Regional Classification of Traditional Japanese Folk Songs from Southwest Regions

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Introduction

The main purpose of this study is to grasp the pitch transition patterns from pieces of traditional Japanese folk songs among southern three regions of Honshu (the Main Island of Japan), and by making comparisons with Koizumi's tetrachord theory in order to make the regional classification by the tendency in pitch information.

A tetrachord is a unit consisting of two stable outlining tones called kaku-on (nuclear tones), and one unstable intermediate tone located between the nuclear tone. Influenced by the methods of Western comparative musicology, the Japanese musicologist Fumio Koizumi conceived of a scale based not on the octave unit but rather on the interval of a perfect fourth, and has developed his tetrachord theory to account traditional Japanese music (Koizumi, 1958). Depending on the position of the intermediate tone, four different tetrachords can be formed (see Table 1 and Figure 1).

Type	Name	Pitch intervals
I	Min'yo	Minor third (3) + major second (2)
II	Miyako-bushi	Minor second (1) + major third (4)
III	Ritsu	Major second (2) + minor third (3)
IV	Ryu'kyu	Major third (4) + minor second (1)

Table 1. Koizumi's four basic tetrachords.

In the previous study, we have sampled and digitized the five largest song genres within the music corpora of the Nihon Min'yo Taikan (Anthology of Japanese Folk Songs, 1944-1993) from 45 Japanese prefectures, and have clarified the following three points by extracting and comparing their respective musical patterns (Kawase and Tokosumi 2011): (1) the most important characteristics in the melody of Japanese folk songs is the transition pattern, which is based on an interval of perfect fourth pitch that constructs Koizumi's four basic tetrachords; (2) regionally adjacent areas tend to have similar musical characteristics; and (3) the differences in the musical characteristics almost match the East-West division in the geolinguistics or in the folkloristics from a broader perspective. However, to conduct more detailed analysis in order to empirically clarify the structures by which music has spread and changed in traditional settlements, it is necessary to expand the data and make comparisons based on the old Japanese provinces (ancient administrative units that were used under the ritsuryo system before the modern prefecture system was established).

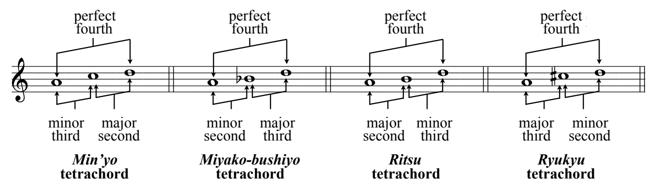

Figure 1. Example of four different types of Koizumi's tetrachord when taking A-D as kaku-on (nuclear tones).

Overview of data

We extracted the musical notes for works included in the "Nihon Min'yo Taikan", and digitized the entire scores from each province in the Kyushu district (geographically located in the southern part of Japan), Chugoku district (the westernmost region of Japan's largest island of Honshu), and Shikoku district (literally meaning four provinces, located south of Honshu and east of Kyushu district). In total, there were 474,191 tones in the sample of 2,383 songs for the 25 provinces (see Figure 2).

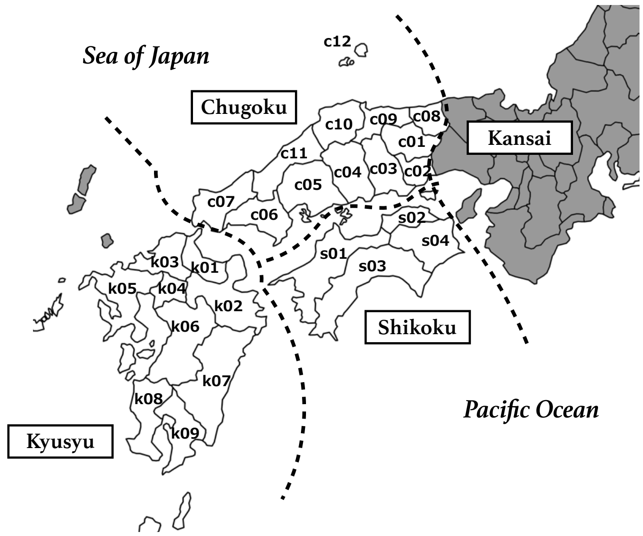

Figure 2. Geographical divisions of the three districts under the old provinces

Procedure

The procedures are as follows: (1) we digitized all the songs from each district and generated sequences that contain interval information from the song melodies; (2) extracted four transition probabilities of tetrachords for every province separately, and create a 24-dimensional data with 25 samples (provinces); and (3) applied principal components analysis (PCA) to identify patterns in the data, and to highlight their similarities and differences.

