Improving Music Classification Using Harmonic Complexity

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Categorization

Outline

- Motivation
- Music harmony
- Our music harmony model
- Example analysis
- Experiments: Music classification using our new feature

User preferences

User preferences

recommends

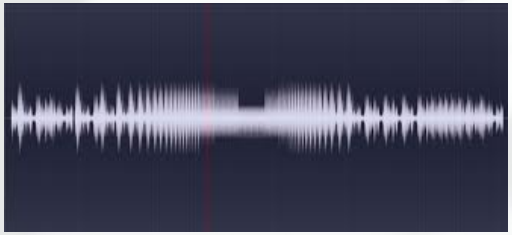
- Using what?

Tempo, Volume, Mood, Genre, Harmony, Melody, Author, Interpret, Music period, Instruments, ...

Music classification

- Determining genre / author / mood (or other category)

- Using what?



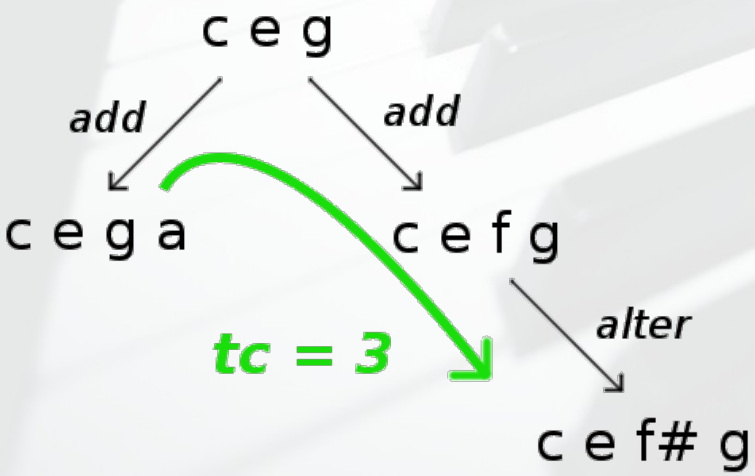
Tempo, Volume, Harmony, Melody, Instruments, ...

What we are working on?

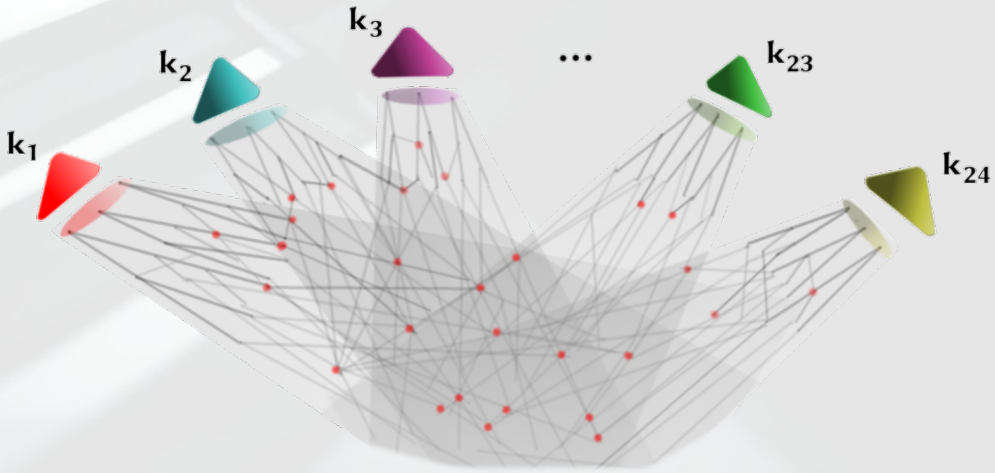
- Finding a standard set of descriptors for music harmony
- Motivation: there is no such descriptors yet

