CHAPTER FIVE

THE SOUND WORLD OF GUITAR MULTIPHONICS

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Guitarists who collaborate with composers find that research on the tone colour of the (classical) guitar is better achieved by those who do not play the instrument (Torres 2015a; Torres and Ferreira-Lopes 2014a). But non-guitarist composers tend to avoid the guitar. There are various reasons for this state of affairs, including the prejudice against the guitar as an art instrument; the difficulty in writing for the instrument; its sonic limitations (e.g. short sustaining of sound); and/or a certain dislike for its paradigmatic sound, arguably a consequence of the conservative practice via which Andrés Segovia (1893-1987) promoted the guitar. All these factors have led to a gap in research on the tone colour of the guitar. This gap motivated us to further study guitar multiphonics, because unconventional performing techniques not only give rise to unusual tone colours but can also be useful in overcoming limitations (Torres 2015a; Torres and Ferreira-Lopes 2014a). Our intention is amply justified by the scarceness of literature on guitar multiphonics, and by the gaps found therein (Torres 2015a). With our investigation, we aim to advance all research carried out on the tone colour of the guitar, to promote this innovative research area and to establish multiphonics as a core part of the guitar vocabulary.

Researchers have only very recently started showing renewed interest on guitar (and piano) multiphonics—Table 5-1 presents the literature by other authors dealing with guitar multiphonics. This consists essentially of compendia on unconventional guitar techniques, which contain limited information mainly due to their large scope. The lack of interest on guitar multiphonics until recently (1) could explain the absence of the technique from the artistic literature—as Tables 5-2 and 5-3 show, only a limited number of pieces make use of it, which nevertheless employ a myriad of notations (Torres 2015a; Torres and Ferreira-Lopes 2013); (2) is in contrast with the attention given (a) to woodwind multiphonics, a subject that has been widely popular for almost half a century; and (b) to bowed-string multiphonics, which started to receive renewed attention at the beginning of this century (Torres 2015a).

The technique of guitar multiphonics produces sounds with colours that are quite distinct from those produced through traditional techniques. It works much better on wound strings (usually the three lowest-pitched strings) and consists, like the technique of harmonics, in damping out some of the vibrational modes (v.ms.) of the string (i.e. suppressing the v.ms. at least to the point at which their strength is negligible) by lightly touching it during or after its excitation (or both). Unlike with harmonics, with multiphonics the filtering of the v.ms. is not systematic with respect to mode number, which makes the perception of multiple pitches easier; moreover, the technique is continuously possible along the string (Torres 2015a; Torres and Ferreira-Lopes 2012a). The maximum overall loudness of the sounds is mostly lower than conventional sounds; the relative loudness of some of their main components may be quite low. In spite of this, the amplification of the sounds was not explored. This led us to conduct an experiment, to prove that the amplification of sounds of multiphonics with close microphone placement allows presenting an audience with a wider palette of colours, thus avoiding associations with the non-amplified instrument, which could disappoint the listener (Torres 2015a; Torres and Ferreira-Lopes 2012a, 2012b, 2014b).

When conveying information on sounds arising from an unconventional technique, it is important to explain the technique, and to characterise and categorise the sounds and their respective form of production according to different criteria. None of the scientific authors, however, have categorised the sounds they suggest differently, nor have they proposed descriptors thereof. Moreover, they have only used some of the possible descriptors for the characterisation of sound production (Torres 2015a). In this chapter, we aim to narrow this gap, by proposing and explaining descriptors for the characterisation and categorisation of sounds of guitar multiphonics and their form of production, some of which are based on our research results. We also discuss the artistic use of multiphonics, giving examples thereof and of the characterisation and respective notation of the sounds and their form of production in a score.

