ANALYSIS OF USUL STROKES AND NOTES IN TURKISH MAKAM MUSIC

Şiyar Vurucu, Miguel Pérez Fernández
Music Technology Group, Universitat Pompeu Fabra, Barcelona
{siyarramazan.vurucu01, miguel.perez01}@upf.edu

ABSTRACT

Makam music was created during the ages of Ottoman empire. It follows certain strict rules for melody and rhythm. The pattern created by the melody is called the *Makam* itself. Te set of rules that convey the rhythm, the kind of strokes and the tempo, are put together into different kinds of *Usuller*. In this paper we explore the distribution of the notes played at the same time of the Usul strokes. The results opens the possibility of Makam recognition using the discovered patterns.

1. INTRODUCTION

1.1 Makamlar

Makam is a set of rules to be applied on a set of notes. A Makam defines a scale and the karar (tonic), yeden (leading, subtonic), güçlü (dominant) of that scale. A makam is characterized by its melodic progression, called Seyir. Seyir has long-term and short-term facets [3]. Theory books mention long-term facets. In long-term, seyir of makamlar are grouped in three categories; ascending, descending and ascending-descending. Short-term facets describe makam specific motives and ornaments. For further details, reader is referred to the review by Bozkurt et al. [2].

The description for seyir of the makam Rast from the book by Özkan [5] can be translated as "One can start the progression (seyir) from tonic (karar), or notes above the tonic, or from the extended section under the tonic. After mixed wandering, half cadence on Neva (the dominant) is played. Meantime, before or after (the half cadence is played) suspended cadences are played *when they are needed*. Then, after wandering on whole scale, additionally with the extended section *if desired*, half cadence on the tonic (Rast) is played, *usually* with the leading tone (yeden)."

Another description of seyir for this makam is also presented by Aydemir [1], which can also be found in [3]. Noticeably, there are differences between two descriptions. Description above suggests that a seyir is flexible with milestones to reach correctly.

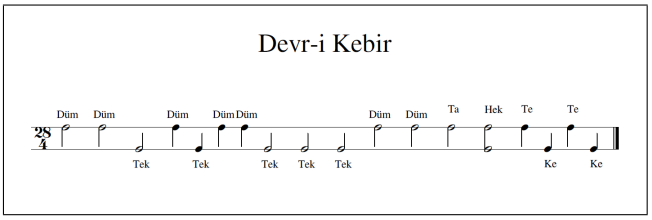

Figure 1. Score of the usul Devr-i Kebir.

1.2 Usuller

Altought sometimes *Usuller* are translated as *meters*, the translation is not very exact. *Usuller* comprehend rhythm, tempo, and a set of strokes that set the stress of the notes. There are different kind of strokes in Usul as we can see at Figure 1. Strokes done with right hand are in the upper part of the score, and strokes that correspond to the left hand are written in the lower part of the score. In this case we can see that *Te* and *Ke* strokes are played one after another, and we can also see that *Hek* is a special stroke that uses both hands.

2. METHODOLOGY

2.1 Makam data

Our dataset is a subset of SymbTr [4]. SymbTr is a collection machine readable symbolic scores of Turkish Makam music [1]. SymbTr dataset provides scores in text, MusicXML, PDF, MIDI and mu2 formats. We chose to work with text files, as they are more comprehensive and accurate. We selected those ten makamlar with most number of scores: Hicaz, Rast, Nihavent, Uşşak, Segah, Hüseyni, Hüzzam, Mahur, Kürdilihicazkâr and Muhayyer.

2.2 Usul data

The Usul scores were done according to the *Turkish Music Makam Guide* [1]. All scores are available in the GitHub repository for the project [2] in both *Musescore3* and *mxl* formats. Due to the high variety of *Usuller* we selected only the ones present in the book [1].

