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On the Impact of Labialization Contexts on Unit Selection Speech Synthesis

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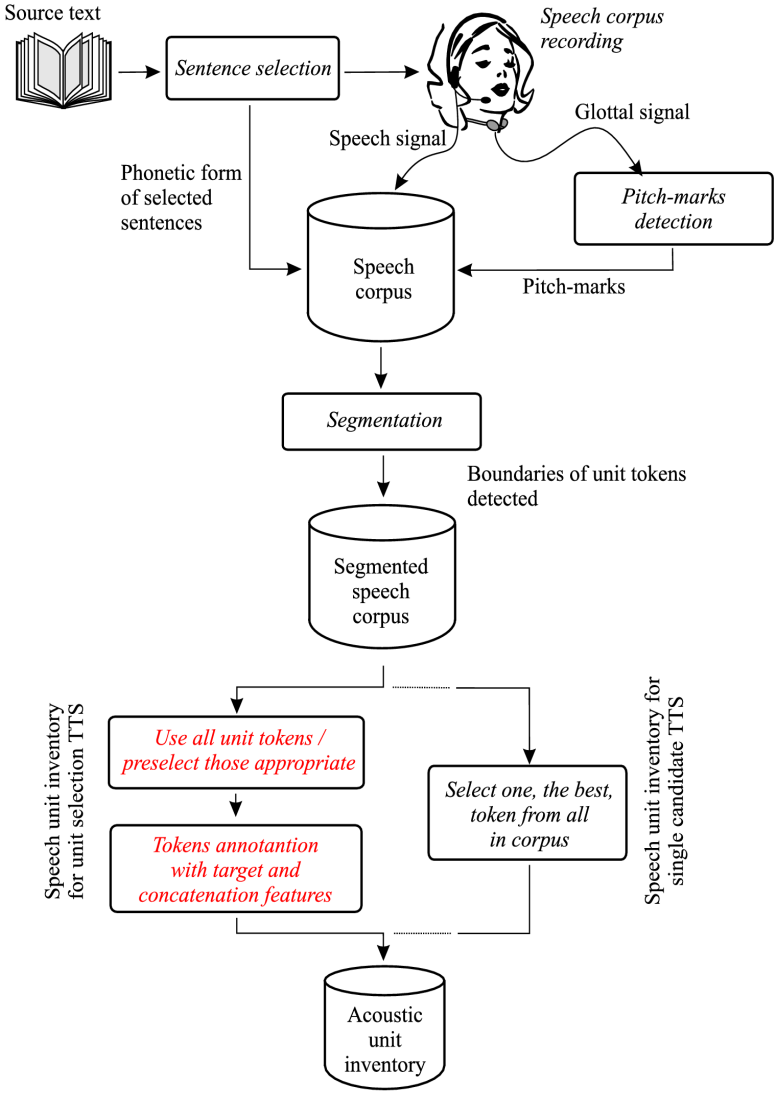
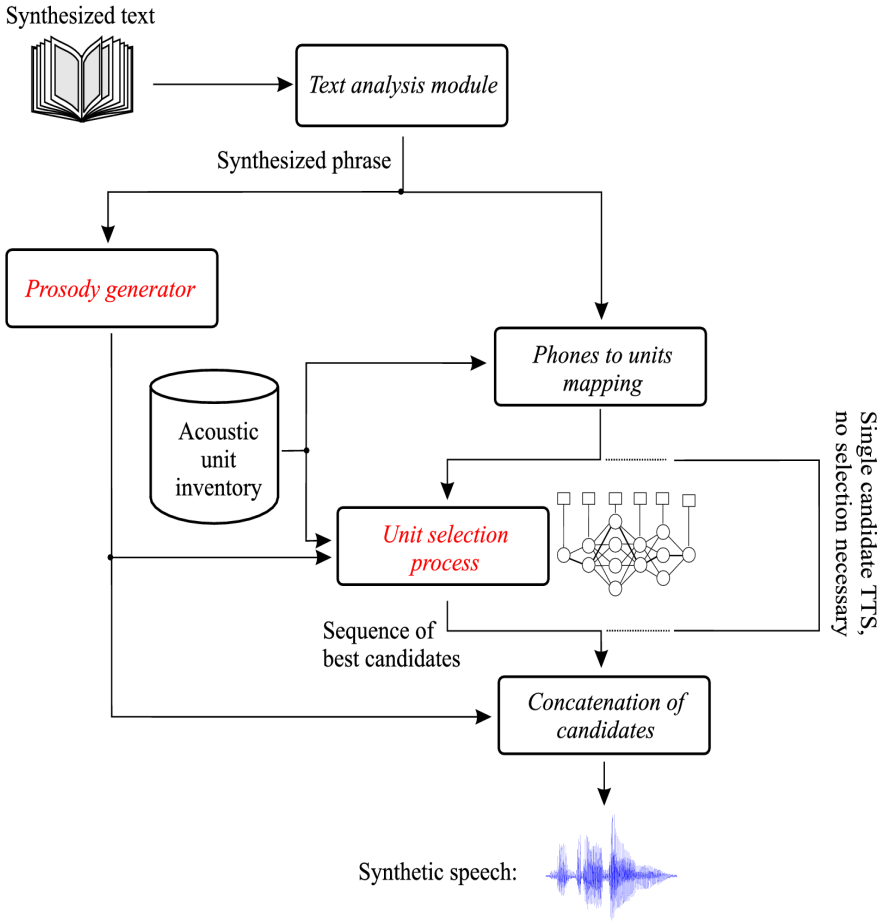
Outline