Year	Title (Kind, Publisher)	Author(s)
1983	Comment écrire pour la guitare?: Petit état de lieux à l'ssage des Compositeurs non-guitaristes (Handout, The author)	Rafael Andia
1985	The Contemporary Guitar (Book, University of California Press)	John Schneider
ca. 2002	Comment écrire pour la guitare?: Petit état de lieux à l'ssage des Compositeurs non-guitaristes / How to Write for Guitar: A Guide for Non Guitarist Composers (Webpages, The author)	Rafael Andia
2010	Some notes on writing for the guitar (Handout, The author)	Jonathan Leathwood
2011	Armónicos [Enciclopedia de la Guitarra: Suplemento] (Encyclopedia entry, Piles)	Julio Gimeno
	The Adaptation of Bağlama Techniques into Classical Guitar Performance: Contemporary Techniques, Etudes and Arrangements (Book, VDM Publishing)	Tolgahan Çoğulu
2013	Composing for Guitar: Technical and Acoustical Parameters of Composing for Guitar (MA Dissertation, Konservatorium Wien Privatuniversität)	Nejc Kuhar
	Physically-Informed Indirect Acquisition of Instrumental Gestures on the Classical Guitar: Extracting the Angle of Release (PhD Thesis, McGill University)	Bertrand Scherrer
2014	A Survey of Extended Techniques on the Classical Six-String Guitar with Appended Studies in New Morphological Notation (PhD Thesis, City University of London)	Martin Vishnick
	The Techniques of Guitar Playing (Book, Bärenreiter)	Seth Josel, Ming Tsao
2015	The Contemporary Guitar [Revised and enlarged edition] (Book, Rowman & Littlefield)	John Schneider
	Sculpting Sound on the Classical Six-String Guitar (Book, CreateSpace Independent Publishing Platform)	Martin Vishnick

Table 5-1. Scientific literature by other authors dealing with guitar multiphonics.

<table>
<tr><th>Year(s)</th><th>Title</th><th>Composer</th><th>Instrumentation</th></tr>
<tr><td>ca. 1832</td><td>Fantasie Villageoise</td><td>Fernando Sor</td><td>Guitar</td></tr>
<tr><td>1972</td><td>Auser</td><td>Bruno Bartolozzi</td><td>Oboe, guitar</td></tr>
<tr><td rowspan="4">1975</td><td>Untitled Composition in Three Sections</td><td rowspan="2">William Bland</td><td>Flute, guitar</td></tr>
<tr><td>An impression by Crumb</td><td>Guitar, ensemble</td></tr>
<tr><td>Memorie</td><td rowspan="3">Bruno Bartolozzi</td><td>Three guitars, orchestra</td></tr>
<tr><td>Repitu</td><td>Flute, viola, guitar, percussion</td></tr>
<tr><td rowspan="2">1977</td><td>Adles</td><td>Guitar</td></tr>
<tr><td>Salut für Caudwell</td><td>Helmut Lachenmann</td><td>Two guitars</td></tr>
<tr><td rowspan="2">1984</td><td>Voces de Profundis</td><td>Štěpán Rak</td><td rowspan="2">Guitar</td></tr>
<tr><td>Passing away on two strings</td><td>Uroš Rojko</td></tr>
<tr><td>1985</td><td>Subconscious wave</td><td>Horaţiu Rădulescu</td><td>Guitar, digital sound</td></tr>
<tr><td>1986</td><td>… y a una canción desesperada</td><td>Beat Furrer</td><td>Three guitars</td></tr>
<tr><td>1986/87</td><td>Nombres</td><td>Fritz Voegelin</td><td rowspan="4">Guitar</td></tr>
<tr><td>1990</td><td>Sette studi</td><td>Maurizio Pisati</td></tr>
<tr><td>1991</td><td>etwas Klang von meiner Oberfläche</td><td>Hans Ulrich Lehmann</td></tr>
<tr><td>1994</td><td>RAP</td><td>Claudio Ambrosini</td></tr>
<tr><td>1996</td><td>variationen und alte themen</td><td>Clemens Gadenstätter</td><td>Trombone, guitar, cello, double bass</td></tr>
<tr><td rowspan="2">1997</td><td>AXE[S]</td><td>Sam Hayden</td><td rowspan="2">Guitar</td></tr>
<tr><td>Nach Innen</td><td>Christoph Neidhöfer</td></tr>
</table>

Table 5-2. Artistic literature from 1832 to 1997, featuring classical guitar multiphonics (from Torres 2015a).

