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Microtonal Peculiarities in Lithuanian Folk Songs as the Background for Scale Construction in *Bloomy Ice* for String Orchestra (2020)

Abstract. This article explores a specific study of interval relations in Lithuanian folk melodies, which became a stimulus to integrate the obtained data into the compositional system. The research of archival sound recordings of Lithuanian folk songs and their instrumental versions was carried out to determine interval distances and possible tone deviations compared with natural harmonic series and 12-TET. Therefore, regularly repeated scale degrees corresponding to the particular tones and microtonal overtones of the natural 31-harmonic series were identified. It was noticed that the interval distances in the scale are very close to the interval *ratio* of natural harmonic series (3:2, 4:3, 5:4, 9:8, 11:8, 13:8, 21:16, 25:16, 29:16, 31:16). The results of this research were used to create a new scale construction for the new work *Bloomy Ice* for string orchestra (2020). Thus, a progression of both 12 microtonal harmonics and non-microtonal scales was built, existent in two natural harmonic series. In another work (*I was Killed by a Banana Tree,* 2019) for tenor recorder, a scale of 29 tones in one octave that refers to transformations of microtonal tetrachord that was constructed by determining microtones of specific scale degrees comparatively with the 12-TET tuning system. This article presents the strategies for shaping the microtonal sound structures and their teleological course via music composition.

Keywords: microtones, microtonal overtones, interval relations, Lithuanian folk songs, Vytautas Germanavičius, composition *Bloomy Ice* for string orchestra, compositional system, natural 31-harmonic series.

This article focuses on the research of specific interval relations in Lithuanian folk melodies, which may be applied to the creation of the original compositional system. The area of interval relations in Lithuanian folk music was not considered much important until the 21st century as many Lithuanian and foreign scholars did not give a preference for the analysis of interval distances in the scale. The main source for this research was archival sound recordings from a period between the 1930s to the 1940s, which could presumably preserve the ancient tunings, unequal tone distances, and the manifestation of microtonality in vocal and instrumental tradition, and which could change and redefine the structure of the scale compared to 12-TET[1], and its interval relations.

First attempts to describe microtonality in Lithuanian folk music

Since the 19th century, the studies of Lithuanian folk melodies were implemented in the works of Lithuanian, Prussian, and other scholars, among them Christian Bartsch, Eduard Gisevius, Louis-Albert Bourgault-Ducoudray, Ludwig Rhesa, but most of the transcriptions of Lithuanian tunes were made at the turn of the 20th century. In that period ethnomusicologists and researchers relied on the 12-tone chromatic scale notational system and tunings of the church organs. However, German educationist and music theorist Friedrich August Gotthold, who studied folklore traditions of the Baltic region, noted this about the Lithuanian melodies published in Rhesa's collection in 1825 that:

> "Some tones could have been chromatically altered, and the melodies were softened or modified" (Bartsch 2000: 43)[2].

During the interwar period of the 20th century, the Lithuanian microtonal composer Jeronimas Kačinskas[3] in his article "Prague—the city of creative music initiatives" wrote that:

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1 12-tone equal temperament (12-TET) means that the octave is divided into 12 semitones of equal size in standard pitch tuning of A=440 Hz where each semitone is measured at 100 cents.

2 This quotation was taken by Bartsch from the article by Friedrich August Gotthold, "Über die Kanklys und die Volksmelodien der Litthauer", published in 1847. In: E. A. Hagen (Ed.), *Neue preußische Provinzial-Blätter*, Band IV. Königsberg, pp. 241–256.

3 The composer and conductor Jeronimas Kačinskas (1907–2005) is considered to be one of the most prominent modernists in the interwar period in Lithuania. He spent two years at Prague Conservatory where he took a course in quarter-tone music under Alois Hába from whom he acquired knowledge of the microtonal and athematic style of music. He adopted an individual approach to microtonality, in a number of his works written in the forties, which became the first examples of avant-garde music in Lithuania. In 1933 Kačinskas established classes of microtonal music in Kaunas and Klaipėda, and regularly published microtonal music articles in the magazine *Muzikos barai* (Fields of Music). Kačinskas' *Nonet* was premiered in 1938 at the International Society for Contemporary Music Festival in London alongside premieres of works by Béla Bartók and Olivier Messiaen; however, most of his microtonal works were lost during World War II. After immigrating to the US, in 1967–1986 he taught composition and conducting at Berklee College of Music in Boston. "Alois Hába considered Kačinskas' *Nonet* to be one of the prime examples of modern music composed in the 1930s, and repeatedly showcased the work in concerts representing his school in various European countries" (Stanevičiūtė 2017: 3). Hába wrote some remarks about Kačinskas' piece Concerto

"According to some famous musicians of the city of Prague, the orientalism is closer for Lithuanians than the Western European spirit: it is noticeable in the character of rhythm and melody of Lithuanian folk music. If we take a look at our antique instruments (panpipes, little horns, trumpets, etc.), we will find here the intervals smaller than semitones. It could be assumed that since antiquity Lithuanians have not been familiar with the Greek and German major and minor tonalities. Here will be the most likely influence of later centuries" (Kačinskas 1932: 102).

Lithuanian music theorist and ethnomusicologist Jadvyga Čiurlionyte in her article "How to Transcribe Folk Melodies" (Čiurlionytė 1940: 100), and later Genovaitė Četkauskaitė, the first transcribers of Lithuanian folk melodies, saw the need to notate smaller intervals than a semitone in the scales, and recommended to use these symbols: by arrows up and down (↑↓) for tones less than a semitone; by the cross (×) for indeterminate pitches, and by a wavy line for glissando to the first degree in the scale (Četkauskaitė 2007: 7–8).

