SCULPTING THE SOUND. TIMBRE-SHAPERS IN CLASSICAL HINDUSTANI CHORDOPHONES

Matthias Demoucron
IPEM, Dept. of Musicology, Ghent University, Belgium
matthias.demoucron@ugent.be

Stéphanie Weisser
Musical Instruments Museum Brussels, Belgium
s.weisser@mim.be

Marc Leman
IPEM, Dept. of Musicology, Ghent University, Belgium
marc.leman@ugent.be

ABSTRACT

Chordophones of the contemporary classical Hindustani tradition are characterized by the presence of one or both of these two specific devices: the sympathetic strings taraf (from about 10 to over 30) and the curved wide bridge jawari (sometimes reinforced by a cotton thread). The influence of the taraf and jawari devices has been scarcely investigated, even though players consider both the taraf’s response and the jawari effect as fundamental to the instruments sound. Based on field recordings and interviews, this study aims to quantify the contribution of taraf strings and wide curved bridge jawari to the global sound of the different instruments and settings. Acoustical analyses are correlated with ethnomusicological analyses, in order to evaluate the tarafs and jawaris aesthetic, musical and perceptual role.

1. INTRODUCTION

Classical Hindustani music is characterized by its highly complex and theorized nature as a musical system, in which four main aspects have to be taken into consideration [1,2]: (1) the main melodic line, (2) the drone, (3) the accompanying melody line and (4) the percussive line. The melody is related to the concept of rag, encompassing the idea of a scale (a selection of musical degrees), an ethos (emotional content), typical motives and ornaments as well as the classical performance altogether. The drone is one of the most important feature in Indian (both Hindustani and Carnatic) music and is built on the ground-note (the Sa) and usually, but not always, on the fifth (Pa). The accompanying melody line is only performed in a vocal performance, although the paradigmatic nature of the singing voices characteristics in instrumental performances allows to generalize its importance as a general concept of Hindustani music. Finally, the percussive line is based on a cyclical concept of time, the tal, comprising a metrical pattern, defined by an internal organization in subgroups of stressed and unstressed beats.

A classical musical performance is traditionally led by the melodic instrument (or vocalist) and comprises four parts: alap (slow, unmeasured introductory part), jor (portion with a little faster tempo than the alap, meter starts to be perceivable), jhala (fast portion, in which constant repetition of pitches including drones creates a driving rhythm) and gat (instrumental composition, usually brief but played with extensive metered improvised developments). As noted by Jairazbhoy [2], “the successive cycles generally increase in intensity, thereby creating the effect of an upward spiral. This is accomplished by the development of melodic ideas, the increasing complexity of both melodic and rhythmic variation, and the accelerating tempo which frequently culminates in a powerful climax”.

Regarding musical instruments, two specific devices are present in most of Hindustani chordophones: taraf, sympathetic strings responsible for a haze of harmonic resonances, and jawari, wide, slightly curved bridges that produce a buzzing, spectrally rich sound. The sounding features resulting from these devices would be linked to a general ideal of “aesthetic saturation” and participate to the realization of three essential aesthetic ideas of Indian music: “continuity of line, ornaments and a ‘sonic depth’ or textural richness that must be achieved without compromising the dominance and subtlety of melody” [3].

Preliminary studies [4, 5] have focused on isolated notes, showing how taraf strings influence the spectral content of the sound, the attack duration, or variations of partials’ amplitude over time, for example. In contrast, this paper will analyze the effect of these devices in a melodic, (quasi) musical context. It aims to quantify the contribution of tarafs and jawari for the achievement of the performance aesthetic and musical ideals described before, i.e. achieving a sense of continuity and spectral richness while preserving the clarity of the melodic line.

This paper is organized as follows. First, Sect. 2 will briefly describe the use of timbre-shapers in the two instruments discussed in the following of the text. Taking the example of the sarangi and the effect of taraf strings, we will present the experiments, the analysis, and discuss computational and performance issues resulting from the nature of this instrument for this specific example (Sect. 3), and from a more general point of view (Sect. 4).