Year(s)	Title	Composer	Instrumentation
1998	Mouvement apparent	Philippe Durville	Guitar
	Non-lieu I	Thierry Blondeau	
1998-99	Petit non-lieu	Thierry Blondeau	Guit. [pedagogic]
2000	Mich.Stille	Helmut Oehring	Guit. quartet, tape
2002	Die illegale Ausübung der Astronomie I	Roman Pfeifer	Guitar
2003	Schnitt & Fortsetzung	Michael Reudenbach	Flute, harp, guitar, piano, timpano
1998-2004	Pêle-mêle	Thierry Blondeau	Ensemble (amplified guitar), electronics
2004	Um-Risse	Hans Ulrich Lehmann	Guitar, bariton saxophone
	Cyrano-Szenen	Rita Torres	Guitar
2005	Tempo Mental Rap	Michael Edgerton	Guitar
2004/06	4 Szenen nach Francisco Goya	Clemens Gadenstätter	Guitar and voice in one person
2007	Lieu I	Thierry Blondeau	Guitar
	Bento Box	Joseph Pereira	Alto flute, guitar, vibraphone
2008	Imamusi	Lin-Ni Liao	Viola, guitar, baritone saxophone, piano
	p. 53		Guitar
2009-10	silhuetas de uma dança imaginária	Rafael Nassif	Guitar quartet
2010	Le train de la vie – Doris	Lin-Ni Liao	Guitar, tape
2012	Le tombeau de Falla	Rita Torres	Medium voice, guitar
2014	Flageoletts	Willian Lentz	Guitar
	Wavelets		Flute, guitar, cello

Table 5-3. Artistic literature from 1998 to present, featuring classical guitar multiphonics, excluding the pieces composed in the context of this research (from Torres 2015a; guit.: guitar).

Multiphonics descriptors

In the literature dealing with woodwind and bowed-string multiphonics, the sounds are usually categorised according to a general information descriptor related to sound production (e.g. conventional vs. unconventional fingering) or to the sounds themselves (e.g. stable vs. pulsating). Once individual sounds are charted, they are then ordered in each category according to a specific information descriptor related to the sounds (e.g. lowest/highest resulting pitch in ascending order) (Torres 2015a). The categorisation of the sounds according to specific information descriptors, and their ordering in each category according to general information descriptors related to the sounds or their form of production is, however, also possible. The proposed sound-production and sound descriptors are therefore organised in Tables 5-4/5-5 and Table 5-6 respectively, according to these two types. An explanation of the descriptors follows below.

Sound production descriptors

The spectral characteristics of a multiphonics sound depend on a series of playing conditions. These may be divided into excitation and touching conditions. Some of the excitation conditions determine the amplitudes to which the vibrational modes (v.ms.) of the string may be excited when the string is free from touching, whereas others determine the excitation amplitudes of the v.ms. of the soundboard. The touching conditions together with these potential excitation amplitudes for the string's v.ms.—in case the touching takes place during the excitation—or with the excitation amplitudes of the string's v.ms. on the moment of touching—when the touching takes place after the excitation—determine the amplitudes to which those v.ms. are damped (Torres 2015a: vol. 1: 66-72). Each of the descriptors explained below corresponds to one of these playing conditions, except for the last descriptor, which characterises the result of the combination of others. These descriptors may also be used for harmonics.

Touch location: The touching may take place anywhere on the string. The greater the displacement of a vibrational mode at a touch location, the stronger its damping. The sounds at locations between the nut and fret XII are essentially the same as those at mirrored locations between fret XII and the saddle (because the positions of the string nodes of one half of the string are mirrored at the other half). Our approach excludes the locations for which it is not possible to find good orientation references for their visual situation. Therefore, the technique of multiphonics is only played at frets, and at virtual frets, that is, locations between frets (or between the nut and fret I), but only at virtual frets which are equidistant from each other and the two consecutive frets surrounding them. The factor used for the subdivision of the spaces between frets should not be higher than six, otherwise orientation is lost.

Toucher: The toucher, conventionally the finger pad or tip, may be of different kinds. The wider and/or softer the toucher, the stronger the damping of the v.ms.

Touch pressure: The touching may take place with any pressure, but, at some locations, stronger pressures will not always give rise to sounds of multiphonics (e.g. at locations near the nut or the saddle and at harmonics locations; in regard to the latter see "Technique" below). The stronger the pressure, the stronger the damping of the v.ms. (this will also be caused by the increase of the surface of a soft toucher). We consider the conventional harmonics pressure to be light; we consider strong and very strong pressures to cause significant bending of the string.

Touch beginning: The touching may begin before the excitation, during the excitation or after the excitation at any point of the sound's decay. In the latter case, if this takes too long, it might not be possible to play multiphonics.