Next to the scale analyses in the 12-tone chromatic system, refers to the interval peculiarities related to the natural harmonic series – the natural simplicity of frequency ratios between tones. Musicologist Antanas Venckus in his article "Hexatonic Scales in Lithuanian Folk Music" wrote about the importance of the perfect fifth and perfect fourth (3:2, 4:3) for the construction of a scale. According to him, these intervals (or the probe tones) form the framework of the scale in Lithuanian folk music (Venckus 1969: 69, 72, 74).

In the book *On the Road of Sutartinės and Skudučiai* the vocal and instrumental music researcher Stasys Paliulis mentioned the Lithuanian traditional wood-wind instrument *daudytė* which produces the first five overtones[4] of the natural harmonic series (Paliulis 2002: 188):

Figure 1. Harmonic numbers of natural harmonic series produced by wood-wind instrument daudytė (Paliulis 2002: 188).

Figure 2. *Sutartinė* (Paliulis 2002: 188).

Figure No 1 introduces 5 overtones produced by two *daudytė* long and short tuned in G and A respectively. In Figure No 2 the *sutartinė* polyphonic chant is performed in two tunings G and F: from the fundamental G it produces the 4th, 5th, and 6th harmonics of the natural harmonic series and from F—the 5th and the 6th harmonics. In other tunings of the instrument *daudytė,* the number of produced overtones is practically the same, nevertheless, the G, A, and B tunings produce five harmonics of natural harmonic series the 3rd, 4th, 5th, 6th, and the 8th.

In the book *On the Structure of the Chord* (Juzeliūnas 1972) composer Julius Juzeliūnas focused on the melodic features of Lithuanian polyphonic songs *sutartinės*, the tonal hierarchy, probe tones, intervallic structures in a 12 equal-tempered system but the slight changes of the interval pitch and timbre was not an important area to the composer. However, the different distances of the intervals introduce other tastes and colors, and not only to the particular scale but to the particular sound of the interval itself.

for Trumpet and Orchestra that the Lithuanian composer "builds [quartertone] harmonies in a completely distinct way, and his work is characterized by combined rhythms and polyphonic figurations rich in quintuplets and septuplets" (Hába 1931: 3).

4 Harmonics may also be called "overtones", "partials" or "upper partials". The difference between "harmonic" and "overtone" is that the term "harmonic" includes all of the notes in a series, including the fundamental frequency (e.g., the open string of a guitar). The term "overtone" only includes pitches above the fundamental. In some music contexts, the terms "harmonic", "overtone" and "partial" are used fairly interchangeably (Microtonal Encyclopedia, *Harmonic*, 2018).

The psychoacoustics and tonal hierarchies in Lithuanian folk scales were recently conducted by Rytis Ambrazevičius who applied acoustic, statistical, cluster, and other scientific methods for analyses of folk songs. He stated that:

> "It can be safely concluded that none of the samples resembles twelve-tone equal temperament, i.e., its diatonic subsets including the minor and major versions and other diatonic scales (e.g., so-called Ancient Greek or Gregorian modes)" (Ambrazevičius 2009: 13).

From this wide range of studies, it can be concluded that the analysis of the interval distances in the scale has not been comprehensively studied, and the sounds which were determined as inconsistent to 12-TET have been equalized or emitted as extraneous tones, or later by adding to the tone a particular symbol marking tone deviations from 12-TET which indicated inexact interval distance and the structure of the scale. In the first study "on the phenomena of interval evolution and unfolding scales" (Ambrazevičius, Budrys, & Višnevska 2015: 172–191), misleading conceptions of "Ancient Greek", and validations of the assumptions of equidistant scales in the Lithuanian traditional music were conducted by Ambrazevičius. However, it was not primarily focused on the approach to micro-interval relations, interval distances, or tuning systems in Lithuanian folk music songs.

The musical temperaments of the 18th and 19th centuries

In the 20th century, the term "microtonal" is conceivable as in any musical style the intervals in the scale differ from the others compared to the 12-tone equal temperament system. Historically accurate but different medieval, renaissance, baroque instrument tuning systems, and temperaments had an interest for many music composers and theorists of the 20th century in combining sounds and building compositional systems inspired by non-Western cultures. As early as the last century composers began to incorporate microtones into their compositional techniques introducing them in 12-TET, and dividing the octave into 24 equal tones (quarter tones), or tuning 33.3 cents to have divisions of 36 tones (sixth tones), 48 tones, 72 tones, 96 tones, etc. The others were interested in just intonation, Pythagorean, or 5-limit, 7-limit, 11-limit, 13-limit, 31-limit, and beyond tunings to "improve" the 12-TET model.

It could not be eliminated the fact that 18th- and 19th-century tunings were not equally perfect if we take a look at Thomas Young's[5] widely used well temperament of 19th century varied in interval relations with deviations approximately until 10 cents compared to the 12-equal chromatic scale.

