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PSYCHOACOUSTIC AND COGNITIVE ASPECTS OF MUSICAL SCALES AND THEIR MANIFESTATION IN LITHUANIAN TRADITIONAL SINGING

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Introduction

Relevance of the topic. Musical scale is one of the key elements of musical thinking. For deeper insight into the origins and development of musical scales, modes and their historical layers which have survived in Lithuanian traditional music, studies objectivizing the phenomenon of musical scale as well as studies on their perception and cognition are prerequisite.

Another issue is the ethnomusicological interpretation of scales and modes when it is caused by apperception of the template of Western equal temperament or that of diatonics, in general. The main **assumption** is that this apperception has become an impediment, usually resulting in misperception of the original emic structures and, consequently, in fictitious scales, false transcriptions and fallacious theoretical classifications of the scales. It is assumed that objective acoustical analysis should reveal these types of mistakes and provide the possibility to avoid them. Thus the key **issue** of the study is traditional intervallic thinking and its ethnomusicological interpretation.

Novelty of the research. Musical scales in Lithuanian traditional singing as well as in Lithuanian traditional music in general have never been studied by Lithuanian or other scholars in a way that was unbiased to the Western twelve-tone system, i.e., as a component of original and intrinsic musical language. No acoustical measurements of actual scales used in practice in Lithuanian traditional music were carried out before. Additionally, psychoacoustic and cognitive phenomena causing peculiarities of intervallic thinking in Lithuanian traditional music have never been explored. The evaluation of the collision of two emic systems resulting in various misinterpretations of traditional musical scales has also never been carried out, both for Lithuanian sources and other East-European sources.

Aim of the research: to reveal regularities of musical scales in typical samples of Lithuanian traditional singing and to gain insight into their psychoacoustical and cognitive origins as well as to their phylogenetic background.

Tasks: to overview factors, determining the phenomenon of musical scale and its genesis; to develop methods of acoustical measurements of pitch, perceptual evaluation and mathematical processing of their results; to apply the methods to study on musical scales in Lithuanian traditional singing.

Focus: phenomena causing musical scale and its genesis; sound recordings of samples of Lithuanian traditional singing are analyzed applying the **methods** of acoustical analysis, mathematical-statistical analysis, mathematical modeling, comparison, classification, and generalization.

For the computerized acoustical analysis and sound editing, specialized software, Wincecil and Speech Analyzer, as well as sound editors Cool Edit Pro and Sound Forge, were used. Over 4.100 measurements of sound frequency or pitch were carried out. For the mathematical calculations and graphical representation of the results MS Excel was used.

Thus the study is **original** because of its interdisciplinary facets, regarding both the object and the approach. The investigation can be accomplished only by employing scholarship and methodology from different fields, such as ethnomusicology, the psychology of music, acoustics, and mathematics. Specific methods of mathematical modeling, mathematical description of scales, and, to some extent, acoustical analysis, have been developed by the author.

Sources: studies by Lithuanian and foreign ethnomusicologists on musical scales, modes and their transcription (Brazys, Čiurlionytė, Četkauskaitė, Stumpf, Hornbostel, Sachs, Husmann, Grainger, Sevåg, Boswell, Arom, Voisin, List, Nettl, Ellingson, Messner, Brandl Ellis, Will, Chenoweth, During, Krishnaswamy, Czekanowska, Alexeyev, Kharlap, Kvitka, Rubcov, and others); studies by foreign psychologists of music on perception of pitch, intervals, and musical scale, aural classification, ontogenesis and phylogenesis of scales (Helmholtz, Stumpf, Plomp & Levelt, Kameoka & Kuriyagawa, Terhardt, Parncutt, Zwicker & Fastl, Wright & Bregman, Sloboda, Krumhansl, Deutsch, Dowling, Harwood, Trehub, Schellenberg, Sundberg, Huron, Zurcher, Cross, Brown, Nesse, Patel, and others); studies by foreign experts of acoustical analysis and automatic transcription (d'Alessandro, Castellengo, Askenfelt, Ross, McNab *et al*, Mertens, Pauws, Viitaniemi, Klapuri, and others).

The total number of the sources exceeds 300 items.

Results of the research. Equitonics is identified in the samples of Lithuanian traditional singing, in interaction with diatonics and other structures. Equitonics of *sutartinės* (Lithuanian archaic polyphony) is based on psychoacoustical origins. The study of traditional musical scales is usually based on biased perception, which leads to problems of theoretical misinterpretation.

Structure of the study: introduction, three chapters, conclusions, references, and appendices.

I. THEORETICAL ASPECTS OF MUSICAL SCALES, THEIR ORIGINS AND EVOLUTION

1.1. Phenomenon of consonance/dissonance

1.1.1. Problem of consonance/dissonance and empirical knowledge. The phenomenon of consonance/dissonance has generated interest since ancient times. Even today, there are attempts to base theories of practical musical scales on the numerological concepts of consonance. Scales of Lithuanian *sutartinės* (type of *Schwebungsdiaphonie*) are supposedly also based on the psychoacoustical qualities of dissonance. Therefore, the phenomenon is discussed in the special chapter in the present study.

The longevous Pythagorean tradition treated practical scales as merely successful or not successful reflections of ideal theoretical rules. Even Cartesian attitudes on empirical knowledge have not changed this concept. As we primarily deal with practical musical scales in this study, we do not address the detailed discussion on the theories of musical scales developed before the end of 19th century, i.e., before the landmark studies by Hermann von Helmholtz.

1.1.2. Theories of consonance/dissonance. An overview of the theories of consonance/dissonance, mostly of psychophysical and cognitive nature, relevant for the present study is presented. The main ones are: the "place theory" (Helmholtz; the role of beats is discussed), the opposing theory of "tonal fusion" (*Verschmelzung*; Stumpf), newer tonotopic theories (Greenwood, Plomp & Levelt, Kameoka & Kuriyagawa), the theory of "virtual pitch" (Terhardt), and the theory of "stream coherence" (Wright & Bregman).

1.1.3. Relevant conclusions from the theories of consonance/dissonance. a) the phenomenon of consonance/dissonance is multifaceted and no single theory is able to cover it universally. b) the numerological rule of "simple ratios" has actually no impact on the discrimination between consonances and dissonances. This rule appears as an epiphenomenon or a consequence of physiological and psychological "mathematics," not vice versa. c) usage of such terminology as "quartertone" or "sixth of tone" is usually not legitimate if we are concerned with practical scales. Referring to decimals of cents is more adequate as it implicates a certain approximation. d) physiological consonance/dissonance depends not only on fundamental frequency ratios, but on other parameters of sounds as well, for instance, on their spectral qualities. This aspect should be also taken into account when interpreting the nature of the scales. It is of primary importance in the tunings of inharmonic sources. e) obviously, consonance/dissonance depends not only on the objective parameters of sound, but also on, e.g., exposure of an individual to a certain soundscape. For instance, the culturally dependent sense of consonance/dissonance results in the perception of just intervals by modern listeners as "lacking warmth" or "tasteless" and the preference is given to equal temperament (Roberts &

Mathews, Vos). On the other hand, the sense of consonance/dissonance varies noticeably even in the frame of single musical language (examples of the intervals in barbershop singing and violin music; Sundberg, Greene).

1.1.4. Genetic aspects of consonance/dissonance. Some issues regarding the genesis of the harmonic and melodic consonance are discussed. According to Terhardt, the sense of consonant intervals might be developed in the prenatal stages as, in the training of synthetical hearing, the fetus is exposed to natural fifths, fourths and thirds formed between the partials of the mother's voice. This is a seemingly interesting idea, however, it does not correspond to the peculiar manifestations of the sense of consonance throughout musical cultures, as well as to the fact that the fetus nevertheless is exposed to noise more than to tones.

In the study of the genesis of consonance/dissonance, replacing of the question "what makes cons-/dissonance?" with the question "why cons-/dissonance is desirable?" is quite promising. On the one hand, dissonance signals physiological danger (Nesse), on the other hand, the desire for musical dissonance can be treated as one of the peculiar forms of general demand of stimulation or thrill (Huron).

1.2. Regularities of musical information. Universals

Discussion of universals in music emerged in the 1970s, mostly under the influence of Schenker and Chomsky. The application of the issues raised in the discussion to the research on musical scales is based on the following idea: if certain universals of intervallic thinking exist, then they can explain certain features of musical scales and their development.

1.2.1. Octave equivalence. Equivalence of sounds separated by "mathematical" (2:1) octave(s) is found to be the general principle of scale structures. There are some notable exceptions to the rule, however. First, the phenomenon of "stretched octaves" or "stretched intervals," all in all, is common for different cultures and different cases. Nonetheless, the principle of octave equivalence can be valid in this case as well, only the interval itself is different. The second point is more important: some musical cultures do not care about the octave at all. For instance, some musical cultures in Central Africa do not treat the exact octave "better" than the seventh, the ninth, or any intermediate interval (Arom, Voisin). Also, significance of this universal is dubious in the case of oligotonic cultures, i.e., where the octave does not appear or almost does not appear in music. All in all, the octave equivalence probably plays an important role in the scales based on division, but not on addition of intervals.

1.2.2. Pitch continuum and categories. Categorization of pitch continuum is regarded as one of the musical universals. (The largest) optimal number of sounds in musical scales is also supposed to be universal and it is linked to the operational unit (so-called "magical Miller's

number 7±2"). The system of categories and the structure of category ("in tune," "not in tune," "indeterminate") is of big importance in cognition and transcription of sound material.

Nevertheless, pitch categorization is not absolutely universal either. The exceptions include primarily vocalizing glides and similar structures ("tumbling strains," "indeterminate-pitch chants," "β-intonation;" according to Sachs, Kunst, Malm, Alexeyev, etc.).

1.2.3. Scale intervals. Optimal intervallic step (the interval between two succeeding sounds in a scale) is caused by several phenomena. These are: the abovementioned "magical Miller's number," physiological and perceptual problems that limit production and cognition of very small intervals, and phenomenon of stream segregation that limits usage of large steps. Therefore, intervals ranging approximately from one to three semitones are mostly used as the rough material for scales.

Asymmetry of scale (i.e., unequal steps) improves identification of the scale, assigning functional qualities to its sounds and other modal qualities (Sloboda, Schellenberg, Trehub, Rosch, Krumhansl and others). Consequently, asymmetrization actually goes in step with the scale's acquirement of modal features. Krumhansl's approach of tonal profiles is shown to be valid in intercultural studies as well (Castellano, Bharucha & Krumhansl). The universal of unequal scale steps, however, seems to be an overestimation, since equitonics is also widely known in different musical cultures all over the world.

1.2.4. Melodic contour. There are many experiments that confirm the universality of the Gestalt of melodic contour and its prevalence over precise intervals in different cases. Thus, comparative study of musical scales can be senseless if the determinant is the melodic contour in the case under investigation.

1.2.5. Quasiuniversals. Numerous exceptions from supposed musical universals gave birth to some scepticism concerning musical universals, especially among musicologists with an anthropological inclination (e.g., Merriam and Blacking). Strictly speaking, the universals should be treated as quasiuniversals, but this fact does not disprove their manifestation and importance. So, the balance between the universal and local qualities should be stated in every case.

1.3. Aspects of genesis of musical scales

1.3.1. Parallels in phylogenesis and ontogenesis of scales. The "fundamental biogenetical law," postulated by Haeckel in 1828, declares that ontogenesis repeats phylogenesis. According to this paradigm it is enough to explore how modal thinking of the infant develops and then to transfer the phenomena revealed to the phylogenetic plane. Those two processes, however, are not strictly isomorfic: at least universal (innate) and cultural (acquired) components of ontogenesis should be disentangled.

Sandra Trehub and her colleagues carried out a number of experiments that revealed these components and were based on responses of infants. They have found the principle of non-equidistance (asymmetry of scale) to be innate and the certain shape of the scale (e.g., occidental diatonics) to be acquired. Support for these implications was gained from a study of Thai scales as well. Trehub and others also ascertained that infants at the age of 2–6 months listen intently to consonances but not to dissonances which leads to the conclusion about the relative archaicity of the former.

Pierre Zurcher, however, has completely converse results. Children were asked to sing familiar diatonic tunes. He found four developmental stages: 1) no order in the system of sounds, 2) sounds ordered in ascendant succession, with progressive contraction of intervals observed, 3) the system of sounds roughly equitonic (anhemitonic), and 4) diatonics reproduced, though not perfectly.

Thus, first, Zurcher emphasizes the facet of performance, not of response (the latter encounters some methodological problems, as pointed out by Cross). Second, according his results, equitonics is anterior to diatonics in ontogenesis.

1.3.2. Links between language and music in the development of scales. Analogies between language and music were noticed long ago. Recent research – e.g., on syntax of the two systems (Gibson, Lerdahl) or their neurophysiological correlation (Patel) – shows that links between them are closer than ever supposed before. Now there is a tendency to seek the origins of language and music in more or less common protofaculty ("musilanguage", according to Brown), sometimes even carried back and linked to "zoomusic."

