

Enhancing Chord Classification Through Neighbourhood Histograms

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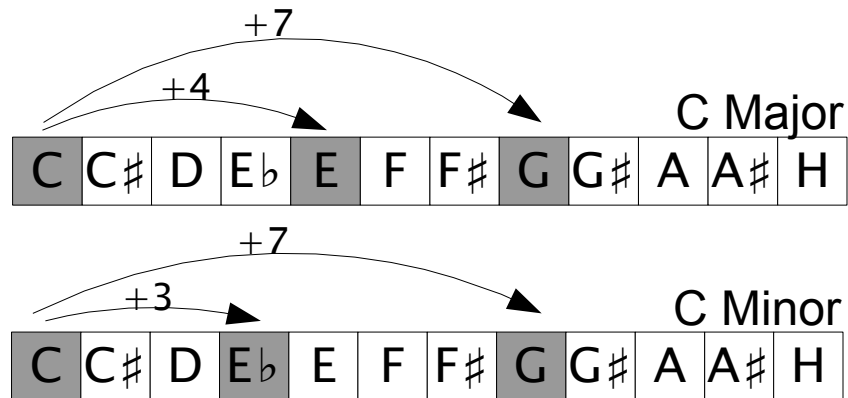
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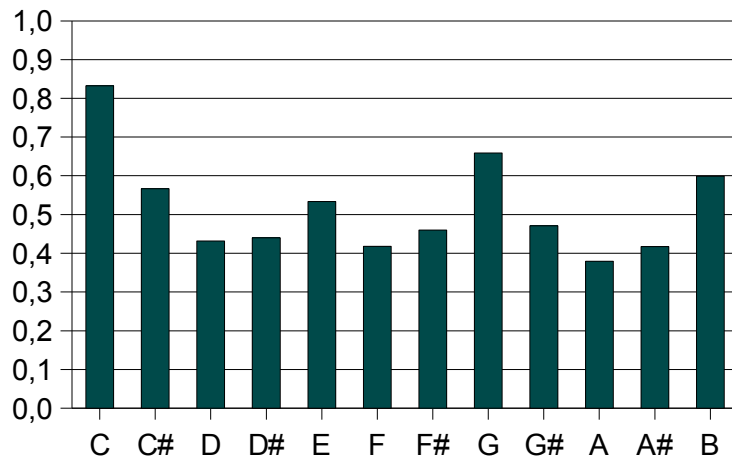
- What's a chord?
- General model for the process of chord recognition
- A different smoothing approach: Viterbi
- Histogram Smoothing
- Results
- Summary and Future Work

