

Appendix 6: Background Information and Rationale for Guitar and Tabla

8-string regular interval guitar

The 8-string regular interval guitar used is an adaptation of the standard 6-string guitar. A detailed history of the guitar and its various modifications and alternative tunings is not within the scope of the current dissertation, nor is it the intent of the research. A brief justification for the context-specific advantages of the 8-string regular interval guitar as it applies to the current dissertation is, however, warranted.

Concept

In simple terms, the guitar has two significant modifications:

- Two additional strings, one extending the lower range, the other extending the higher range.
- Tuned in regular fourths, starting from low A and ending in high A flat, its tuning is: A D G C F B^b E^b A^b.

The first 6-string guitar

The standard acoustic guitar in its current 6-string format has been around for about 250 years.¹ The earliest known 6-string guitar was built in 1779 by Gaetano Vinaccia of the Vinaccia family of luthiers in Naples, Italy. Italian luthiers Giulio Regondi and Luigi Legnani experimented with 8-string guitars in the 1900s, none of which became standard-use guitars.²

8- and 10-string guitars — earlier designs

Both 8-string and 10-string guitars have been used in classical guitar music. The most well-known of these would be the Yepes 10-string guitar and the Brahms 8-string guitar. The Yepes 10-string guitar was invented by Narciso Yepes in collaboration with José Ramírez III. Yepes publicly debuted the Yepes 10-string guitar in his 1964 performance of *Concierto de Aranjuez* with the Berlin Philharmonic Orchestra.³ The tuning is demonstrated below:

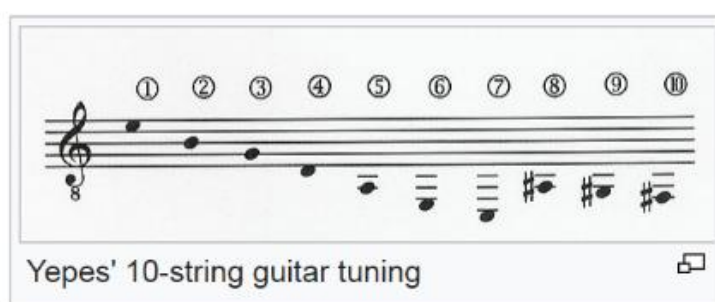


Figure 1: Yepes 10-string guitar tuning

¹ “When Was the 6 String Guitar Invented?” Fundamental Guitar. <https://www.fundamental-guitar.com/when-was-the-6-string-guitar-invented/>

² Jeffrey Noonan, *The Guitar in America: Victorian Era to Jazz Age* (American Made Music Series, University Press of Mississippi, 2008), 205.

³ “Narciso Yepes,” Wikipedia. https://en.wikipedia.org/wiki/Narciso_Yepes.

The Yepes 10-string guitar is a standard guitar with 4-string resonators, tuned to C, A#, G#, and F#, functioning as sympathetic strings.

The Brahms Guitar is an 8-string guitar played and co-designed by Paul Galbraith and luthier David Rubio and played by Paul Galbraith. It is so named because it was originally designed to play Brahms's Theme and Variations Op 21. The Brahms guitar is tuned like a standard guitar, but it includes a low A and a high A string. It also has fanned frets to allow string length differences for the extra strings, thus improving string tension and sound.

The 8-string guitar in jazz

Australian guitarist Laszlo Sirsom plays an 8-string guitar made by Phil Carson Crickmore. The guitar has normal guitar tuning with added low B and high A strings.

American guitarist Charlie Hunter plays an 8-string guitar that is a bass–standard hybrid. Its tuning is thus E A D (corresponding to the bass guitar's lowest three strings) and A D G B E (corresponding to the upper five strings of the standard guitar).⁴

Orientation of earlier 8-string guitars and rationale for modifications

Musicians who have used 8-string guitars have generally made modifications for one of two reasons.

Within classical guitar performance:

- To extend range, thus allowing the guitar repertoire to be extended to compositions otherwise outside its normal range.
- To provide alternative fingering options at the extremes of the instrument. This includes more open bass note options whilst playing in the open position.

In jazz guitar performance:

- To extend range.
- To increase string numbers to allow the instrument to play multiple parts, such as bass, chords and melody, simultaneously.

Maintenance of irregular inter-string intervals in earlier 8-string guitars

A significant common factor in all described 8-string modifications of guitar tuning is that, within these modified tunings, *irregularity of tuning is maintained*. In other words, the described configurations are essentially a standard-tuned guitar with more strings in their upper and lower ranges.

Because such modifications maintain the standard E A D G B E tuning, the previously described 8-string guitars also maintain the guitar's sharp keys bias. (The sharps keys bias of the guitar in its standard tuning is further discussed in the following sections.)

The 8-string guitars described are thus designed to play a standard guitar repertoire in a standard way, more or less, with some extensions of capacity and additional ease of facility.

Orientation of 8-string regular interval guitar

The 8-string regular interval guitar's orientation is not designed like earlier 8-string guitars. Rather it is designed with an intent for openness of approach to playing, especially improvised music.

⁴ "Eight-String Guitar," Wikipedia. https://en.wikipedia.org/wiki/Eight-string_guitar

Its regular horizontal and vertical hand positional movements for transposition and modulation are designed around its capacity to transpose musical ideas seamlessly, vertically (up or down), or horizontally across the fingerboard within its extended range, without requiring consideration of the vertical position from which it starts. Interestingly, it would be difficult to play a normal guitar repertoire on the instrument because such a repertoire would have been written for the irregularly tuned guitar in its standard tuning configuration.

The 8-string regular interval guitar has thus been designed with the capacity to play new and improvised music, including music not oriented towards sharp keys nor the performance of existing repertoires. Specifically, this includes *Oscillation 1*, which, being equi-harmonic, is not oriented towards sharp keys. More generally, the instrument has been designed for improvisation.

Rationale for modifications

The standard E A D G B E tuning format has been adequate for a wide variety of uses in popular, folk, classical, and jazz idioms. The modification of such a “satisfactory” arrangement thus warrants justification beyond that of novelty alone.

In proposing a justification for the modifications of the 8-string regular interval guitar over the standard 6-string irregularly tuned guitar, it is informative to consider in what musical context the standard guitar is typically played. It is then possible to consider what advantages are conferred by the standard irregular tuning and in what *contexts* such design properties of the instrument are advantageous or in what context the standard tuning is a hindrance.

Rationale for standard tuning

The guitar is played in multiple genres and idioms. A particularly common role, however, is as an accompaniment instrument for the voice. The standard irregular tuning of the guitar would thus seem to be designed around ease of playing the guitar within a specific role, including as a support instrument for the voice. In such a role, simple, easily fingered open chords are often used. This, and other advantages of irregular tuning are discussed below.

Advantages of irregular tuning

The following explanation comes from the article *Why Is the Guitar Tuned the Way It Is?*⁵

By using a major 3rd between G and B, the chord tones on the higher strings come down a fret, making them easier to play as part of the chord.

Also, if the guitar used a true all-fourths system, it would be EADGCF. But that means you would have a minor 2nd interval between your low string and your high string. Things like barre chords wouldn't be possible because you would constantly need to compensate in order to avoid voicing that minor 2nd interval ...

