On the Use of Note Onsets for Improved Lyrics-to-audio Alignment in Turkish Makam Music

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A hidden Markov model phonetic recognizer with variable-time transition matrix, guided by onset-aware phoneme transition rules

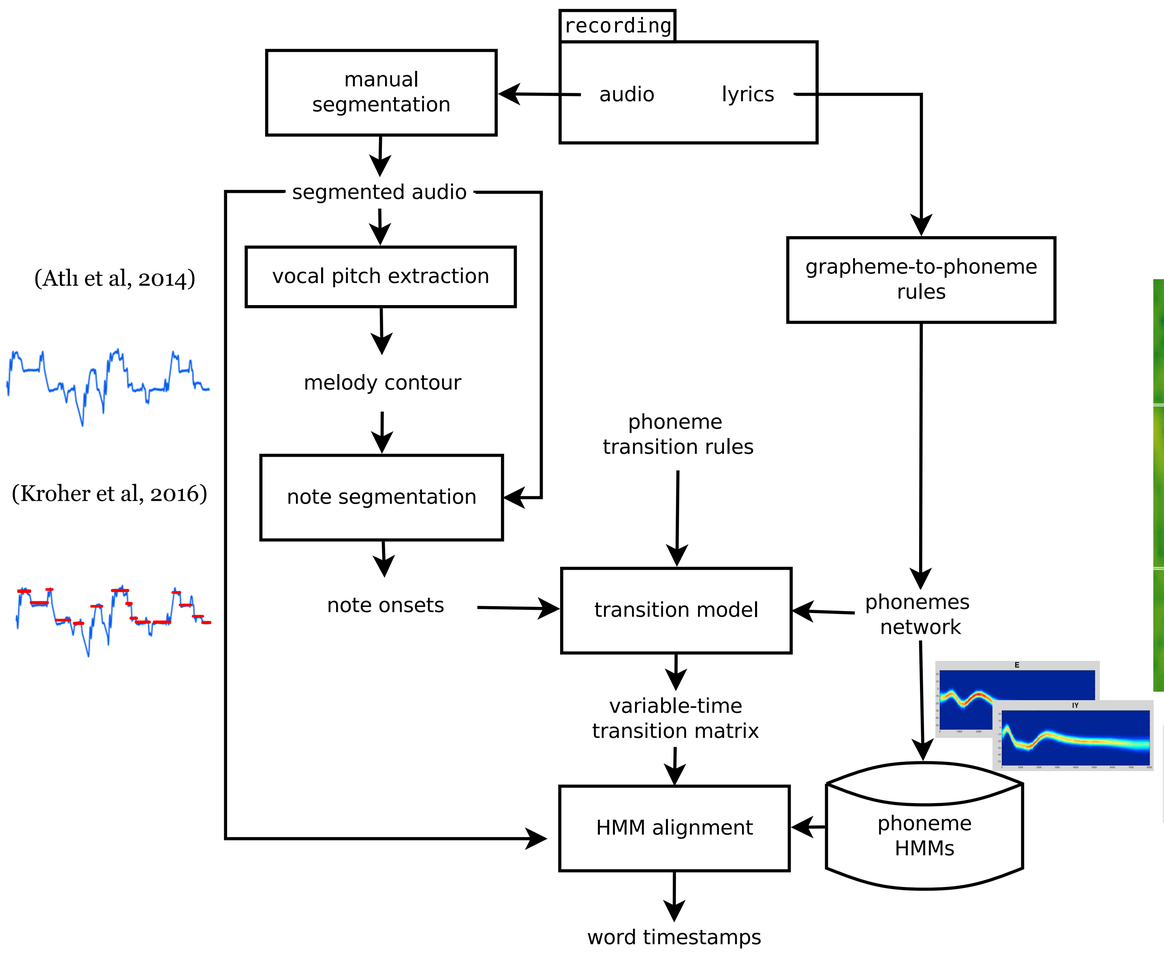
Abstract

- detect begin and end timestamps of words
- make use of note onsets detected automatically

1. phoneme transition rules aware of note onsets
2. alter transition probabilities according to the rules