Concerning interval-type qualities, correspondence can be found between the characteristic pitch range in prosody and characteristic leaps as well as range in traditional singing. This fact led to the concept of the "age of the fourth" in the development of mode. Two roughly contrasting zones of pitch in speech (Jackendoff & Lerdahl) correspond to archaic type of vocalizing two registers (α-intonation, by Alexeyev). A closer look at the genesis of language and music also reveals some inconsistencies in descriptions of intervals and scales of certain interjacent forms between speech and singing.

1.3.3. Alexeyev's theory of mode development. One of the most consistent theories of genesis of mode was developed by Russian ethnomusicologist Eduard Alexeyev. This chapter briefly reviews the main ideas of Alexeyev, their sources and similarities to other theories (by Kharlap, Rubcov and others).

Alexeyev considers three basic and stadial types of archaic intonation which he denominates as α-, β-, and γ-intonation. α-intonation is based on two contrasting registers of voice, i.e., here pitch is not yet crystallized. β-intonation means gliding intonation, i.e., containing neither quasistable pitches, nor approximate contrasting qualities. And finally,

γ-intonation corresponds to loosely intoned sequences of sounds with approximate intervallic relations. This roughly corresponds to equitonics and "semi-equitonic" its versions (gradually contracting, to the upper boundary of vocal register, "proportional scales," "evolving scales," etc.). The sounds in the scale based on γ-intonation are **coordinated** but **subordinated** (by Kharlap), i.e., they are approximately equal in their perceptual weights. The more advanced stage in the development can be characterized by subordination, which means asymmetization in the perceptual weights of the scale steps, corresponding to the stabilization of intonation and to development of modal qualities.

1.4. Some peculiarities of "exotic" musical scales

By "exotic" musical scales the author is referring to scales which in many cases do not conform to established musical universals.

1.4.1. Equitonics and "negotiated" musical scales. Equidistant (in pitch domain) scales have been the source of scholarly interest from the very beginning of comparative musicology (Stumpf, Hornbostel, then Husmann, Wachsmann, and others). Hornbostel raised a controversial, but still relevant theory of "overblown fifths" which explains the formation of equipentatonic, equiheptatonic and similar structures spread throughout the world. Currently there are few doubts about the significance of equitonal musical thinking in archaic musical cultures.

There are also instances when equitonics interacts with other intervalic rules and constraints. For example, the relatively stable frame of a pure fourth filled out by loosely-knit intermediate tones (i.e., quasiequitonal structures) is observed in different cultures. Concurrently, in some cases there is strong evidence that acoustically consonant (i.e., natural) fourths or fifths are not at all important.

Thorough research of (quasi)equitonic scales reveals some emic/etic issues. Arom and colleagues developed an interesting interactive approach which they applied and consequently found that seemingly different versions of Sub-Saharan scales flow from a single general scheme affected by two processes – mutation and permutation.

1.4.2. The manifestation of dissonance in musical scales. Quite a few musical cultures favour dissonances (in terms of physiological acoustics) rather than consonances in their polyphonies. This was described as various types of psychoacoustically based "diaphony of beats" (*Schwebungsdiaphonie*) by Messner and Brandl in the Balkans and southeastern Asia. There are more places throughout the world where this type of polyphony can be found, including Lithuania.

Moreover, dissonances are exploited in the music of idiophones. Beats between their partials occur due to inharmonicity of their spectra. This effect, as well as deliberate mistuning is used, e.g., for producing the distinctive "shimmering" quality of gamelan music.

1.4.3. Specific aspects of frequency domain in musical scales. So-called instrumental scales occupy a special and significant place among musical scales. These are inbuilt in the design of certain musical instruments. Most of all instruments producing sequence of natural tones are meant. The natural scale also inherently appears in overtone singing since it is based on the successive exaggeration of separate partials of the voice spectrum by means of specific articulation.

At least one tradition (in central Australia, according to Ellis and Will) exhibits extremely peculiar musical thinking where frequency differences instead of pitch differences are operational. This leads to doubts regarding the unquestioned universality of the principle of frequency logarithmization.

1.5. Problems of theoretical interpretation of musical scales

Musical cultures of the world present a wide variety of musical scales and scale phenomena. Regrettably, the original wealth of the scales quite often is blocked by biased theoretical schemata.

1.5.1. Emic/etic problem. The problem stated by Kenneth Pike in 1954 in its general form is a problem of relation between categories and continuum, or, partially, between specific (cultural) and general (supracultural, universal). The denotation comes from linguistics manifesting as the "phonemic vs phonetic" dichotomy, often used to illustrate the issue as the difference between phonemic spelling and its phonetic transcription. For intercultural studies, the problem is important, first of all, in its extended form: (insider's) emic → etic → (outsider's) emic. Briefly, insider's and outsider's classifications do not in general coincide. Therefore, outsider's implications about the phenomena intrinsic for distant cultures may appear to be fictitious.

Projection of the problem onto the plane of musical scales results in the following statement: since insider's and outsider's classifications of pitch continuum are not necessarily the same, the musical scales perceived by an outsider are not necessarily those intended by an insider. This kind of phenomenon is sometimes referred to as an "aural ghost." For instance, suppose that the thirds are not differentiated into minor, major and "neutral" thirds in some musical culture. The implication made by European musicologists about the usage of distinct versions of the third and about the corresponding chromatic changes would be merely a kind of "aural ghost" (Chenoweth).

Since the results of perception of music are then depicted in its transcription, the emic/etic problem becomes a problem of transcription as well. Provided the transcription aims to present the insider's intentions (certainly, at the level they are recognized), it should accommodate his or her musical language. Therefore, modification of key signature (including

introduction of additional marks for microtonal alterations), as well as relocation of accidentals from notes to key signature (if the accidentals are systematic and thus characterize the scale) is needed. If the intervallic thinking of an insider differs substantially from the one of the musicologist (i.e., equal temperament), even overall modification or rejection of the Western five-lined staff is preferable.

1.5.2. Numerological syndrome. The longevous tradition of describing practical scales by "simple ratios" is discussed. Some impact of theoretical musical scales (designed with the help of "simple ratios") onto practical ones is possible in the case of high cultures. The real basis of such an impact in the case of verbal cultures is, however, hardly imagined. Recent research shows that this impact is definitely overestimated even for high cultures. For instance, it is found that the practical scales of Arabs have very little in common with the theoretical systems developed by Al-Fārābī and others (During). Krishnaswamy has revealed that the arithmetical system of 22 *sruti* in Indian classical music is merely the result of tendentious explication of historical sources as well as of the wish to put the scale into neat form. The system of *sruti* indeed exists, but it is not totally based on "simple ratios." Krishnaswamy concludes that a hybrid scheme most likely appears in Indian instrumental music: tuning of the strongest consonances in characteristic accords shows some resemblance to "simple ratios" (such as 3/2; 4/3), but this is not valid for the other procedures of tuning. The inadequacy of the theoretical system of *sruti* to vocal practice is even more noticeable.

Similar problems occur when attempting to explain the construction of scales with the help of the circle of fifths. First, this approach falls short when explaining oligotonic cultures. Second, even pentatonic or heptatonic scales do not necessarily suppose pure fifths between their sounds.

1.5.3. Syndrome of equal temperament. With the invention and establishment of equal temperament a new competitive type of numerology came into existence. It can be defined as a conscious or unconscious attempt to wedge scales of traditional musical practice into the framework of equal temperament, which was regarded as a perfect scale. Sometimes musicologists do not differentiate between twelve-tone equal temperament and diatonics, in general.

This syndrome leads to various issues of interpretation. Formal classifications of scales and modes based on the nomenclature of twelve semitones often lack valid foundation and misinform us about the unique features of scales. Those classifications (which also include more complex systems than lexicographic systems) are suitable only for the primary ordering of material. The twelve-tone system is sometimes treated as the initial system in the development of scales and the scales used in traditional musical practice are seen as kind of decline of this system (Wallaschek, Czekanowska). This decline purportedly results in "incomplete", "defective" or "nontempered" scales. Thus the history of the development of scales is actually reversed.

Another issue common in studies on European and Euro-American traditional music is the issue of so-called "Pseudogreek" or "Pseudogregorian" modes. It is shown, however, that in most cases these apparent modes are mere conscious or unconscious approximations of archaic, loosely-knit "anhemitonic heptatonics" (Grainger, Sevåg). The notion of "Ancient Greek" modes in Lithuanian traditional music was set forth in the first half of 20th century (Brazys, Čiurlionytė and others) and still dominates the literature, but without verification. Sometimes "strange" notes "reluctant" to equal temperament are simply omitted from subsequent consideration. For this case, Czekanowska creates a category of "heterogeneous intervallic structures" incorporating ostensibly "extraneous" tones into diatonic twelve-tone systems. The syndrome of equal temperament becomes a stumbling block when distinction between the whole tone and semitone is crucial. For instance, Kvitka provides ample notated and described samples, which help refute theories declaring the precedence of pentatonics and anhemitonics over diatonics. However, a large part of the samples are unreliable for the purpose of this study as the Western-staff notations mask and falsify equitonics (in which the interval is slightly smaller than the tempered whole tone) possibly occurring in the actual performances. Chromatic change is another phenomenon that seems to be non-existent in most of cases. It presumes highly developed musical thinking on the part of a traditional performer, allowing him to play with chromatic "lights and shades of mood" (Kvitka, Rubcov, Čiurlionytė, Četkauskaitė and many others). A mere glance at the transcriptions discussed, however, raises suspicions that, as a rule, "nontempered" pitch and/or a wide zone of pitch intonation are actually at work.

II. ACOUSTICAL METHODS OF STUDY ON MUSICAL SCALES IN VOCAL PERFORMANCE

Objectivization of musical scales is needed for unbiased insight into the phenomena of scales. This is achieved with the help of acoustical methods, which include computer-aided acoustical analysis. However, measurements of pitch and the subsequent decisions regarding the scales, pose different problems and some additional techniques should be applied for adequate results. These are the matters discussed in this section.

2.1. Elements of methods of acoustical analysis

2.1.1. Development of methods of acoustical analysis. Acoustical methods are sometimes undeservedly treated as novel methods in ethnomusicology, whereas these are the methods used in the dawn of ethnomusicology. Moreover, the beginning of comparative musicology is associated namely with acoustical measurements of musical scales (Ellis, Hornbostel and others), i.e. with the subject of the present study.

Later historical developments in acoustical methods came in stages and were conditioned by the invention of the oscillograph, melograph, and the computer. These developments increased the range of possibilities for graphic representation of sound. For a long time automatic transcription (pitch track) was probably the most important graphic representation of acoustical analysis.

2.1.2. Evaluation of parameters of vocal performance by means of acoustical methods. Characteristic applications of acoustical graphs (such as pitch track, SPL track, spectrogram, spectrum, as well as graphs for the processed data – F1-F2 chart, tempo curve, histograms of different statistical distributions, etc.) in ethnomusicological studies are overviewed. The features of vocal style discussed include scale (basic aspects), vibrato, glissando, ornaments, rhythm, dynamics, phonetics, vocal technique, and timbre. In certain cases these features interact with the pitch phenomena that are in the main focus of the present study.

2.2. Measurement and interpretation of pitch and musical scales

2.2.1. The problem of objective and subjective pitch. Computer-aided measurement of sound frequency and the subsequent calculation of pitch do not pose a problem. Difficulties arise because of perception – the gap between objective and subjective sound. The subjective pitch simply does not correspond to the objective pitch. (Here and henceforth "objective pitch" will be used to refer to normalized log frequency). Thus methods for estimating the integrated subjective pitch by analyzing the undulating tracks of the objective pitch (i.e., automatic transcription) of vocal performance should be delineated.

Fortunately, requirements for the software used are not severe (errors up to some 10 cents are acceptable) as both the vocal production of pitch height and the perception of pitch are far from precise.

2.2.2. Intrasonic change of pitch. Rapid change of the objective pitch is characteristic of vocal performance. It takes place in the time span perceptually attributed to a discrete sound. There are a few basic types of change: glissando, vibrato and trill. All of them have different outcomes on pitch perception. Empirical evaluations connecting objective pitch contour and perceived integral pitch as well as more sophisticated mathematical approximations simulating ("stylizing") pitch perception were made (d'Alessandro, Castellengo, Mertens, Ross and others). Thresholds separating qualitatively different modes of perception (trill threshold, glissando threshold) were estimated.

2.2.3. Intersonic change of pitch. Musical scales. The perceived integral pitches estimated from the objective contours by certain evaluative and simulative approaches generally vary in the course of vocal performance, in terms of scale steps: pitch of the same scale step is not the same at the different points of melody contour. If they nevertheless approximate equal

temperament with A4 = 440 Hz and the deviations are small enough, simple quantification of the pitch (log frequency) continuum is applied in the process of automatic transcription. (Here by "automatic transcription" the whole automated procedure from sound signal to note values is meant. It should be not confused with another meaning of "automatic transcription" as the initial stage of the procedure, mentioned earlier.) If a performer shifts the overall position of the scale up and/or down in the course of performance, i.e., if the gradual transposition is noticeable, the procedure of automatic accommodation to the shift can be applied (McNab *et al*, Pauws).