Touch duration: The touching may take place with any duration, but the sounds of multiphonics may not last long touching. The longer the touching, the stronger the damping of the v.ms. without a node at the touch location, thus the shorter the decay of most of the partials of the sound. We consider the conventional harmonics duration to be short, and a sound of multiphonics to not last longer than a long duration (thus with a very long duration, either the sound is completely damped out or there is a transition to the technique of harmonics).

Excitation location: The excitation may take place anywhere on the string. The closer the location is to a node of a vibrational mode (v.m.), the less excited the v.m. The excitation at symmetrical counterparts on each side of the touch location gives rise to sounds of a different colour and loudness (because the force on the bridge is of different strength). Exciting the string vey near the bridge ensures the excitation of as many v.ms. as possible (because we ensure that all v.ms. have a loop at the location).

Exciter: The exciter, conventionally a fingernail, may be of different kinds. The harder and/or narrower the exciter, the stronger the excitation of the v.ms. (because the displacement of the string is greater and there is less damping, respectively). A wide exciter will not excite a v.m. if it covers two consecutive nodes thereof. The softer and/or rounder the exciter, the weaker the excitation of the higher v.ms. of the soundboard (because it enhances a gradual release of the string, see "Exciter angle" below).

Excitation form: The string may be excited in ways other than the conventional single-stroke plucking. Bowing is more limited, because it should only take place near the nut or the saddle, otherwise the string gets sticky from the rosin.

Excitation angle: When the string is unconventionally pulled outwards or upwards/downwards, the angle of the string's displacement on release is essentially perpendicular or parallel to the soundboard, respectively; in a rest or free stroke the angle contains both components. The perpendicular direction component favours the excitation of the soundboard's lower v.ms. (because it drives the soundboard directly, whereas the parallel direction component drives it through a very slight rocking of the bridge) and is stronger in a rest stroke than in a free stroke.

Exciter angle / String release: When the string is played conventionally, the nail slides obliquely across the string, which gradually releases the string. The smaller the angle of the exciter with the string (traditionally requested in terms of the resulting timbre), the more abrupt the string's release, thus the greater the excitation of the higher v.ms. of the soundboard (because the string deformation on release is sharper, the impulses that exert force on the bridge thus have a sharper waveform).

Excitation force magnitude: The stronger the force of excitation, the stronger the excitation of all v.ms. (because the displacement of the string is greater), which is particularly significant for the higher v.ms. of the string (because they have lower excitation strengths—this is inversely proportional to the square of the mode number).

Technique feasibility / Technique: The feasibility of multiphonics, (i.e. the degree of achievement of mode-number unsystematism in the filtering of the v.ms. of the string) depends on the playing conditions. For example, at the usual harmonics locations (frets V, VII, XII and XIX) it is only possible to play multiphonics if the string is touched with an extremely light pressure (resulting this in a sound in which the string's fundamental may also be perceived). This, however, has a low feasibility when the string is excited conventionally (i.e. when it is plucked with a single stroke). At other harmonics locations, it is also possible to play sounds with a different kind of spectrum by touching the string also with an extremely light pressure and exciting it very near the bridge. At most locations, however, the technique of multiphonics is the only technique feasible right after the attack, not being always possible to play harmonics during the decay of the sound.

Sound descriptors

Most sound descriptors we propose are based on our approach in, and on results from, an experiment, in which five guitarists touched string 6 at 88 different locations with a light to very light pressure during and very briefly after its excitation, which was carried out with nail and a rest stroke near or very near the bridge; the sounds resulting from three takes of this procedure were recorded with high-sensitivity microphones placed at three positions close to the guitar, and spectrally analysed at two time segments: one right after the attack, and the other after 0.5 seconds (Torres 2015a: vol. 1: 75-93, 107-122).

Maximum overall loudness: Similar to the sounds of harmonics, the maximum overall loudness of most sounds of multiphonics is lower than that of conventional sounds. Nevertheless, given their different spectral content, different loudness levels may be differentiated for the same excitation force magnitude.

Colour: Apart from the use of more conventional descriptors, it is also possible to generally characterise the sounds' colour in terms of associations with other sounds. Many of the sounds of multiphonics have a bell-like character due to the inharmonicity of the higher partials (i.e. their frequencies are not integer multiples of the fundamental frequency), whereas others resemble an insect buzz, because their higher main partials form a cluster (see "Main partials" below).

Main partials: The main partials of a sound are the partials whose pitches may be perceived more easily. In the sounds of our experiment, these partials are not higher than partial 29, and those with mode number 26 to 29 hardly last more than half a second.