- evaluate on a cappella and polyphonic Turkish Makam

Method overview



Dataset

Training Corpus

500 minutes Turkish speech

Test Corpus

- 12 acappella recordings, 18 minutes
- especially recorded for this study
- words and note onsets annotated

http://compmusic.upf.edu/turkish-makam-acapella-sections-dataset

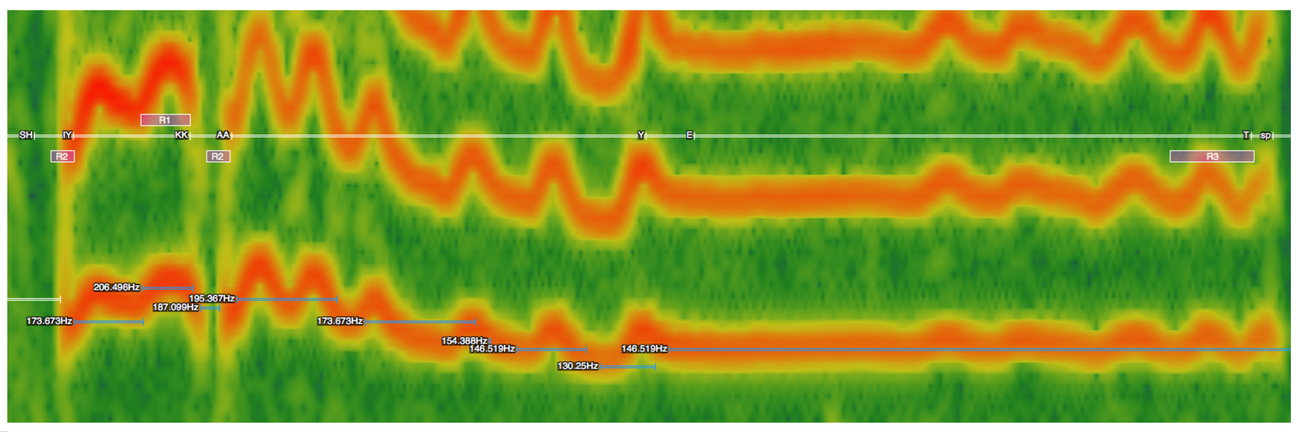
Phoneme Transition Rules

R1: $i_t = V \quad i_{t+1} = C \backslash L$
R2: $i_t = C \backslash L \quad i_{t+1} = V \text{or} L$ *
R3: $i_t = V \quad i_{t+1} = C$

} inter-syllable
} intra-syllable

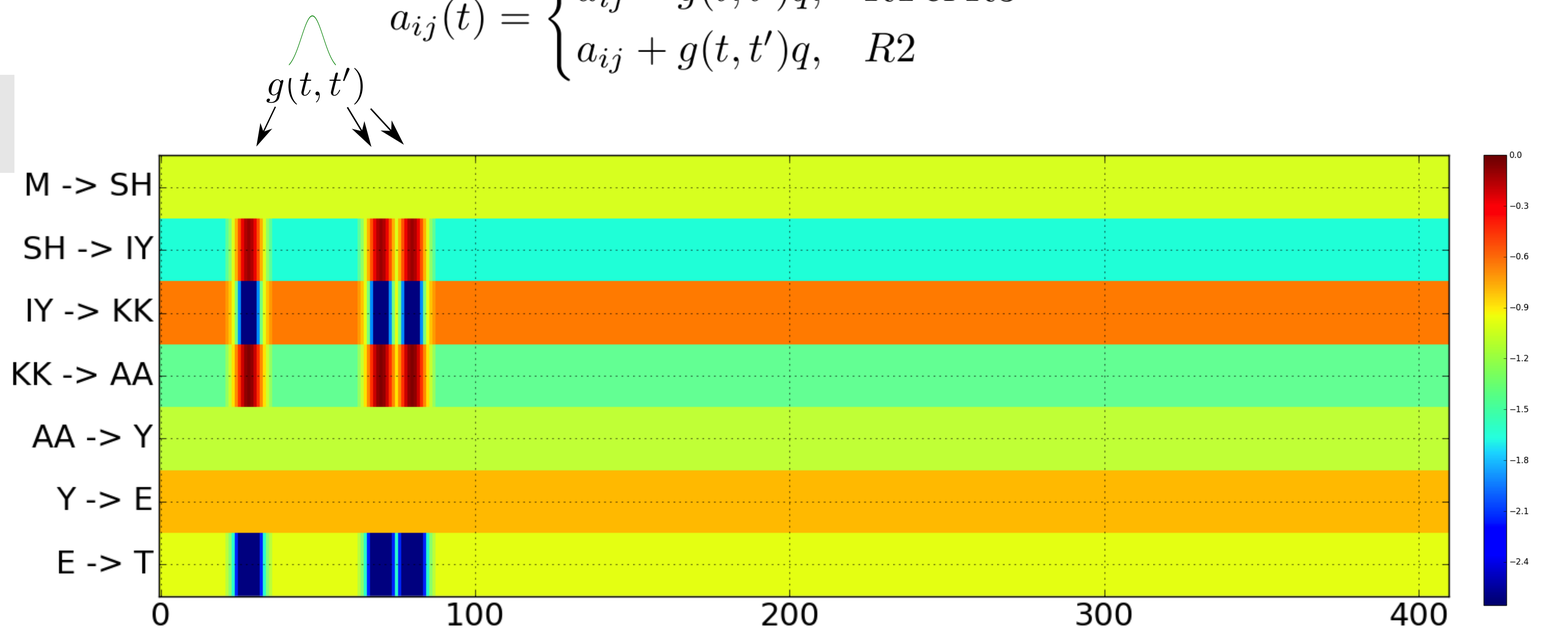
C: consonant V: vowel L: liqud(L,M,N) or semivowel Y

