

Incorporating features of distribution and progression for automatic makam classification

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Outline

- ▶ Motivation
- ▶ Data
- ▶ Method
- ▶ Experiments
- ▶ Results
- ▶ Future Work



Studies on Traditional Makam Music

- ▶ Not widely studied
- ▶ Not fully explained with solid theory
- ▶ Need to solve the mismatch in theory and practice
- ▶ Large collections of data needs to be organized
- ▶ Need to design supportive tools for musicians (composers, students, teachers, amateur musicians...)
- ▶ ...



Selected Symbolic Makam Collection

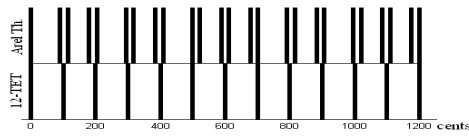
- ▶ M. K. Karaosmanoğlu, "A Turkish makam music symbolic database for music information retrieval: SymbTr," in Proc. Int. Society for Music Information Retrieval (ISMIR), 2012

<i>Makam name</i>	<i>Total # of Songs</i>	<i>Total # of Notes</i>
Beyati	42	17347
Hicaz	117	39301
Hicazkar	49	14775
Hüseyni	71	23787
Hüzzam	65	23581
Kürdilihicazkar	51	18332
Mahur	54	18039
Muhayyer	50	16774
Nihavent	86	28724
Rast	88	29103
Saba	45	16486
Segah	74	21744
Uşşak	85	26379
TOTAL	877	294372

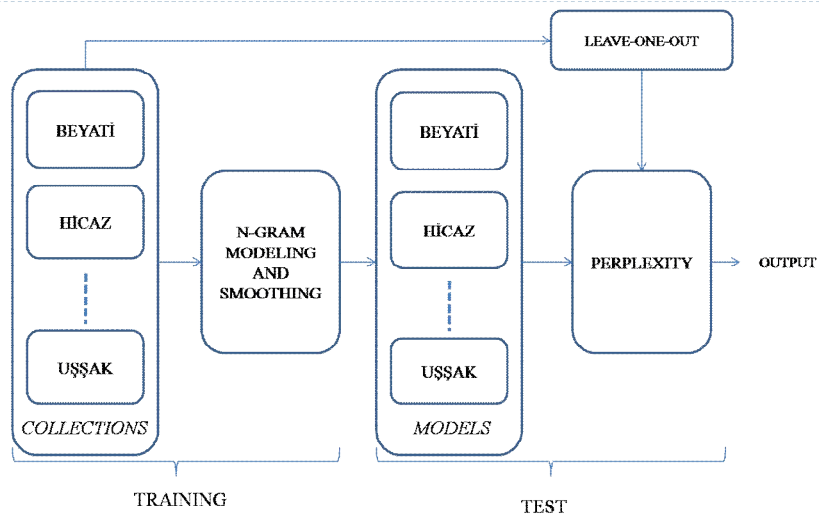


Classification Approach

- ▶ Erdem Ünal, Barış Bozkurt, and Mustafa Kemal Karaosmanoğlu, “N-gram based Statistical Makam Detection on Makam Music in Turkey using Symbolic Data”, ISMIR 2012
 - ▶ Slightly smaller database (847 pieces in 13 makams)
 - ▶ Compared the affect of different representations
 - ▶ 12TET (A Alpkoçak, A. C. Gedik)
 - ▶ KomaAE (Arel Ezgi representation)
 - ▶ KomaDelta (For testing the usability in audio input)