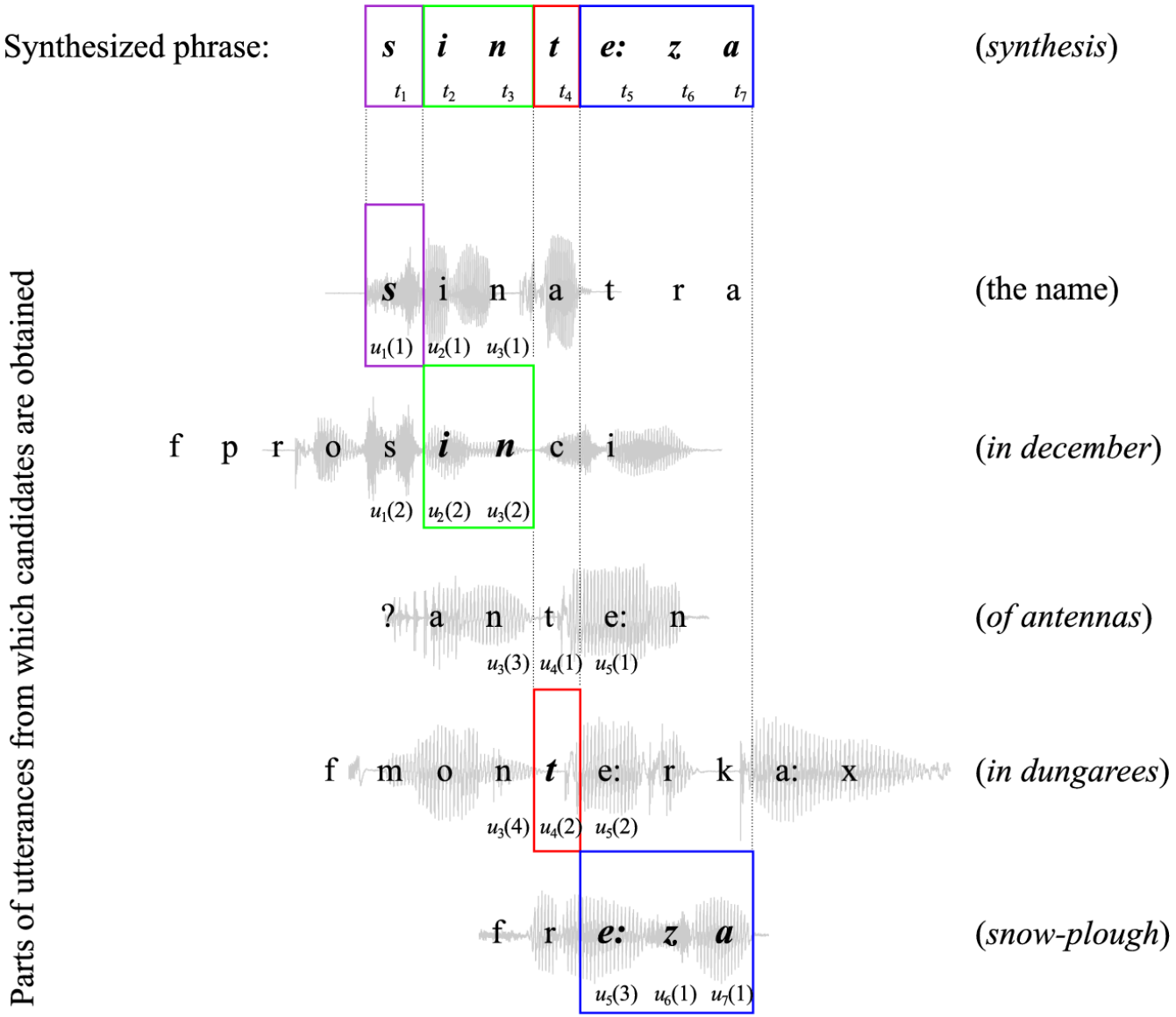
- Unit selection speech synthesis
- Coarticulatory labialization
- Experiments and results
- Conclusion
- Speech samples