Loudest main partial: The loudest main partial (l.m.p.) of a sound might not be its strongest main partial, as a tone's loudness depends on its frequency (and on its possible partial or total masking by other partials). The l.m.p. of the sounds of our experiment is mostly a partial with mode number between 2 and 11.

Relative loudness category of each main partial: The relative loudness (r.l.) category of a partial results from the comparison between its loudness and that of the l.m.p. We chose four categories for the perceivable partials: loud, moderately loud, soft, very soft.

Number of loud main partials: Some main partials may have loudness levels close to that of the l.m.p. For example, the sounds of our experiment have up to 9 loud partials right after the attack, and up to 4 loud partials after half a second. This descriptor is useful when the sounds are not amplified, since partials of moderately loud or lower r.l. are not expected to be perceived in a medium-sized or larger room.

Lowest main partial: The lowest main partial of a sound may have a very soft r.l., but last longer than the highest main partial, therefore being more useful as a descriptor. The lowest main partial of the sounds of our experiment is mostly a partial with mode number between 2 and 5.

Reliability of the sounds: The reliability of the sounds of multiphonics, (i.e. the degree of maintenance of the main partials of the sound during a certain period of time; we considered 0.5 seconds), depends, like the feasibility of the technique, on the playing conditions. For example, at the usual harmonics locations (at which the feasibility of multiphonics is low when the string is excited conventionally, as discussed in "Technique feasibility"), it is only possible to play highly reliable sounds (using the conventional string excitation) when the touch duration is extremely short.

Descriptor			Attributes
Kind of	Touch location		fret / virtual fret / between last fret and saddle
	Toucher	malleability	hard / soft
		width	wide / narrow
	Touch pressure		conventional / unconventional
	Touch beginning		before excitation / during excitation / after excitation
	Touch duration		conventional / unconventional
Kind of	Excitation location		fretboard / sound hole / rosette / bridge
	Exciter	malleability	hard / soft
		width	wide / narrow
		surface	round / flat
	Excitation form		discrete / continuous
	Excitation angle		two component / one component
	String release		abrupt / gradual
	Excitation force magnitude		strong / weak
Technique			harmonics / multiphonics

Table 5-4. General information descriptors and respective attributes for the characterisation and categorisation of the production of multiphonics and harmonics sounds.

Descriptor	Attributes
Touch location	[string numeral, name, pitch symbol or graphic representation]
	[fretboard-location numeral, pitch symbol or graphic representation] / [see "Excitation location" for other locations]
Toucher	finger pad [cvt.] / fingertip [cvt.] / finger side / finger nail side / finger nail surface / plectrum side / plectrum surface / …
Touch pressure	very strong / strong / moderately strong / light [cvt.] / very light / extremely light
Touch beginning	before excitation [cvt.] / during excitation / *n* seconds/beats after excitation
Touch duration	very long / long / moderately long / short [cvt.] / very short / extremely short
Excitation location	[fretboard-location numeral] / *sul tasto* / between last fret and middle of sound hole (s.h.) / middle of s.h. / between middle of s.h. and rosette / rosette [cvt.] / between rosette and *poco sul pont.* / *poco sul pont.* / *sul pont.* / *molto sul pont.*
Exciter	finger flesh / fingernail [cvt.] / hard plectrum / soft plectrum / bow /...
Excitation form	pluck (single-stroke) [cvt.] / *tremolo* / *tremolato* / strike / pull / bow
Excitation angle	oblique to soundboard [cvt.] (free / rest stroke) / perpendicular to soundboard / parallel to soundboard
Exciter angle	oblique (*n* degrees) to string [cvt.; "round sound"] / parallel to string ["sharp sound"]
Excitation force magnitude	... / *ff* / *f* / *mf* / *mp* / *p* / *pp* / ...
Technique feasibility	high / moderate / low / very low

Table 5-5. Specific information descriptors and respective attributes for the characterisation and categorisation of the production of multiphonics and harmonics sounds (cvt.: conventional).