Methodology



Perplexity

- ▶ Perplexity

$$2^{\sum_{i=1}^N \frac{1}{N} \log_2 q(x_i)}$$

- ▶ Cross Entropy (The exponent)

$$H(p, q) = - \sum_x p(x) \log_2 q(x)$$

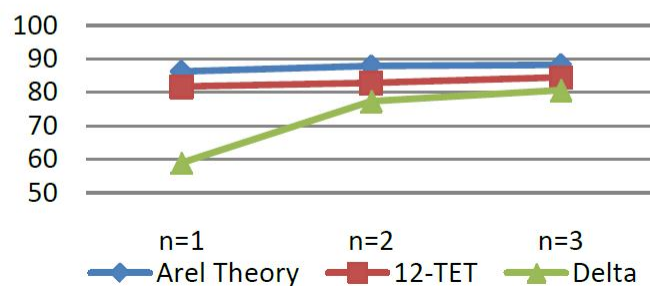
- ▶ X_i drawn from p ; predicting how well p is generated by q . our case : how well the note progressions are predicted by the makam models

- ▶ Used the SRILM toolkit.



Overall performance comparison

Recall	n=1	n=2	n=3
Arel Theory	86.3	87.9	88.2
12-TET	81.7	82.8	84.5
Delta (in commas)	58.9	77.3	80.6



CompMusic Contribution

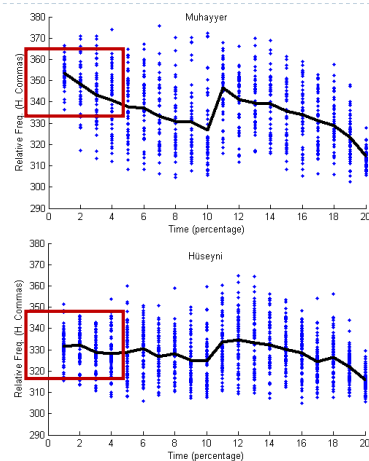
- ▶ Incorporating progression related macro information
 - ▶ Operate on local points where makams are more distinct
- ▶ Hierarchical clustering
 - ▶ Group similar makams together
 - ▶ Train makam groups and test accordingly
 - ▶ Use knowledge based rules for detailed classification



Local Progression Information

▶ Progressions

- Model derived from the whole, test performed on the whole
- Model derived from the whole, test performed on the first quarter
- Model derived from the first quarter, test performed on the first quarter



Whole vs Whole

2-gram RESULTS:														
byati	hicaz	hezkr	hsyni	huzzm	krdhz	mahur	muhyr	nhvnt	rast	saba	segah	ussak		
20	0	0	5	0	0	0	1	0	1	0	0	15	byati	47,6
0	117	0	0	0	0	0	0	0	0	0	0	0	hicaz	100
0	0	48	0	0	1	0	0	0	0	0	0	0	hezkr	98
4	1	0	45	0	0	0	14	0	1	1	0	5	hsyni	63,4
0	0	0	0	62	0	0	0	0	0	0	3	0	huzzm	95,4
0	0	0	0	0	51	0	0	0	0	0	0	0	krdhz	100
0	0	0	0	0	0	51	1	0	2	0	0	0	mahur	94,4
3	0	0	5	0	0	0	37	0	1	0	0	4	muhyr	74
0	0	0	0	0	1	0	0	85	0	0	0	0	nhvnt	98,8
0	0	0	0	0	0	0	1	0	81	0	0	6	rast	92
0	0	0	0	0	0	0	1	0	0	44	0	0	saba	97,8
0	0	0	0	1	0	0	1	0	0	0	72	0	segah	97,3
9	0	0	9	0	0	0	5	0	3	0	1	58	ussak	68,2
55,6	99,2	100	70,3	98,4	96,2	100	60,7	100	91	97,8	94,7	65,9		
TOTAL WEIGHTED ACC is: 87,9														
TOTAL MAKAM ACC is: 86,7														

Table 1. Results for the first test: model derived from the whole, test performed on the whole