This tuning is also the reason that guitarists tend to favour “sharp” keys, such as the key E, G, A, or D. Since the strings are tuned to important notes from these keys, it's very easy to play chords with open strings which sound more resonant.

Guitar teacher Brian Bunnell captures this concept succinctly as follows:⁶

⁵ The Guitar Journal, “Why Is the Guitar Tuned the Way It Is?” (June 2017). <https://www.theguitarjournal.com/why-is-the-guitar-tuned-the-way-it-is/>

⁶ Quora, “Why Do Most Guitars Have Six Strings?” <https://www.quora.com/Why-do-most-guitars-have-six-strings>

The current model of six strings in a standard tuning has been settled on because it offers an adequate range of pitches and the hundred or so most commonly used chords can be played by the human hand fairly comfortably.

Tuning biases of the traditional guitar

In such a context, the guitar is typically played with a bias towards:

- simple music over more complex music
- ease of strumming over single notes
- open position over advanced positions
- sharp keys over flat keys.

This includes the use of open chord hand positions where the standard irregular tuning allows certain chord voicings to be played easily. Because of this, however, the overall orientation of the instrument strongly favours some keys over others in a manner perhaps not seen to the same extent in any other 12-key instrument.

General considerations

The 8-string regular interval guitar, as used for the current dissertation, is tuned in perfect fourths starting from A. Thus, from low to high, the tuning for its open strings is as follows: A D G C F B^b E^b A^b. Such a modification allows these design advantages:

- **Increase in range**

The 8-string octave guitar increases the range of the guitar by almost an octave. Specifically, it increases the lower range by a perfect fifth and the upper range by a major third, increasing the overall range by 11 semitones.

- **Horizontal and vertical (inter-string) interval regularity**

In contrast to the “standard” guitar tuning of EADGBE, where four of the five inter-string intervals are a perfect fourth, and one interval (the G to B inter-string interval) is a major third, the inter-string intervals of the 8-string regular interval guitar are consistent — all seven inter-string intervals are a perfect fourth.

The advantage of this regularity is that it permits universal transposition of positions — be they notes, chord shapes or melodic phrases — not only up and down the fretboard but also *across the fretboard* (i.e., from string to string).

Notes, melodies, scalar movements, arpeggios, chords, chord sequences, and entire songs can thus be transposed without any adjustments to hand position or fingering beyond moving up and down the fretboard horizontally or across the fretboard vertically. This regularity of transposition allows the unaltered transposition of multi-string passages in a way not unlike the regular transposition of musical segments on the piano.

In addition to the ease of transposition, the 8-string interval guitar, by its regularity, also lends itself to improvisational capacity.

- **12-tone and equi-harmonic orientation**

Having both horizontal and vertical interval regularity, the 8-string interval guitar is ideally suited to 12-tone and equi-harmonic styles of music.

The basis for this lies in the regular capacity afforded by the design for forward and reverse functional harmonic movement, as described below, a capacity that in the composition *Oscillation 1* permits ease of both *linear* and *cyclic* harmonic movement.

- **Forward and reverse functional harmonic movement orientation — movements and modulations to the sub-dominant and dominant**

Being separated in horizontal (string-crossing) movements by a perfect fourth, the 8-string regular interval guitar easily permits forward and reverse functional harmonic movement.

- **Forward functional harmonic movement**

On the 8-string regular interval guitar, movement of a note, melody, or scalar “up a string” constitutes *transposition* up a fourth or modulation up a fourth to the subdominant key — that is, forward harmonic motion.

- **Reverse functional harmonic movement**

Conversely, movement of a note, melody, or scalar “down a string” constitutes *transposition* down a fourth or modulation down a fourth to the dominant key — that is, reverse harmonic motion.

Because of the regularity of its tuning, the 8-string regular interval guitar, in contrast to the traditionally tuned guitar, has regular and unchanging forward and reverse harmonic movement orientation.

For this reason, the guitar is ideally suited to a composition like *Oscillation 1*.

- **Linear and cyclic modulation capacity because of forward and reverse functional harmonic movement orientation**

By its *forward and reverse harmonic movement orientation*, the 8-string regular interval guitar also permits two distinct harmonic movement modulation options — one being *linear* (i.e., one-dimensional and bi-directional, akin to the movement of a pendulum through its arc and its return), the other being *cyclic* (i.e., two-dimensional and uni-directional, akin to the movement of a pendulum through a circular displacement as seen from above).⁷

Form and void representations of linear and cyclic modulations

The modulation movement designated to demonstrate the concepts of linear and cyclic modulation (and the suitability of the 8-string regular interval guitar to playing music structured around such modulations) is the fundamental modulation from a root I key to the subdominant IV key and back again: I – IV – I.

The “void” or “home” position of the described modulation is “I” or the *root position*.

The “form” or “away” position of the described modulation is “IV” or the *subdominant position*.

The *linear* modulation pathway from void (home) to form (away) to void (home) is characterizable as a *uni-dimensional, bi-directional* movement

⁷ Linear modulation is achieved by moving the hand position up one string (“up” means higher in pitch — physically, it is a downwards movement to the next string) and then returning it back down to the original string. Cyclic modulation is achieved by moving the hand position up one string and then up an additional string. Variations on these linear and cyclic hand movement algorithms occur when the modulation also includes a modulation of up or down an octave, to keep the modulation within the instrument’s playing range.

The *geometrical representation* of the *linear modulation pathway* is thus akin to the *uni-dimensional and bi-directional* movement of a pendulum traversing its forward-and-backward arc.

In harmonic formulaic representation, this linear modulation void-form-void pathway would be represented as: I – IV – I.

For the example of the key of C Major, in *alphabetic* representation, this *linear modulation void-form-void pathway* would be represented as: C – F – C.

In contrast, the *cyclic* modulation pathway from void (home) to form (away) to void (home) is representable as a *two-dimensional, uni-directional* movement.

Similarly, as described earlier, the *geometrical representation* of the *cyclic modulation pathway* is thus akin to the *two-dimensional, uni-directional* movement of a pendulum traversing a circular path as viewed from above.

In harmonic formulaic representation, this linear modulation void-form-void pathway would be represented as: I – IV – vii^b – iii^b – vi^b – ii^b – v^b – vii – iii – vi – ii – V – I.

For the example of the key of C major, in *alphabetic* representation, this *linear modulation void-form-void pathway* would be represented as: C – F – B^b – E^b – A^b – D^b – F[#] – B – E – A – D – G – C.

What is apparent in the functional harmonic representation of the *cyclic* modulation void-form-void pathway is that to complete the void-form-void cycle, there must be *iterative progressive modulation*, which is the process of *repeated modulation from the away position rather than the home position*, such that for sequential modulations *what was previously the “away” (or form) position becomes the new “home” (or void) position*.

In the alphabetic representation above, the “F” key centre initially functions as the “away” (or form) position *relative to the key for its home position — the key of C*.

Continuing the *iterative progressive modulation*, however, for the next step of the cyclic sequence, the “F” key centre changes its function as the “away” (i.e., form position) to become a *new home* (i.e., void position) *relative to the new key — the key of F*.

