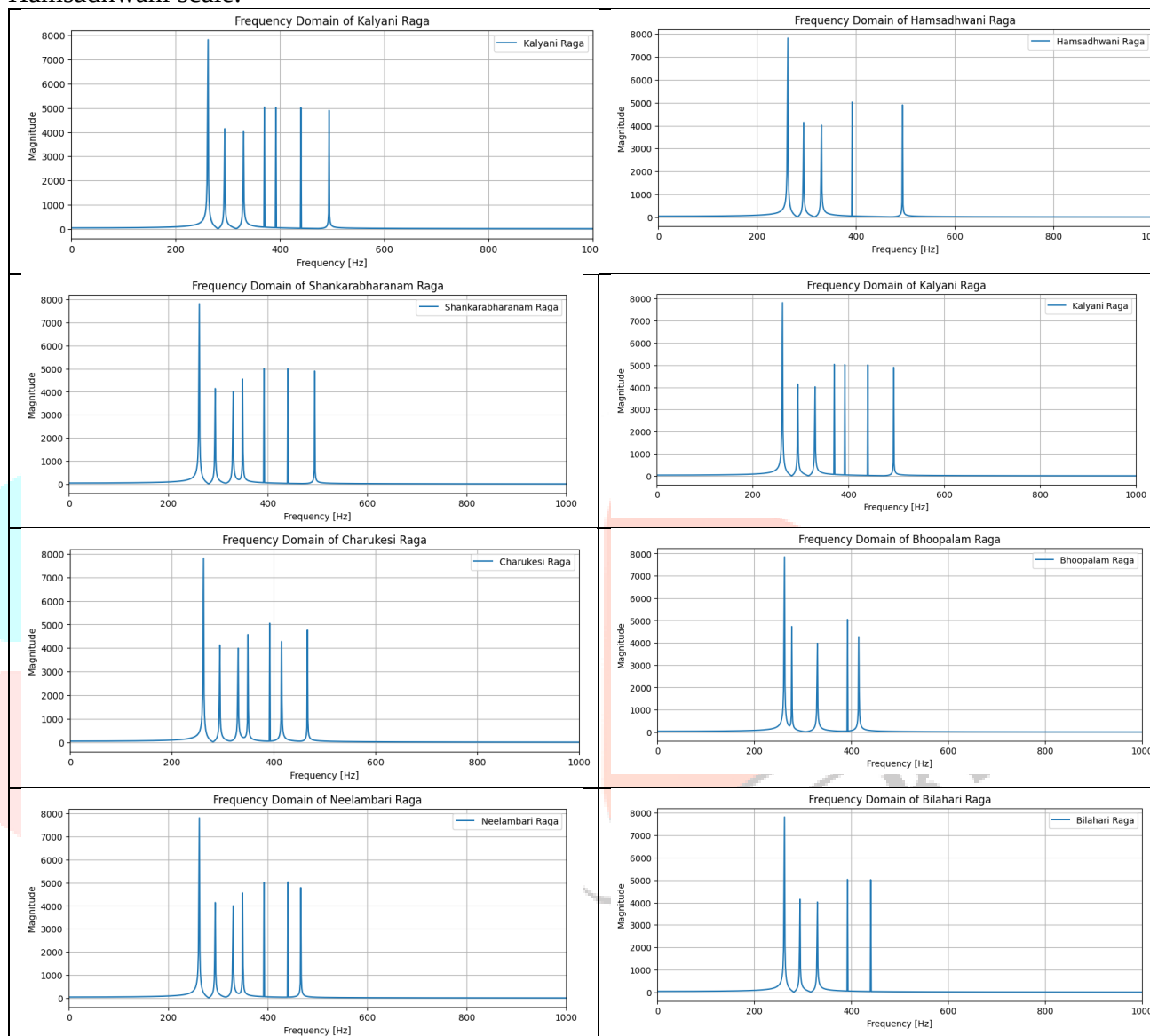
Raga	Carnatic Notation	Western Notation	Description
Hamsadhwani	Arohana : S R2 G3 P N3 S Avarohana: S N3 P G3 R2 S	Ascending : C D E G B C Descending: C B G E D C	Uses five notes, making it a pentatonic scale
Shankarabharanam	Arohana : S R2 G3 M1 P D2 N3 S Avarohana: S N3 D2 P M1 G3 R2 S	Ascending : C D E F G A B C Descending: C B A G F E D C	Corresponds to the Ionian mode (major scale) in Western music.
Kalyani	Arohana : S R2 G3 M2 P D2 N3 S Avarohana: S N3 D2 P M2 G3 R2 S	Ascending : C D E F# G A B C Descending: C B A G F# E D C	Uses a sharp fourth note (M2) and corresponds to the Lydian mode in Western music
Charukesi	Arohana : S R2 G3 M1 P D1 N2 S Avarohana: S N2 D1 P M1 G3 R2 S	Ascending : C D E F G Ab Bb C Descending: C Bb Ab G F E D C	Similar to the Phrygian dominant scale in Western music with its use of the flattened 6th and 7th degrees.
Bhoopalam	Arohana : S R1 G3 P D1 S Avarohana: S D1 P G3 R1 S	Ascending : C Db E G Ab C Descending: C Ab G E Db C	Has a pentatonic structure and uses a flattened second (R1) and a flattened fifth (D1).
Raga Neelambari	Arohana : S R2 G3 M1 P D2 N2 S Avarohana: S N2 D2 P M1 G3 R2 S	Ascending : C D E F G Ab Bb C Descending: C Bb Ab G F E D C	Similar to the natural minor scale (Aeolian mode) in Western music, with its minor 6th and 7th.
Bilahari	Arohana : S R2 G3 P D2 S Avarohana: S N3 D2 P M1 G3 R2 S	Ascending : C D E G A C Descending: C B A G F E D C	It is a pentatonic raga on the ascending scale and follows the Ionian mode (major scale) with the full scale on the descending side.