2.3 Analysis

For every possible combination of *Makam* and *Usul* present in the dataset, we retrieve every note that is played

[1] https://github.com/MTG/SymbTr
[2] https://github.com/migperfer/AMPL-UPF-MSC

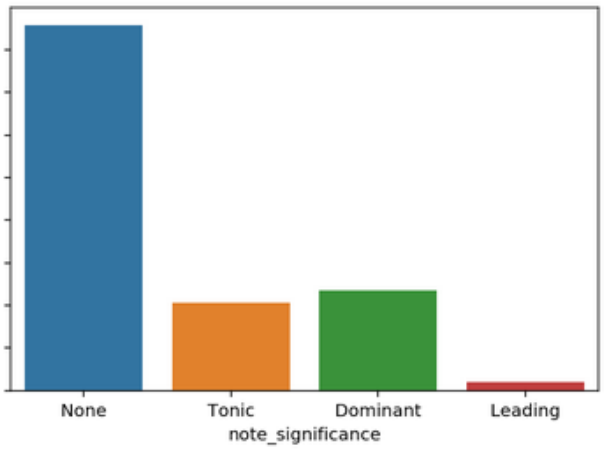

Figure 2. Degrees played at Usul strokes

at the same time of an *Usul* stroke. The information we store for each note is:

- Note played
- Significance (Tonic, Leading, Dominant or None)
- Hand(s) used for the stroke
- Type of stroke (Düm, Ta, Hek, etc)
- Duration of the stroke

3. RESULTS

According to what can be expected, most of the notes played are not the Tonic, Dominant or Subdominant, as we can see in figure Figure 2. For the distribution of the strokes in Figure 3, we can notice a clear peak in the *offset 0* and the *0.5*. The distribution of the degrees and strokes can be seen as well in Table 1. We also analysed the degrees for each stroke type in Table 2, for each duration (of stroke) in Table 3, and the distribution of strokes for each hand Table 4.

Comparing Figure 4 and Figure 5, in makam Muhayyer, relative ratio of tonic, dominant and leading note are similar in both usuller. In following notes, dominant note is more frequent and use of tonic note increases after second strokes. On the last stroke, tonic surpasses the dominant in the usul Düyek (8/8), but not in Aksak (9/8). In Düyek, last stroke 'Tek' is two beats, even though there is no empty space on the right of that stroke to indicate this. Last stroke of the usul Aksak is one beat.

In Figure 6 usul is again Düyek but the makam is Segah. With the usul Düyek, tonic of the makam is most frequent at 'Düm' strokes.

4. CONCLUSIONS

There are several conclusions we can extract from the results. According to the results in Figure 3, there is a clear peak on the *offset 0* (at the beginning of the bar) and the *offset 0.5* (in the middle of the bar). This could be due to

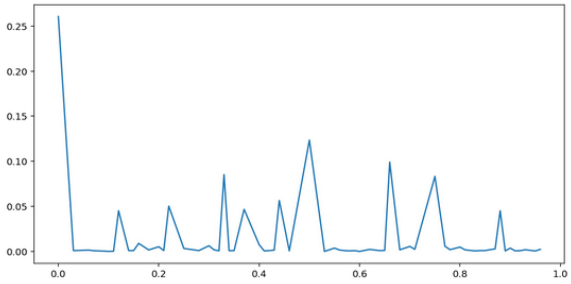

Figure 3. Distribution of the offsets where strokes and notes are played simultaneously