With F as the new home key, B^b becomes the new “away” key.

Thus the cyclic modulation becomes C – F – B^b

Cyclic modulation and iterative progressive modulation — non-transitive and transitive formulaic nomenclatures

Referring to the above example, the *cyclic* modulation pathway from void (home) to form (away) to void (home) may have *either*:

- alphabetic representation: C – F – B^b or
- harmonic formulaic representation I – IV – vii^b

The “vii^b” (i.e., flat-seventh degree of the scale) is flat-seventh relative to the original home key (i.e., C) rather than relative to the “new” home key (i.e., F).

Such a harmonic formulaic representation may be said to be *non-transitive* harmonic nomenclature — that is, the home (void) position *does not transition or move with the sequential modulation*.

By contrast, referring again to the above example, the *cyclic* modulation pathway from void (home) to form (away) to void (home) may also be represented as harmonic formulaic representation, I – IV –

IV^T , where IV^T indicates the IV or subdominant is relative to the *transitioned* new home (or void) key — relative to the new modulated key of F rather than relative to the original key of C.

In the above example of the cyclic sequence of C – F – B^b, the “B^b” may be represented as “vii^b” — the flat seventh relative to the original (non-transitive) home key of C.

Alternatively, the “B^b” may be represented as “IV^T” — that is, as the subdominant of relative to the new (transitive) home key of F.

Function of transitive and non-transitive nomenclatures

The main reasons for introducing the concept of transitive and non-transitive nomenclatures in this section is twofold:

- Firstly, such nomenclatures allow a concise description of the suitability of the 8-string regular interval guitar for the playing of an equi-harmonic composition such as *Oscillation 1*. The nomenclature can be used to describe the **positional change algorithm** of the classical hand positions (based on fret position) for the linear and cyclic modulation movements needed for the guitar part of *Oscillation 1*.
- Secondly, the transitive nomenclature provides a concise language for describing the linear and cyclic vectorial movements that make up the composition, as described in Chapter 2 (Methodology).

Demonstrating these concepts, the following section describes the **positional change algorithm** of the classical hand positions (based on the fret position for the left index finger) for the linear and cyclic modulation movements, as required for the guitar part of *Oscillation 1*.

The essential structure of the repeating equi-harmonic cycle of the composition, *formulaically* expressed, is:

Where B is in the subdominant key of its corresponding A-section, and A^{n+1} is in the subdominant key of its preceding B-section B^n , The equi-harmonic cycle is representable as:

$$A^1B^1 A^1B^1 > A^2B^2 A^2B^2 > A^3B^3 > A^4B^4 > A^5B^5 A^5B^5 > A^6B^6$$

Referencing the above concept of transitive nomenclature, the same essential structure of the equi-harmonic cycle may be more concisely described as:

Where B is in the subdominant key of its corresponding A-section, and A^{n+1} is in the subdominant key of its preceding B-section B^n , and

For $n = 1 - 6$, where T indicates transitive nomenclature

The equi-harmonic cycle is representable as:

$$A^1B^1 A^1B^1 > A^T1B^T1 A^T1B^T1 > A^T1B^T1 A^T1B^T1 > A^T1B^T1 A^T1B^T1 > A^T1B^T1 A^T1B^T1 > A^T1B^T1 A^T1B^T1$$

or

$$A^T1B^T1 A^T1B^T1 \times 6$$

Forward and reverse linear, and cyclic harmonic movement

The compositional units section describes the structure of the composition as being made up of seven-bar A and B sections, effectively working as call and response respectively, so that the seven-bar B-section harmonically functions as the modulation of the seven-bar A-section to its subdominant key.

The algorithmic representation of the ABA'B' cyclic modulation movement is:

- Play the A-section.
- Go up a string and play the B-section from this position.
- Go back down a string, move down two frets. *If this is beyond the instrument range, play the A-section an octave higher by moving up a string and remaining in the same classical guitar position.*⁸
- Play the A-section in the new cyclically modulated key from this position.

This ABA'B' movement corresponds to the repeated *perpetually forward* movements of the bidimensional, uni-directional, *cyclic* pendulum movements.

This is thus the method by which the 8-string guitar accommodates cyclic modulation.

It is notable that in the $A^1B^1 A^1B^1 > A^2B^2 A^2B^2 > A^3B^3 A^3B^3 > A^4B^4 A^4B^4 > A^5B^5 A^5B^5 > A^6B^6 A^6B^6$ formulaic representation of the full equi-harmonic cycle, the algorithm for forward cyclic harmonic movement could shift the hand position at A^2 from the 2nd position to the open position, the harmonic movement being $F B^b F B^b E^b A^b E^b A^b$ etc.

This would, however, require a change of fingering pattern as the open strings would be played open rather than by the index finger (represented in Figure 2 as “1”). Such an irregularity defeats the described purpose of the 8-string guitar as an instrument that does not require adjustments in vertical (inter-string) or horizontal (intra-string) movements.

For this reason, in the 1st cyclic modulation of the composition, occurring at bar 29, when the composition moves into the key of E^b , the hand position remains in the 2nd classical guitar position, commencing on the 6th G string.

The capability of the 8-string guitar to do this demonstrates the benefits of its additional strings and extended range.

Before moving on, the topic of chords and chord shapes for the 8-string interval guitar will be briefly addressed.

Chord fingering chart for the 8-string regular interval guitar — the concept of vertical regions

In *Oscillation 1*, the guitar functions as a “harmonic tanpura”. To that extent, its melodic sequence defines the harmonic movement of the composition, similar and analogous to the role of the traditional tanpura in Indian classical music, albeit at the level of a repeating pattern of modulations between moving harmonic centres rather than at the level of a single tonal centre.

As notated and recorded, *Oscillation 1* does not include an accompaniment (known as “comping”) part for the guitar. Nonetheless, like the regular guitar, the 8-string guitar has the capacity to play chords in a comping style.

The suggested initial chord shapes for all chords within one three-minute equi-harmonic cycle are graphically represented in Appendix 9.

⁸ The converse applies when the upper limit of the range of the instrument is reached. In this scenario, the modulation that occurs lowers the modulation by an octave, permitting the modulation to be accommodated within the range of the guitar. Such accommodations permit the equi-harmonic cycle to be played perpetually within the range of the instrument.

It is notable that, as it is an instrument with eight strings rather than six, playing chords on the 8-string guitar can be approached from a perspective where *not all strings of the guitar need to be played*.

Thus, rather than including all eight strings in chord positions, which (for reasons described in the cited article “Why Is the Guitar Tuned the Way It Is?”) is not feasible, the 8-string guitar can be approached from the perspective of *vertical regions*.⁹

The chord shapes provided in Appendix 9 are three-note chords played within the vertical region of three strings. The chord fingerings presented in Appendix 9, even when played in all 12 keys with reasonable voice leadings, when played as three-note chords within defined vertical regions, do not extend outside the range of five strings — using strings 7, 6, 5, 4, and 3 only. Such an approach emulates the way a piano keyboard is played. The difference, however, is that the piano keyboard, when played in a comping style, limits its horizontal regions, while the 8-string guitar limits both its horizontal and vertical regions. This is a fundamentally different approach to playing the guitar as an instrument where all strings need to be sounded at once in a consonant way.