Table 1. Thomas Young's Well Temperament No. 1 (Gann 2019: 94)

Major third	Cents	Perfect fifth	Cents	Minor third	Cents
C – E	391.7	C – G	697.9	C – E♭	297.8
G – B	393.9	G – D	697.9	G – B♭	301.9
D – F♯	396.1	D – A	698	D – F	304.1
A – C♯	400.1	A – E	697.9	A – C	306.2
E – G♯	404.1	E – B	700.1	E – G	310.3
B – D♯	406	B – F♯	700.1	B – D	304
F♯ – A♯	407.9	F♯ – C♯	702	F♯ – A	301.9
D♭ – F	406	D♭ – A♭	701.9	C♯ – E	297.8
A♭ – C	404.2	A♭ – E♭	702	G♯ – B	296
E♭ – G	400.1	E♭ – B♭	702	E♭ – G♭	294.1
B♭ – D	396	B♭ – F	700.1	B♭ – D♭	294.1
F – A	393.9	F – C	700.1	F – A♭	295.9

In Table 1 there are four perfectly just fifths F♯-C♯-G♯-A♯ and the timbral variety of thirds including Pythagorean major third F♯-A♯. Looking down the first column one can notice a more gradual progression of major third sizes from C-E to F♯-A♯ and back. There is only one close minor third E-G equal to 310.3 cents,

[5] Thomas Young (1773–1829), English physician and physicist who established the principle of the interference of light and thus resurrected the century-old wave theory of light. He was also an Egyptologist who helped decipher the Rosetta Stone. He developed what is now known as Young Well Temperaments No. 1 and No. 2, the latter being very close to Francesco Antonio Vallotti's temperament.

though there are two Pythagorean minor thirds from E♭ and B♭. Even within the perfect fifths, there is a graduated progression from 697.9 to 702 and back down. Young described his temperament as "the best instrument makers" were practicing:

> "making C : E too sharp by a quarter of a [syntonic] comma, which will not offend the nicest ear; E : G-sharp, and A-flat : C, equal; F-sharp : A-sharp too sharp by comma; and the major thirds of all the intermediate keys more or less perfect, as they approach more or less to C in the order of modulation" (Gann 2019: 95)[6].

Although in other unequal temperaments and tunings the interval sizes significantly differ, e.g., the size of a quarter-tone (50 cents 12-TET) could be wider or smaller, or refer to the other degree in the scale. Piano technician and expert on temperaments Owen Jorgensen praised Young's 1799 temperament as being "the most perfect idealized form of well temperament ever published" (Ibid.). It should be noted that specific instrument tuning in the previous centuries was especially important for composers to determine the sound of one or another musical work:

> "As noted, to some extent the differences between these temperaments are merely theoretical. Piano tuners were guided by their experience and their own and their patrons' taste throughout the eighteenth and nineteenth centuries, an era in which tuning was an art, not a science" (Ibid.).

Therefore, it is not a coincidence that the archival recordings of Lithuanian folk songs were selected from the 4th decade of the 20th century that could preserve other principles of instrument tuning.

Identification of microtonal overtones in Lithuanian vocal and instrumental folk music

Implementing my research of Lithuanian folk songs and their instrumental versions, firstly the distances between the intervals in the scale were identified, and secondly, the collected results were compared with two tempered systems: natural harmonic series and 12-TET. Several examples of *sutartinės* and *monodies* were taken to determine tonal distances in the scale. One of them, with a clear audible microtone, was the monody *Lėkį̇s lėkį̇s sakalėlis* (Fly fly little falcon; recorded in 1937). I started this research during my internship at the Sibelius Academy of Music in Helsinki. Together with composer Juhani Nuorvala, I used his microtonal instrument Tonal Plexus to detect tones by ear. In this tune, we identified the second degree with the deviation of 30 cents approximately compared to 12-TET. It was somewhat surprising to notice that the deviation corresponds to the *rast* microtone in *maqāmāt* Arabic scale.

Referring to the research of contemporary scholars, the smallest audible microtones are determined by measuring the distance from the reference tone (or fundamental) usually from 33 to 50 cents within a semitone to compare to 12-TET[7]. Identifying the intervals in the scale, a distance of limits was made for the detection of microtones from 20 to 80 cents compared with 12-TET, and until 10–15 cents for harmonics compared with natural harmonic series[8].

Figure 3. Harmonics on C from 1st fundamental to 32 harmonic, notation is based on the extended just intonation by Ben Johnston (Gann 2019: 120)

[6] Gann quoted from the book: Jorgensen, Owen (1991). *Tuning: Containing the Perfection of Eighteenth-Century Temperament, the Lost Art of Nineteenth-Century Temperament, and the Science of Equal Temperament*. East Lansing: Michigan State University Press.

[7] Composers and music theorists of Western music culture proposed to divide the octave into 12 equal parts with distances of 100 cents of the semitone. Thus, a quarter-tone equals 50 cents, a sixth tone—33.3 cents, a 12th tone—7 cents, and a 16th tone—12.5 cents. In this calculation the octave is divided into 96 equal parts, thereby the semitone *b–c* consists of eight 16th tones.

[8] "Given the described implementations of pitch scatter and formant smear in syntheses of unison choir sounds, the present experiment showed that – on the average, experienced listeners preferred pitch scatter to be between 0 and 5 cents and would tolerate scatter between 10 and 15 cents" (Ternström 1991: 48).

12-TET (tone equal temperament) (12)	C	C♯ / D♭	D	D♯ / E♭	E	F		F♯ / G♭	G	G♯ / A♭		A	A♯ / B♭		B	
12-TET in cents	0	100	200	300	400	500		600	700	800		900	1000		1100	
Natural harmonic series in one octave (16)	C	C♯	D	E♭	E	-F	F+,-F♯	F♯+	G	G+	G♯+	A	-B♭	B♭+	B	B+
Interval distances in cents	0	105	204	298	386	471	551	628	702	773	813	906	969	1029	1088	1145
Harmonic No.	1	17	9	19	5	21	11	23	3	25	13	27	7	29	15	31
Deviations in cents to compared to 12-TET		+5	+4	-2	-14	-29	+51, -49	+28	+2	-27	+41	+6	-31	+29	-12	+45

Table 2. Natural Harmonics and 12-TET Scales

Table 2 presents a natural harmonic series in one octave compared to the 12-TET chromatic scale. The microtonal harmonics are marked in grey color.