Concatenative TTS system





Unit selection scheme



Unit selection

- each speech unit described by:
  - description / context of its original occurence
    - neighbouring (preceding and following) speech units
    - position in sentence / phrase / word / syllable
    - type of phrase, accent
  - its acoustical properties
    - spectral parameters (MFCC, LSP, formant frequencies) fundamental frequency, energy
- selection criteria:
  - **target cost** – selected unit should originate from similar context
  - **join cost** – neighbouring units should be smoothly concatenated (no abrupt changes in acoustical properties)
  - optimizing both target and join cost through the whole sequence of units – dynamic programming
  - crucial problem – setting the proper weighs for particular costs

Labialization

- **coarticulation**
  - mutual influencing of neighbouring speechsounds during speech production
  - has to be considered during unit selection and concatenation
- **coarticulary labialization**
  - inherent phonetic feature of back vowels
  - lowers formant frequencies F_2 and partly F_3
  - influences phonetic makeup of neighbouring consonants

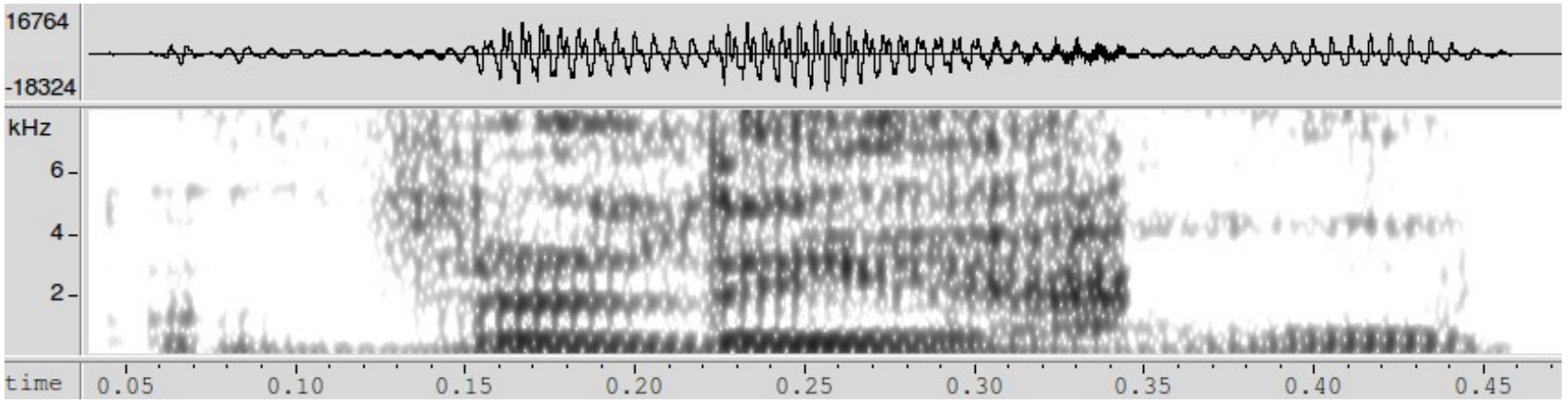
Labialization

- examples for voiced laryngeal fricative ***h*** (high probability of coarticulatory effects)