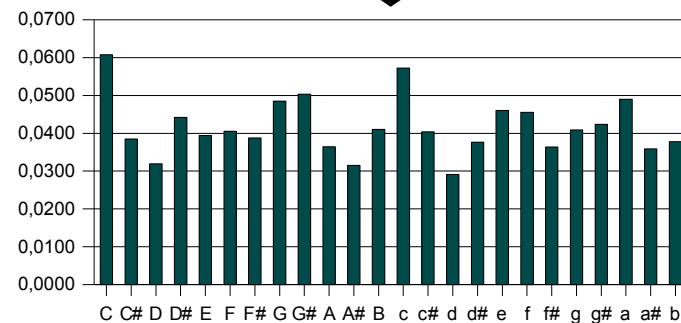
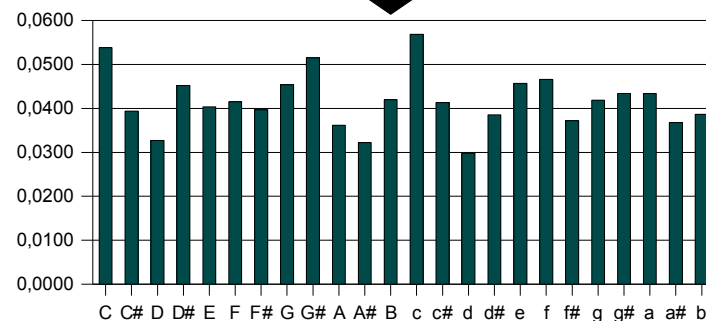
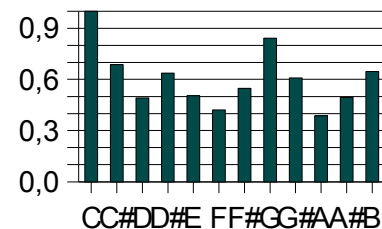
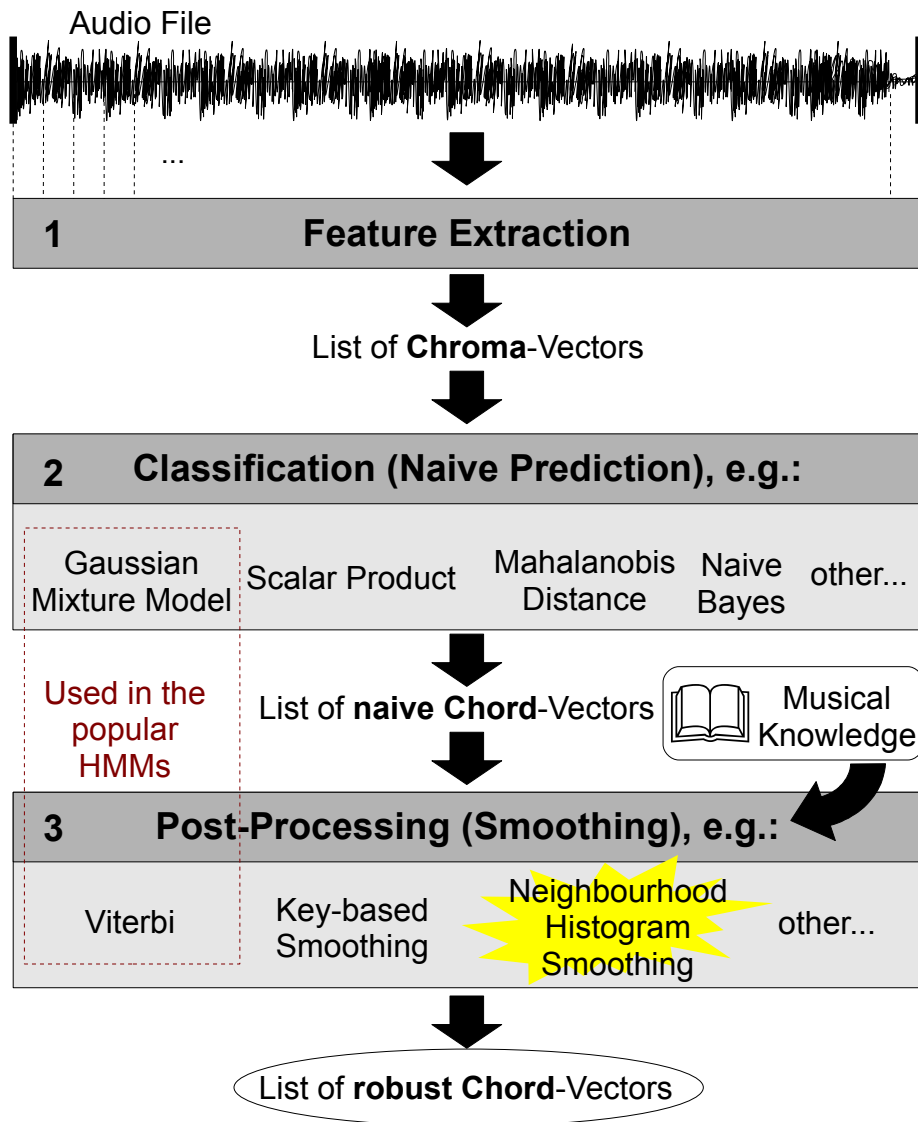
DKE What's a chord?