To measure the distances of tones in scale, I used the computer software Melodyne, which can detect sound deviations even in polyphonic music audio samples.

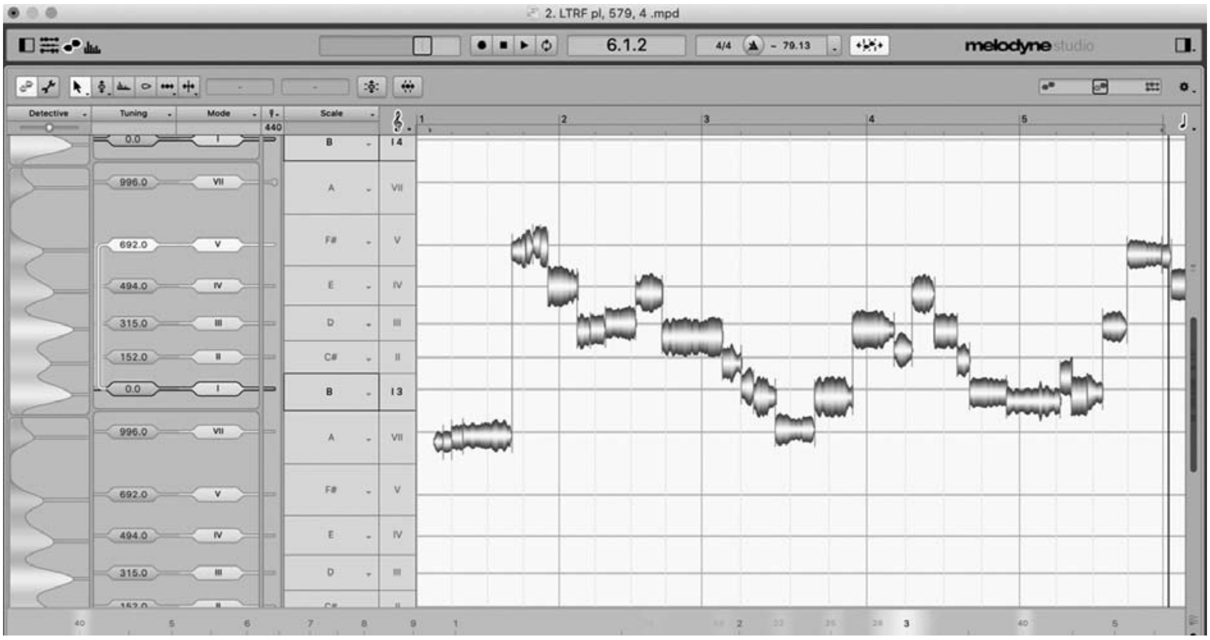

Figure 4. Interval distances in the scale. Analysis of the monody "Lėkįs lėkįs sakalėlis" (Fly fly little falcon) in the Melodyne computer software (The Institute of Lithuanian Literature and Folklore; http://archyvas.llti.lt/irasai).

Table 3 displays the interval distances of the song and comparison with the interval distances of the 12-tone chromatic scale. There is a clear interval of perfect fifth calculating from the reference tone (or tonic), which constantly forms a framework of the probe tones in the scale. Therefore, the scale of six tones is arranged within the interval of a perfect fifth interwoven with neutral and microtonal interval structures. It would be pointed out an interesting shift b-c♯ = 152 cents, is a neutral second (or microtone), between the whole tone and semitone, as such an interval is frequent in Arabic music[9]. The other intervals correspond to narrowed or large semitones, or whole tones, e.g. the interval b-e is very close to just perfect fourth (498 cents) with the ratio of 4 : 3.

9 In Arabic music, the *maqam* rows are heptatonic and constructed from augmented, major, neutral, and minor seconds. Many different but similar ratios have been proposed for the frequency ratios of the tones of each row and performance practice (Touma 1996: 18).

Interval deviations from reference tone	B 0		C# +52		D +15		E -6		F# -8			A -4
Interval distances In cents	B 0.0		C# 152		D 315		E 494		F# 692			A 996
Chromatic scale	B 0.0	C 100	C# 200	D 300	D# 400	E 500	F 600	F# 700	G 800	G# 900	A 1000	

Table 3. Interval deviations of the song *Lėkjs lėkjs sakalėlis* compared to 12-TET

Using Melodyne software, the analysis of polyphonic folk chant *sutartinė* was carried out, thus Table 4 presents the collected data: the numbers in bold with the asterisk indicate two microtonal degrees in the scale, and below the numbers in bold with the serial number indicate three harmonics—No. 5, No. 11, No. 3.

Du žaliūs berželiai (Two green little birches), LTRF pl. 189b, 1
Performers: Zuzana Yčienė, Marė Jakubonienė, Petras Lapienė, Ona Striužienė, 1935.

SONIC CODE G♭+ A B♭+ C D♭+

SCALE	G♭	A	B♭	C	D♭
INTERVAL DISTANCES	I	II	III	IV	V
from reference tone	0.0	**246***	386	**559***	702
INTERVAL DEVIATION (12-TET)		–54	–14	–41	+2
HARMONICS in cents			**386**	**551***	**702**
HARMONIC No.			5	11	3
HARMONIC DEVIATION			0	+8	0
DISTANCES	246	140	173	143	

* – microtone

Table 4. *Sutartinė* analysis

Table 5 presents the number of harmonics with their serial numbers that were detected in the vocal and instrumental music corresponding to the natural harmonic series from C. In vocal music I identified the most frequent five harmonics (Nos. 3, 5, 11, 9, 21) (G, E, F+, D, –F), including two microtonal harmonics 11, 21 (F+, –F), and not so frequently used harmonics Nos. 13, 25, 29, 23, 31 (G♯+, G+, B♭+, F♯+, B+) which one of them non-microtonal (No. 27) corresponds to the sound (A).