Approaching the playing of the 8-string regular interval guitar from the perspective of limitation of vertical (as well as horizontal) regions thus addresses the “minor second” problem of consecutive fourths tuning in a novel way. Rather than sounding all strings open or fretted, the guitar is played within selected vertical regions — for example, three strings only.¹⁰ Such an approach is like the way the piano keyboard is played, as is described next.

Keyboard-like qualities of the 8-string regular interval guitar

With its regular intervals, increased range, and 12-key orientation, it is proposed that the 8-string regular interval guitar has a place in certain musical contexts — in particular, 12-tone music, equi-harmonic or 12-key music, and improvised music that maintains a traditional Western harmonic organisation.

It is proposed that the 8-string regular interval guitar is less “idiosyncratic” than the traditionally tuned 6-string guitar, particularly in relation to its regular organisation of intervals, chord shapes, and modulation algorithms.

Whereas the traditional 6-string tuned guitar orients towards the ease of playing I, IV and V chords in open position strongly biased towards sharp keys, the 8-string interval guitar is more “harmonically open” in its orientation.

For this reason, the 8-string regular interval guitar is more *keyboard-like* than the traditionally tuned 6-string guitar. This is for two reasons:

- Firstly, like the layout of the keyboard, the 8-string regular interval guitar, having open string tunings equally distributed in sharps and flats, is *relatively flat-keys-sharp-keys neutral*.
- Secondly, repeated movements of hand positions correspond to repeated regular-interval movements.

For these reasons, it is proposed that the 8-string regular interval guitar is more keyboard-like in orientation than the traditional guitar. Further to this, the 8-string regular interval guitar is arguably more “open” to play music that is not inherently guitar-oriented, including improvised music within a traditional Western harmonic organisational framework.

⁹ *The Guitar Journal*.

¹⁰ *The Guitar Journal*.

12-drum tabla set

The tabla in its traditional usage in North Indian classical music has a rich lineage. Important historical milestones, styles, and examples of some characteristic pieces and their historical period are listed in the discography (see Appendix 8).

Dr Sam Evans contextualises the musical language of the tabla and related Indian musical concepts using the following orthographic convention:

Specific terms related to Indian music are included in this text, most derived from the Hindi language. Transliteration of these terms is according to *The Oxford Hindi-English Dictionary* (McGregor: 1993) and are italicised throughout. . . . The word bayan has not been italicised as it is one of the main drums in the tabla set that is central to the work and often appears in conjunction with the word tabla. The spellings for the mnemonic syllables that define the notes performed on the tabla (tabla bols) are defined in the notation indications at the beginning of the scores document of this portfolio.¹¹

In referencing and representing such concepts, the current dissertation assumes the same conventions as those defined by Evans. These conventions appear in two main contexts in Chapter 2.

- Firstly, the convention is applied to the tunings and notation of tabla drums — particularly the naming and spelling of the “bayan” (in Hindi बेयान) — the left-hand drum of the tabla pair.
- Secondly, in the composition score/transcription for *Oscillation 1*, the convention is applied in the spelling of tabla “bols” — the *mnemonic syllables that define the notes performed on the tabla*.¹² The notation convention used in the current research for the tabla’s score/transcription is described in further detail in the next section.

Score/transcription notation for tabla

As described above, traditional tabla notation is defined *mnemonically* as “bols”, being of fixed and unchanged tuning. Thus, traditional bols make no reference to pitch — they refer to timbre and rhythm only.

The particular significance of this for the current research is the requirement of the tabla set in the composition *Oscillation 1* to have melodic, harmonic, chord sequential, and key modulation capacity.

Not only is the tabla required to have pitch, but *Oscillation 1* also requires the tabla drums to have *changing pitch*. (The pitch of both drums changes every 30 seconds.)

In the context of the current dissertation being otherwise written within a Western musical system, the tabla notation used for the composition is the same contemporary notation system as that used by Evans in “Tabla without Borders” as a notation to indicate pitch. The essence of this contemporary tabla notation is a hybrid notation that notates tabla and bayan pitch on the standard Western staff, alongside the tabla’s mnemonic bols.

Given that the tabla part of the composition originated from and extends the work of Evans, it is logical and appropriate to use the same convention as that used by Evans.

¹¹ Evans, “Tabla without Borders,” v.

¹² Evans, “Tabla without Borders,” v.

Relative and absolute pitch references in Eastern (North Indian classical) and Western musical systems

Being an intercultural composition, the current research refers to both Western and Eastern (North Indian classical) musical systems.

Coming from a Western musical paradigm, however, and being primarily written for a Western academic audience, most of the description and analysis refers to the terms and concepts of the Western musical system. The exception is in the description of the tabla drum and bayan drum tunings, which are described both in terms of *absolute pitch* (Western nomenclature) and *relative pitch* or *scale degree nomenclature* (North Indian classical musical system, also known as *sargam*).

A brief outline of the North Indian classical musical system and where it is referenced in the research follows.

The North Indian Classical “sargam” system

Though by no means synonymous with Western musical notes,¹³ the musical notes system of North Indian classical musical nomenclature or *sargam* is sufficiently like the Western musical system to justify a statement about the basic correspondence between notes in Western and North Indian classical systems.

Like the Western musical system, the *sargam* system divides the octave into seven notes or “swara”. The notes are called shadja (षड्ज), rishabha (ऋषभ), gandhara (गान्धार), madhyama (मध्यम), panchama (पञ्चम), dhavata (धैवत) and shadja (षड्ज). They are collectively abbreviated to *Sa, Re, Ga, Ma, Pa, Da, Ni*,¹⁴ roughly corresponding (regarding relative pitch at least) to the Western diatonic scales of *Do, Re Mi, Fa, So, La, Ti*. Importantly, *Sa, Re, Ga, Ma, Pa, Da, Ni* and *Sa* notes have no absolute pitch — that is, they have musical definition and relative pitch only in the context of comparison with one another.

In summary, for the current research, the intervals and tunings for the bayan and tabla drum are described both in Western musical notation terms and in reference to the Indian *sargam* system.

Tabla terminology

The term “tabla” requires clarification as it is used differently in different contexts. The *general* use of the word in music refers to *both drums of a pair of drums* played by a tabla player. The *specific* use of the word is a reference to the right-hand drum only. In this terminology, the left-hand drum is called the *bayan*. The term *tabla* used in the general sense thus refers to *the pair of drums* — the left-hand *bayan* drum and the right-hand *tabla* drum.

Going forward from this position in the research, the term *tabla* will be used interchangeably with the term *tabla drum* (as opposed to *tabla drums*) to refer to the right-hand drum only of the tabla pair. When emphasising the capacity of the 12-drum tunings used in the composition to play in all 12 keys, the terms *harmonic tabla set* and *12-drum harmonic tabla set* are used interchangeably with the term *tabla*.

¹³ Significant differences include that the *sargam* system uses untempered tuning, has 22 shruti or micro intervals, and the concept of the note extends beyond the musical concept of a scale tone to include a vast array of non-musical associations (each note for instance has a ruling deity), the scope of which is beyond the purpose of the current dissertation.