- Chord = Set of tones sounding simultaneously
- Most common chords are *major* and *minor*

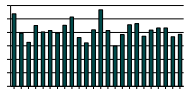


- Feature used for chord recognition: *chroma*

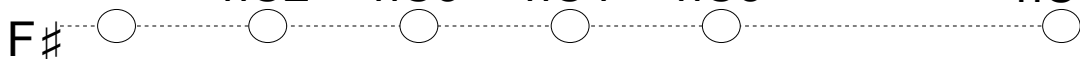




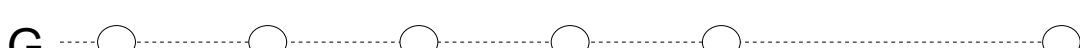
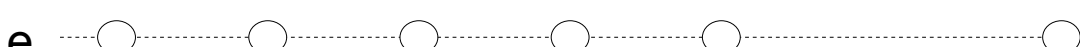
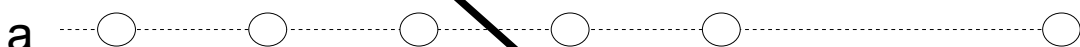
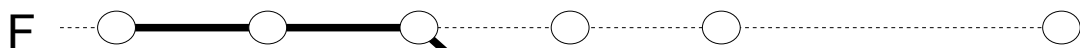
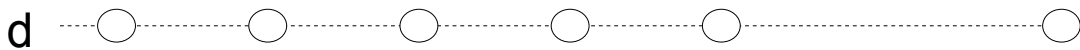
naiveChord1



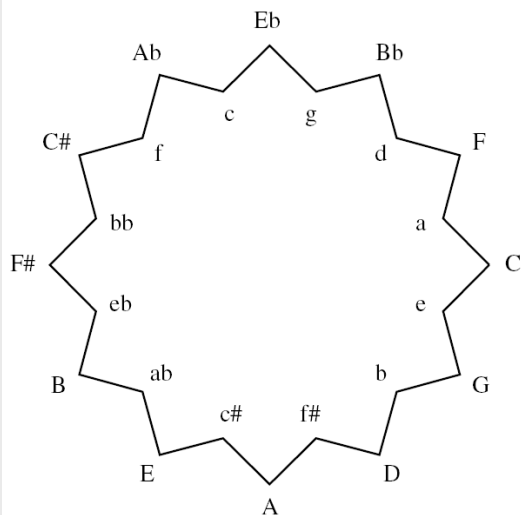
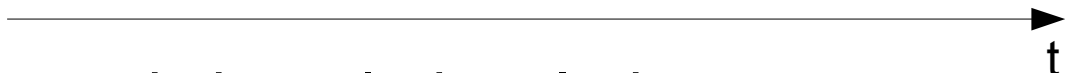
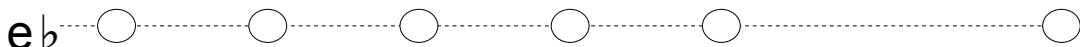
nC2 nC3 nC4 nC5 ... nCT



⋮



⋮

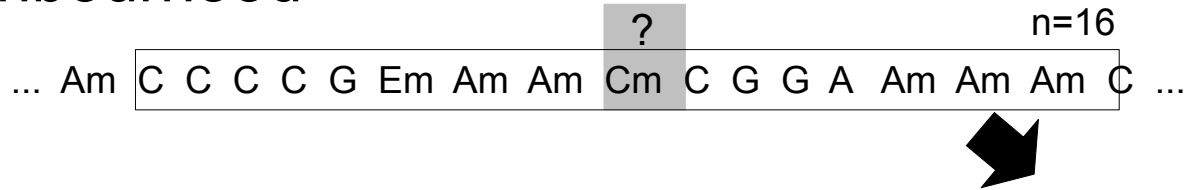


Double Nested Circle of Fifth
(Bello, Pickens 2005)

This approach uses static knowledge. It does not consider extractable harmonic movement of the piece.