2. TIMBRE SHAPERS IN INDIAN INSTRUMENTS

Most classical Indian string instruments contain one or both of the devices shown in Fig. 1c and Fig. 1d: sympathetic strings (called taraf), or wide curved bridges (called jawari). Jawari are responsible for the buzzy spectrally rich
sound of the sitar, and taraf produce the highly harmonic reverberation characterizing the sarangi, for example.

**Table 1.** Taraf and jawari settings and characteristics for two hindustani chordophones: the sitar and the sarangi.

<table>
<thead>
<tr>
<th></th>
<th>Sitar</th>
<th>Sarangi</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Taraf</strong></td>
<td>Material: Metal</td>
<td>Metal</td>
</tr>
<tr>
<td></td>
<td>Bridge: Independent bridge</td>
<td>Shared with playing strings</td>
</tr>
<tr>
<td></td>
<td>Tuning: According to the rag, c. 280-750 Hz</td>
<td>According to the rag and chromatically, c. 150-630 Hz</td>
</tr>
<tr>
<td></td>
<td>Number: From 11 to 13, grouped in a single set</td>
<td>Up to over 35, grouped in four sets</td>
</tr>
<tr>
<td></td>
<td>Location: In the closed handle, below the playing strings</td>
<td>Partly in the open unfretted handle, partly next to the playing strings</td>
</tr>
<tr>
<td><strong>Jawari</strong></td>
<td>Number: Two</td>
<td>Two</td>
</tr>
<tr>
<td></td>
<td>Strings concerned: All (playing and taraf)</td>
<td>Only 11 (Two sets of the taraf)</td>
</tr>
</tbody>
</table>

**Figure 1.** (a) Sarangi player Sarwar Hussein during recording. (b) Sitar player Supratik Sengupta in concert. (c) Two sets of sympathetic strings taraf of the sarangi, equipped with bridge jawari. (d) Jawari of the playing and sympathetic strings of the sitar. Photos by S. Weisser except for (b): © L. Bonner, MIM.

Table 1 summarizes some building characteristics of the two instruments that will be discussed in the paper. The sitar (Fig. 1b) is a plucked lute comprising relatively few taraf strings (11 to 13) and six or seven playing strings. Three or four of the playing strings are intermittently plucked together to provide a drone (cikari strings). Both playing and taraf strings are equipped with a jawari bridge. In contrast, the sarangi (Fig. 1a) is a bowed fiddle with numerous taraf strings (up to 35) and three or four playing strings, generally made of gut except for the lowest one. The bridge of the main strings is not curved, and only two sets of taraf strings are equipped with a jawari bridge. Another important difference between the two instruments is that the sarangi is not fretted, which obviously results in very different fingering and playing techniques.

When a note is played on these instruments, part of the vibration is transmitted to the taraf strings whose mode frequencies (fundamental frequency or higher partials) correspond to harmonics of the played note. This has two major consequences on the sound. First, it creates strong modulations of partials’ amplitude during the decay of the notes (plucked strings) and the sustained part of the sound (bowed strings). In musicians’ words [4], they bring “beauty and richness to the sounds”, which would otherwise be “dry and lifeless”. Second, because the taraf strings vibrate freely, the release of their energy will be little influenced by subsequent changes in the vibration of the main playing string (changing the note or stopping the vibration, for example), extending the lifetime of specific notes and frequencies beyond the raw melodic progression.

The latter aspect is illustrated in Fig. 2, showing the spectrograms of a short melody played on the sarangi, without and with taraf (top and bottom, respectively). While the spectrogram without taraf shows only spectral components in harmonic relation evolving in parallel, the same piece played with taraf reveals a more complex structure, with lingering energy contributions corresponding to the slow release of sympathetic resonances excited along the melody. These remaining spectral components create the haze of harmonic resonances so characteristic of instruments with sympathetic strings. More importantly, they contribute to a certain continuity in the musical flux and are partly responsible for the characteristic spectral richness of these instruments.