As for instrumental music, the most frequent harmonics were identified and arranged as follows:

- in the *ragas* (wooden trumpets) ensembles there are five harmonics Nos. 9, 5, 11, 3 (D, E, F+, G),
- in *skudučiai* (panpipes) ensembles—three harmonics Nos. 5, 11, 3 (E, F+, G),
- in the melodies for stringed instrument *kanklės* (instrument of the zither family)—three harmonics Nos. 3, 9, 13 (G, D and G#+).

Among the not so frequently used harmonics, I would point out the *skudučiai* ensembles—Nos. 15, 27 (B, A).

Thus, four commonly used harmonics were identified in instrumental music samples—Nos. 3, 5, 9, 11 (G, E, D, F+), one of them is microtonal—No. 11, and these harmonics are consistent with all vocal and instrumental music samples.

Harmonics No.	1	3	5	9	11	13	15	17	19	21	23	25	27	29	31
Sutartinės	17	8	11	5	8	1				4	1	1	1		
Monodies	20	13	7	4	6	5	1	1	1	4	2	4	3	5	1
Horns	16	12	10	15	14										
Panpipes	4	2	2		2		1						1		
Kanklės	4	3		2		1									

Table 5. Number of harmonics identified in the 27 *sutartinės*, 21 monodies, 12 *ragas*, 5 *skudučiai*, 3 *kanklės* recorded samples

In Table 6, the summarized data of harmonics are provided. You can see that vocal music tunes have 7 exactly produced harmonics compared to natural harmonic series, and for instrumental music, there are 2. In *sutartinės* chants and monodies 70 sounds with deviations 1–15 cents were detected, and in traditional instruments tuning, *ragas* ensembles—32, *skudučiai*—9, *kanklės*—6 harmonics, respectively.

		Sutartinės		Monodies		Horns		Panpipes		*Kanklės*
	0 ct	-5	-	2	-	1	-	1		
-1	+1 ct	-2	-	2	-	2			-	1
-2	+2 ct	-2	-	2	-	2				
-3	+3 ct	-2	-	3	-	3				
-4	+4 ct	-1	-	4	-	2				
-5	+5 ct	-2	-	5	-	5	-	2	-	2
-6	+6 ct	-1	-							
-7	+7 ct	-2	-	6	-	2	-	3		
-8	+8 ct	-2	-	3	-		-	2		
-9	+9 ct	-1	-	3	-	1	-	1		
-10	+10 ct	-2	-	3						
-11	+11 ct	-4	-	3	-	1	-		-	1
-12	+12 ct	-2	-	4	-	7	-		-	1
-13	+13 ct	-	-		-	1				
-14	+14 ct	-1	-	2	-	2	-		-	1
-15	+15 ct	-2	-	4	-	3				

Table 6. Scale of tone deviation from the original sound of natural harmonics

Comparing the number of vocal songs with instrumental music, e.g. *ragas* ensembles have three times, and *kanklės*, *skudučiai* ensembles five, and ten times fewer examples (due to a minimal number of good quality recordings, and a small selection of performers), than compared to vocal music. Therefore, the same results as in vocal music could be tentatively obtained by multiplying the number of harmonic deviations of *ragas* ensembles by 2, and the number of harmonic deviations of *kanklės* and *skudučiai* ensembles by 5, 10. Thus, in instrumental music examples: *ragas* ensembles have 17 sounds with deviations of 1–10 cents, and 14 sounds with deviations of 11–15 cents; *skudučiai* ensembles have 8 sounds with deviations of 1–10 cents; *kanklės*—3 sounds with deviations of 1–10 cents, and 3 with deviations of 11–15 cents.

Application of interval relations of folk songs in composition

Referring to the material of my research I have selected 12 microtonal overtones to compose an original microtonal scale, which corresponds to the pitches of two harmonic series from *C* and *G*. Below you can see a chromatic scale, which consists of sounds from natural harmonic series of *C* and *G* with common tone *b* and non-systematic tone *f*. The scale forms two pentachords. Therefore, the pitches of both microtonal scale and non-microtonal scale are combined to form interval structures.

A. Scale of selected twelve microtonal harmonics from *C – G* of natural harmonic series

B. Scale of selected tones from natural harmonics series *C – G*

Figure 5. Microtonal and non-microtonal scales

Interval structures are built on one harmonic structure of 3 tones—trichord structure, which expands in time by adding more structures or replacing one with another. Those trichord harmonic structures are formed on the following intervals: third + second, fourth + second, fifth + second, and the seconds one after another, which include one or two microtonal sounds[10]:

Figure 6. Trichordal structures

Both microtonal structures of the fourth and seventh form a complex texture of harmonic structures. Thus, the selected "archaic" microtones expand and split up the intervals of the chromatic scale into a dense microtonal complex. These enriched sound structures are manifested by timbre and harmony modulations whereas the pitch reaches a certain boundary moving to one or another parameter when the pitch and the rhythm gain a new function—hierarchy of timbre (compared to the hierarchy of harmony in tonal music) is realized by the intensity of textures, registers, dynamic changes, sound-producing techniques. This process fuses the synthesis of timbre and harmony, but where is that boundary of separation when the sound parameters gain other functions and meanings?