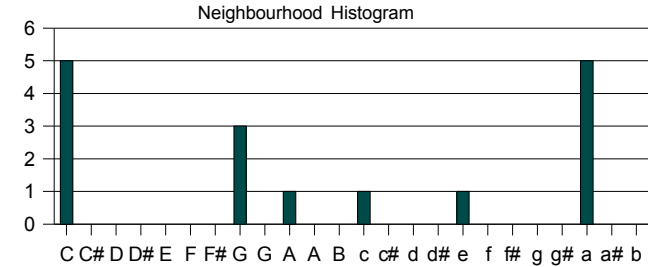
DKE Histogram Smoothing

- Idea: Increase probability of those chords, present in the neighbourhood

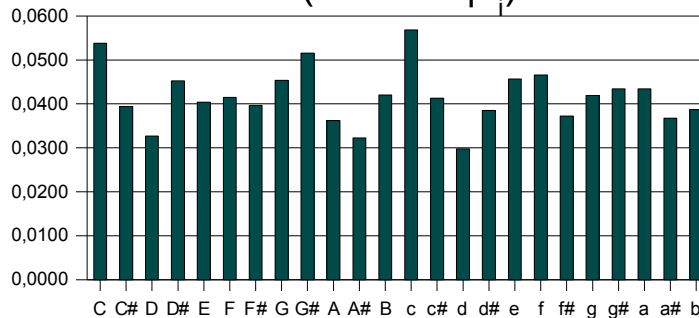


- New chord probabilities

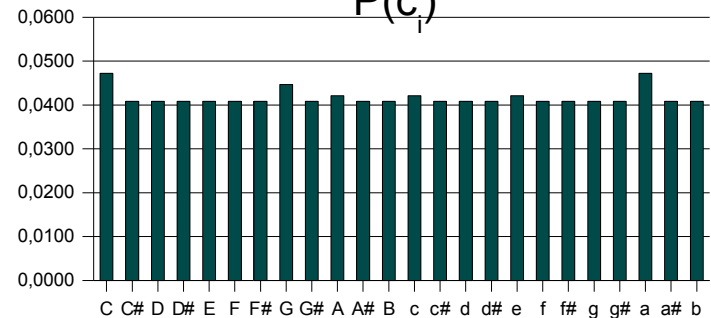
$$P[c_i|Chroma] = \frac{P[Chroma|c_i] \cdot P[c_i]}{P[Chroma]}$$