Nevertheless, the described procedures applied in the automatic transcription are hardly suitable for study of traditional music as the traditional musical scales correspond neither to equal temperament, nor to any other predefined scheme, in general. Regarding traditional musical scales, there are three basic cases of study different in their complexity. If the intersonic changes of pitches of scale steps are negligible, the corresponding frequencies or pitches (log frequencies) can be easily measured. This case is characteristic of musical instruments with fixed tuning. If those pitch changes are quite significant, yet if the means and zones of intonation are stable enough, the insight into the scale structure can be gained from the histograms of pitch distributions (either compiled from the arrays of estimated values of the discrete pitches made beforehand or gained automatically from processing of the continuous pitch contours) or even from LTAS spectra (from the integral spikes of fundamentals or other partials). The most complicated case is the case of gradual transposition: the discrete spikes in the histograms or spectra blend together and no scale structure can be identified. Additional methods are needed to eliminate the phenomenon of gradual transposition from the data analyzed; there are developed in the subsequent section of the present study.

Applications of the methods of recognition of musical scales in the ethnomusicological studies are overviewed.

2.2.4. Acoustical methods in the study of musical scales in Lithuanian traditional singing. Up until now, this author has been the only researcher to apply acoustical methods to the study of musical scales in Lithuanian traditional music. The measurements carried out earlier, as well as in the present study in general apply the methods described above.

The pitches of the dyads of polyphonic *sutartinės* are determined from the spectra of the dyads: certain partials are identified as belonging to one or the other of two voices, and these two pitches are calculated. Relatively stable portions of the dyads are considered in terms of spectrum (fortunately, the intrasonic intonation of *sutartinės* features quite stable segments). Sound editor Sound Forge is used.

When only mean values of pitches of scale steps are needed the simpler LTAS method is applied. Nevertheless, sometimes some of the scale steps cannot be identified from LTAS as the spikes of the corresponding partials do not clearly stand out against a background (mostly because

of the rarity of occurrence of those steps). Then the segments not containing those steps are removed from the sound record and LTAS analysis of the remaining part of the record is executed.

For analysis of records of monophonic performances, the software programs Wincecil and Speech Analyzer are applied. Perceived (integral) pitches of tones are estimated from continuous tracks of objective pitch (log frequency) automatically transcribed by the software; only structural notes are considered. The following methods are applied: 1) Gliding onset and offset of a tone are omitted from consideration and pitch of the remaining quasistationary segment is measured. The pitches were estimated within a range of 10 cents as the intratonal pitch fluctuations are rarely less than 5–10 cents; these numbers are also characteristic for the jnd of pitch. 2) In the case of considerable and irregular intratonal pitch change, pitch of short segments chosen from the track is aurally compared to the pitch of the entire tone. This way is applicable, provided more or less stationary short segments are found in the track. Also short segments of monotonically ascending or descending pitch track are accepted for the estimation. In this case the aspect of memory decay in perceptual pitch evaluation is taken into account. 3) In cases where it is impossible to evaluate pitch using the methods described, the perceived pitch is aurally collated with generated tones from a 10 cents-grid. This method is also used for a complementary check of the results obtained by methods (1) and (2).

3. STUDY OF MUSICAL SCALES IN LITHUANIAN TRADITIONAL SINGING

This section aims to reveal psychoacoustical and cognitive phenomena in Lithuanian traditional singing. Two polar extreme layers of Lithuanian vocal tradition are chosen for the investigation. These are polyphonic *sutartinės* – a Lithuanian type of *Schwebungsdiaphonie* – and traditional solo singing. The raw data of the investigation consists of the arrays of pitch values. The pitch measurements and evaluations are carried out applying the methods described in the preceding section.

3.1. Musical scales in *sutartinės*

The most distinctive kind of Lithuanian *sutartinės* present a peculiar type of *Schwebungsdiaphonie*, i.e., diaphony of the *sutartinės* is based mostly on intervals of the second occurring between the voices.

3.1.1. Samples. Regrettably, there are very few sound recordings of *sutartinės* made in the 1930s, before the continuous tradition vanished totally. All available samples (22 *sutartinės* and, additionaly, 11 pieces of *sutartinės*-type music for traditional aerophones *skudučiai* and *ragai*) are discussed in the present study. The samples studied belong to several idiolects. The

idiolect of the Biržai group featuring the largest number of registrations (8) is chosen for more thorough analysis.

Musical scales of the samples are measured by means of LTAS, as described in the previous section of this study.

3.1.2. Aspects of interval structure of the scales. For the evaluation of interval structure of the measured scales the factor of diatonic contrast is introduced. The diatonic contrast is normalized to equal temperament, i.e., if the value of the diatonic contrast equals 1, which means that the corresponding set consists of scale steps separated by tempered whole tones and semitones. 0 for diatonic contrast means ideal equitonics (equal intervals between the steps). It was found that the interval organization is closer to equitonics than to diatonics for the majority of the idiolects. For the Biržai idiolect, for instance, the largest value of diatonic contrast is only 0.1. The mean interval between scale steps equals 172 cents, averaged across all samples.

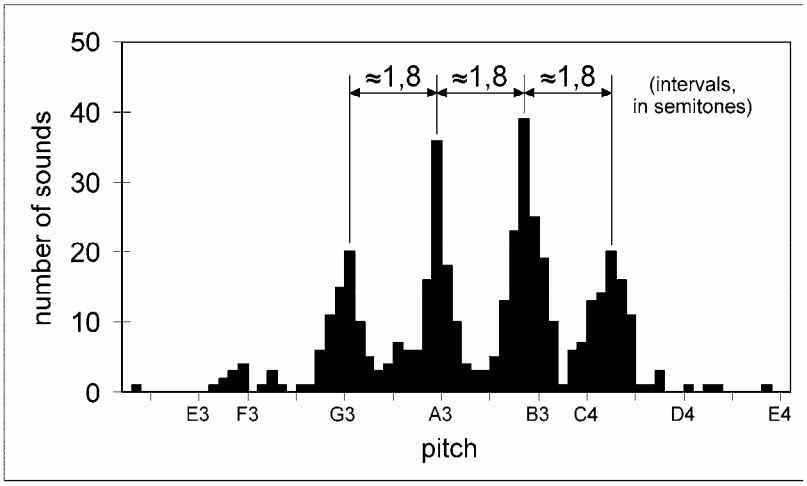

Fig. 1. *Sutartinė* "Mina, mina, minagaučio lylio": statistical distribution of pitches.

One *sutartinė* ("Mina, mina, minagaučio lylio") from the repertoire of the Biržai idiolect is chosen as a sample for thorough measurement of all separate dyads. The results (Fig. 1) reveal distinct equitonic structure of scale steps with roughly 180 cents in between. That means, two simultaneously sounding modi show two trichords displaced by 1.8 semitones and comprised of neutral thirds (sized appr. 3.6 semitones each). In the structure, the central bichord clearly stands out. The two steps are intoned very steadily in the course of the entire performance thus forming the nucleus of the scale. The marginal steps show greater freedom in intonation.

The implication is that the Western staff used for the transcription of *sutartinės* actually falsifies the original principles of scale design in *sutartinės* as it implies diatonic contrast that is absolutely not characteristic in this case. Some ways of managing the problem are discussed.

3.1.3. Psychoacoustical aspects of vocal dyads. In reference to performers, one of the most significant qualities in the performance of *sutartinės* is a sense of the "perfect clash of voices." According to Brandl, the psychoacoustical correlate of the ideal ring in

Schwebungsdiaphonie (found in the Balkans and elsewhere) is of maximum roughness. In general, the measurements in the present study support this statement when applied to Lithuanian *sutartinės*. According to earlier investigations of roughness (Plomp & Levelt, Kameoka & Kuriyagawa), for frequency and SPL ranges characteristic for *sutartinės* performance, the maximum roughness should appear in the vicinity of some 170–180 cents between the voices composing a dyad. This is in perfect concordance with the results of the present measurements of *sutartinės*. Therefore it can be credibly stated that the scales of *sutartinės* are actually determined by psychoacoustical, i.e. by extramusical phenomenon.

However, it should be pointed out that the requirement of maximum roughness is not categorical in the Lithuanian case for the following reasons: the intonational zone of a second is too wide, durations of the sounds are too short to produce exact intervals (initial glides are characteristic), and the partials are, on the average, too different in SPL. All these factors diminish the role of maximum roughness. It could be stated that maximum roughness is a desirable quality, but the zone of the suitable roughness is quite wide; the factor of roughness is possibly reduced by other important factors of articulation.

Additionally, a peculiar sense of support, almost a sort of consonance possibly could be attributed to the manifestation of combination tones and "virtual pitch" (*basse fondamentale*) of dyads. This idea, however, needs further examination.

Because of the different combinations of vowel phonetics in dyads, a variety of common spectral patterns are created during the performance. When two vowels are similar in one or more formant frequencies, distinct beats appear. Otherwise, if the dyad is "flat," beats are not prominent, and the sense of roughness (dependent on the factor of modulation) is weak. This outcome is further spread to timbral and SPL relations of voices.

3.1.4. Parallels in sounding of *sutartinės* and bells. Kinship between the vocal "diaphony of beats" and the sounding of church bells is often mentioned by performers and researchers of *Schwebungsdiaphonie*. This is explained by beats that are characteristic both for the two soundings as well as by the common spectral ranges (Brandl). Here an additional idea, based on the resultant spectral inharmonicity of vocal dyads is proposed.

3.1.5. Parallels in musical scales of *sutartinės* and Lithuanian traditional instrumental music. Instrumental polyphony similar to *sutartinės* was common roughly in the same region as *sutartinės*, i.e., in Northeastern Lithuania. Analysis of the tunings of *skudučiai* (disassembled panpipes) and *ragai* (wooden trumpets) shows resemblance to the musical scales of *sutartinės*. The interesting issue is that performances recorded from the same sets of *skudučiai* or *ragai* slightly differ in their tunings. Since the tunings were most likely not intentionally changed (for *ragai*, this is not even possible), this change could result from the slightly different blowing techniques and/or different rhythmic patterns produced. This

demonstrates the fact that precise tuning was not the main focus of the players. Emphatic implications cannot be drawn concerning the tunings of these instruments, as there are very few records. Nevertheless, it is clear that the tunings were generally not based on diatonics similar to equal temperament.

3.2. Static aspects of musical scales in solo singing

3.2.1 Samples. Samples of three repertoires of Lithuanian traditional solo singing were chosen for the investigation. Two repertoires represent two male idiolects of *Dzūkai* (Southern Lithuania) vocal tradition. Both singers – Jonas Jakubauskas (1908–2000; Žagariai; Seinai Dst.) and Petras Zalanskas (1900–1980; Mardasavas; Varėna Dst.) – were outstanding representatives of the tradition. The third repertoire represents the dialect of *Suvalkiečiai* (Southwestern Lithuania) vocal tradition.

The reasons for such a choice are the following. First, the *Dzūkai* dialect is the richest dialect in Lithuania, in terms of variety of musical scales. Second, it seems that the traces of archaic intonation survived most of all in this dialect. The same holds for the recordings made during the first half of the 20th century (but not nowadays) in *Suvalkija*. Third, the samples had to be typical, i.e., the performers should be recognized as representatives of the tradition in their environments. Fourth, it is worth studying individual and dialectal or more general features of musical thinking.

The first statistical sample (henceforth JJ) contains all 26 songs from the album of Jakubauskas recorded and compiled by the author. The criteria of the compilation embraced general poetic and melodic features, so the collection is unbiased in terms of nuances of scales. The second statistical sample (henceforth PZ) contains 20 songs of Zalanskas picked out randomly from the collections kept in the Archives at the Department of Ethnomusicology, Lithuanian Academy of Music and Theatre. The third statistical sample (henceforth S) contains all 25 songs recently published in the collection of phonograph records made in 1935–1939 in *Suvalkija* (Nakienė and Žarskienė, 2003).

Nevertheless, the statistical samples described remain too numerous for processing purposes. Rough evaluation shows that the detailed study of all sounds in all selected songs would be based on some 14.000 pitch measurements. Therefore, the sample size is reduced to approximately 2.000, pitch values limiting the analysis to one melostrophe of each song. (This holds only for the analysis of static aspects of musical scales, covering a large set of songs.) The second melostrophe of every song is chosen, since choice of the first one is risky because of the possibility of a not stabilized mode of performance or even different melodic contour, in comparison with the rest of the melostrophes. Verification of validity of such a choice shows

that generally, for evaluation of static features of musical scales, the change of the scales in the course of performance (from melostrophe to melostrophe) is negligible.