Jawari bridges also contribute to this spectral richness but in another way. Raman [6] showed that the jawari transforms the vibrating behaviour of the plucked string into a quasi-Helmoltz motion, causing a global increase of spectral richness and the “buzzing” nature of sounds produced with jawari. On sitar strings and most strikingly on tampura strings, it makes the attack slightly softer, provokes a slowly increasing amplitude at the beginning of the note, reinforces high frequencies of the sound and prolongs their decay. The reinforcement of some harmonics can often be heard as another note sounding above the main played note, or secondary melodies showing through the main me-
The spectrogram with taraf strings reveals lingering spectral components corresponding to the slow release of sympathetic strings. For the sarangi, in which only two sets of taraf strings are equipped with jawari, mainly the latter aspect is noticeable, with high frequency harmonics "shining” in the course of the melody.

These specific organological settings of Indian chordophones have consequences for both the performer and the researcher developing performance analysis tools. These consequences can be well illustrated with the example shown in Fig. 3. The figure shows the spectrogram of an usual ornament performed on the sitar: the meend, consisting in pulling the string to change the pitch of the note in the resonant part (decreasing in intensity) of the sound. In this example, the string is first plucked, then, after two seconds, the vibration of the main string is shifted to a lower frequency by lowering the string’s tension controlled by the index or middle finger of the left-hand. However, energy at the initial frequency is still released by a corresponding taraf string, splitting the initial spectral components into two. A too-slow decay of the taraf string, compared to the main string, may be “in the way” of the ornament and hide the subtlety of the melodic line. Musicians are aware of the consequence, and evoke the need to control (and sometimes limit) the tarafs response. Alternatively, these issues may force the players to adapt their playing to some sounding aspects on which they don’t have an absolute control.

For the researcher developing computational tools for performance analysis, the example shows an ambiguous situation as well: with a strong decay of the taraf strings, an algorithm for melody tracking may fail to detect the pitch shift corresponding to the main string and may follow the release of the taraf instead. From a more general point of view, the efficiency of most performance analysis tools developed for western music and western classical instruments (including pitch tracking or detection of note onset / offset) may be challenged by the specificities of Indian chordophones. Indeed, highly harmonic reverberant sound or strong harmonic resonances arising from the melody are very rarely encountered in classical western instruments for which these tools have been developed.

In the next section, both consequences (for the performer and for the researcher) will be illustrated through the analysis of taraf strings’ contribution to the overall sound of the sarangi in some short musical excerpts.

3. ANALYSIS OF TARAFL RESPONSE IN SARANGI PLAYING

In this section, we will first introduce the experiments that were carried out and give a qualitative illustration of taraf’s effects. Then, we will describe the analysis procedure with the measurement of the taraf’s tuning, issues related to pitch tracking with this instrument and finally, a measure of the spectral enrichment related to the sympathetic strings.

3.1 Experimental procedure and illustration

Experiments with sitar and sarangi were carried out in ITC Sangeet Research Academy (Kolkata, India) and Brussels, Belgium. They consisted of recording of players performing isolated notes and musical examples, with and without taraf, complemented by interviews with the players about the influence of the jawari and taraf on their performance. In this section, we focus on the recording of a virtuoso sarangi player who was asked to play a short musical composition (gat) with various tempi (laya).

One of these musical compositions was shown in Fig. 2, revealing spectral components due to the excitation and the release of taraf strings along the melody. The consequences can be better observed in Fig. 4, middle. The spectrum of one note of the melody played with taraf shows clearly that strong spectral peaks are present beside the har-
monic components of the main note, when compared with the same note played without taraf (Fig. 4, top), increasing the spectral complexity of the sound. The purpose of the following procedure will then be to quantify the contribution of the additional spectral components, discuss consequences for musical performance and underline issues related to performance analysis.