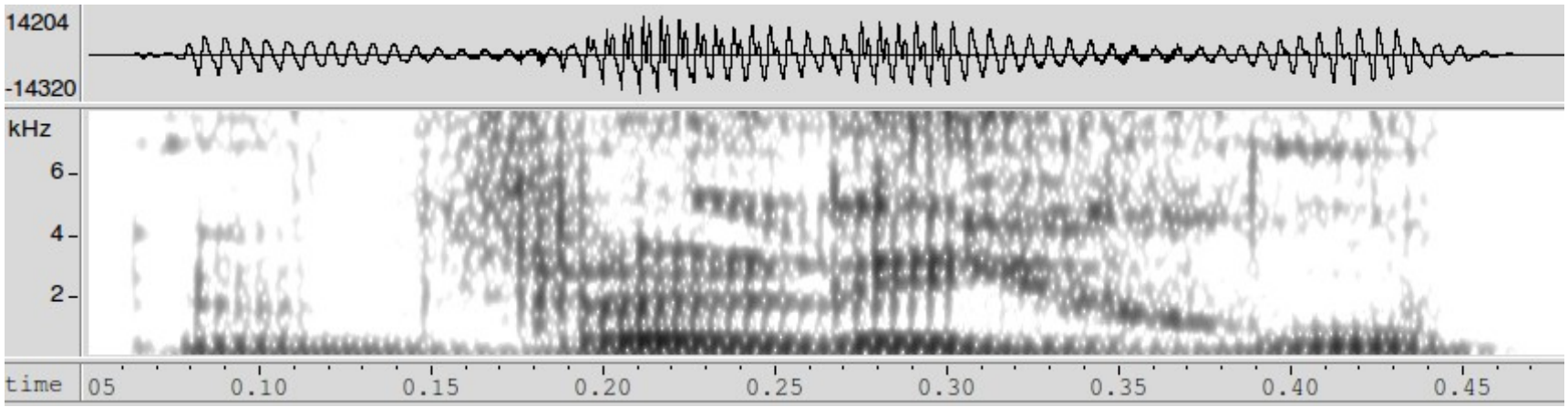
	labial. combination	example	transcription	diphones
1	V(lab0) - C - V(lab0)	v**yhy**nul	v**ihi**nul	#v **vi ih hi in** nu ul l#
2	V(lab+) - C - V(lab+)	v kr**uhu**	fkr**uhu**	#f fk kr **ru uh hu u#**
3	V(lab0) - C - V(lab+)	v l**ihu**	vl**ihu**	#v vl **li ih hu u#**
4	V(lab+) - C - V(lab0)	v kr**uhy**	fkr**uhi**	#f fk kr **ru uh hi i#**

- each diphone could be influenced by the labialization of both left and right neighbouring unit
- labialization context within speech synthesis:
- respected or violated
- partly (one side) or fully (both sides)

Labialization



violated labialization



respected labialization

Experiments

- running TTS-system without considering labialization
  - 5 000 utterances ~ 195 964 diphones

Context	Mismatched phone context	Mismatched labial context
left	23.9 %	4.3 %
right	23.8 %	4.1 %
both	5.6 %	---

Experiments

- 2 preference listening tests (pairwise comparison)
- for non-phoneticians
  - simplified setup - pairs with fully respected (both sides) and fully violated labialization only
  - participants: 19 phonetic laymen
  - 40 queries
- for phoneticians
  - complex setup – all possible combinations of fully and partly (one side) respected and violated labialization
  - participants: 8 students of phonetics
  - 112 queries

Experiments

- test for non-phoneticians
  - preference respected labial context 55.4 %
  - preference for violated labial context 19.5 %
  - no preference 25.1 %

- test for phoneticians
  - preference respected labial context 74.2 %
  - preference for violated labial context 10.6 %
  - no preference 15.2 %

  - other combinations of partly/fully respected/violated labialization – respected labialization always preferred (detailed results in article)

- consistency of rating
  - non-phoneticians 75,2 (+ 17,3) %
  - phoneticians 83.9 (+ 12.5) %

Conclusion

- importance of considering coarticulatory labialization was confirmed
- future work
  - more detailed study for particular phones in specific contexts
  - incorporating labialization feature into TTS system (modify target cost, specify new weighs in unit selection criterion...)
  - other coarticulation-related features of speech (e.g.nasalization)

Speech samples

Respected labialization

Violated labialization

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Thank you for your attention!