¹⁴ “Svara,” Wikipedia at <https://en.wikipedia.org/wiki/Svara#:~:text=Svara%20or%20swara%20is%20a,complete%20dimension%20of%20musical%20pitch.&text=These%20seven%20swaras%20are%20shortened,Pa%2C%20Dha%2C%20and%20Ni>

This convention, as it relates to the terminology of individual drums of the tabla pair, is consistent with that used by Dr Sam Evans in “Tabla without Borders”.

The 12-drum harmonic tabla set

The 12-drum harmonic tabla set used in the current dissertation is a novel adaptation and extension of the traditional tabla pair. As such, it is a tuning modification involving both the left-hand *bayan* drum and right-hand *tabla* drum.

Purpose of modification

Like the situation stated for the guitar, the essential design of the tabla pair has been satisfactory for the music styles in which it has traditionally been played. Also like the guitar, over time the tabla has progressively modernised — up to its present form as it appears in contemporary North Indian classical music.

In the last half of the twentieth century, solo instruments such as the santoor (a small, hammered dulcimer played on the lap) and the bansuri (Indian classical flute) have transitioned from “folk instruments” to concert instruments traditionally accompanied by the tabla. References to such transitions from folk to concert music are listed in the discography (Appendix 8) and include the post-2000 recordings of bansuri virtuoso Hariprasad Chaurasia.

The tabla has supported such instruments and modernised alongside them. To modify an instrument that is perfectly adequate in its traditional context thus requires a good reason.

In the context of the current dissertation, the purpose of conceiving, creating, notating for, and recording the 12-drum harmonic tabla set has been conceived as a modification and contemporising of the instrument to permit it to play in all 12 Western keys. Such a modification significantly increases the instrument’s potential repertoire and allows it to make a novel contribution to contemporary Western music.

Evans provides examples in various recordings, reference to which will be made later regarding the tabla’s capacity for melody, harmony, and chord changes, and poses these questions:

What role can, and does the tabla play, in contemporary music that does not adhere to the musical conventions for which the current repertoire is devised? Which musical elements and conventions that are not accounted for in the current repertoire may be brought to and performed on the tabla in such music?¹⁵

In regard to extending the melodic, harmonic, chord sequential, and ultimately key modulation possibilities for the tabla, the current research extends the tabla set as conceived, constructed, and composed for by Evans, to the *12-drum harmonic tabla set*, further contemporising the instrument and specifically providing a mechanism for the tabla to play *equi-harmonically* (i.e., with equal distribution of harmonic content in all 12 keys), a requirement of the submitted creative work, *Oscillation 1*.

Summary of modifications

If the conceived 12-drum harmonic tabla set were an instrument akin to a piano or guitar, the conception and construction of an instrument capable of playing 12-key music within the Western musical system would be straightforward — one would simply build 24 drums (12 tabla and 12 bayan) and play them. Though conceptually this is a rational and simple enough idea, in a practical

¹⁵ Evans, “Tabla without Borders,” 16.

sense, as determined by the practice-based research of Evans, it appears not to be a viable option for several reasons, the most important of these being:

- Both bayan and tabla drums, being hand drums, have *limited range*, which is less than an octave. The lower limit is limited by timbre, a minimum tension being necessary to produce a musically acceptable tone. The upper limit is limited by tolerance — that is, the reliability of the instrument to both remain in tune and not to break under tension. Bayan and tabla, though apparent to the onlooker as two drums, are in fact played like the combined left and right hand playing of the piano, a *combined system*. Of importance is not only the absolute pitches of each of the drums but also their relative pitches — that is, the interval between them.
- Specifically, the tuning of the bayan relative to the tabla is, for the most part, limited to tonic, fifth and occasionally fourth. Typical bayan-to-tabla tunings are thus *Sa: Sa* (tonic: tonic) and *Pa: Sa* (fifth: tonic).
- Unlike a stringed instrument, such as a piano or guitar, for the tabla, the fundamental of every individually tuned note needs to be played on a different drum, a reality that creates (due to the limited reach of the human arm) ergonomic limitations to the number of drums that can be simultaneously used as part of a multi-drum tabla set.

Fortunately, however, innovations in the current dissertation both in tuning and in recording and mixing technique, enabled the establishment of a usable 12-drum harmonic tabla set that allowed, with the assistance of studio-recording techniques, the recording of the submitted creative work, *Oscillation 1*. Appendix 5 details how this was achieved.

Evans's "Tabla without Borders" as the foundation for developing the harmonic capacity of the tabla

Given that the 12-drum harmonic tabla set configuration proposed, recorded, and noted in *Oscillation 1* has its origins in, and is a conceptual extension of, the melodic, harmonic, and chord sequential playing capacity of the tabla set (as achieved by Evans), it is appropriate to summarise the capacity of the tabla to play contemporary melodic and harmonic music (as demonstrated by Evans), particularly the challenges, limits, and pathways that allow the tabla to be played as a multi-pitched instrument.

Building from this foundation, this dissertation extends the work of Evans to find ergonomic, configurative, performance-based, arrangement/compositional, and studio-recording process adaptations and accommodations that collectively provide a music production mechanism that allows the tabla to play in, or modulate between, any of the 12 Western major keys.

Considerations for multiple pitch tunings in tabla and bayan

In designing a mechanism and process for the tabla pair, it is possible to conceive tuning configurations that provide multiple tunings for either tabla or bayan or both.

For reasons stated below, Evans's work on melodic, harmonic and chord sequential tabla configurations involves multiple tunings (up to four) of tabla only — that is, with a fixed single-pitch bayan tuning.

The reasons for this are multiple and are summarised by Evans as follows:

In this investigation, I found that melodic content on multiple tabla drums was more effective than that on multiple bayan drums for a variety of reasons. When required,

the pitch and sound of the bayan may be adjusted during performance and in most cases, this alone negates the use of multiple bayans. Also, in practical application, the bayan is most often played with sustain. The register of the bayan is between one and a half, and two octaves below middle C, the same register as the lowest notes on an electric bass. Multiple sustaining pitches in this register create an incoherent lower register in the music. Finally, during the research process I discovered the traditional tabla technique easily adapted to playing multiple tabla drums but multiple bayans always felt very awkward. I suggest this is mainly due to the nature of the playing technique on the bayan that requires constant contact between the palm of the performer and the skin of the drum to continually adjust the sound. Breaking that contact also broke the flow of the playing in my experience. For these reasons, I have not included the bayan drum as part of the melodic investigations in this research.¹⁶

In contrast to Evans's compositions, this dissertation provides a mechanism and configuration that involves multiple tunings of *both* tabla drums — that is, both right-hand tabla and left-hand bayan. This is achieved via accommodations of ergonomics, configuration, arrangement/composition, performance process, and studio-recording process, discussed below.