Classifier output
 $P(Chroma|c_i)$

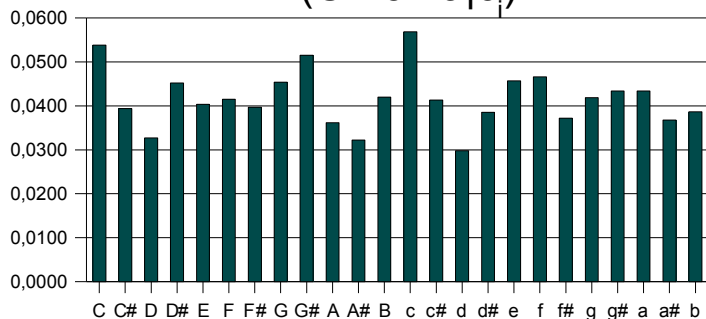


Smoothed neighbourhood histogram
 $P(c_i)$

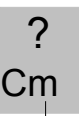
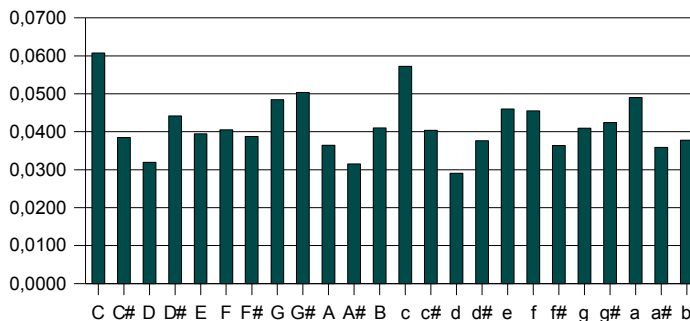
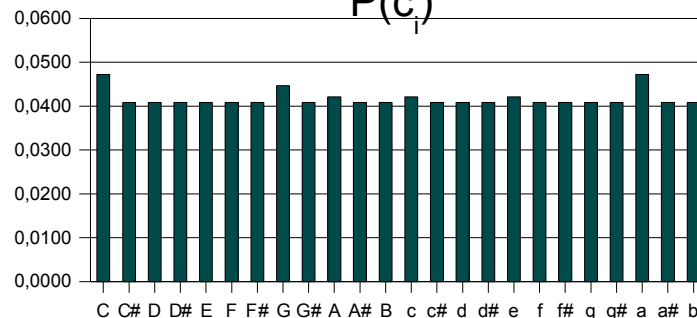


$$P[c_i|Chroma] = \frac{P[Chroma|c_i] \cdot P[c_i]}{P[Chroma]}$$

Classifier output
 $P(Chroma|c_i)$



Smoothed neighbourhood histogram
 $P(c_i)$



... Am C C C C G Em Am Am **Cm** C G G A Am Am Am C ...
 ... Am C C C C G Em Am Am C C G G A Am Am Am C ...

- Window size n
 $n \in \{4, 8, 16, 32\}$; NB: $n \in \{8, 16, 32, 128, 1000\}$
- Virtual appearance factor *virtAppFactor*
 (virtualAppearance = *virtAppFactor* * n)
 $virtAppFactor \in \{2, 5, 10\}$; NB: $virtAppFactor \in \{0, 0.5\}$
- Chords included into histogram until rank r
 $r \in \{1, 2, 3, 12, 24\}$; NB: $r \in \{1, 3, 12\}$
- Bonus for most reliable chord *relBonus*

$$\text{Reliability} = P_{\text{Rank}=1} * (P_{\text{Rank}=1} - P_{\text{rank}=2})$$
 $relBonus \in \{0, 1, 3\}$; NB: $relBonus \in \{0, 2\}$
- Number of additional iterations k
 $k \in \{0, 1, 2, 3, 4\}$

ScalProd MahDist NaiBay

4	4	1000
5	10	0
3	12	*
1	1	*
4	4	3

- Results of the Histogram Smoothing (HS) with three different classifiers:

	Scalar Product		Mahalanobis		Naive Bayes	
	Baseline	with HS	Baseline	with HS	Baseline	with HS
Please Please Me	56,52	69,05	54,6	72,52	49,85	54,25
Beatles for Sale	63,91	74,02	62,81	75,56	60,81	66,5
Overall	60,16	71,62	58,7	74,04	55,02	60,37

- Comparison between HS and Viterbi Smoothing:

	Scalar Product			Mahalanobis		
	Baseline	with HS	Viterbi	Baseline	with HS	Viterbi
Please Please Me	56,42	69,05	71,89	54,6	72,52	75,74
Beatles for Sale	63,91	74,02	74,22	62,81	75,56	73,61
Overall	60,16	71,62	73,06	58,7	74,04	74,68
All Beatles	52,81	63,00	62,47	52,42	65,69	64,12

Summary

- Generalised Chord Recognition process:
Feature Extraction, (naive) Classification, Smoothing
- Histogram Smoothing as a way to integrate vague knowledge of the harmonic movement of a song in order to improve prediction

Future Work

- Meta-Classifer combining HS with Viterbi
- Investigate influence of parameters (make approach less sensitive to parameter settings)

Thank you for your attention!
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