Type	Descriptor		Attributes
General information	Maximum overall loudness		loud / moderately loud / soft / very soft
	Colour	Brightness kind	with/without higher partials
		Balance kind	balanced / unbalanced
		Connotation	bell-like / insect-like
	Main partials' relative loudness categories		loud, moderately loud, soft and/or very soft
	Number of loud m.ps.		[number/numeral]
Specific information	Colour	Brightness	dark / bright / metallic / ...
		Balance	bassy / balanced / piercing / ...
	Main partials (m.ps.)		[partials' numbers/numerals and/or pitch names/symbols]
	Lowest main partial		[see "Main partials"]
	Relative loudness category of each main partial		loud / moderately loud / soft / very soft
	Loudest main partial		[see "Main partials"]
	Reliability of the sounds		high / moderate / low / very low

Table 5-6. Specific information descriptors and respective attributes for the characterisation and categorisation of the sounds of multiphonics.

Artistic use of multiphonics

The sounds of guitar multiphonics afford being used in live performance with the guitar and the amplified guitar, as our results show; and suit both note-based and sound-based work, as existing compositions attest (Torres 2015a). Given their unusual colours, the sounds of multiphonics are for many listeners of uncertain origin when they do not see the guitar. The sounds, therefore, also lend themselves untransformed to artistic usages such as sound art or fixed-media pieces in which the source is not to be recognised. Some degree of alienation may, nevertheless, still be achieved by using, for example, only a part of the sounds' decay. When, in future, the sounds become more familiar, timbral transformation may be necessary, if the source is to remain unidentifiable. Up to now, the technique has, to our knowledge, been used only in the musical pieces for live performance given in Tables 5-2 and 5-3, of which some are sound-based and some are note-based. For example, in the solo pieces by Sor, Blondeau and Torres, the sounds are, presumably or explicitly, requested to evoke the sound of a bell; in the voice piece by Torres, a single sound, in which five pitches may be perceived, is used to paint the words "five swords"; Pfeifer chose the sounds for harmonic reasons, and some of them served as point of departure for harmonic development; Nassif's choices were also partly motivated by harmony; Oehring desires *dirty* sounds of harmonics; and Rojko uses the sounds to carry out continuous transitions between the sounds of harmonics (Torres 2015a: vol. 1: 3, 50-64).

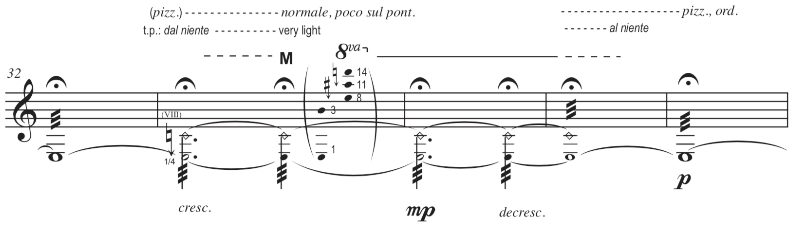
Our results and assumptions based thereon were, up to now, implemented by Torres in three pieces, which are mostly sound-based (Torres 2015b, 2018a, 2018b). "Si Amanece, nos Vamos" (2015) for solo guitar introduces a new form of usage of multiphonics, narrowing thus an existing gap in what concerns variation in the beginning and/or end of the sounds. Throughout most of the piece the sounds arise and disappear from a pedal tone on the lowest pitch of the traditional tuning of the guitar, which is played in *pizzicato* with *tremolato* (i.e. rapidly and repeatedly exciting the string with a single exciter by plucking downwards and upwards). The effect is achieved respectively by gradually increasing and decreasing the touch pressure—thus putting in evidence the sound filtering that the technique involves—and is emphasised respectively by gradually removing the pizzicato in *crescendo*, and returning thereto in *decrescendo* (Torres 2015a: vol. 1: 100-101, 123-124), as shown in Example 5-1. The use of *tremolato* allows playing multiphonics at the usual harmonics locations without feasibility problems; thus, these locations are also used.

In the other two pieces, which are scored for amplified guitar and live electronics, the sounds of multiphonics are played conventionally; in some cases, they are followed by other sounds of multiphonics. Example 5-2 presents such gestures in "The Fireflies, Twinkling Among Leaves, Make the Stars Wonder" (2015, revised 2018). Here, when only one pitch is notated, it is because the desired sound is the sound with that pitch, which remains after the others have rapidly decayed. "Luminescências" (2018) is a pedagogical piece that departed from "The Fireflies" but has, at the same time, influenced its revision. In both pieces the sounds of multiphonics symbolise the stars and are played against repetitions by the electronics of sounds produced by striking the strings with a plectrum, which symbolise fireflies. In "The Fireflies" the rhythms of the repeated sounds correspond to the flash patterns of certain species (Torres 2015a: vol. 1: 94-100, 117-122; in the revised version, the number of patterns against which the sounds are played has been reduced).