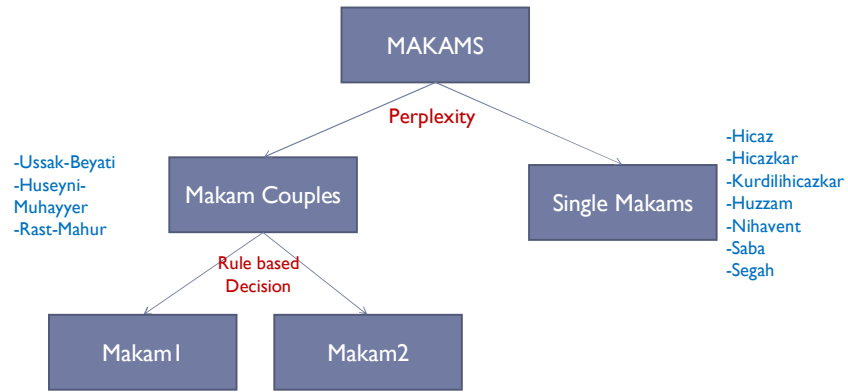
First Quarter vs Whole

2-gram RESULTS:														
byati	hicaz	hezkr	hsyni	huzzm	krdhz	mahur	muhyr	nhvnt	rast	saba	segah	ussak		
20	0	0	5	0	0	0	1	0	0	0	0	16	byati	47,6
0	116	0	1	0	0	0	0	0	0	0	0	0	hicaz	99,1
0	0	47	0	1	1	0	0	0	0	0	0	0	hezkr	95,9
5	1	0	47	0	0	0	12	0	1	1	0	4	hsyni	66,2
0	0	0	0	63	0	0	0	0	0	0	2	0	huzzm	96,9
0	0	0	0	0	51	0	0	0	0	0	0	0	krdhz	100
0	0	0	0	0	0	51	1	0	2	0	0	0	mahur	94,4
2	0	0	5	0	0	0	41	0	0	0	2	0	muhyr	82
0	0	0	0	0	1	0	0	85	0	0	0	0	nhvnt	98,8
0	0	0	0	0	0	0	1	0	82	0	0	5	rast	93,2
0	0	0	0	0	0	0	1	0	0	44	0	0	saba	97,8
0	0	0	0	2	0	0	1	0	0	0	71	0	segah	95,9
8	0	0	8	0	0	0	5	0	3	0	1	60	ussak	70,6
57,1	99,1	100	71,2	95,5	96,2	100	65,1	100	93,2	97,8	95,9	69		
TOTAL WEIGHTED ACC is: 88,7														
TOTAL MAKAM ACC is: 87,6														

Table 2. Results for the second test: model derived from the whole, test performed on the first quarter

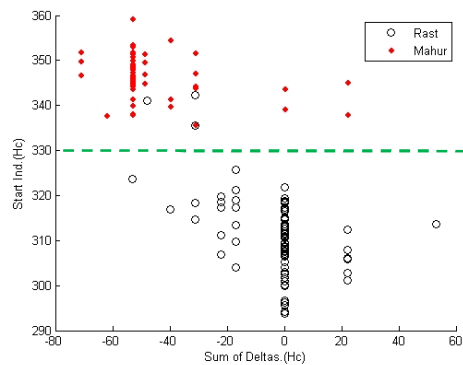


Hierarchical Approach



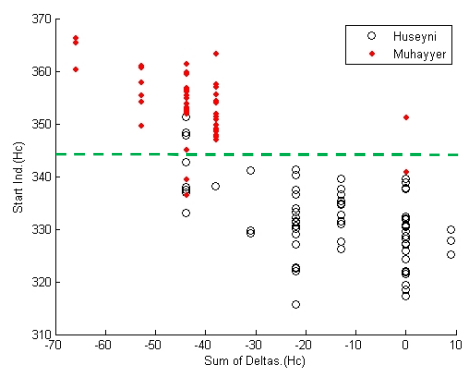
Theoretical Clues 1

- ▶ Rast and Mahur ends with G4 = 296.