Fig. 2 summarizes observations of the scales the Samples JJ, for illustration. The pitch of a certain scale degree is calculated as the average of all occurrences of that degree in the melostrophe.

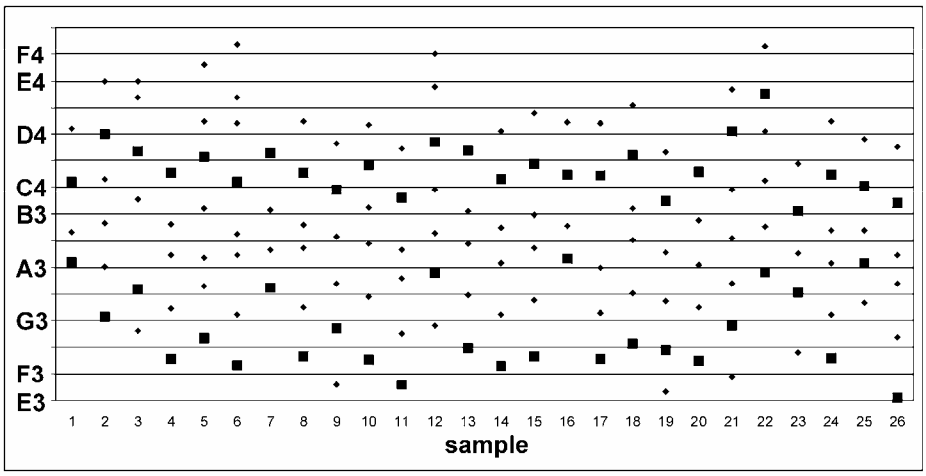

Fig. 2. Scales of Samples JJ. Bold dots mark the two most distinct tonal anchors.

3.2.2 Parameters of static features. To cover the entire set of the musical scales and to evaluate their general features, three parameters are introduced: **diatonic contrast**, **stability of intonation** and **modal weight**. Diatonic contrast was described in the analysis of *sutartinės*. The stability of intonation is defined as the reciprocal of the standard deviation of pitch (the occurrences of the certain scale degree in the melostrophe are considered). The modal weight is attributed to each single tone in melody contour and it is evaluated according the significance of the tone in the time domain. The main factors contributing as partial weights include the rhythm value of the tone (normalized to the main value of the rhythmic movement) and the weights of the tone in the hierarchical tree structures of metrorhythm and cadences. Then all the weights of the tones belonging to the same scale degree are summed up and the profile of modal weights of the certain song is derived.

The **modal contrast** (i.e., the distinctness of modal structure) is defined as the ratio of the total weight of anchor degrees of a scale divided by the total weight of the rest degrees.

3.2.3 Relationships of parameters of static features. Based on the calculated values of diatonic contrast, stability of intonation and modal contrast, examinations of the statistical distributions of these parameters and attempts to estimate the relationships between the parameters are made.

It is found that generally, for the samples under investigation, equitonics is more characteristic than diatonics. Diatonic contrast is found to be less than 0.5 in 61% of Samples JJ, 70% of Samples PZ, and 80% of Samples S. Since the discussion on “ancient Greek” or “Gregorian” modes is valid only in the case of diatonics, those notions cannot be applied to

most of the samples discussed. As the studied samples are typical, at least, for a considerable area of Lithuania, the natural question arises regarding the validity of usage of such terminology in Lithuanian traditional music in general. The strong tradition of stating the existence of "Greek" modes in Lithuanian traditional music is still alive. From the present examination, it becomes clear that the kind of "Greek" modes can be stated in considerably fewer cases than one thinks based on first impression.

It is also found that (statistically) greater diatonic contrast corresponds to the greater modal contrast. (The confidence levels of the correlation are 98%, 94% and 92% for the Samples JJ, PZ and S, correspondingly.) Thus, it is assumed that crystallization of modal functions of scale sounds is in step with asymmetrization of equitonics, i.e., with the formation of diatonics. This finding serves as further (experimental) evidence for the theoretical propositions on genesis of mode.

It is worth noting that the correlation between diatonic contrast and modal contrast is observed without the aid of comparative studies on historically distant musical dialects or idiolects. It is, rather, found in the frame of each single idio-/dialect that is actually homogeneous chronologically. Some assumptions are made concerning this issue. First, possibly this manifests "bimusicality" or even "multimusicality," in terms of modal thinking. Second, possibly here physiological or cognitive aspects of singing are at work: possibly the equitonic (or γ-) intonation is more convenient in the case of not distinct modal functions and the relatively asymmetrical diatonic intonation is preferred in the opposite case.

The same modal contrast corresponds to different values of diatonic contrast in the three sets under investigation. The singing of Zalanskas features the greatest diatonic contrast and the samples from Suvalkija feature the least. Consequently it can be said that the singing of Zalanskas is the most "diatonicized."

The most steady scale steps, in respect to the tonal center and averaging across all samples, are the fourth and the fifth; this assertion is true even if we assume that there are different diatonic versions of the second and the third. They are slightly (up to 10–20 cents) wider than their pure equivalents, with exception of the slightly narrower average fifth in the samples from Suvalkija.

Intonation of the modal anchor tones is found to be statistically more stable than the average intonation. Additionally, for *Dzūkai* samples, intonation of the upper anchor tone is found to be more stable than the intonation of the lower anchor tone (the nominal tonal center). This fact correlates with the theories of mode development (Kharlap, Alexeyev) assigning a more or less primary role to the upper anchor tone. It seems that the lower anchor tone is relatively more of a cognitive nature, whereas the upper anchor tone is relatively more of an acoustical-physiological nature.

Correlation between the stability of intonation and the modal contrast is undistinguished.

3.3. Models of elimination of gradual transposition

The sample JJ 9 is chosen as the main sample for the modeling of scale features. The results of the pitch measurements of all melostrophes are summarized in Fig. 3a. At first glance, the pitch distribution is quite chaotic. Clearly nothing can be stated about the scale based on this graph. The reason for such chaotic distribution becomes clear from Fig. 3b: the strophic realizations of the melodic contour differ considerably in pitch. This depicts the phenomenon of floating tonality or gradual transposition (usually a gradual rise of pitch) common in traditional, unaccompanied singing. This is the phenomenon that results in the blend of pitch classes.

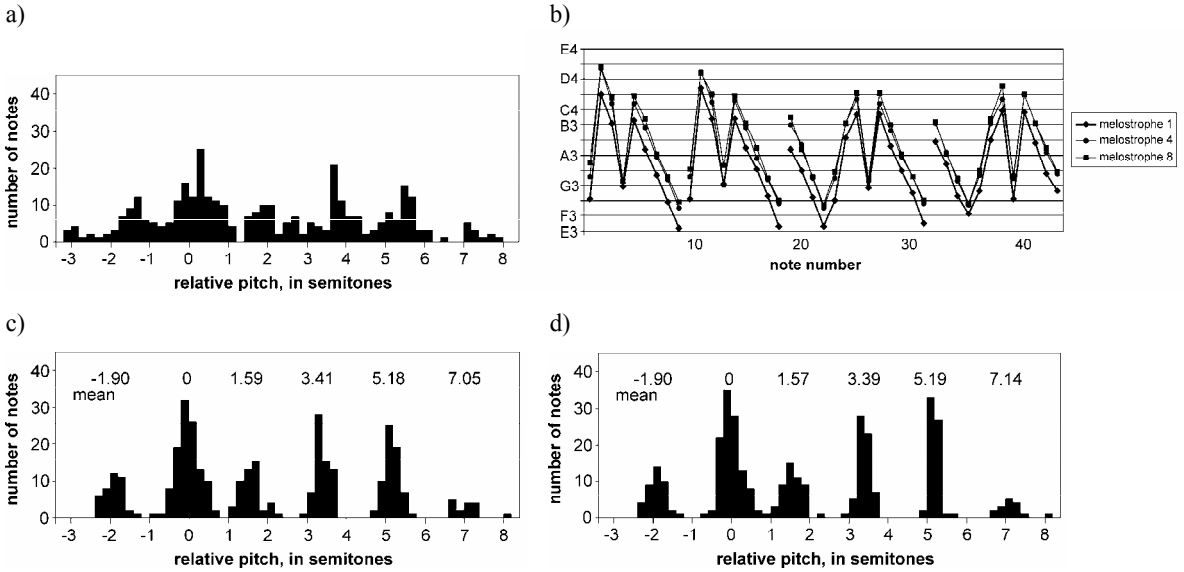

Fig. 3: a) Pitch distribution of Sample JJ 9. Here and henceforth pitch is normalized to the mean intonation of the tonal center; b) Measured melodic contours (three melostrophes are presented); c) Pitch distribution of Sample JJ 9 according to the model of melostrophic transposition (1); d) Pitch distribution of Sample JJ 9 according to the model of continuous transposition (3).

Since neither performer nor listener perceives the transposition of scale as a change of scale, the results of pitch measurements cannot be applied directly to the reconstruction of the performer's scale. Additional procedures are needed to eliminate the transposition of scale as an obstacle in the process of reconstruction. In this study, this is achieved through mathematical modeling.

3.3.1 Model of melostrophic transposition. All models are based on the idea that a kind of invariant melodic contour exists. It represents a sequence of pitches of one melostrophe; different pitch versions of scale degrees at different points of invariant contour occur, in general.

The model of melostrophic transposition (henceforth Model 1) is based on the additional assumptions that a) the invariant is realized in every melostrophe in more or less different microtonality, i.e., the tonal center plunges up or down from strophe to strophe; and b) the zonal deviations of these realizations from the invariant are as small as possible. Then the task of finding of the invariant means the following task of minimizing:

$$\sum_{i=1}^{M}\sum_{j=1}^{N}(a_{ij}-t_i-c_j)^2=\min,$$

here a_{ij} marks absolute pitch of the *j*th tone in *i*th melostrophe, t_i stands for the relative position (in terms of pitch) of the *i*th melostrophe, and c_j marks pitch of the *j*th tone in the invariant. In a non-normalized form (e.g., to $t_1 \equiv 0$), solution of the expression gives the values of c_j simply equal to averages of a_{ij} across melostrophes. However, a melodic contour has several distinct (emically) melostrophic versions, in general. Therefore c_{ij} is substituted for c_j in those more complicated cases; this holds for the subsequent models as well.

Figure 3c shows the statistical distribution of the relative pitches ($a_{ij} - t_i$) normalized to the averaged relative tonal center. The scale structure obviously becomes more distinct if the transposition from strophe to strophe is taken into account.

3.3.2 Models of continuous transposition. The model of melostrophic transposition quite successfully simulates the emic design of the scale. Nevertheless, more thorough examination reveals that the fluctuating gradual transposition manifests not only when proceeding from one melostrophe to the next one, but within a melostrophe as well. So the following model (henceforth Model 2) assumes that a performer presents an intended invariant of pitch track, with slight and tolerable deviations, as well as slightly fluctuating transposition. Again, the assumption is made that the realizations of the invariant are as precise as possible and the transpositional changes from tone to tone ($t_{i\,j+1} - t_{ij}$) are as small as possible:

$$\sum_{i=1}^{M}\sum_{j=1}^{N}(a_{ij} - t_{ij} - c_j)^2 + \chi^2 \sum_{i=1}^{M}\sum_{j=1}^{N-1}(t_{i\,j+1} - t_{ij})^2 = \min .$$

The corresponding pitch distribution in the case of χ^2=1 shows that average pitches of the scale steps vary only slightly from the previous model. However, the precision of intonation differs quite noticeably. Clearly, if the fluctuation of transposition from note to note is assumed, the calculated pitch intonation becomes more precise. It seems that the precision of intonation is even overestimated to some extent, i.e., χ^2 should be more than 1. Verification of this assumption leads to the following modification of the model (henceforth Model 3). The additional condition of correlation between the different tones in the melodic contour is formed. On the one hand, standard deviation of the interval between two certain tones in the melodic contour is calculated directly from the experimental data. On the other hand, this deviation is evaluated bounding standard deviations of the subjective pitches ($a_{ik} - t_{ik}$) and those of the transpositional changes ($t_{i\,j+1} - t_{ij}$) intermediate between the two tones under consideration. Then the corresponding two totals of the two arrays are calculated and a minimization of the difference between the two values is carried out. The corresponding pitch distribution is depicted in Fig. 3d. Again, average pitches of the scale steps are approximately the same as in the previous evaluations. However, the calculated precision of intonation depends on the model chosen. It is caused by neglecting the local transposition in the Model 1 and, on the contrary, by too prominent transpositional fluctuations assumed in the Model 2. In addition, the same

conclusion on average pitches and intonational zones can be reached from the comparison of results based on different numbers of pitch measurements. Therefore, the essential regularities of the mean intervals between the scale steps can be recognized by applying simple modeling and a large number of measurements is not required to obtain reliable results. However, if the zonal features of the scale are studied from the pitch distributions, a more accurate model is needed, similar to the last one presented.