![Spectra without and with taraf](image)

**Figure 4.** Spectra corresponding to the spectrogram of Fig. 2 around t = 2.3 s, without taraf (top) and with taraf (middle). The panel at the bottom indicates the frequencies of the different sets of taraf strings (fundamental mode indicated with circles, upper modes with stars). The medium tonic $f_0 = 329$ Hz is played in both cases, but the spectrum with taraf is more complex, with the presence of high peaks corresponding to taraf’s modes previously excited.

### 3.2 Tuning of taraf and decay of individual notes

The tuning and the number of sarangi taraf strings are set according to players’ personal taste, but the famous player Narayam [7] gave general rules, recommending to tune the 15 side tarafas on a chromatic scale, the 9 other side tarafas to the notes of the rag, and the upper tarafas (equipped with a jawari bridge) at the players whim, but preferably to important notes of the rag. It is therefore important to examine the specific tuning configuration used by the player before undertaking any analysis.

During the experiment, the player was first asked to tune the instrument, then taraf strings were plucked one by one until complete extinction of the sound. Each individual taraf was analyzed subsequently in order to determine the mean fundamental frequency during the first -30 dB drop, as well as the frequencies and decay rates of the first 10 partials of the sound.

The results of the fundamental frequency analysis showed that the player followed approximately Narayam’s recommendations. The side tarafas contained all the chromatic scale, the side-left set containing predominantly notes of the rag, while the two up sets of taraf strings were tuned to the rag. In Fig. 4, bottom, the position of the taraf fundamental frequencies and four first harmonics are represented for the four sets of taraf, showing that the additional spectral peaks observed in the spectrum corresponded well with the frequency response of the taraf.

As for the decay of partials, the magnitude variation over time showed very strong modulations due to the coupling of taraf strings with mode frequencies close to each other. However, the overall magnitude decrease could be well fitted with an exponential decay. The exponential time constants were found to vary between 1 and 2 s for the first two harmonics and to drop well under 0.5 s above the sixth harmonic, in average, decreasing with increasing pitch. This result suggested that, when taraf strings are excited by a note played close to their fundamental frequency, only the first few harmonics would contribute to the remaining reverberant sound. Therefore, we limited the subsequent analysis to a range of frequency between 200 and 2000 Hz, the upper limit corresponding roughly to the 10th and 3rd harmonic of the lowest and highest taraf string, respectively.

### 3.3 Melody tracking

The effect of taraf can be measured by separating the respective contribution of taraf strings and played strings in the global sound. This requires to first track the pitch of the melodic line in order to identify all corresponding harmonics in the spectrum. However, pitch tracking of instrument with strong resonances, such as the sarangi, raises various issues that will be addressed in this section.

The presence of many, slowly decaying, resonances with frequencies in harmonic relation can be very confusing for pitch trackers. Pitch tracking algorithms may have troubles deciding which harmonic structure is effectively played by the instrumentalist, and we observed that they often switched from one pitch candidate to another one, according to their relative magnitude. The use of spectral models of the bowed string could theoretically help in deciding which harmonic structure corresponds to the played note, but sympathetic resonances produce also interferences with some harmonics of the played pitch, resulting in strong amplitude variations of the partials over time [5].

To make the tracking more efficient, it can be useful to introduce knowledge about the music played and specific properties of the instrument whose fundamental frequency is being tracked. For example, one of the essential features of Indian music (according to Napier [3]) is the “continuity of line”. Therefore, sharp discontinuities, or huge intervals, in the pitch evolution should be watched suspiciously. Concerning properties of the instrument, the sound of the sarangi is characterized by the presence of multiple harmonic structures at the same time, as seen before, due to the slow decay of sympathetic resonances in the trajectory of the melody. However, these harmonic structures can be separated in two sets with different properties: the notes played on the main strings are bowed and show continuous excitation, while the string resonances show free decay similar to the one of a plucked string, for example. From a spectral point of view, it means that the sound corresponding to the bowed pitch is characterized by a series of peaks with quite high amplitudes (even for high partials), in a
strictly harmonic relation with the fundamental. In contrast, sounds corresponding to sympathetic resonances are expected to be less strictly harmonic, and to have peaks quickly disappearing for high partials (over the fifth partial, as seen in section 3.2). The pitch tracking procedure that we used take into account this knowledge in an indirect way. First, we computed the harmonic product spectrum [8] for each frame and frequency \( f \), giving the total contribution of the \( N \) first harmonics