Projections of harmonic sound structures in the composition *Bloomy Ice* for string orchestra[11]

This piece represents the idea of timbre and harmony and their relationship in musical form. The timbre and harmony synthesize several elements amongst them the clarity of sound and the texture (smooth or rough). These elements are particularly important that influence the change in musical form. The control of timbre through the work is closely related to the tensity and statics of harmonic tissue as a contrast of smooth and dense episodes or in comparison as a shift of consonance to dissonance in tonal music. When listening to the piece we could hear more or less tension in some of the episodes that make transformations from the smooth/clear to the rough/uneven textures. Thus, the function of timbre is considered vertical and that of harmony as horizontal. Harmony often provides the impetus for rhythmical movement, while timbre constructs

[10] It depends on a particular combination of microtones; the interval distances vary in each case.

[11] The idea to write this piece was born in Northern Scandinavia. I see the endless desert covered by ice, and under the ice—frozen multicolored plants. When the dessert is illuminated and warmed by the Sun, the underwater microscopic processes commence, awakening a fragile life for a short flowering cycle, like a colorful mirage flickering under the ice. The composition *Bloomy Ice* was premiered at the Baltic Chamber Orchestras Festival performed by St. Christopher Chamber Orchestra, conductor Modestas Barkauskas, October 29, 2020, Vilnius City Hall:

Frozen multicolored plants,
Sunk in the layers of Northern Ice.
Through the Suns' rays,
Bloom a second time.

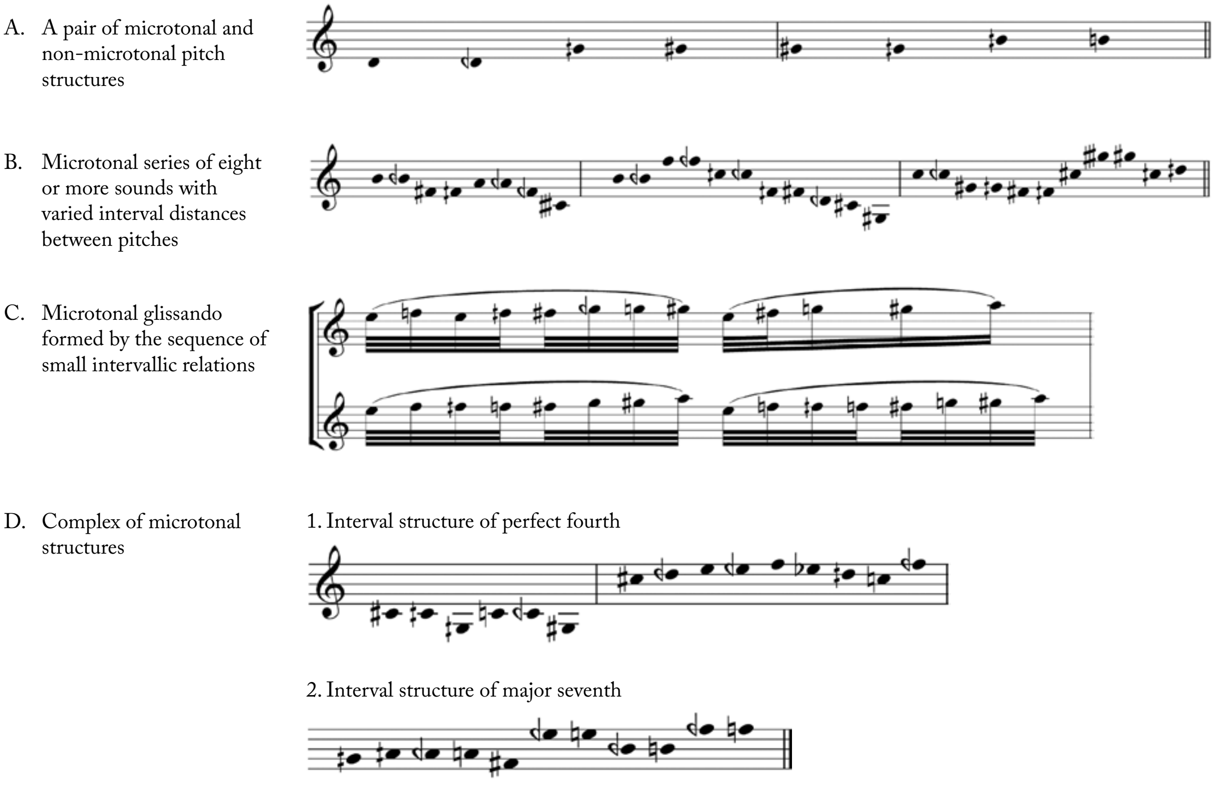

Figure 7. Other types of harmonic structures

the musical form as the leading parameter of the piece. The sound space of the work is expanded by using various sound parameters and performance techniques to reach the transitory result between textures. There are three types of textures indicated in this piece:

1. The static type of texture is characterized by linear motion, e.g. episode with solo motives, or in the episode of smoothly passing harmonics.
2. The dynamic type of texture is an articulation of musical space that reveals the creation of harmonic tension, pulsation of musical tissue with fast, accentuated, timbrically modifying sound parameters.
3. The static-dynamic type of texture is characterized by microtonal shifts, transformations of harmonic texture.