In order to digitize the Japanese folk song pieces, we generate a sequence of notes by converting the music score into MusicXML file format. We devised a method of digitizing each note in terms of its relative pitch by subtracting the next pitch height for a given MusicXML. It is possible to generate a sequence T that carries information about the pitch to the next note: T = (t1, t2, ... , ti, ..., tn). An example of the corresponding pitch intervals for ti can be written as shown in Table 2. We treat sequence T as a categorical time series, and execute N-gram to capture transitions and their trends.

Using a bigram model representing pitch transitions, all four types of tetrachords from Table 1 can be expressed as follows in ascending order: min'yo (+3, +2), miyako bushi (+1, +4), ritsu (+2, +3), and ryukyu (+4, +1). Depending on the positions of the three initial pitches in a tetrachord, six transition patterns can be considered in perceiving a tetrachord in two steps (bigram). Therefore, the amount of tetrachords within two steps can be obtained by counting the pairs of 24 transition patterns in sequence T.

t_i	Pitch Intervals	t_i	Pitch Intervals
0	perfect unison	7	perfect fifth
1	minor second	8	minor sixth
2	major second	9	major sixth
3	minor third	10	minor seventh
4	major third	11	major seventh
5	perfect fourth	12	perfect octave
6	aug.fourth/dim.fifth	13	minor ninth

Table 2. Corresponding pitch intervals

Results and discussions

The relative frequency of the first transition (unigram), is maintained between "-5" and "+5"; the interval of a perfect fourth pitch (see Figure 3). As the graph forms a symmetric shape with respect to "0", the pitch transitions occur almost equally in both descending and ascending order.

The implementation of the PCA is summarized as follows. As shown in Table 3, the component loadings for the first three principal components of each province explain more than 85.88% of the variability.

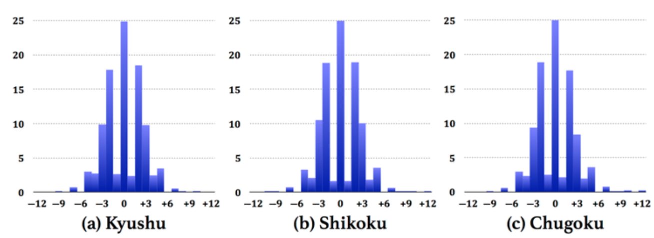

Figure 3. First transition frequencies for three regions

In the first column, the values of all 24 variables represent a positive quantity, and have almost the same weight. This result indicates that the profile of the first PCA axis is the persuasiveness of the tetrachord. Thus, as the value increases, the inclination of a pitch transition enhances its persuasiveness, and the value decreases, it loses its persuasiveness. In the second column, all variables for the min'yo and the ritsu represent a negative quantity, while 11 variables for the miyako-bushi and the ryukyu represent a positive quantity. According to ethnomusicological research, the min'yo and ritsu tetrachords appear frequently in Japanese folk songs. In contrast, the miyako-bushi and ryukyu tetrachords, steadily shifted from the ritsu and min-yo tetrachords respectively, and then increased in popularity as an emotional crutch (Koizumi, 1977). This result indicates that the profile of the second PCA axis is the relative pitch intervals between the nuclear tone and its intermediate tone, or in other words, the differences in patterns of transition from the nuclear tone. Thus, as the value increases, the adjacent intermediate tone forming the tetrachord tends to form a minor second interval (sort of a minor key progression), and as the value decreases, it tends to form a major second interval (sort of a major key progression).

The corresponding scores for each sample are plotted in a two-dimensional space to complete the PCA (Figure 4). We see that there is a strong contrast between min'yo, ritsu, miyako-bushi, and ryukyu. It is possible to clarify the structural commonalities and differences between areas. Figure 5 is the result of applying the hierarchical cluster analysis (Euclid distance, Ward method) to the corresponding scores. In addition, if we look for a height where there are three vertical lines and trace the lines down to the individuals, the partition corresponding to three clusters. If we plot this result on a map, we see that provinces are clearly classified according to geographical factors and cultural backgrounds (Figure 6).

Variables		1st PCA axis	2nd PCA axis	3rd PCA axis
minyo-1	(+3, +2)	0.947	-0.224	-0.021
minyo-2	(+5, -2)	0.893	-0.330	-0.136
minyo-3	(+2, -5)	0.879	-0.340	-0.136
minyo-4	(-3, +5)	0.888	-0.204	-0.151
minyo-5	(-2, -3)	0.951	-0.229	-0.090
minyo-6	(-5, +3)	0.876	-0.321	0.006
miyako-1	(+1, +4)	0.819	0.404	-0.107
miyako-2	(+5, -4)	0.684	0.531	-0.241
miyako-3	(+4, -5)	0.638	0.406	0.046
miyako-4	(-1, +5)	0.719	0.556	-0.170
miyako-5	(-4, -1)	0.779	0.552	-0.220
miyako-6	(-5, +1)	0.796	0.372	-0.103
ritsu-1	(+2. +3)	0.932	-0.267	0.006
ritsu-2	(+5, -3)	0.879	-0.298	-0.111
ritsu-3	(+3, -5)	0.797	-0.547	0.098
ritsu-4	(-2, +5)	0.904	-0.199	-0.190
ritsu-5	(-3, -2)	0.947	-0.244	-0.085
ritsu-6	(-5, +2)	0.784	-0.534	0.068
ryukyu-1	(+4, +1)	0.788	0.475	0.008
ryukyu-2	(+5, -1)	0.451	0.015	0.779
ryukyu-3	(+1, -5)	0.687	0.346	0.384
ryukyu-4	(-4, +5)	0.670	-0.067	0.508
ryukyu-5	(-1, -4)	0.699	0.606	-0.061
ryukyu-6	(-5, +4)	0.612	0.307	0.601
Eigen value		15.448	3.490	1.675
Percentage of var.		64.367	14.541	6.979
Cum.percentage of var.		64.367	78.909	85.888