Timbral considerations for pitched tabla

Evans notes that, *compared with non-hand drum instruments*, there are inherent timbral challenges for the tabla to play pitched music. He notes that the timbral difference between hand drums and traditional melody-playing instruments are such that “unlike other instruments that may typically play a chord progression, such as guitar or piano, the sound of the tabla has a very fast attack”.¹⁷

Conversely, *within the field of hand drums*, the tabla has advantageous timbral qualities, leading to the possibility of melodic playing. In this regard, Evans notes that:

Due to the sustaining pitch and long decay produced on the tabla the instrument may be considered favourable in harmonic settings relative to other drums.¹⁸

Evans provides evidence of these propositions graphically, by way of their contrasting wave forms, as shown in Figure 3 (next page). These timbral qualities are attributed specifically to the tabla; the bayan has very different timbral qualities. Perhaps the most important of these is that it has less attack than the tabla (being pitched in the bass register). Regarding sustain, however, the bayan (being lower) has a much longer sustain than the tabla, and even more so when allowed to ring un-muted by the palm of the left hand.

Further explanation of the acoustics of the bayan are beyond the scope of the current research. It is important, however, to note that the timbral qualities of the tuned bayan drum, particularly in its role of outlining the harmonic movement of the piece at its modulation points, contribute significantly to the novel timbral quality of *Oscillation 1*.

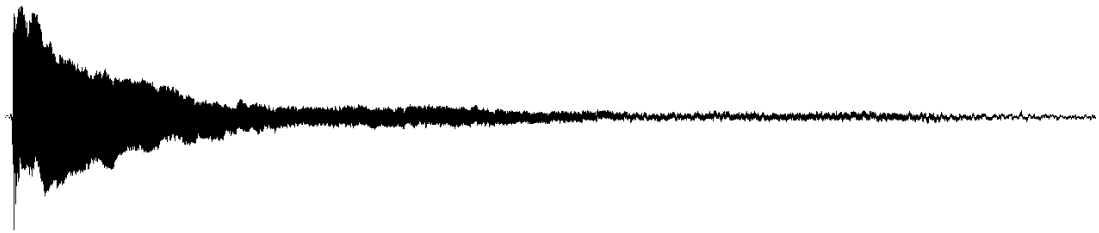
¹⁶ Evans, “Tabla without Borders,” 57.

¹⁷ Evans, “Tabla without Borders,” 87.

¹⁸ Evans, “Tabla without Borders,” 87.



Guitar wave form



Piano wave form

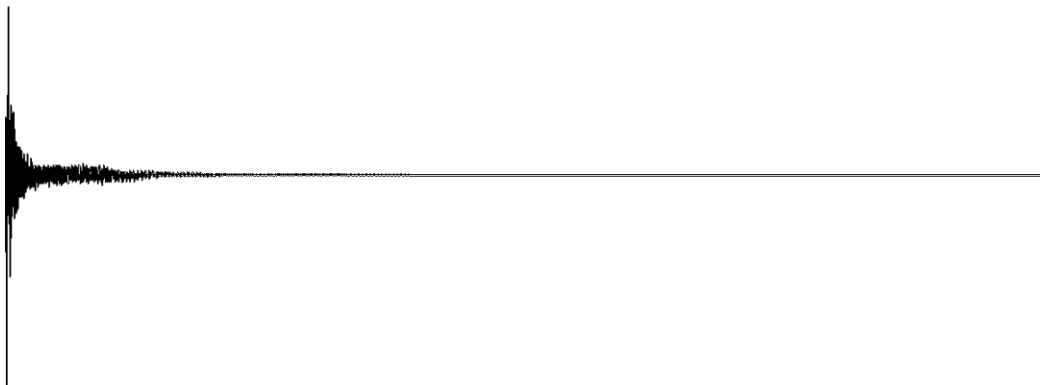


Figure 3: Tabla wave forms

Source: Evans, “Tabla without Borders.”

Melodic capacity of tabla as formulated by Evans

In “Tabla without Borders”, Evans has devised a method for playing tabla within a melodic context, using 2, 3, and 4 tabla sets.¹⁹ He also describes a historically novel instrumental method for tabla for the playing of melodies with 2, 3, and 4 notes.²⁰

Configurational accommodations

The configurational accommodations devised by Evans for playing two-, three- and four-note melodic tabla are demonstrated in the following photos (see Figure 4).²¹

¹⁹ Evans, “Tabla without Borders,” 56.

²⁰ Evans, “Tabla without Borders,” 60–64.

²¹ Evans, “Tabla without Borders,” 60–64.



Figure 4: Examples of configurations for two, three, and four tabla (with one bayan)

Compositional accommodation

The arrangement of melodic content to allow playing on the tabla is an example of what may be referred to as *compositional accommodation* or adjustment. In principle, such compositional accommodation is no different from writing for any instrument with awareness of the biases and limitations of the instrument. The difference, however, for the tabla is that in many cases (such as the limit of pitch choices) the limitations are absolute rather than relative.

As an example of compositional accommodation, a composition written for the cello would conceivably be preferentially written in the key of C rather than D flat because of the biases of the instrument. For the case of a melodic tabla in “Tabla without Borders”, the keys and notes are not just biases but, in the absence of significant innovation and novelty, absolute constraints.

In the following examples taken from “Tabla without Borders”, Evans uses such compositional accommodations to write melodically for tabla within the scope of the multi-drum instrument configurations.

Examples of two-, three- and four-note melodies

The following figures demonstrate examples of two-, three- and four-note melodies.

159 Shakuhachi feature in G harmonic min#4

Shak.

Pno. Or Similar in G harmonic min#4

Bass

Tabla. dhin dhin dha te dha dhin dhin dha te dha dhin dhin dhin na na na dhin dha na na na na na
Or Similar. Played on outer edge of tabla

167 Shakuhachi feature in G harmonic min#4

Shak.

Pno. Or Similar in G harmonic min#4

Bass

Tabla. dhin dhin dha te dha dhin dhin dha te dha dhin dhin dhin na na na dhin
Or Similar. Played on outer edge of tabla

Figure 5: Two-note melody in Evans's *The Valley of Vung* (3:50)

9 A

Cello

Tabla

ka tin tin ke tin tin ka ka ka ka ka tin tin tin tin ka tin tin tin

16

Cello

Tabla

tin tin tin ke tin ke tin tin tin tin tin ka tin ka

22 wordless...

Voice

Cello

Tabla

ke ke tin tin ke tun tun tun tun tun tun tun tun tun tun tun tun tun tun tun tun

strike outer rim of tabla

Figure 6: Three-note tabla melody in Evans's *Shifter* (0:5)

14

Piano

Bass

Tabla

19 tin tin tin

Piano

Bass

Tabla

tin tin na na

24

Piano

Bass

Tabla

tin tin na na tin

30

Piano

Bass

Tabla

dhin dha ta ke ne te ta dhin te ke ne te tin ke ke tin ke ke tin ke ke tin ke ke tin ke ke

Figure 7: Four-note melody in Evans's *In a Milky Way* (3:22) 62

Harmonic capacity of tabla as formulated by Evans

Extending the re-imagining of the tabla and its role in “Tabla without Borders”, Evans further proposes a system for harmonic playing of the tabla, devoting a chapter to the formulation of how this may be achieved.²² Evan’s formulation includes subsections devoted to *pedal point*, *root-based harmony*, *triad-based harmony*, *moving harmony*, and *the creation of harmony through multiple parts*.