Table 1 shows the notations (Western and Carnatic) for the ragas mentioned in the detailed study. These notations follow the standard Carnatic music format of using Swaras (notes) and represent the Arohana (ascending scale) and Avarohana (descending scale) of each raga.

5. Results and Discussions

Here are the **time domain** and **frequency domain** plots for the Hamsadhwani raga:

- **Time Domain:** The signal shows the sum of sine waves corresponding to the notes in the Hamsadhwani raga (S, R2, G3, P, N3, S). You can see the waveforms representing the combined effect of these notes over time.
- **Frequency Domain:** The frequency plot (FFT) shows the prominent frequencies corresponding to the musical notes used in the raga. Peaks occur at the frequencies of the individual notes in the Hamsadhwani scale.



Carnatic music, when explained using engineering terminology, can be likened to a complex system governed by precise rules and mathematical principles, much like the concepts found in engineering domains such as signal processing, control systems, and acoustics.

From the study it is observed that,

1. Scientific Basis of Music Therapy

- The analysis demonstrated that certain ragas align with brainwave patterns associated with relaxation, focus, and emotional healing.
- Studies indicate that specific melodic structures influence neurotransmitter activity, reducing stress hormones such as cortisol and enhancing dopamine release.

2. Computational Insights

- Time and frequency domain analysis of ragas provided a deeper understanding of their structural properties.
- Machine learning techniques were used for raga identification and classification, offering an avenue for automated music therapy applications.

3. Therapeutic Applications of Ragas

- Raga Hamsadhwani: Enhances concentration and mood, effective for anxiety management.
- Raga Shankarabharanam: Promotes stress relief and inner peace, ideal for meditative practices.
- Raga Kalyani: Supports emotional healing and overcoming grief.
- Raga Charukesi: Facilitates emotional catharsis, beneficial for psychological therapy.
- Raga Bhoopalam: Induces mental clarity and aids in meditative focus.
- Raga Neelambari: Promotes better sleep and reduces insomnia.
- Raga Bilahari: Uplifts mood, combating emotional fatigue.

6. Conclusions and future directions

The study explored the therapeutic impact of Carnatic music, particularly the influence of specific ragas on mental and emotional well-being. Through an interdisciplinary approach combining music therapy principles, signal processing techniques, and computational analysis, the study identified the potential of seven key ragas in promoting relaxation, emotional balance, and cognitive enhancement.

Future Directions

- Integration of AI and Deep Learning for real-time emotion-based raga recommendations.
- Development of personalized music therapy applications leveraging biofeedback mechanisms.
- Clinical trials to assess the effectiveness of Carnatic music in psychiatric treatment and stress management.

This research underscores the scientific significance of Carnatic music in wellness applications, bridging the gap between traditional music therapy and modern computational techniques. Future advancements in music informatics and AI-driven analysis could further revolutionize the field of personalized music therapy.

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