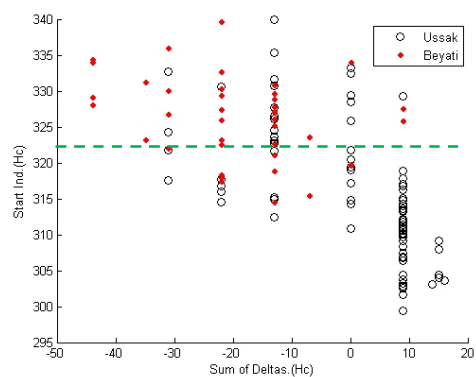
Theoretical Clues 2

► Huseyni vs Muhayyer



Theoretical Clues 3

► Beyati-Uşşak (Problematic Classification)



Confusion Matrix for Hierarchical Classification

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TOTAL WEIGHTED ACC is: 90.7
TOTAL MAKAM ACC is : 90
=====
3-gram RESULTS:
bytus  hicaz  hczkr  hsynh  huzzm  krdhz  nhvnt  rstmh  saba  segah
104  0  0  21  0  0  0  0  0  2  bytus  81.9
0  117  0  0  0  0  0  0  0  0  hicaz  100
0  0  49  0  0  0  0  0  0  0  hczkr  100
14  1  0  105  0  0  0  1  0  0  hsynh  86.6
0  0  0  0  63  0  0  0  0  2  huzzm  96.9
0  0  0  0  0  51  0  0  0  0  krdhz  100
0  0  0  0  0  0  86  0  0  0  nhvnt  100
0  0  0  1  0  0  0  101  0  0  rstmh  99.3
0  0  0  1  0  0  0  0  44  0  saba  97.8
0  0  0  1  2  0  0  0  0  71  segah  95.9
88.1  99.2  100  81.4  96.9  100  100  99.3  100  94.7
TOTAL WEIGHTED ACC is: 94.6
TOTAL MAKAM ACC is : 95.9
=====
beyati  hicaz  hczkr  hsyni  huzzm  krdhz  mahur  mhyrr  nhvnt  rast  saba  segah  ussak
24  0  0  51  0  0  0  0  0  0  0  13  0  0  beyati  57.1
0  117  0  0  0  0  0  0  0  0  0  0  0  0  hicaz  100
0  0  49  0  0  0  0  0  0  0  0  0  0  0  hczkr  100
7  1  0  59  0  0  0  2  0  1  0  0  1  0  hsyni  83.1
0  0  0  0  63  0  0  0  0  0  2  0  0  0  huzzm  96.9
0  0  0  0  0  51  0  0  0  0  0  0  0  0  krdhz  100
0  0  0  0  0  0  54  0  0  0  0  0  0  0  mahur  100
6  0  0  3  0  0  0  41  0  0  0  0  0  0  mhyrr  82
0  0  0  0  0  0  0  0  86  0  0  0  0  0  nhvnt  100
0  0  0  1  0  0  0  0  0  0  0  0  0  0  rast  95.5
0  0  0  1  0  0  0  0  0  0  44  0  0  0  saba  97.8
0  0  0  1  2  0  0  0  0  0  0  0  71  0  segah  95.9
12  0  0  14  0  0  0  0  0  0  0  2  55  0  ussak  64.7
49  99.2  100  68.6  96.9  100  94.7  95.3  100  98.8  100  94.7  79.7
TOTAL WEIGHTED ACC is: 90.9
TOTAL MAKAM ACC is : 90.2
=====

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improvement

	Forward	Hierarchical	Improvement
Beyati	47,6	57,1	19,9
Hicaz	99,1	100	0,9
Hicazkar	95,9	100	4,8
Huseyni	66,2	83,1	20,3
Huzzam	96,9	96,9	-
Kurdilihicazkar	100	100	-
Mahur	94,4	100	5,9
Muhayyer	82	82	-
Nihavent	98,8	100	1,2
Rast	93,2	95,5	2,4
Saba	97,8	97,8	-
Segah	95,9	95,9	-
Uşşak	70,6	64,7	-8,3
TOTAL	88,7	90,9	2,3

Future Work and Conclusion

- ▶ Larger database ...
- ▶ A more detailed study on Uşşak-Beyati Classification
- ▶ Melodic analysis
- ▶ Incorporating rhythmic information?
- ▶ **TESTS with AUDIO**