Examples of tabla playing harmonic roles in various capacities are as follows:

73

Voice

The te - lling and the re -

Vc.

Tabla

dhin na dhin dhin na tin na dhin dhin na dhin na dhin dhin na

Tabla E

dhin na dhi ge dhi na ke te tha ka ta ka te re ke te tha ka ta ka te re ke te dhin na dhi ge dhi na ke te

76

Voice

te - lling. Of your -

Vc.

Tabla

tin na dhin dhin na dhin na dhin dhin na tin na dhin dhin na dhin na dhin dhin na

Tabla E

tha ka ta ka te re ke te tha ka ta ka te re ke tedhin na dhi ge dhi na ke tin tin na dhi ge dhi na ke dhin na dhi ge dhi na ke

Figure 8: Two harmonised tabla parts in Evans’s *Blueprint* (2:16) 84

²² Evans, “Tabla without Borders,” 71–90.

Condensed

9

Tabla

Em D Bm C Em D Bm C

Cello

17

Tabla

Em D G Bm C Am Em Em

Cello

128

Voice

it all

Shak.

Vc.

Tabla

dha ti ge tin ge tin ge na dha ti ge tin ge tin ge na dha ti ge tin ge tin ge na dha ti ge tin ge tin ge na

Tabla E

dha ti ge tin ge tin ge na dha ti ge tin ge tin ge na dha ti ge tin ge tin ge na dha ti ge tin ge tin ge na

Tabla B

dha ti ge tin ge tin ge na dha ti ge tin ge tin ge na dha ti ge tin ge tin ge na dha ti ge tin ge tin ge na

Condensed

18

Tabla

Cello

Figure 9: Three harmonised tabla parts in Evans's *Blueprint* (3:43)

Chord sequential capacity of tabla as conceived by Evans

Regarding the capacity of the tabla to play chord sequences, Evans notes:

Further extending this approach of multiple tabla pitches in harmony led to the creation of compositions with tabla parts that fulfil a complete changing chord progression. This approach requires many drums and either sufficient players or overdubs to achieve.²³

²³ Evans, "Tabla without Borders," 87.

In relation to the piece exemplifying this concept, he notes:

The harmony in *While You Were Sleeping* is produced entirely with tabla parts alone as an example of the extent to which the tabla may function as a harmonic instrument (track 12, *The Tabla Project*).²⁴

The image displays a musical score for the piece 'While You Were Sleeping'. It features four staves for tabla parts, labeled T2, T3, T4, and Bia, and a separate staff for chordal harmony. The tabla parts are written in treble clef and include lyrics: 'tin na tin tin na tin tin na tin tin na tin' for T2, T3, and T4, and 'ge ge ge ge ge ge ge ge ge ge ge ge ge ge ke ke ge ge ge ge ge ge ge ka ka ka ka ka' for Bia. The chordal harmony staff shows a sequence of chords: C major, F major, G major, D major, and E major.

Figure 10: Chordal tabla harmony in Evans's *While You Were Sleeping*

Regarding the achievement of the tabla to play chord sequences, Evans further notes:

As far as I have uncovered during this research, it [*While You Were Sleeping*] is the first piece to be written with a complete chord progression performed on the tabla.²⁵

Regarding the capacity for the tabla to play in a jazz and extended harmonic context, and summarising the significant advancement and re-contextualisation of the tabla into a Western framework, Evans notes:

While there is a long history of tabla performance in jazz dating back to the 1960s (Farrell 1997: 169²⁶), with famous musicians such as Miles Davis, John Coltrane and Pharoah Sanders incorporating the tabla, this approach, in which chord changes may also be outlined by the tabla, is yet to be adopted.²⁷

To that extent, not only are the *configurations* of multiple tabla proposed in “*Tabla without Borders*” unique and novel, but so too is the depth to which the tabla is incorporated to *harmonically contribute* to the structure of compositions.

Adaptations and accommodations

Regarding the extended compositional possibilities for tabla, the current dissertation builds directly on the work of Evans in “*Tabla without Borders*” to propose a 12-key harmonic tabla set with capability to play in all 12 keys of the Western harmonic system, the details of which are presented in the next section.

²⁴ Evans, “*Tabla without Borders*,” 87.

²⁵ Evans, “*Tabla without Borders*,” 90.

²⁶ Gerry Farrell, *Indian Music and the West* (Oxford: Oxford University Press, 1997) 169, cited in Evans, “*Tabla without Borders*.”

²⁷ Evans, “*Tabla without Borders*,” 90.

The method used to achieve this is discussed as follows, noting the contribution of various accommodations and methods that were collectively applied in the current research to permit the tabla to play in 12 keys, and to permit the recording of the equi-harmonic composition *Oscillation 1*.

Configurative adaptations

Configurative adaptations are adaptations of the tabla set configuration that allow multi-pitch tabla playing and hence the capacity for melodic and harmonic capacity.

In “Tabla without Borders”, Evans found two important ergonomic limitations to the extent to which the normally two-drum tabla set could be configured to play more than one pitch:

- The tabla was the only drum of the pair for which multiple drum configurations were feasible, this being for reasons previously listed, including the bayan’s bass pitch and a playing style that required constant contact between the palm of the left hand and the drum.
- The ergonomic limit of multiple tabla was four tabla drums and one bayan. Granted the size of the tabla and the time taken to move the hand from one drum to another (as opposed to the time to move the finger only as is required on, for instance, piano, guitar, wind instruments), the limit of such a tabla set to four tabla drums does not require further explanation.

In the establishment of a 12-key tabla to record *Oscillation 1*, no configurative adaptations were used — that is, the standard configuration of two drums, bayan and single tabla played together, was the only configuration used.

Performance-based adaptations

In “Tabla without Borders”, Evans refers to what may be broadly classified as “performance adaptation”. This is not a new concept. In the public playing of a piano concerto, for example, the performer may use a “page-turner”. In a pop music performance, an electric guitarist may use an assistant to replace one guitar with another. Such examples of performance adaptations have in common the need for an assistant to manage a task that the musician cannot manage because they are occupied playing the instrument.

Before recording *Oscillation 1*, performance adaptations were discussed, but both Sam and I felt that the amount of human assistance required to replace one tuned tabla with another and to play the pitches required for the music was impractical to the point of being not feasible. Thus, no performance-based adaptations nor any configurative adaptations were undertaken for the recording.

Arrangement/compositional adaptation

For the current dissertation, the arrangement or compositional accommodations that allow the ease of playing a composition are referred to as *arrangement/compositional adaptation*.

Referring to the previously cited example, an arrangement/compositional adaptation for a piece of cello music originally written or intended for the key of D^b would be to write the music in the key of C.

As another example, for the case of the guitar being required to play a piano piece that has an eight-note chord, an *arrangement/compositional adaptation* would be to leave out the two least-important notes and *re-arrange* the chord as a six-note chord instead.

Except for the tabla voicings between A and B sections (as described in the next section), composition of the tabla part for *Oscillation 1* did involve arrangement/compositional adaptation.