3.3.3 Models of outsider's perception. The preceding models strive to simulate the insider's model of thinking and to reconstruct his or her intrinsic musical scales. Those scales are discussed in the present study first and foremost. However, the outsider's perception of the scales is worth mentioning too. The models below (that are more of illustrative character only) deal with this issue. It is assumed that the emic system on the perceiver is based on equal temperament (or, generally, on diatonic scale) and the perceived pitches tend to be forced into the frame of equal temperament. A very simple model simulates the pitch perception based on comparisons with the two nearest neighbors in melodic contour. Both neighbors are assumed to be perceived as tempered equivalents of the scale and then the two corresponding evaluations of the intermediate pitch are made. The resultant pitch is derived as average of these evaluations. The second, advanced model takes into account longer span of melodic contour, with weights of the contextual tones gradually decreasing with the distance between the tones in the contour because of the memory decay. Also additional weighting of tones forming roughly tempered intervals (and thus working as cognitive anchors or "correct" tones) is applied.

It is shown that even the simplest model quite effectively simulates outsider's perception. The modeled "correct", "raised" and "lowered" tones correspond to aural impressions. It is also illustrated how the biased perception creates "aural ghosts," i.e., fictitious scales and chromatic change.

3.4. Dynamic aspects of musical scales in solo singing. Nominal chromatic change

This chapter considers intramelostrophic changes of pitches of scale steps. It is important to clarify the mechanism of the emersion of such changes, as well as their possible implications on the biased perception and on the theoretical interpretations.

3.4.1 Aspect of zonal intonation. Several samples from the repertoire JJ are chosen for the study of this aspect, and the characteristic sequence of prime–second–third (1–2–3; or the corresponding descending sequence, 3–2–1) is considered. Aurally the patterns under investigation tend to be perceived as realizations of the Phrygian or Aeolian (or even sometimes Ionian) trichords. Therefore one can gloss over the alternations of these trichords as manifesting chromatic change. However, the study of the acoustical data shows that the pitch zone of the second degree does not split into two distinct sub-zones, i.e. it is quite homogeneous. For

instance, in one of the samples (JJ 19), the zone of the second ranges from approximately 120 to 220 cents, with the mean value of 178 cents. It means that the seeming chromatic change of the trichord 1–2–3 results from nothing but the zonal intonation, and the wide zone testifies the traces of equitonal γ–intonation, in terms of Alexeyev. The seeming chromatic change appears only because the apperception based on Western diatonical musical thinking. Consequently, it cannot be treated as the real alternating chromaticism, in a classical meaning.

This phenomenon should be taken into account when studying scales of the traditional music, otherwise it could lead to misinterpretations and fictitious classifications of the scales.

3.4.2 Aspect of melodic context. From the invariant melograms (here defined as the pitch tracks in the form of line joining succeeding averaged pitches of the melodic contour), it can be seen that scale degrees are intoned differently, depending on the certain point of a melodic contour. This, certainly, can result from errors of measurement and from the insufficiently large statistical samples. However, if the changes are big enough and systematic, then, most probably, they reflect certain features of the horizontal (temporal) component in the modal thinking or in the physiology of vocal technique.

Pitch change can appear between the occurrences of the same scale degree in the **ascending and descending sequences**. In the samples under investigation, if not obscured by the additional counterphenomena, the pitches in the ascending sequences tend to be raised whereas those in the descending sequences tend to be lowered. For instance, in the Sample JJ 13, the thirds in the ascending sequences are systematically intoned approximately 46 cents higher than in the descending sequences, on average. This issue in the Sample JJ 13, as well as in the other samples under investigation, can be conditioned by the tendency to widen intervals. This tendency seems to work as the mean for the distinction of tones, especially the anchor tones or the other somehow important tones.

Other examples of the specific melodic contexts are the patterns consisting of the **anchor tone and its closest neighbor** in the musical scale, i.e. kind of leading tone. Behavior of the second interval formed between the third and the fourth degrees is studied in several samples. In the cases when no strong interaction between the third and the fourth degrees is observed (i.e. when the intermediate tones appear between the two tones in the melodic contour or, e.g., when the two tones are nevertheless separated by a division in the time structure), the second interval occurring between the third and the fourth degrees tends to be relatively wide. Thus the third is relatively low in this case. On the contrary, when strong interaction between the two scale degrees is characteristic (e.g., when the third appears as an intermediate tone between two anchor fourths in melodic contour), the second interval tends to be narrowed, i.e., the third is raised. For instance, in Sample S19, the discussed difference between the thirds equals 36–50 cents, on average.

Hereby the high third works as something similar to (or as the prototype of) the leading tone in diatonical thinking and thus strengthens the anchor quality of the fourth.

The next discourse deals with similar observations, on a surface level, as those just described. However, the alteration of the intervals formed between the thirds and fourths seems rather to be the outcome of a different origin in this case. The samples characteristic of a distinctive type of melodic contour are analyzed. This type of melodic contour consists of several arches situated in different scale ranges. For instance, Samples JJ 4 and JJ 26 consist of four arches. The first and the last arches fall to the lower tetrachord (1–2–3–4), the second one falls to the upper tetrachord (3–4–5–6), and the third one starts in the upper tetrachord and ends in the lower tetrachord. So, the two tetrachords are almost separated in the melody line. The clue is that the scales of the two tetrachords are designed in different ways. This is particularly apparent from the comparison of the various intonations of the third in this song: it is significantly higher when falling into the upper tetrachord than into the lower one. We can recognize that the lower tetrachord follows the rules of γ-intonation (we can even guess that it corresponds to Alexeyev's "proportional" scale), whereas the upper tetrachord probably expresses the impact of a newer diatonic musical thinking in which the whole tone-semitone contrast is distinct enough.

If the proposition about the **contamination of two different musical languages** in the same song is legitimate, then an explanation of such a phenomenon is needed. Most likely, the different intonations associate with the kindred material in the repertoire coming from remote historical and musical layers.

As in the case of purely accidental (non-systematic) change of intonation, the systematic change conditioned by melodic context can lead to obtaining pseudo-chromatic changes as well.

3.4.3 Aspect of tone duration. In the preceding examinations of dynamic aspects of musical scales, samples with short tones or abundant ornaments were consciously avoided. (Here "short tones" mean the durations approximately expressed by sixteenth notes and shorter values. This roughly corresponds to the "perceptual moment," for the typical moderate tempos in Lithuanian song lore.) It is because the short tones are performed with a noticeable tolerance concerning the precision of intonation. This feature of perception, as well as its physiological background, are generally well known. It is agreed that the "true" scale is the scale manifested by the long tones, i.e., by the durations long enough to be intoned precisely enough and to be perceived clearly enough.

However, short tones contribute to the problem of nominal chromaticism. First, the zones of intonation of the short tones are wider, and this can result in the phenomenon of the seeming chromatic change, as described above. There is a supplementary effect: as the perception of pitches of the short tones is less definite, these tones are more easily forced into

the template of the scale of a biased perceiver. Thus construing of a "needed" scale from aural data becomes more hazardous.

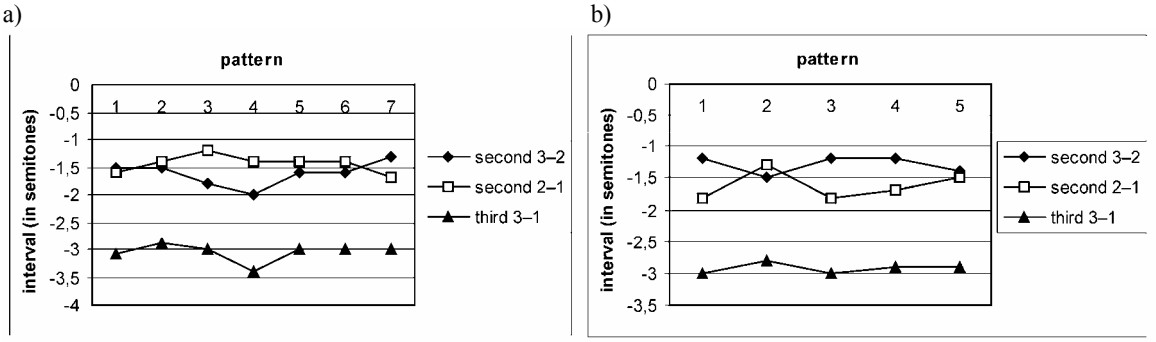

Fig. 4. Intervals occurring in the sequences 3–2–1 of Sample JJ 1 (1–4 melostrophes), constituted of a) long and b) short tones.

Second, in the case of short tones, specific physiological issues of vocal technique are at work and they can predetermine different pitches of short tones in the different melodic patterns as well as the differences between intervals in analogous patterns but made of short and long tones. Obviously, this can have an impact on determination of nominal chromatic change. For instance, Fig. 4 depicts intervals occurring in several sequences 3–2–1, constituted of long and short tones (Sample JJ 1). The long tones form quasi-Phrygian patterns (the second 3–2 equals 161 cent and the second 2–1 equals 144 cents; in average) whereas the short ones form quasi-Aeolian patterns (130 and 162 cents, correspondingly). Physiological origin of these findings might be envisaged: possibly, inertia of the mode of vocalization causes performance of the second in the way close to the performance of the third that is the accented (anchor) tone in this pattern. Therefore, the second is slightly raised, in comparison with the case of long tones.

3.4.4 "Evolving" scales. This chapter considers peculiar gradual development of scale intervals in the course of performance (see Fig. 5). This results in what Alexeyev has named "outspreading" or "evolving" scales, an archaic phenomenon connected with the physiological and cognitive matters of singing inter alia. So the present findings provide an experimental contribution and support of Alexeyev's theory with Lithuanian examples.

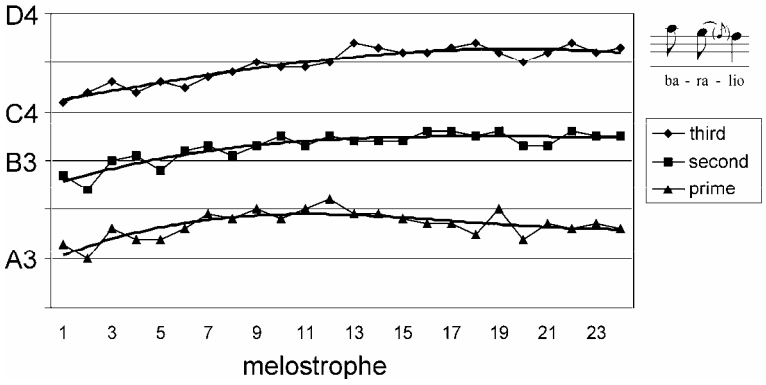

Fig. 5. Intermelostrophic change of the sequence 3–2–1 (long tones) of Sample JJ 1.

It would be a mistake to treat an interval as changing from the minor third to the major third in the transcription, for instance, in terms of the original phonemic system, since, for the performer, it remains the same interval. In other words, the spreading intervals do not illustrate a **change** of the scale, they represent a **feature** of the scale.

Conclusions

1. The legacy of pre-diatonic (quasi)equitonic scales is observed in Lithuanian vocal traditions. From 60 to 80 percent of the analyzed samples of sound records of Lithuanian traditional solo singing are closer to equitonics than to diatonics; the samples represent two idiolects of Southern Lithuania (Dzūkija) and the dialect of Southwestern Lithuania (Suvalkija).

The majority of recorded *sutartinės* (Lithuanian type of *Schwebungsdiaphonie*) also are found to show strong inclination to equitonics.

2. (Quasi)equitonic scales of *sutartinės* feature an average of 170 to 180 cents in between neighboring scale steps. This corresponds to the maximum roughness of dyad in the case of frequencies and SPLs discussed. Therefore the psychoacoustical correlate of the ideal sounding in *sutartinės* (so-called sense of the "perfect clash of voices") is of maximum roughness. So, in this case, musicological quality – scale structure – results from a universal extra-musicological (psychoacoustical) quality – the auditory sense of roughness. However, it should be stated that while the maximum roughness is a desirable quality, the zone of the suitable roughness is quite wide; the factor of roughness is possibly reduced by other important factors of articulation in the performance of *sutartinės*.

3. Comparative study shows that crystallization of modal functions of scale sounds is most likely in step with asymmetrization of equitonics, i.e., with the formation of diatonics. This holds even for a variety of scales in each single synchronic idio-/dialect and presumes "multimusicality," in terms of modal thinking, and/or simpler physiological or cognitive nature of the phenomenon.

4. Equitonics of the samples considered is shown to be in interplay with the steady frame of basic or anchor tones comprising the intervals of the fourth or fifth, as a rule: the generative scale rests on the tonal frame complemented with the loosely-knit intermediate steps.