\[
H(f, t) = 10 \log_{10} \left( \prod_{k=1}^{N} P(kf, t) \right) = \sum_{k=1}^{N} P_{dB}(kf, t) \quad (1)
\]

where \( P(f, t) \) is the magnitude interpolated in the spectrogram at frequency \( f \) and frame \( t \). The summation over the harmonics is computed every 1 Hz for frequencies between the minimum and maximum frequencies expected for the fundamental frequency. The result of this operation is shown in Fig. 5. The panel at the top shows the initial spectrogram computed every 128 samples with windows of 2048 points, STFT over 4096 points. The panel in the middle shows the summation over the 10 first harmonics, for fundamental frequencies between 250 and 600 Hz. Because harmonics above 5 tend to disappear quickly in the decay of sympathetic resonances, this operates some kind of filtering on the spectrogram, clearly revealing the melodic line played with the bow. At each frame, the five strongest pitch candidates were selected and a tracking algorithm based on dynamic programming [9] was applied in order to compute the most probable melodic contour. The trajectory cost among the selected pitches took into account the magnitude of the candidates and the frequency difference between candidates from one frame to the other. Maximum continuity of the melodic line was encouraged by employing costs exponentially increasing with increasing frequency difference. The result of the procedure is illustrated in Fig. 5, bottom, showing the contour with maximum magnitude (gray line) and the melodic contour selected by the algorithm with continuity rules (black line). Note that, in some situations (for example, during alternations between two notes), the continuity rule may favour pitches corresponding to the release of the taraf strings (with no frequency discontinuity). Consequently, a right balance had to be found between the cost parameters in order to track the melodic line corresponding to the played string. Alternatively, additional costs related to novelty may correct this side effect of the continuity rule.

### 3.4 Spectral peak density

A rough measure of the spectral enrichment of the sound can be given by the number of spectral peaks located within a given frequency range. The detection of signficative peaks in the spectrum is performed as following. At each frame, the spectrum (in dB) is first fitted with a second order polynomial in order to obtain a baseline for the evolution of the spectral magnitude with frequency. The threshold is a curve situated 30 dB below the magnitude of the most prominent peak, and varies over frequency with same quadratic and linear coefficients as the polynomial fit. Peaks lying within the frequency range of interest and situated above this empirical threshold are counted in the measure of spectral enrichment. This procedure ensures that only peaks with a magnitude sufficiently higher than the noise...
The measurement of spectral enrichment on a musical example is illustrated in Fig. 6. The top panel shows the spectrogram of the gat described in Sect. 3.2 in the frequency range of the peak detection (250 - 2000 Hz). The middle panel shows the number of peaks computed with the detection procedure described above. In this figure, the thick black line represents the number of harmonics of the main pitch located below 2000 Hz, providing a reference for comparison with the total number of peaks detected. Without taraf (Fig. 6, left), the number of peaks stays very close to the reference line, except at bow changes, where the excitation of a wide spectral range produces a sudden increase of detected peaks. In contrast, the number of peaks with taraf (Fig. 6, right) is relatively high, compared to the harmonic peaks corresponding to the pitch. The number of peaks $N_p$ found in a given frequency range gives a first indication of the spectral richness of the sound. However, a second measure could be useful in order to compare the relative magnitude of the overall energy related to the peaks and the harmonic part corresponding to the note played on the main string. The energy related to the peaks is given by

$$E_p = \sum_{i=1}^{N_p} P_p(f_p(i)) \quad \text{with} \quad f_p(i) \in F_{\text{range}} \quad (2)$$