* liquids might bear onsets (Sundberg, 2006)



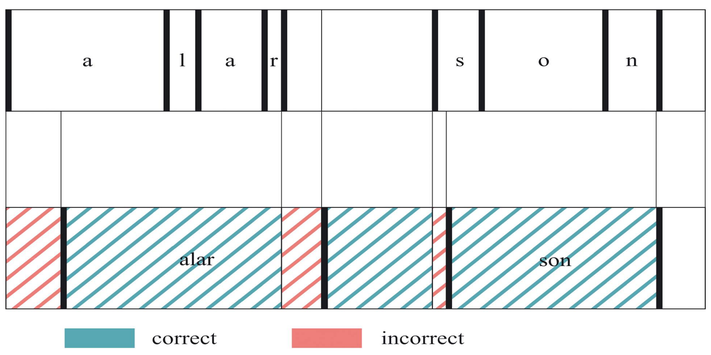
Variable-time Transition Matrix

$$a_{ij}(t) = \begin{cases} a_{ij} - g(t,t')q, & R1 \text{ or } R3 \\ a_{ij} + g(t,t')q, & R2 \end{cases}$$



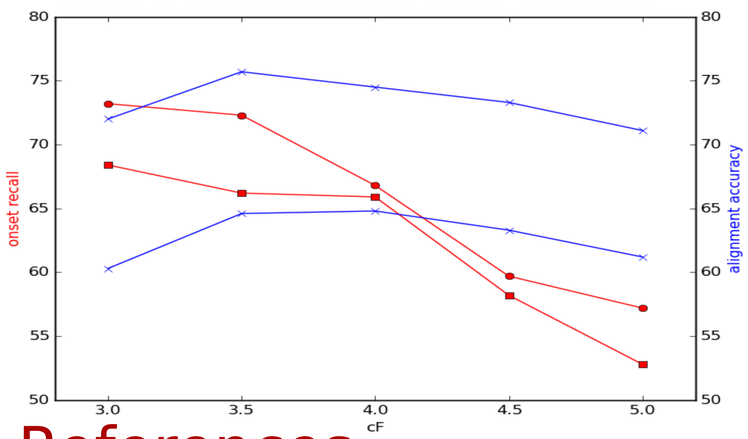
Evaluation

Alignment accuracy (in %) for phrases of 1-4 words



Results

Alignment accuracy Vs recall of automatic note onset detection



Comparison between baseline HMM, proposed Variable-time HMM (VTHMM) and VTHMM with annotated oracle onsets

	HMM	VTHMM	oracle
a cappella	70.2	75.7	83.5
polyphonic	61.5	64.8	67.1

available in python at:
https://github.com/georgid/AlignmentDuration/tree/noteOnsets

demo available at:
http://dunya.compmusic.upf.edu/makam/lyric-align/727cff89-392f-4d15-926d-63b2697d7f3f

Conclusion

- Onset-aware transition probabilities improve alignment
  - Rules R1 and R3 discourage premature transitions of vowels
  - No contribution for onsets not complying with rules and at sustained vowels
- Lightweight model
- Could be easily combined with other modeling concepts

References

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