5. Thorough analysis of the scales of individual samples of traditional solo singing cannot be carried out in a customary, straightforward manner, i.e., directly from pitch histograms obtained from acoustic measurements. This is because floating tonality, i.e., slight alteration of the pitch of the reference tone (e.g., pitch of the tonic) is characteristic of such solo performance, and the zones representing different scale degrees are blended. Additional mathematical-statistical modeling based on regularities of scale perception is needed to eliminate the transposition of scale

as an obstacle in the process of identifying an insider's emic musical scale. Corresponding models are developed and shown to be appropriate for reconstruction of scales and for the purpose of gaining insight into intramelostrophic scale dynamics.

6. Three interacting aspects of intramelostrophic scale dynamics are revealed: zonal intonation, melodic context, and tone duration. Their basis is physiological and/or cognitive but, with the exception of some special cases, hardly true scalar. Nevertheless, the systematic dynamic deviations can be stabilized because of diatonization. Only then they can result in true scalar (or modal) changes or chromatic changes.

7. Aside from scalar and chromatic changes, for the most part, so-called ancient Greek or Gregorian modes are also merely "aural ghosts." This phenomenon results from the collision of two emic scale systems – that of the cultural insider's (performer's) and outsider's (ethnomusicologist's): templates conditioned by apperception of equal temperament (or diatonic apperception, in general) can mislead a researcher to identify fictitious scales. This conscious or unconscious neglect of the original scale structure can result in false transcriptions and, consequently, in false theoretical conclusions about the scale system in traditional music. Therefore, the notion of Greek modes in Lithuanian traditional music as well as the notions of chromatic and scalar changes should be revised.

8. The results of the study generally correlate with the findings of researchers of scales in other musical cultures, as well as with theories of development of modes and theories of the genesis of music. (Quasi)equitonic scales can be compared to Alexeyev's "γ-intonation"; several cases of "γ-intonation" are found in Lithuanian traditional singing.

Įvadas

Muzikinė darna – vienas iš pagrindinių muzikinio mąstymo elementų, ypač nerašytinėje kultūroje. Tradicinės muzikos darnų savybes lemia suvokimo ir psichoakustiniai reiškiniai, modifikuojami balso fiziologijos, muzikos instrumento konstrukcijos bei muzikavimo motorikos istoriniame ir sociokultūriniame kontekste.

Lietuvių tradicinio dainavimo daržnos ir apskritai lietuvių tradicinės muzikos darnos iki šiol, remiantis objektyviais duomenimis apie darnų intervaliką, iš viso nėra tyrinėtos kaip muzikinio mąstymo elementas. Netyrinėti psichoakustiniai darnų fenomenai. Nenagrinėtos etnomuzikologinės darnų interpretacijos problemos. Tuo grindžiamas šio darbo **naujumas**. Tyrimo problema yra **aktuali** dėl kelių priežasčių, iš kurių svarbiausiomis laikytume šias: a) gilesnėms įžvalgoms apie darnų kilmę, raidą ir istorinius sluoksnius lietuvių tradicinėje muzikoje kliudo tyrinėjimų, objektyvizuojančių darnos fenomeną bei nagrinėjančių jos suvokimo dėsningumus, stoka; b) etnomuzikologinis dermių ir darnų interpretavimas, lemiamas tolygiosios dvylikalaipsnės temperacijos apercepcijos, gali iškreipti autentiškas darnos savybes ir išvirsti neadekvačiomis dermių ar darnų transkripcijomis bei, toliau, jų pasekmėmis – fiktyviomis klasifikacijomis ir klaidingomis teorinėmis išvadomis. Pastaroji priežastis yra numanoma, ją kaip **prielaidą** reikėtų patikrinti objektyviais metodais. Jeigu ši prielaida pasitvirtintų, darnų objektyvizavimas leistų atskleisti tokias klaidas ir suteiktų galimybę jų išvengti. Taigi svarbiausia šio darbo **problema** yra tradicinis intervalinis mąstymas bei etnomuzikologinė jo interpretacija.

Darbo **tikslas** – nustatyti tipiškų lietuvių tradicinio dainavimo pavyzdžių darnų intervalikos dėsningumus, jų psichoakustines bei kognityvines prielaidas ir filogenetinį kontekstą.

Darbo tikslui pasiekti keliami tokie **uždaviniai**:

- apžvelgti veiksnius, lemiančius darnos fenomeną ir jo raidą;
- sukurti akustinių darnos matavimų bei percepcinio interpretavimo metodiką ir
- pritaikyti ją tradicinio lietuvių dainavimo pavyzdžiams tirti.

Tyrimo **objektas** – muzikinių darnų ir jų genezės reiškiniai, darbe tiriami lietuvių tradicinio dainavimo pavyzdžių garso įrašai, tyrime naudojami akustinės analizės, matematinės-statistinės analizės, matematinio modeliavimo, klasifikavimo, lyginimo bei apibendrinimo **metodai**. Kompiuterinei akustinei analizei bei įrašų redagavimui naudotos specializuotos akustinės analizės programos „Wincecil“, „Speech Analyzer“ ir garso redaktoriai „Cool Edit Pro“ bei „Sound Forge“. Atlikta virš 4100 garso dažnio arba aukščio matavimų. Matematiniams skaičiavimams bei grafiniam rezultatų vaizdavimui naudota „MS Excel“.

Taigi darbas **originalus** tarpdalykiniais objekto ir metodų aspektais: tyrimo tikslą įmanoma pasiekti tik pritaikius įvairių mokslo sričių (etnomuzikologijos, muzikos psichologijos, akustikos, matematikos) žinias bei įvairius metodus. Darbe naudojami specialūs matematinio modeliavimo metodai, matematinio darnų aprašymo metodai bei, iš dalies, akustinės analizės metodai yra sukurti autoriaus.

Tyrimo **šaltiniai**:

- Lietuvos bei užsienio etnomuzikologų darbai darnos, dermės bei jų transkripcijos temomis (T. Brazys, J. Čiurlionytė, G. Četkauskaitė, C. Stumpfas, E. M. von Hornbostelis, C. Sachsas, H. Husmannas, P. Graingeris, R. Sevågas, G. W. Boswellis, S. Aromas, F. Voisinas, G. Listas, B. Nettlis, T. Ellingsonas, G. F. Messneris, R. M. Brandlis C. Ellis, U. Willis, V. Chenoweth, J. Duringas, A. Krishnaswamy, A. Czekanowska, E. Aleksejevas, M. Charlapas, K. Kvitka, F. Rubcovas ir kiti);
- užsienio muzikos psichologų garso aukščio, intervalų bei darnos suvokimo, garsų klasifikavimo, darnų ontogenezės bei filogenezės temomis (H. von Helmholtzas, C. Stumpfas, R. Plompas ir W. J. M. Leveltas, A. Kameoka ir M. Kuriyagawa, E. Terhardtas, R. Parncuttas, E. Zwickeris ir H. Fastlis, J. K. Wrightas ir A. S. Bregmanas, J. Sloboda, C. Krumhansl, D. Deutsch, J. Dowlingas, D. Harwoodas, S. E. Trehub, E. Schellenbergas, J. Sundbergas, D. Huronas, P. Zurcheris, I. Crossas, S. Brownas, R. M. Nesse, A. D. Patel ir kiti);
- užsienio kompiuterinės akustinės analizės ir automatinės transkripcijos specialistų darbai (C. d'Alessandro, M. Castellengo, A. Askenfeltas, J. Rossas, R. McNabas ir kiti, P. Mertensas, S. Pauwsas, T. Viitaniemis, A. Klapuris ir kiti).

Iš viso nagrinėta per 300 šaltinių.

Tyrimų **rezultatai:**

Lietuvių tradicinio dainavimo darnų pavyzdžiuose identifikuota ekvitonika, sąveikaujanti su diatonika ir kitomis darnos struktūromis. Sutartinių ekvitonikos prigimtis yra psichoakustinė. Tyrinėjant tradicines darnas dėl derminio mąstymo stereotipų kyla tam tikrų teorinės interpretacijos problemų, lemiančių klasifikacijos klaidas.

Darbą sudaro įvadas, trys skyriai, išvados, literatūros sąrašas ir priedai.

I. Teoriniai darnų, jų kilmės ir raidos aspektai

Darnõs, intervalinio mąstymo kilmė glūdi psichoakustinės ir kognityvinės prigimties reiškiniuose, todėl norint adekvačiai interpretuoti konkrečias darnas būtina šiuos reiškinius patyrinėti.

Bene ankstyviausia žinoma darnų aiškinimo koncepcija remiasi pitagoriečių tradicija, skelbiančia, kad darnos formuojasi konsonuojančių intervalų pagrindu. **Konsonansai** aiškinami kaip numerologijos pasekmė. Kaip bebūtų keista, ši metafizinė darnų susiformavimo koncepcija gyva iki šiol, nors daugiau nei šimtmetį besitęsiančiais konsonanso ir disonanso suvokimo tyrinėjimais atskleistas daugiasluoksnis ir daugiamatis šių reiškinių pobūdis. Konsonansą ir disonansą tyrinėja samplaikų (H. von Helmholtzo), „tonų susiliejimo“ (C. Stumpfo), modifikuotos H. von Helmholtzo tonotopijos (R. Plompo ir W. J. M. Levelto, A. Kameokos ir M. Kuriyagawos), „virtualiojo aukščio“ (E. Terhardto, R. Parncutto), informacijos srautų koherencijos (J. K. Wrighto ir A. S. Bregmano) bei kitos akustinės, psichofizinės, kognityvinės, akultūracijos teorijos. Įvairialypis konsonanso/disonanso veiksnys turi labai nevienodos įtakos įvairių muzikinių kultūrų darnoms formuotis, ši įtaka priklauso ir nuo specifinių estetinių kategorijų (pavyzdys – *Schwebungsdiaphonie* estetika).

Psichoakustikos ir suvokimo dėsningumai yra daugiau ar mažiau universalūs, todėl aiškinantis darnų prigimtį tikslinga pasiremti, pirma, žiniomis apie bendruosius psichinės ir specifinius **muzikinės informacijos** įsiminimo, apdorojimo bei saugojimo dėsningumus, antra, komparatyvistine pasaulio muzikinių kultūrų darnų analize siekiant išgryninti **universalijas**. Pagrindinis veiksnys, apsprendžiantis garsų kontinuumo kategorizavimą ir garsų skaičiaus darnoje ribas yra operacinis vienetas arba vadinamasis „magiškasis Millerio skaičius“ (7±2), darnos ar dermės (siauraja prasme) prerogatyvą – ekvitonika ar neekvitonika, susijusios su įsiminimo ir identifikavimo dėsningumais. Audringas diskusijas apie universalijų, giliųjų struktūrų egzistavimą muzikoje aštuntajame praeito amžiaus dešimtmetyje sukėlė H. Schenkerio ir ypač N. Chomsky'io idėjos. Diskutuotos šios intervalikos, darnos bei dermės universalijos: oktavos ekvivalentiškumas, kaip pagrindinis aukščio organizavimo principas, logaritminė aukščio skalė (t. y. logaritminė aukščio priklausomybė nuo dažnio), aukščio diskretizavimas, garsų skaičius darnoje, optimalus intervalinis žingsnis, aukščio stabilumo hierarchijos bei melodijos linija, kaip svarbi garsų organizavimo priemonė. Įdėmiau pastudijavus pasaulio muzikines kultūras prieita prie išvados, kad nė viena iš šių universalijų nėra absoliuti – jos laikytinos kvaziuniversalijomis, kartais neatpažįstamai iškreipiamomis sociokultūrinių ir specifinių kognityvinių aspektų.

Viena iš populiariausių ir, atrodytų, objektyviausių muzikos filogenezės rekonstravimo koncepcijų remiasi **onto- ir filogenezės paralelės paradigma**. Tačiau praktinis šios paradigmos taikymas susiduria su problemomis: a) dažnai neįmanoma eliminuoti muzikinės kultūros veiksnio; b) ontogenetinių muzikos suvokimo tyrimų metodologija ir metodika dažnai nėra

pakankamai patikimos. Todėl kartais tyrimų rezultatai yra priešingi: pavyzdžiui, S. Trehub (ir Toronto universiteto muzikos psichologų grupės) eksperimentų rezultatai liudija įgimtą prototipinę neekvitoniką, tuo tarpu P. Zurcherio duomenimis kaip tik ekvitoninis principas yra būdingas intervaliniam ankstyvojo kūdikystės laikotarpio mąstymui.

Tradicinė nuostata apie kalbos ir muzikos filogenezę skelbia, kad muzika (bent jau vokalinė) išsivysčiusi iš kalbos, specifinio jos intonavimo. Tačiau pastaruoju metu linkstama manyti, jog kalba ir muzika išsirutuliojo iš bendro protofenomeno (**„muzikalbos“**, *musilanguage*, pagal S. Browną). Kalbos ir muzikos filogenezės teorijos pateikia duomenų apie emocinį-prozodinį elementą melodinėje linijoje ir darnoje, ypač ekmelinio, nestabilaus glisandinio intonavimo atveju.