The peaks corresponding to the harmonics of the fundamental frequency are detected and their magnitude is summed up with Eq. 2 in order to obtain an energy $E_h$ where only peaks related to the melodic pitch are considered. The ratio $E_h/E_p$ provides then a measure of the importance, in energetic terms, of the reverberant part of the sound, compared to melodic part. If the ratio is close to 1, the melodic part predominates, and the lower the ratio, the more the taraf strings resonate. This is shown in Fig. 6, bottom. On the left, without taraf, the ratio stays very close to 1, except at the bow changes, which means that the haze of harmonic sound is almost non existent. In contrast, Fig. 6, left, shows that the taraf strings resonate greatly, with ratios reaching 0.5 (i.e. half of the peaks energy contained in the resonating part). The decay of sympathetic vibration can also be observed, for example around 2 s or 3.5 s, with peaks getting exponentially closer to 1 on sustained notes. It should also be noted that this measure depends on the evolution of dynamic level in the melody. For a note played loudly followed by a note played softer, the ratio will shows a sudden drop toward zero at the second note, which could explain some drops in the measure, such as between 2.1 and 2.7 s in Fig. 6, right.

3.5 Excitation of taraf and adjustment

Choosing specific playing techniques can be made in order to change taraf’s contribution to the sound: for the sarangi, the amount of notes, their repetitions, the bow direction and the bow pressure are examples of playing parameters having consequences on taraf’s responses. For example, the position on the bow at the start of the bow stroke (close to the frog or the tip) may help giving more strength or presence to the resonance of a note, “overshadowing” (in the player’s own words) the emergence of the next note. As for the sitar, players note fewer possibilities for controlling the taraf: the direction of plucking (upwards $da$ or
downwards ra), the choice of the plucking techniques and the strength of the plucking may influence the reverberant sound. Both sarangi and sitar players (and makers) face an intricate situation: the taraf's response must be balanced in very different musical situations, from the soft, slow alap (characterized by a low-density of sonorous events) to the loud, fast and virtuoso jhala played at maximum speed. They must produce a haze, a halo of (secondary) sounds but not interfere with the melodic line. Their contribution must be relatively moderate, but they must also distinctly and individually shine when properly excited. Instruments are then set in a thin edge between two almost opposite sonorous necessities, according to players’ aesthetic choices. In order to fine-tune this response, a sarangi player can, for example, remove some of the taraf strings, or try to find a bridge position giving the best compromise between taraf’s response and loudness of the playing strings.

In this respect, it would be interesting to analyze how different settings or configurations influence the ratio between the reverberant part and the melodic part. For example, settings in which taraf’s response are considered too strong by the player may allow us to investigate optimal ratios between the reverberant and melodic parts of the sound. Similarly, the analysis of different parts of a musical performance (alap vs. faster portions, for example) could allow to better understand the use of taraf’s resonance along the performance and specific aesthetic ideals that are looked for.

3.6 Improvement and adaptation to other instruments

The main issue of the analysis process presented in this section lays in the adequate tracking of the melodic contour. The method gave accurate results in most of the cases, but it could be improved by considering two possible supports: novelty (no new pitch can appear if it is not played by the main strings) and past (in case of ambiguous cases, frequencies corresponding to taraf’s tuning and note played in a short time window before should be watched suspiciously). The analysis process could be used to investigate the contribution of taraf strings in other instruments as well. They may however require us to slightly adapt methods, in particular pitch tracking methods, to the problem at hand. Indeed, the pitch tracking used here relies on two properties very specific to the sarangi: a sound sustained through bowing and rather continuous melodic movements from one pitch to the other. In contrast, the strings of the sitar are plucked, and the playing technique mixes discontinuous melodic displacement - from one fret to another, sometimes quite far away from each other - with continuous pitch variations performed by pulling the string. However, considering that the plucking provides a clear attack on the melodic part, and taking into account the maximum pitch variation reachable on one fret with the meend technique (usually up to more than a sixth), it should be possible to provide knowledge facilitating the melody tracking as well.