Table 3. Component loadings for 24 transition patterns for tetrachords

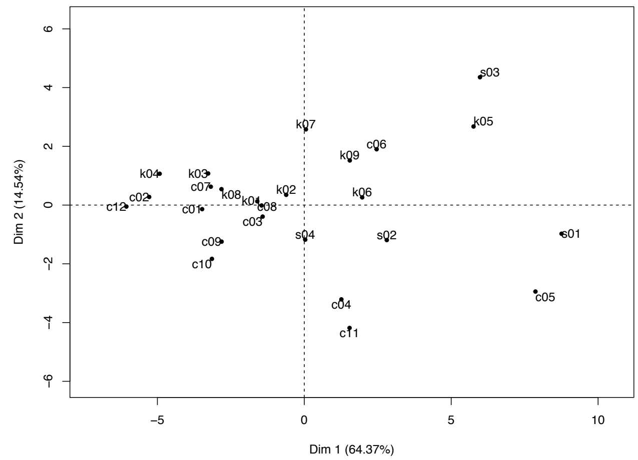

Figure 4. Plot of the first two component scores

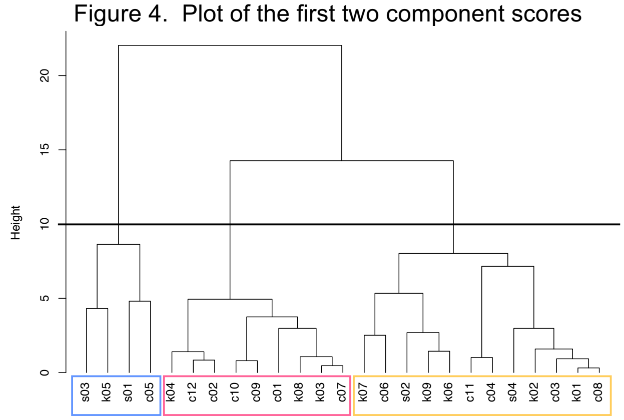

Figure 5. Dendrogram based on component scores using Ward method

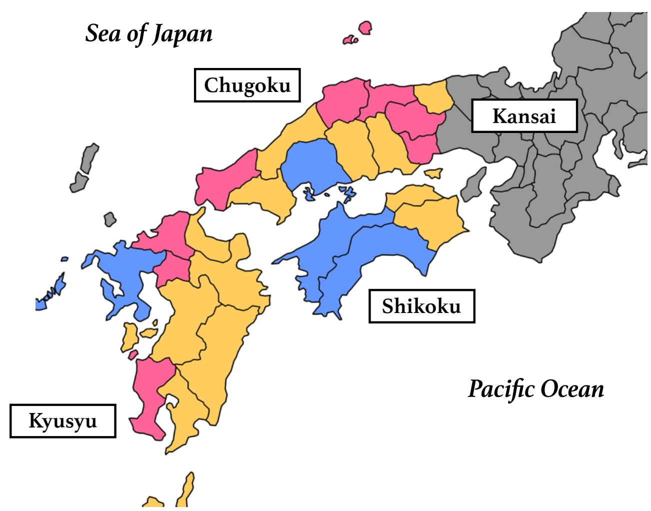

Figure 6. Clustering results plotted on a map

Conclusion

In this study, we digitized the melodies of endangered traditional Japanese folk songs from three regions, and quantitatively classified them according to the old province by executing principal components analysis and hierarchical cluster analysis in terms of pitch transitions based on a unit of Koizumi's tetrachord theory. As a result, compared to our previous studies on the small amount of data (e.g. Kawase 2016a, 2016b, 2016c), regions were successively classified according to both geographical factors and cultural backgrounds in detail, and classified the melodies into two basic groups according to the behavior of the intermediate tone. We firmly assured that the melodic structures of tetrachords in each province are shared by land and sea routes based on actual music data analysis.

Acknowledgments

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