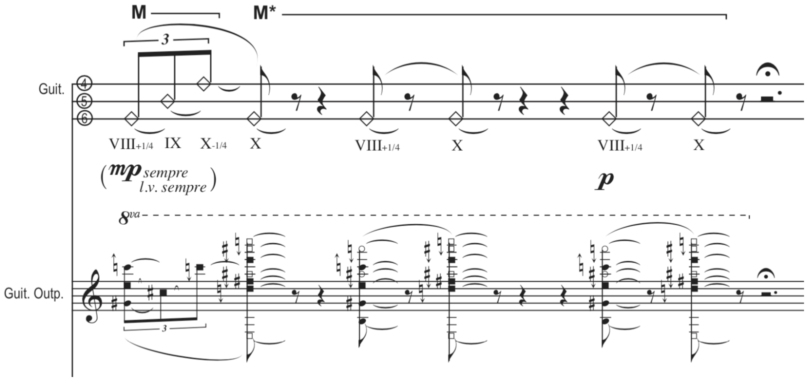
In the scores of the above-described pieces, only non-conventional playing conditions were notated, to avoid excess of information. All these playing conditions are explained in detail in the performance instructions. As can be verified in Examples 5-1 and 5-2, the technique is specified by an "M" above the staff, and by the result in parentheses or in a lower staff. In Example 5-1, the result includes both the numbers and pitches in the guitar transposition of the main partials of the sound (these were considered to be the loud partials of the sounds right after the attack in our experiment, since they result from *tremolato* and are not amplified). In Example 5-2, only the pitches are provided: the numbers of the main partials are only specified in the performance instructions, to avoid excess of information, since the sounds are repeated various times; their relative loudness categories are represented by different note heads (the scale in decreasing order is: black square, black circle, white square, white circle).

The notation of the touch locations was chosen according to the compositional approach of the piece and/or the notation of its other sounds. In "Si Amanece" both string and fretboard locations are notated symbolically (see Example 5-1; the nearest fret is redundantly supplied in parentheses to suit the taste of guitarists who prefer the numeric notation of fretboard locations), whereas in the other pieces the string is notated graphically and the fretboard location numerically (see Example 5-2). With regard to the latter's meaning, (1) the fret number, or its pitch without the arrow in the accidental, indicates the nearest fret to the location; (2) the plus or the minus symbol, or the arrow, indicates whether the location is, respectively, lower or higher than that of the fret; (3) the fraction's denominator indicates the subdivision factor of the space between frets, and its numerator the position of the virtual fret counting from the fret. In Example 5-1, for instance, of the three virtual frets that result from the subdivision of a space between frets into four equal parts, the string is touched at the first virtual fret below fret VIII.

The notation of the touch pressure is verbal in "Si Amanece", and symbolic in the other pieces. Here, a very light pressure is differentiated from the conventional harmonics pressure by an asterisk after the "M" (see Example 5-2). The touch duration is always very short except for two sounds in "The Fireflies"—in these cases, a short duration is then verbally requested. A plectrum is also used as an exciter in all pieces—this is specified when it is first introduced; its angle with the string is specified in the performance instructions of "Si Amanece" to be between zero and 45 degrees. In "The Fireflies" the fingernail is only used after the plectrum, which is specified when introduced for the first time.



Example 5-1. Gesture using guitar multiphonics with plectrum-played *tremolato* (t.p: touch pressure). Reprinted from "Si Amanece, nos Vamos" (p. 2) by Rita Torres, 2015, Karlsruhe: The composer.



Example 5-2. Gestures using guitar multiphonics conventionally (slow tempo). Reprinted form "The Fireflies, Twinkling Among Leaves, Make the Stars Wonder" (p. 8), by Rita Torres, 2018, Lisboa: The composer.

Conclusion

The technique of multiphonics gives rise to sounds of unusual colours, which may be used in different forms of artistic production. We have proposed a myriad of descriptors that serve not only to adequately convey information on the sounds and their form of production and represent these in a score, but also to differently categorise them and organise them within each category. We have also shown that the descriptors may be differently notated in a score depending on the compositional approach and/or the notation of the other sounds.

References

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