4. DISCUSSION

Hindustani music relies on aesthetic ideas that could be described as an ideal of aesthetic saturation realized through various means including textural richness and continuity of line. Timbre shapers like sympathetic strings and curved bridges conform to this aesthetic ideal by providing specific sound properties to the instrument, namely a highly harmonic reverberant sound and a spectrally rich sound changing over time. In addition, other musical means in Hindustani music also conform to this aesthetic ideal. For instance, the drone performed by the tampura contributes to fill the sound space and provide a textural ground on which the melodic line emerges. Another example is given by the intermittent plucking of the drone open strings cikari in sitar playing. Cikari are played in all parts of the performance, but are used the most frequently and with the fastest tempo in jhala (climatic part), in which one ‘melodic’ note can be followed by several repeated pluckings of the cikari, providing a drone and a rythmical accompaniment. Cikari fulfill an important, although slightly different, musical function in the other parts of performance, such as alap and gat. They contribute to the “filling of the void” evoked by Napier [3], symptomatic of the ideal of aesthetic saturation. In all cases however, the cikaris part in musical structure seem to be close to the production of a ‘ground’ (in Gestalt sense), the melody being the ‘figure’. It is however probable that ambiguity in this ground-figure relationship is looked for, as the ground and the figure tends to overlap.

These aesthetic ideas are quite far from the ideals of western classical music, for example, and may challenge the computational processes used to analyze musical performances. Researchers in music information retrieval or music performance analysis have developed powerful methods to extract musically relevant information from recorded music. However, it should be emphasized that most of these methodological tools and procedures were created to investigate a very specific style of musical expression, ruled by the organization structure of the western tonal musical system and its specific sound ideal. Usual performance features like pitch, tempo or dynamic are well adapted to the description of western music, but other aspects of the performance may be relevant to analyze in the case of non-western music like Hindustani classical music. This factor has a major conceptual impact on any potential use of these tools for music developed in any other social and musical context. Pertinence of the tools and results obtained with these tools must therefore be systematically questioned, as even perception is a culturally-modeled act, and should be considered as such.

5. CONCLUSION

In this paper, we aimed to provide qualitative information about the function of timbre-shapers in Hindustani chordephones and, more specifically, to quantify the contribution of taraf strings to the overall sound in a musical context. The basic idea was that an optimal setting of the taraf...
would rely on a compromise between two somehow antagonistic principles of Indian music: continuity and textural richness on one hand, and melodic clarity on the other hand. For that purpose, we analyzed recordings in which a sarangi player was asked to play a musical example with and without taraf strings. The analysis was based on the computation of the ratio between the spectral energy representing the melodic part of the sound and the spectral energy in the reverberant part, and showed that, in the studied example, the latter could contribute to up to half of the total energy of the sound.

A second aim of this study was to illustrate some problems arising through the computation. Indeed, most computational tools have been developed for the analysis of western music, while musical systems are numerous, varied, and based on very different rules of organization, expressed in extremely different musical characteristics. In our specific case, strong sympathetic resonances in Hindustani chordophones hindered some basic processes of musical performance analysis, such as pitch following, and it was necessary to adapt algorithms to the problem at hand. We therefore aimed to show that the introduction of some basic, musically pertinent, knowledge in the algorithms, as well as knowledge about the instrument behaviour, player techniques and even performance context can undoubtedly help improving these computations.

Performance analysis of non-western systems may question, challenge our usual computational processes, and provide new insights. Some performance features may appear irrelevant in other musical traditions, and other descriptive features may be necessary. In any case, differences between musical systems lay in the cultural concept underlying the music, and is vital to its understanding - and to a proper, pertinent computing of its characteristics. Ethnomusicology is not just some musicology applied to ‘exotic’ music. It requires specific paradigms, methodological approaches and analytical tools. In the same way, Ethnomusicological Information Retrieval (EIR) should also develop its own tools and frameworks, or facing the risk of irrelevance regarding both its object and its objectives.

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6. REFERENCES