Pasaulio muzikinių kultūrų darnose identifikuojamos įvairios psichoakustinių aspektų kombinacijos, dominuoja įvairūs darnos konstravimo principai. Nemažai muzikinių kultūrų naudoja apytikslę ekvipentatoniką ir/arba ekviheptatoniką (pavyzdžiui, gamelano *slendro*, iš dalies Afrikos ir Pietryčių Azijos ksilofonai, Pietų Amerikos preinstrumentinės kultūros ir pan.), archaiškose muzikinėse kultūrose aptinkami „tolygiosios dažnių temperacijos“ pėdsakai. Pastebima „kompromisinių“ darnų tendencija: darną sudaro sąlygiškai stabilių atramų (dažnai kvartos) branduolys ir tarpiniai, laisvai, apytiksliai ekvitoniniu principu intonuojami garsai. Rusų etnomuzikologas E. Aleksejevas, išanalizavęs buvusios Sovietų Sąjungos bei kaimyninių kraštų tradicinės muzikos darnų savybes, įžvelgia tris istorinius ikidiatoninio intervalinio mąstymo sluoksnius ir su jais susijusius vokalinio intonavimo tipus, kuriuos jis įvardija kaip **α-intonavimą** (grindžiamą balso registrų kontrasto principu), **β-intonavimą** (grindžiamą glisandiniais kontūrais) bei **γ-intonavimą** (grindžiamą apytiksliai ekvitonine garsų koordinacija).

Deja, kai kuriose etnomuzikologinėse darnų bei dermių interpetacijose ir klasifikacijose vis dar ignoruojamas žymus XX amžiaus muzikos psichologijos progresas ir netgi pirmieji tonometriniai lyginamosios muzikologijos tyrinėjimai, mėginant a) praktines tradicinės muzikos darnas paaiškinti teoriniais numerologiniais matematinių trupmenų principais arba b) įsprausti bet kokias tyrinėjamas darnas į tolygiosios dvylikalaipsnės temperacijos rėmus. J. Duringas atskleidžia numerologijos ir praktinių darnų neatitikimą tradicinėje arabų muzikoje, A. Krishnaswamy – tradicinėje indų muzikoje (*šruti* sistemoje). Į „(pseudo)graikiškas“ arba „(pseudo)grigališkas“ dermes (T. Brazio „graikų arba bažnytines tonų rūšis“), kaip klaidingas kvaziekvitonikos muzikiniame anglų folklore interpretacijas, dėmesį atkreipė dar P. Graingeris, vėliau šį reiškinį norvegų muzikiniame folklore nagrinėjo R. Sevågas ir kiti. Pažymėtini įdomūs rusų etnomuzikologo F. Rubcovo dermių tyrinėjimai: nors jaučiama tendencija įžvelgti vidinius dermių dėsningumus, tačiau tam kliudo tolygiosios temperacijos stereotipai. Su panašiomis **„graikiškųjų“ dermių**, **tariamojo chromatinio kitimo** ar **derminio svyravimo** problemomis

ir apskritai su dermių klasifikavimo problemomis susidūrė nemažai kitų Rytų Europos, tuo pačiu ir Lietuvos tyrinėtojų (K. Kvitka, A. Czekanowska, J. Čiurlionytė, G. Četkauskaitė ir kiti).

Šios problemos kyla iš esminės kultūrų tarpusavio suvokiamumo – **emic/etic** – problemos.

II. Akustiniai dainavimo darnų tyrimo metodai

Akustiniai metodai, ypač jų taikymas darnų tyrinėjimuose, turėjo didelės įtakos jau pačiam lyginamosios muzikologijos gimimui: „atradus“ egzotines muzikines kultūras į akis krito darnų savitumai, jų tyrimui buvo konstruojami įvairūs mechaniniai aukščio matuokliai. Keičiant juos tobulesniais prietaisais (oscilografu, melografu, kompiuteriu), ilgą laiką pagrindiniu akustinių matavimų objektu liko garso aukštis bei jo kitimas, o pagrindiniu tyrinėjimų, besiremiančių akustiniais metodais, objektu – daržnos bei atlikimo stilistikos elementai, lemiami mikroritminio aukščio kitimo (vibrato, glissando, melizmai ir pan.).

Remiantis kompiuterinės akustinės analizės metodais objektyvusis garso aukštis (t. y. dažnio logaritmas) yra apskaičiuojamas išmatavus pagrindinio tono dažnį iš spektro grafikų, o monofoninio atlikimo atveju – ir iš automatinės transkripcijos grafikų (dažnio arba aukščio laikinio kitimo kontūrų). Išmatavus visų atlikimo įrašo garsų aukščius, sudaromos aukščio histogramos (aukščio statistinio pasiskirstymo grafikai). Iš jų nustatomi objektyvūs darnų parametrai – vidurkiniai garsaeilio aukščiai bei jų intonavimo zonos. Vietoje tokių aukščio histogramų naudojami ir artimi joms ilgalaikio suvidurkinto spektro (*LTAS*) grafikai (A. Askenfelto ir kt. metodu).

Šie garso aukščio bei darnų tyrimo metodai yra tinkami kvazistabilaus intonavimo atveju. Žymaus nestabilumo atveju jie yra nepakankamai tikslūs arba tampa apskritai nebepanaudojami.

Viena iš problemų – žymus **intrasoninis** aukščio kitimas, t. y. aukščio kitimas nuo garso atakos iki pabaigos. Nustatyta, kad suvokiamas glisanduojančių tonų, trumpo vibrato aukštis nesutampa su objektyviu aukščio kontūro vidurkiu (M. Rossi, C. d'Alessandro, M. Castellengo ir kt.). Todėl šiame darbe taikomi kognityviniai aukščio matavimo metodai: suvokiamas viso garso aukštis yra lyginamas su jo atkarpos aukščiu ar su dirbtinai sugeneruota aukščių skale.

III. Lietuvių tradicinio dainavimo darnų tyrimas

Psichoakustinių ir kognityvinių darnos aspektų raiška lietuvių tradiciniame dainavime, jų bendrumai ir skirtumai atsiskleidžia palyginus du atlikimo principų ir stilistikos atžvilgiu maksimaliai nutolusius dainavimo tipus – solinį neakompanuojamą dainavimą bei polifoninį sutartinių giedojimą.

Visas **sutartinių** repertuaras akustinės analizės atžvilgiu yra aprėpiamas, kadangi, bent kiek žinoma, autentiško giedojimo įrašų iš tarpukario laikotarpio yra išlikę nedaug. Šiame darbe analizuoti kelių idiolektų 22 sutartinių įrašai ir dar 11 skudučių bei ragų įrašų (tai bene dauguma

šiuo metu prieinamų įrašų). Darnos nustatytos LTAS metodu. Kad darnas būtų galima įvertinti ir palyginti ekvitonikos/diatonikos aspektu, įvestas diatoninio kontrasto koeficientas (*k*): tolygiosios dvylikalaipsnės temperacijos atveju jis prilygintas vienetui, idealios ekvitonikos atveju – nuliui. Gauta, kad daugumos sutartinių $k < 0{,}5$, t. y. sutartinių darnos yra artimesnės ekvitonikai, negu diatonikai. Vidutinis intervalas (suvidurkinus visų sutartinių darnų intervalus) yra 172 centų dydžio. Biržų idiolekto netgi didžiausias $k = 0{,}1$. Viena šio idiolekto sutartinė („Mina mina, minagaučio lylio“) pasirinkta pavyzdžiu išsamiai analizei, išmatuoti visi jos diadų aukščiai. Nustatyta, kad visi šeši sutartinės garsaeilio garsai yra išsidėstę maždaug 180 centų dydžio intervalais. To pasekmė – partijų darnos, pagrįstos apibendrintomis („neutraliosiomis“) tercijomis. Centrinis darnos bichordas pasižymi ypač dideliu stabilumu, tolimesni periferiniai darnos garsai vis mažiau stabilesni (t. y. jų intonavimo zonos platesnės). Todėl galima daryti išvadą, kad darnos branduolys (arba „toninis dipolis“) yra būtent centrinis darnos bichordas.

Remiantis R. Plompo ir W. J. M. Levelto, A. Kameokos ir M. Kuriyagawos, E. Zwickerio ir H. Fastlo **sąskambio šiurkštumo** tyrinėjimų rezultatais galima teigti, kad apytiksliai 180 centų dydžio intervalai nagrinėjamų dažnių ir garso lygių diapazone atitinka didžiausią sąskambio šiurkštumą. Todėl didžiausią sąskambio šiurkštumą galima laikyti psichoakustiniu idealaus sutartinių skambesio (vadinamojo **„balsų susidaužimo“**) koreliatu. Tačiau šio veiksnio nereikėtų pervertinti, kadangi susidarantys sąskambiai yra trumpos trukmės, o intonavimo zonos (ypač kraštinių garsų) yra gana plačios. Be to, „balsų susidaužimui“ gali turėti įtakos ir kiti psichoakustiniai reiškiniai – *basse fondamentale* (sąskambio „virtualusis aukštis“, pagal E. Terhardtą), kombinaciniai tonai, taip pat balsų tembrai bei fonetika. Giedotojų pažymimas sutartinių ir varpų skambesio paraleles gali lemti ne tik šiurkštumo analogijos (pagal R. Brandlį, tyrinėjusį Balkanų *Schwebungsdiaphonie*), bet ir spektro neharmoniškumo analogijos.

Ekvitoniškumo požymių esama ir sutartinių tipo instrumentinėje muzikoje – skudučių bei ragų polifonijos darnose. Lyginamieji šių darnų tyrimai leidžia įžvelgti bendruosius ir specifinius vokalinio bei instrumentinio muzikinio mąstymo aspektus.

Lietuvių tradicinio **solinio dainavimo** repertuaro, atvirkščiai negu sutartinių, akustinės analizės metodais aprėpti neįmanoma. Todėl čia gelbsti statistiniai imčių atrankos, tyrimo ir lyginimo metodai. Tyrimui pasirinktos trys imtys – dviejų tipiškų Dzūkijos vokalinės tradicijos idiolektų (Jono Jakubausko, 26 dainos; ir Petro Zalansko, 20 dainų) bei Suvalkijos dialekto (25 dainos). Kadangi tokios imtys vis tiek yra labai didelės (būtų keliolika tūkstančių matavimų), **statinių darnos savybių** tyrimui – t. y. bendram įvertinimui, nesidomint galimu nedideliu darnos kitimu – palikta tik po vieną kiekvienos dainos melostrofą.

Darnos įvertintos trimis čia originaliai įvedamais parametrais: **diatoniniu kontrastu** (jau naudotas įvertinant sutartinių darnas), kiekvieno laipsnio **intonavimo stabilumu** (dydis, atvirkščias standartiniam aukščio nuokrypiui) bei **derminiu kontrastu** (atspindi derminių

funkcijų išryškėjimo laipsnį; apskaičiuojamas pagal tam tikrą derminių svorių priskyrimo kiekvienam melodijos garsui algoritmą, artimą E. Aleksejevo naudojamam algoritmui).

Nustatyta, kad $k < 0{,}5$ 61 proc. J. Jakubausko pavyzdžių, 70 proc. P. Zalansko pavyzdžių bei 80 proc. Suvalkijos pavyzdžių. Taigi visos nagrinėjamos imtys yra artimesnės ekvitonikai negu diatonikai. Taip pat nustatyta teigiama koreliacija tarp diatoninio ir derminio kontrasto. Tai reiškia, jog kuo labiau išryškėja derminės atramos, tuo labiau darna yra artimesnė diatonikai. Tai susišaukia su dermės raidos teorijomis. Tačiau įdomu, kad šis reiškinys yra būdingas netgi atskiram dialektui.

Taip pat palyginus visų imčių pavyzdžius pastebėta, kad kvarta ir kvinta dažniausia yra šiek tiek (iki keliolikos centų) platesnės už natūraliąsias ir, svarbiausia, žymiai pastovesnio dydžio negu kiti intervalai, net jeigu atsižvelgiama į jų diatoninių versijų egzistavimo galimybę. Tai vėlgi susišaukia su minėtomis „kompromisinėmis“ darnomis.

Tiriant intonavimo stabilumą nustatyta, kad dzūkų idiolektams yra būdingas didesnis viršutinės toninės atramos stabilumas. Tai taip pat koreliuoja su M. Charlapo bei E. Aleksejevo užuominomis apie viršutinės atramos reikšmę dermės raidoje.

Aukščiau aprašytame solinio dainavimo darnų tyrime nėra atsižvelgiama į intonavimo dinamikos reiškinius. Jeigu domimasi jais, susiduriama su tokia problema: tas pats garsaeilio garsas nuo kūrinio pradžios iki pabaigos yra intonuojamas labai nevienodai. Ši problema yra ypač ryški **laipsniškos transpozicijos** (dažniausiai balso laipsniško aukštėjimo) atveju, būdingu soliniam dainavimui be stabilaus aukščio akompanimento. Šiuo atveju aukščio histogramoje aukščio klasės persikloja ir tampa nebeidentifikuojamos – darnos nustatyti nebeįmanoma. Todėl norint rekonstruoti atlikimo darną, reikia naujai interpretuoti akustinių matavimų rezultatus.