The most interesting part of this process, and the part that made the most contribution to *new knowledge*, at least within the field of contemporary tabla technique and repertoire, was the *symbiosis* (i.e., mutual benefit) that occurred between composition and instrument design. As a dynamic characteristic of the relationship between research and practice in practice-based research, this symbiosis was so significant that it would not be an exaggeration to say that the *composition begot the instrument, and the instrument begot the composition*.

In other words, the *12-drum harmonic tabla set* came to fruition out of the necessity to play the equi-harmonic composition. Vice-versa, the (tabla part of the) composition came to fruition out of the capacity of the instrument to play in 12 keys — more specifically, out of the *compositional mechanism* that permitted the instrument to play in all 12 keys.

This *compositional mechanism* is addressed in detail in Chapter 2. Here, it is enough to summarise that the compositional mechanism that permitted the 12-drum harmonic tabla set to come to fruition in the format that was used for the recording of *Oscillation 1* was the realisation that it was possible to play in 12 keys without having 12 tuned tabla drums, pitched in sequential semitones.²⁸

Alternative configurations to 12-drum configuration to permit playing of tabla in 12 keys

The alternative possibility was to use fewer drums but to permit 12-key composition via adaptations. Put simply, in *Oscillation 1*, the *compositional adaptation* made to determine tabla pitches *used alternative voicings* in different sections of the composition. This was achieved by two accommodations — one at the level of the composition and the other at the level of instrument configuration.

The accommodation at the level of the composition — the *compositional adaptation* — was to compose the piece such that a single tabla pair tuning (tabla and bayan) could *play the changes*, or, at a minimum, *play within the key centre*, for two different keys. Otherwise expressed, the tunings of the tabla were such that a single paired tuning was used across both an A-section and its corresponding B-section in the subdominant key. There were thus six pairs of tabla-bayan tunings, 12 drum tunings in all.

Configurational adaptations symbiotic with compositional adaptations

The accommodation at the level of the instrument — the *configurational adaptation* (used in this sense to define the tuning configurations of drums needed to play the piece²⁹) — was to reduce the total number of paired tunings from 12 to 6, based on the capacity of the instrument to play in 12 keys, by using alternative voicings within the A-sections and B-sections of the composition.

The result of this was the structure of the composition having a repeating and modulating AB-section such that the A-section and B-section were sufficiently harmonically related for a common bayan and tabla tuning to be able to define, or at the least be *harmonically consistent with*, the 12 key centres of the composition.

Referring to the cycle of fifths as an indicator of “harmonic relatedness”, the simplest harmonic AB relationship that allows a single tabla part tuning to define *the key centre* is the tonic-subdominant

²⁸ Apart from the ergonomic capacity to play 12 tabla drums, tuned in semitones, this is not possible in a practical sense also because of the limited range of the tunings possible for the tabla and the bayan as a hand drum.

²⁹ The term is used here differently from where the term implies multiple tuned drums played at once, in real time.

relationship. The AB-section of *Oscillation 1* is thus written so that in each of the 432 (36 equi-harmonic cycles x 12 A-B movements per equi-harmonic cycle) instances where the composition moves from the A (call) section to the B (response) section of the melody (as described in Appendix 5), the harmonic movement is a modulation up a perfect fourth or down a perfect fifth.³⁰

Adaptations to studio-recording process

In addition to the compositional adaptation that made it possible to compose and record the tabla in 12 keys, the final important adaptation discussed was the recording process itself. In short, the recording adaptations provided a way of recording the tabla whilst in particular tunings and mixing this content into the correct position. The details of the process that permitted this are given in Appendix 5.

Summary

This section has given an account of the research process that culminated in recording *Oscillation 1*. In relation to the tabla part, the research process found a configuration (i.e., a tuning arrangement of both drums) and a mechanism (in this case, a recording and mixing process) by which the recording of a 12-key composition could be made.

The specific tabla tuning that met this challenge has been designated the 12-drum harmonic tabla set.

At the outset, it was noted that the *conceptual* possibility of having 12 tabla tuned in semitones was not feasible from both an ergonomic and a physical instrument-construction point of view. For this reason, a solution was conceived that involved six paired tabla tunings, with *compositional adaptations* in the form of alternative voicings of A and B sections, where the B-section was in a subdominant key. The drum tunings that permitted the physical construction of a *harmonic tabla set* capable of being played in 12 keys was discovered during this process.

The differences between the harmonic tabla set proposed in the current dissertation and the two-, three- and four-tabla multi-tabla configurations proposed by Evans, and successfully used to play Western harmonic compositions, including simple chord sequential movements, involve the following:

1. Whereas Evans's multi-tabla configurations are designed to play harmonic music within one harmonic key centre (as Western musical compositions are typically written in), the harmonic tabla set is designed to play *equi-harmonic* compositions — that is, compositions whose harmonic content is equally distributed across all 12 keys. *Oscillation 1* is an example of such a composition.
2. Whereas Evans's multi-tabla configurations use multiple (up to four) tabla tunings with *a single fixed bayan tuning*, the harmonic tabla set is a set of paired tunings that use *six different tabla tunings*, and *six different bayan tunings* — that is, both the tabla and the bayan are configured in paired tunings. Further, these paired tunings retain the integrity of the tabla-bayan inter-drum interval (this typically being either an octave interval or a perfect fifth interval, consistent with the inter-drum tunings used in traditional tabla configurations).
3. Whereas Evans's multi-tabla configurations are capable of being played in real time, the harmonic tabla set is not. Rather, it is a set of tunings that fit within the range of the tabla drums (both tabla and bayan) and is physically constructible with satisfactory tuning and tolerances (i.e., the drums stay in tune at these tunings, and the skins do not break). The

³⁰ The A-section moves to the B-section 12 times within each equi-harmonic cycle and the composition constitutes 36 repetitions of the equi-harmonic cycle.

recording of equi-harmonic music requires the recording of tabla within one of the six tuning configurations and the subsequent re-assembly of this content. For *Oscillation 1*, the *recording and mixing adaptations* that made the recording of the composition possible are described in Chapter 2.

The tabla tunings used in *Oscillation 1*, summarised in Appendix 5, are reiterated in Table 7.

Table 1: Tabla tunings used in *Oscillation 1*

Key	Pitch of Bayan	Pitch of Tabla	Key	Scale tones [Bayan, Tabla]	Key	Scale tones [Bayan, Tabla]
[A] [B] 1: [F][B ^b]	F 4	F 2	F Maj	[I, I]	B ^b Maj	[V, V]
[A] [B] 2: [E ^b][A ^b]	E ^b 4	E ^b 2	E ^b Maj	[I, I]	A ^b Maj	[V, V]
[A] [B] 3: [D ^b][G ^b]	* _[High] A ^b 4	D ^b 2	D ^b Maj	[V, I]	G ^b /F# Maj	[XI, V]
[A][B] 4: [B] [E]	* G ^b /F# 4	B 2	B Maj	[V, I] _[High]	E Maj	[XI, V]
[A] [B] 5: [A] [D]	A 4	A 2	A Maj	[I, I]	D Maj	[V, V]
[A] [B] 6: [G] [C]	G 4	G 2	G Maj	[I, I]	C Maj	[V, V]