MOVEMENTS	I	II	III
BARS	1–60	61–129	130–200
TYPE OF TEXTURES	STATIC bars 1–11; 15–17; 20–23; 41–67	STATIC bars 73–78; 82–87; 94–96	STATIC bars 129–167, 195–200
		DYNAMIC bars 68–73; 79–81; 88–93; 104–128	DYNAMIC bars 168–191
	STATIC–DYNAMIC bars 12–14; 18–19; 24–40	STATIC–DYNAMIC bars 97–103	STATIC–DYNAMIC bars 192–194
DEGREE OF HARMONY PROGRESSION			
Pitch Amplitude	Low–Middle	Middle–High	Highest
Intensity of Textures:	bars 24–28; 41–48	bars 62–72; 74–85–95–103; 104–113–118	bars 165–176
Rhythmical	Low–Middle	Low–High	Low–High
Pitch Structures	Middle–High	Highest–Middle	Low–Lowest
Speed of Harmonic Tension (Tempos)	Low–Middle	Middle–High	Low–High–Middle–Low

Table 7. Structure of the piece *Bloomy Ice* for string orchestra, 2020

The realization of this network of textures is also represented by instrumental techniques, e.g. tremolo transitions from *sul ponticello—sul tasto* to the extreme places of bowing, microtonal motion, types of vibrato, harmonics, microtonal techniques. It is important to mention that modification of the speed of harmony expansion unfolded by different tempos supports the harmonic tensions of the piece. The structure *Bloomy Ice* presents a hierarchical system of harmony: type of textures and degree of harmony progression which includes: a) pitch amplitude, b) intensity of textures, c) speed of harmonic tension (tempos).

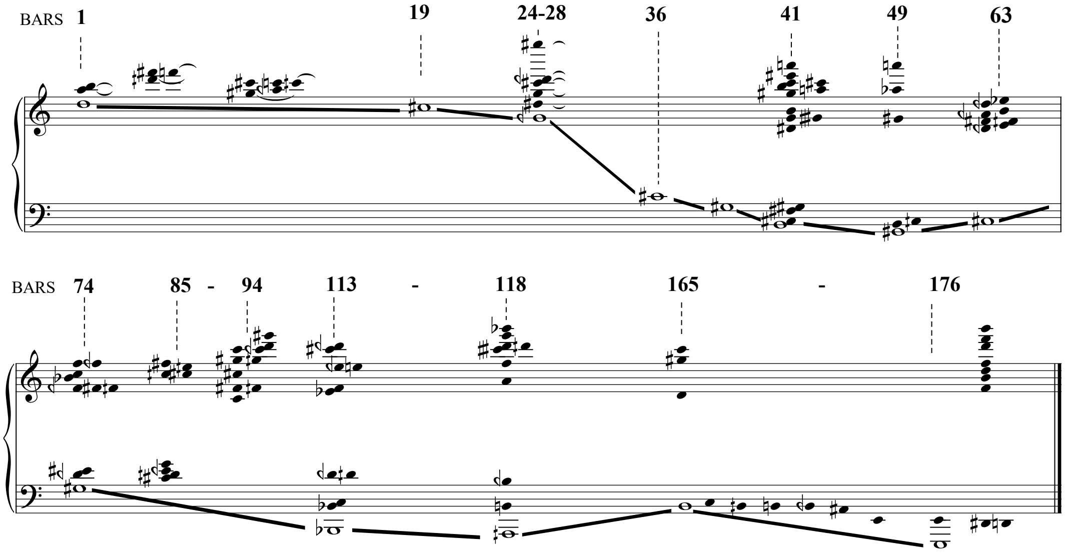

Figure 8. Teleological progression of harmony—expansion of trichord structure

The piece begins with the trichord structure from the sound *D*, which expands to the lowest *E* of the double bass at the end of the piece. The amplitude of the sound gradually increases from one to five and a half octaves. The intensity and tension of textures depend on the density of pitch structure. As the register narrows the degree of intensity increases, the layers of musical tissue become thicker, and on the contrary, if the amplitude increases, the interval distances and the tension of textures decreases.

Nevertheless, pitch amplitude and pitch intensity of textures which relates to harmony and timbre, grow opposite directions: one starts from the low amplitude to the high, and the other from high to the low intensity while the speed of harmonic tension (tempo) and rhythmical intensity have different directions, e.g. low–high–low tempo or intensity.

When writing this piece, I realized timbre and harmony as two separate but interrelated parameters. Thus, the motion of harmonic structures occurs in two modes—stable and dynamic. It begins from a stable state with clear harmonies and moves to the dynamics of timbres—i.e. unclear moving of sound structures. In this process, the progressions of chords and durations of rhythmical lines transform the harmony into timbre, evoking timbral variations separating the complex harmonies from the initial trichord structure. It is the growth and expansion of a single sound cell, which modifies the change of sound parameters through the entire piece building a large micro-interval tissue.

Conclusion

Regarding the research on Lithuanian vocal and instrumental folk music, it could be concluded that the number of harmonics with exact pitch or slight deviations in vocal and instrumental music is constant and has no significant changes. Thus, the Lithuanian vocal and instrumental folk samples have several tones closely related to the tuning of natural harmonic series, including one frequently used microtonal overtone. It could be assumed that performers of the Lithuanian folk music tradition partially reproduced tuning and interval relations of natural harmonic series. On the other hand, constant use of microtones was spotted in Lithuanian vocal monodies.

The implementation of microtones and interval structures into the compositional system was an attempt to transform the harmony into timbrical sonority/extended sonority and to experiment with harmony progression of timbres throughout the structure of the piece, finding points where timbre replaces pitch as the primary parameter. In the composition of *Bloomy Ice* texture and timbre are closely linked, as the timbres have various tendencies for combination and fusion. It is important the primary selection of initial musical parameters and materials that determines a particular set of techniques, specific group of sounds unfolding the process of timbrical transformation. In *Bloomy Ice* there are seven points of harmony transformation that correlate the dynamic structure—the harmony progression of timbres throughout the piece, interchanging with the levels of density and intensity of musical tissues determined by the range and number of micro-interval structures.