Šiame darbe sukurti trys euristiniai **matematiniai-statistiniai modeliai**, imituojantys darnos suvokimo dėsningumus, t. y. eliminuojantys kognityviai nefiksuojamą laipsniškos transpozicijos veiksnį. Pirmasis (**melostrofinės transpozicijos**), paprasčiausias modelis remiasi prielaida, kad kiekviena melostrofa yra dainuojama vis kita pastovia mikrotonacija. Antrasis ir trečiasis (**nuolatinės transpozicijos**) modeliai remiasi prielaida, kad laipsniškai transponuojama nuolatos – ir melostrofos viduje. Šie modeliai skiriasi intonavimo stabilumo ir transpozicijos santykio įvertinimu.

Perskaičiavus akustinių aukščio matavimų rezultatus pagal modelių algoritmus paaiškėjo, kad visais trimis būdais nustatyti vidurkiniai darnos garsų aukščiai skiriasi nežymiai, taip pat tik nežymiai jie priklauso ir nuo matavimų skaičiaus (lyginti keturių ir aštuonių melostrofų matavimo rezultatai). Vadinasi, norint įvertinti vidurkinę darnos intervaliką, užtenka paprasčiausio modeliavimo ir mažesnio matavimų skaičiaus. Tačiau intonavimo zonų pločiai, apskaičiuoti pritaikius tris algoritmus, pastebimai skiriasi bei priklauso nuo matavimų skaičiaus.

Nustatyta, kad norint įvertinti intonavimo zonas, derminius darnos komponentus (visų pirma, tonines atramas), patikimiausias yra trečiasis modelis.

Palyginimui sukurti du **modeliai, imituojantys tyrinėtojo suvokimą**: kaip originali intervalika yra suvokiama veikiant tolygiosios dvylikalaipsnės temperacijos apercepcijai. Pirmasis modelis remiasi prielaida, kad kiekvieno garso aukštis yra suvokiamas lyginant su artimiausiais ankstesniu ir vėlesniu melodinės linijos garsais. Antrasis (patikslintas) modelis remiasi prielaida, kad garso aukščiui suvokti turi įtakos ir tolimesni melodinės linijos garsai. Testuojant modeliavimo algoritmą pademonstruotas dviejų foneminių sistemų sandūros mechanizmas, lemiantis fiktyvių „graikiškųjų dermių“ ir „chromatinio kintamumo“ atsiradimą.

Įvairiai pritaikant aprašytuosius modelius patyrinėta **darnos dinamika**, t. y. kaip nominalioji darna kinta melostrofoje ir (kai kuriais atvejais) nuo dainos pradžios iki pabaigos. Taigi šiuo atveju matuoti jau visų dainos garsų aukščiai. Atskleista, kaip tariamąjį chromatinį kintamumą gali lemti plati **intonavimo zona**, t. y. skirtingos jos versijos gali būti suvoktos kaip skirtingos aukščio klasės. Darnos dinamiką gali lemti ir **melodinis kontekstas**: nevienodai intonuojami **kylančios ir krintančios slinkčių** garsai, priklausomai nuo konteksto specifiškai yra intonuojamas atramos **„vedamasis“ tonas**. Tas pats garsas, įeinantis į skirtingus platesnio garsaeilio darinius, irgi gali būti intonuojamas nevienodai. **Trumpi pereinamieji tonai**, intonuojami kitaip negu ilgi dėl fiziologinių priežasčių, taip pat gali sukurti chromatinio kintamumo įspūdį.

Pabaigoje išanalizuotas ypatingas darnos dinamikos atvejis, iki šiol neminėtas Lietuvos etnomuzikologijoje – vadinamoji „išsiskleidžiančioji“ darna (pagal E. Aleksejevą; viena iš γ-intonavimo versijų).

Išvados

1. Lietuvių tradicinio dainavimo darnose yra išlikę ikidiatoninės (kvazi)ekvitonikos požymių. Šiame darbe tyrinėtos trys lietuvių tradicinio solinio dainavimo pavyzdžių imtys – dviejų tipiškų Dzūkijos idiolektų bei Suvalkijos dialekto. Nustatyta, kad nuo 60 iki 80 procentų kiekvienos imties pavyzdžių yra artimesni ekvitonikai negu diatonikai.

Ekvitonikai artimos ir daugumos iš tyrinėtųjų sutartinių darnos.

2. Ryškių ekvitonikos požymių įžvelgiama sutartinių darnose; tipiškai gretimus darnos garsus skiria vidutiniškai 170–180 centų dydžio intervalai. Nagrinėjamų dažnių ir garso lygių diapazone tai atitinka didžiausią sąskambio šiurkštumą. Todėl pastarąjį galima laikyti psichoakustiniu idealaus sutartinių skambesio (vadinamojo „balsų susidaužimo“) koreliatu. Vadinasi, sutartinių atveju muzikinę kategoriją – darną – suponuoja nemuzikinė (psichoakustinė) kategorija – sąskambio šiurkštumo pojūtis. Tačiau pažymėtina, kad nors

didžiausias šiurkštumas ir pageidaujamas, tinkamo šiurkštumo diapazonas yra gana platus, taigi šiurkštumo veiksnį tikriausiai sumenkina kiti sutartinių artikuliacijos aspektai.

3. Lyginamąja analize nustatyta, kad darnos garsų derminių požymių ryškėjimą atitinka ekvitonikos asimetrizacija, t. y. diatonikos formavimasis. Tai yra būdinga netgi atskiro vienalaikio idiolekto ar dialekto darnų įvairovei. Tikriausia šį fenomeną sąlygoja derminis „multimuzikalumas“ arba tam tikri paprastesni fiziologijos bei suvokimo reiškiniai.

4. Nustatyta, kad nagrinėjamiems pavyzdžiams yra būdinga ekvitonikos ir stabilių tonų karkaso sąveika: generatyvinę darną sudaro sąlygiškai stabili (dažniausiai kvartos arba kvintos) diada, užpildyta laisviau intonuojamais garsais.

5. Įprastu būdu, t. y. tiesiogiai iš garso aukščio histogramų, sudarytų pagal akustinių matavimų rezultatus, tradicinio neakompanuojamo solinio dainavimo darnų išsamiau patyrinėti neįmanoma. Tam kliudo laipsniškos transpozicijos reiškinys, būdingas tokiam dainavimui: kadangi atskaitos tono (pavyzdžiui, toninio centro) aukštis laipsniškai kinta, histogramoje aukščio klasės persikloja ir tampa nebeidentifikuojamomis. Todėl norint rekonstruoti foneminę atlikimo darną prireikia papildomo matematinio-statistinio modeliavimo, imituojančio darnos suvokimo dėsningumus, t. y. eliminuojančio laipsniškos transpozicijos veiksnį. Šiame darbe sukurti modeliai leidžia rekonstruoti laipsniška transpozicija pasižyminčio atlikimo darnas bei įžvelgti darnos dinamikos reiškinius atskiros melostrofos apimtyje.

6. Atskleistì trys sąveikaujantys darnos dinamikos melostrofos apimtyje aspektai: intonavimo zonos, melodijos konteksto bei tono trukmės. Jie yra grindžiami dainavimo fiziologija arba/ir suvokimu, tačiau, išskyrus tam tikrus atvejus, ne derminiu mąstymu. Tiesa, veikiant diatonizacijai, sistemingi intonavimo nuokrypiai gali įsitvirtinti. Tiktai tokiu atveju jie laikytini derminio ar chromatinio kintamumo apraiškomis.

7. Vadinamosios senovinės graikiškosios arba grigališkosios dermės, kaip ir derminis ar chromatinis kintamumas, dažnai tėra subjektyvios „klausos apgaulės“. Šis fenomenas kyla iš dviejų foneminių darnos struktūrų – kultūros reprezentanto ir išorinio tyrinėtojo – sandūros: tolygiosios temperacijos (arba, plačiau, diatonikos) apercepcija gali nulemti fiktyvų darnų identifikavimą. Toksai sąmoningas ar nesąmoningas autentiškos darnos struktūros ignoravimas gali nulemti transkripcijos klaidas ir jų pasekmes – darnų teorinių interpretacijų bei klasifikacijų klaidas. Todėl samprata apie graikiškąsias dermes, derminį ir chromatinį kintamumą lietuvių tradicinėje muzikoje turėtų būti peržiūrėta.

8. Tyrimo rezultatai esminiais klausimais koreliuoja su kitų muzikinių kultūrų darnų tyrinėjimų rezultatais ir su dermių raidos bei muzikos genezės teorijų išvadomis. (Kvazi)ekvitonikos atitikmeniu galima laikyti E. Aleksejevo „γ-intonavimą“. Lietuvių tradiciniame dainavime nustatyti keli „γ-intonavimo“ tipai.

PUBLICATIONS ON THE TOPIC OF THE DISSERTATION IN LITHUANIAN REFEREED SCHOLARLY PERIODICALS

1. On Non-Tempered Scaling in Lithuanian Traditional Singing. *Tiltai*. 2001, Priedas Nr.8. Klaipėda: Klaipėdos universitetas. p. 14–24.
2. Vocal Technique in Aukštaičiai and Dzūkai Male Solo Singing. *Lietuvos muzikologija*. 2001, 2. Vilnius: Lietuvos muzikos akademija. p. 169–179.
3. Tradicinio dainavimo technikos akustinis tyrimas. [Acoustical Analysis of the Technique of Traditional Singing.] *Liaudies kūryba*. 2002, 5. Vilnius: Lietuvos liaudies kultūros centras. p. 147–157.
4. Sutartinių darna: psichoakustinis aspektas. [Tuning of Sutartinės: Psychoacoustical Viewpoint.] *Lietuvos muzikologija*. 2003, 4. Vilnius: Lietuvos muzikos akademija. p. 125–135.
5. Tradicinis dainavimas ir akustinė analizė: egzotiškas objektas ir egzotiškas metodas. [Traditional Singing and Acoustical Analysis: Exotic Subjects and an Exotic Approach.] *Tautosakos darbai*. 2003, 18(25). Vilnius: Lietuvių literatūros ir tautosakos institutas. p. 190–210.
6. Psichoakustiniai darnos rekonstravimo metodai. [Psychoacoustical Approaches of Reconstruction of Scales.] *Tautosakos darbai*. 2004, 20(27). Vilnius: Lietuvių literatūros ir tautosakos institutas. p. 133–150. Also in: http://www.ceeol.com/aspx/getdocument.aspx?logid=6&id=f36430bd-bbef-4f16-831f-df9bbe9c9cd4

OTHER SCHOLARLY PUBLICATIONS ON THE TOPIC OF THE DISSERTATION

1. Formant Technique in Traditional Singing. In: R.Astrauskas, ed. *Ritual and Music. Papers presented at the International Ethnomusicologist Conference held in Vilnius, Lithuania, December 11–12, 1997*. 1999. Vilnius: Lithuanian Academy of Music. p. 122–128.
2. Lithuanian Ethnomusicological Notation in the World-wide Context. In: R.Astrauskas, ed. *Ethnic Relations and Musical Folklore*. 2002. Vilnius: Lithuanian Academy of Music. p. 155–161.
3. Scales in Traditional Solo Singing: Models and Results. In: R. Parncutt, A. Kessler & F. Zimmer, eds. *Proceedings of the Conference on Interdisciplinary Musicology (CIM04). Graz/Austria, 15–18 April, 2004. Hosted by the Department of Musicology, University of Graz. Presented by the European Society for the Cognitive Sciences of Music*. 2004. Graz: University of Graz. (CD-ROM). Also in: http://gewi.uni-graz.at/~cim04/CIM04_paper_pdf/Ambrazevicius_CIM04_proceedings.pdf

4. Scales in Traditional Solo Singing. In: S. D. Lipscomb, R. Ashley, R. O. Gjerdingen, & P. Webster, eds. *Proceedings of the 8th International Conference on Music Perception & Cognition (ICMPC8). August 3–7, 2004. Evanston, Illinois, USA*. 2004. Causal Productions. (CD-ROM). p. 105–108. Also in: http://www.northwestern.edu/icmpc/proceedings/ICMPC8/PDF/AUTHOR/MP040311.PDF

SCHOLARLY MONOGRAPH

Etninės muzikos notacija ir transkripcija. [The Notation and Transcription of Ethnic Music.] 1997. Vilnius: Lietuvos muzikos akademija.

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PSYCHOACOUSTIC AND COGNITIVE ASPECTS OF MUSICAL SCALES AND THEIR MANIFESTATION IN LITHUANIAN TRADITIONAL SINGING

Summary of the doctoral dissertation

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