Harmonic complexity – useful harmony descriptor

- **1st step:** Gathering low-level features using DFT, choosing tones with highest activation to obtain chords (harmonies)
- **2nd step:** Using our **model**, based on formal grammars, calculating „transition complexity“ between the successive chords (analogy to computational complexity)
- Example transitions:



- Graph: 2^{12} vertices, average degree ≈ 8



Music harmony comparison

PREŠOVSKÝ DIXIELAND SLOVAKIA

Harmonic complexity – useful harmony descriptor

- Counting the mean transition complexity

Harmonic complexity – useful harmony descriptor

Chord: **F A C Eb**

Complexity:

Σ: **0**

Harmonic complexity – useful harmony descriptor

Chord: **Bb Db F**

Complexity: **3**

Σ: **3**

Harmonic complexity – useful harmony descriptor

Chord: **Eb F G A**

Complexity: **4**

Σ: **7**

Harmonic complexity – useful harmony descriptor

Chord: **Bb Db F**

Complexity: **4**

Σ: **11**

Harmonic complexity – useful harmony descriptor

Chord: **Eb F G A**

Complexity: **4**

Σ: **15**

Harmonic complexity – useful harmony descriptor

Σ: *60*

Transitions: **19**

Average Transition Complexity:

3.16

Harmonic complexity – useful harmony descriptor

- Counting the mean transition complexity

Harmonic complexity – useful harmony descriptor

Previous:

Now: ***G7*** **(G B D F)**

Next: ***C7*** **(C E G Bb)**

Transition:

Σ: **0**

Harmonic complexity – useful harmony descriptor

Previous:	*G7* (G B D F)
Now:	***C7* (C E G Bb)**
Next:	*F7* (F A C E)
Transition:	**3**
Σ:	**3**

Harmonic complexity – useful harmony descriptor

Previous: *C7* (C E G Bb)

Now: ***F7*** **(F A C E)**

Next: *Bb* (Bb D F)

Transition: **2**

Σ: **5**

Harmonic complexity – useful harmony descriptor

Previous: *F7* (F A C E)

Now: ***Bb*** **(Bb D F)**

Next: *G7* (G B D F)

Transition: **1**

Σ: **6**

Harmonic complexity – useful harmony descriptor

Previous: *Bb* (Bb D F)

Now: *G7* (G B D F)

Next: *C7* (C E G Bb)

Transition: 2

Σ: 8

Harmonic complexity – useful harmony descriptor

Σ: *25*

Transitions: **12**

Average Transition Complexity:

2.08

Supporting experiments

- Neural Network method
- Parameters:
  - 150-dimensional feature vector

    MFCC, RMS Amplitude, Tempo, Transition probability matrix, Number of keys, Number of modulations, Number of similarity segments, Number of distinct chord roots

    with **added mean Harmonic complexity**
  - 20 hidden neurons
  - 5 output classes

Results: Without Harmonic complexity

1: Basic features

CLASSIFIED GENRE \ REAL GENRE	E	J	M	R	P	PRECISION
Electronic	**15**	1	1	4	2	0.65
Jazz	0	**15**	0	2	2	0.79
Metal	1	0	**13**	0	0	0.93
Rock	2	3	0	**12**	1	0.67
Pop	2	1	6	2	**15**	0.58
RECALL	0.75	0.75	0.65	0.60	0.75	OVERALL: 0.70

Results: With Harmonic complexity

2: with HC

CLASSIFIED GENRE \ REAL GENRE	E	J	M	R	P	PRECISION
Electronic	**13**	1	0	1	4	0.68
Jazz	2	**17**	0	0	0	0.89
Metal	1	0	**17**	0	1	0.89
Rock	2	2	0	**16**	4	0.67
Pop	2	0	3	3	**11**	0.59
RECALL	0.65	0.85	0.85	0.80	0.55	OVERALL: 0.74

Conclusion

- Proposed a new descriptor for music analysis
- Underlying grammar based model
- Proved its usefulness for music classification problem

Thank you for your attention