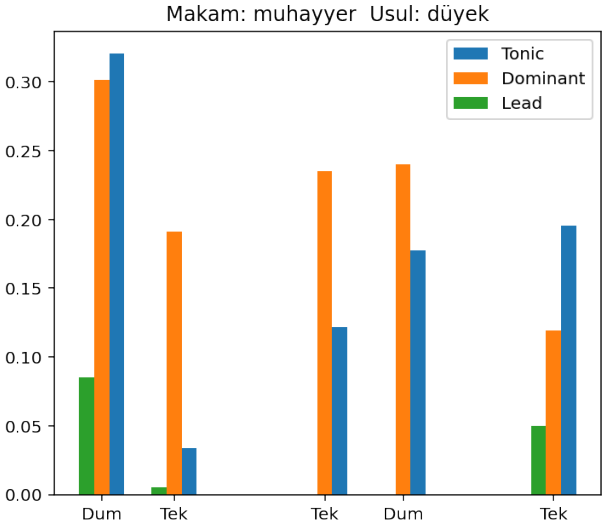

Figure 4. Distribution of Tonic, Dominant and Leading notes of makam Muhayyer, on strokes of usul Düyek. Strokes are separated according to relative time differences between them.

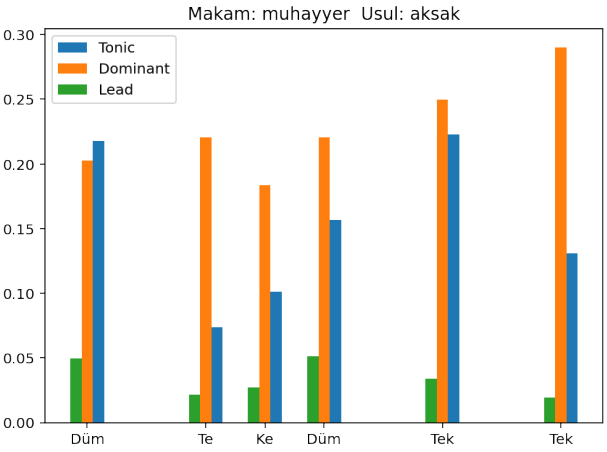

Figure 5. Distribution of Tonic, Dominant and Leading notes of makam Muhayyer, on strokes of usul Aksak.

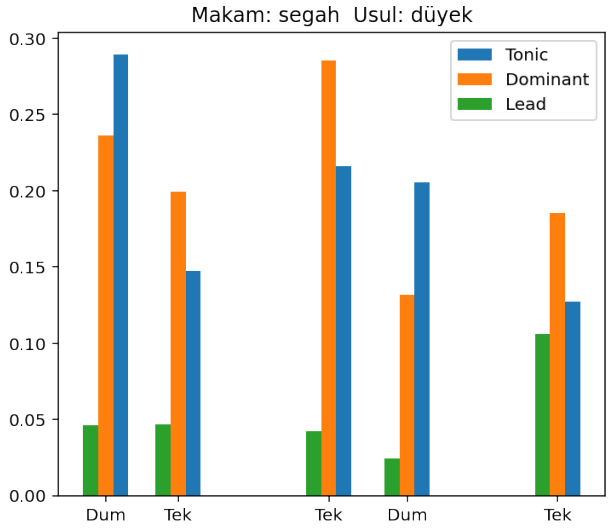

Figure 6. Distribution of Tonic, Dominant and Leading notes of makam Segah, on strokes of usul Düyek.

%	Dominant	Leading	Tonic
Both	11.87	1.56	11.87
Right	20.55	2.83	12.66
Left	19.96	2.16	10.55

Table 1. Distribution of stroke hands on degrees

Note Significance	Stroke	Ocurrence
Dominant	Dum	47.35%
	Hek	0.311622%
	Ka	0.631445%
	Ke	7.083256%
	Ta	0.582242%
	Te	9.953462%
	Tek	34.089837%
Leading	Dum	50,60%
	Hek	0.312159%
	Ka	0.749181%
	Ke	6.758233%
	Ta	0.437022%
	Te	11.596691%
	Tek	29.545809%
Tonic	Dum	53.41%
	Hek	0.518117%
	Ka	0.531752%
	Ke	8.497801%
	Ta	0.490848%
	Te	8.456897%
	Tek	28.087398%

Table 2. Degrees distribution for each stroke type.