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Mikrotoninių santykių ypatumai lietuvių liaudies dainose. Garsaeilio komponavimo aspektai kompozicijoje „Žydintis ledas“ styginių orkestrui (2020)

Santrauka

Straipsnio tikslas – remiantis lietuvių liaudies melodijose nustatytų intervalinių santykių dermėse ypatumais, pristatyti tyrimo rezultatų integraciją komponavimo sistemoje. Šių metų pradžioje buvo atliktas lietuvių liaudies dainų ir jų instrumentinių versijų archyvinių garso įrašų tyrimas, jo metu pagal natūraliojo garsaeilio intervalų atstumus, taip pat įvertinant galimą nuokrypio paklaidą, buvo išskirti būdingieji / dažnai pasikartojantys mikrointervaliniai dermės laipsniai, kurie atitinka harmonikų mikrotonus, įeinančius į natūraliojo garsaeilio pirmos 31 harmonikos eilę. Tyrimas atskleidė, kad senuosiuose lietuvių liaudies muzikos pavyzdžiuose mikrotoniniai tam tikrų dermės laipsnių modeliai iš dalies artimi natūraliojo garsaeilio intervaliniams santykiams (3:2, 4:3, 5:4, 9:8, 11:8, 13:8, 21:16, 25:16, 29:16, 31:16).

Tyrimo rezultatai buvo pritaikyti sudarant kūrinio „Žydintis ledas“ („Bloomy Ice“, 2020) styginių orkestrui garsaeilį: išskirta 12-kos harmonikų-mikrotonų seka bei suformuota nemikrotoninė dermė, esanti dviejų natūraliųjų garsaeilių serijose. Mikrotonų intervalika jungiama trichordinėmis mikrotoninėmis struktūromis plečiant pirminę intervalinę struktūrą, taip susiformuoja skirtingi natūralių garsų ir mikrotonų jungimo tipai. Šiame kūrinyje išskiriami ir garsinės tekstūros tipai: statiška, dinaminė ir statiška-dinaminė bei tekstūrų intensyvumo ir įtampos lygiai, pasireiškiantys garsų kiekiu, garsinės tekstūros (audinio) artikuliacija, ritmika, tempu.

Kompozicijoje šios prisodrintos struktūros išryškėja harmonijos ir tembro moduliacijomis, kai skambėjimas pasiekia tam tikrą ribą, pereinančią į vieną ar kitą parametrą, kada garso aukštis, ritmas įgauna naują funkciją – ne harmoninės hierarchijos (lyginant su tonalios muzikos harmoniniais principais), bet tembrų hierarchijos, kuri realizuojama tekstūrų intensyvumo,

registro, dinaminės kaitos, garso išgavimo priemonėmis. Šiame kūrinyje eksponuojama tembro ir harmonijos idėja pasireiškia kūrinio formos plėtra, t. y. harmoninio audinio sutankinimu ar išskaidymu, kaip lygaus audinio opozicija tankiam / aktyviai judančiam epizodui ar kaip konsonanso / disonanso kaita tonalinėje muzikoje. Klausydamiesi partitūros mes galime suvokti didesnę ar mažesnę vieno ar kito epizodo įtampą, kuri transformuojasi švarių garsų (beveik konsonansų) skambesio harmonija, pereinančia į tembrinius (disonansinius) dinaminės tekstūros epizodus. Taigi tembro funkcija yra vertikalė, o harmonijos – horizontalė. Harmonija suteikia impulsą ritminiam judėjimui, o tembras konstruoja kūrinio formą tapdamas pirmaujančiu kompozicijos struktūrų plėtros parametru. Tembras sintezuoja daugybę elementų, ypač kūrinio garsinę tekstūrą (audinį), išskirdamas intensyvaus tankio sluoksnius su švaraus garso linijomis. Kūrinio garsinė erdvė plečiama pasitelkiant įvairius garso parametrus bei išgavimo technikų įvairovę.

Išanalizavus lietuviškos vokalinės ir instrumentinės muzikos intervalus, galima daryti išvadą, kad tikslių ar su nedideliais nuokrypiais harmonikų skaičius dermėse yra nekintantis. Taigi lietuvių vokalinės ir instrumentinės liaudies muzikos archyviniuose įrašuose randama daugybė tonų, daugmaž atitinkančių natūraliojo garsaeilio serijos intervalų derinimą (tarp jų dažniausiai pasitaiko viena mikrotoninė harmonika). Galima daryti prielaidą, kad lietuvių tradicinės muzikos atlikėjai iš dalies atkartojo natūraliojo garsaeilio intervalinius santykius. Kita vertus, buvo nustatytas pastovus mikrotonų naudojimas lietuviškose vokalinėse monodijose.

Šio tyrimo praktinė forma – mikrotoninių intervalinių struktūrų realizacija kompozicinėje sistemoje, transformuojant harmoniją tembrine sonorika / išplėsta sonorika, kai tembras keičia harmoniją ir tampa pirmaujančiu, kūrinio formą sudarančiu parametru.

Straipsnyje pristatomos šio kūrinio garsaeilio mikrotoninių struktūrų komponavimo strategijos bei teleologinio proceso aspektai kompozicijoje. Kompozicijos „Žydintis ledas“ styginių orkestrui premjera įvyko „Baltijos šalių orkestrų festivalyje“, ją 2020 m. spalio 29 d. Vilniaus rotušėje atliko Šv. Kristoforo kamerinis orkestras (dir. Modestas Barkauskas).