Note Significance	Duration	Ocurrence
Dominant	0.5	17.969535
	1.0	64.714927
	1.5	0.528938
	2.0	16.409373
	4.0	0.377227
Leading	0.5	12.626814
	1.0	68.706103
	1.5	0.374590
	2.0	18.167629
	4.0	0.124863
Tonic	0.5	16.167297
	1.0	61.137812
	1.5	0.429492
	2.0	21.856359
	4.0	0.409040

Table 3. Degrees distribution for each duration (of stroke).

Hand	Stroke	Ocurrence
Both	Hek	100.000000
Left	Ka	1.580436
	Ke	17.600575
	Tek	80.818988
Right	Dum	83.09
	Ta	0.979185
	Te	15.918917

Table 4. Hand distribution for each stroke.

the distribution of the strokes rather than the coincidence of the notes itself.

From Table 2, most of the relevant notes (either dominant, leading or tonic) were played along with a *Düm*, and following this ranking *Tek*.

Half (2.0) and Quarter (1.0) notes of strokes, are more likely to occur at the same time of dominant, leading and tonic as stated in Table 3.

If we look to the relation between strokes and hands in Table 4, we can notice that there are no intersection between the kind of strokes and the hand used for strokes that are played at the same time of notes. For this the results are quite similar to Table 2.

Differences of note distributions of the same makam on different usuller suggests that usul may have an impact on how the makam is executed. This can be seen in Figure 6 and Figure 4. More examples can be found in repository.

5. FUTURE WORK

The knowledge retrieved from Table 4, Figure 3 and Table 2, opens the possibility of retrieve the Makam scale by joining the data of notes played along with *Dum* and *Tek* notes, and the offset of the notes. Pairwise comparisons of usul-makam pairs regarding to stroke and note statistics might help us understand better the effect of usuller. Uneven distributions of usuller is one of our limitations. Usuller such as Sofyan and Düyek are much more common compared to Oynak and Havi (Table 5).

6. REFERENCES

[1] Murat Aydemir. *Turkish music makam guide*. Pan Yayıncılık, Besiktas, Istanbul, 2010.

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[4] M Kemal Karaosmanoğlu. A turkish makam music symbolic database for music information retrieval: Symbtr. In *Proceedings of 13th International Society for Music Information Retrieval Conference; 2012 October 8-12; Porto, Portugal. Porto: ISMIR, 2012. p. 223–228.* International Society for Music Information Retrieval (ISMIR), 2012.

[5] İsmail Hakkı Özkan. *Türk mûzikısi nazariyatı ve usûlleri: kudüm velveleleri*, volume 41. Ötüken Neşriyat, 1990.

Usuller \ Makamlar	Hicaz	Rast	Nihavent	Uşşak	Segah	Hüseyni	Hüzzam	Mahur	Kürdilihicazkâr	Muhayyer
Çenber	0	1	0	1	0	1	0	0	0	0
Evfer	5	2	0	1	0	2	0	1	1	0
Devr-i Kebir	0	1	2	1	2	2	1	1	0	1
Fahte	1	0	1	0	0	0	1	0	0	0
Hafif	0	1	1	1	1	0	0	2	0	0
Türk Aksağı	8	2	6	5	2	1	5	0	4	1
Havi	0	0	0	0	0	1	0	0	0	0
Berefşan	0	0	0	0	0	1	0	0	0	0
Düyek	19	18	24	15	9	7	16	16	6	6
Aksak	26	7	15	19	18	15	21	18	13	12
Semai	8	7	15	4	4	1	5	3	3	1
Raks Aksağı	3	0	0	1	2	2	0	0	0	1
Çifte Düyek	0	2	0	0	0	1	0	0	0	0
Aksak Semai	3	3	3	4	2	5	3	5	4	2
Muhammes	0	1	0	0	0	1	1	1	1	1
Sofyan	20	15	17	19	11	17	5	10	5	12
Oynak	0	1	0	0	1	0	1	0	0	0
Yürük Semai	2	4	3	6	2	4	1	2	1	2

Table 5. Number of pieces of usul-makam pairs