Creation of HMM-based Speech Model for Estonian Text-to-Speech Synthesis

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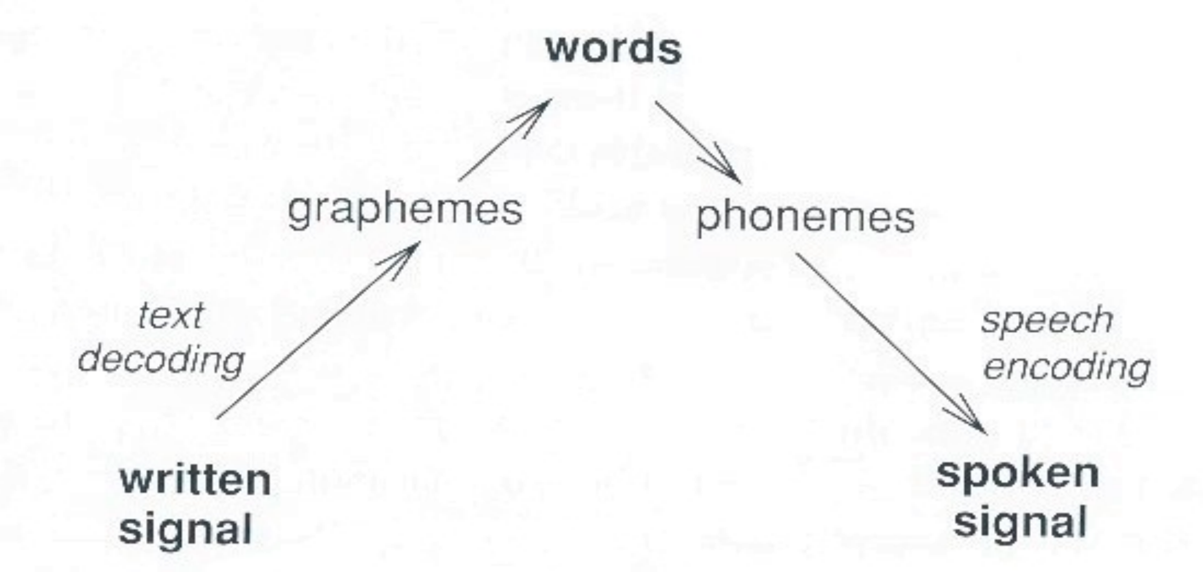
05.10.2012 @ HLT 2012

Speech Synthesis

- Analogue for human reading
- Input – text; output – speech waveform
- Overview of a typical speech synthesis system:



Linguistic Processing

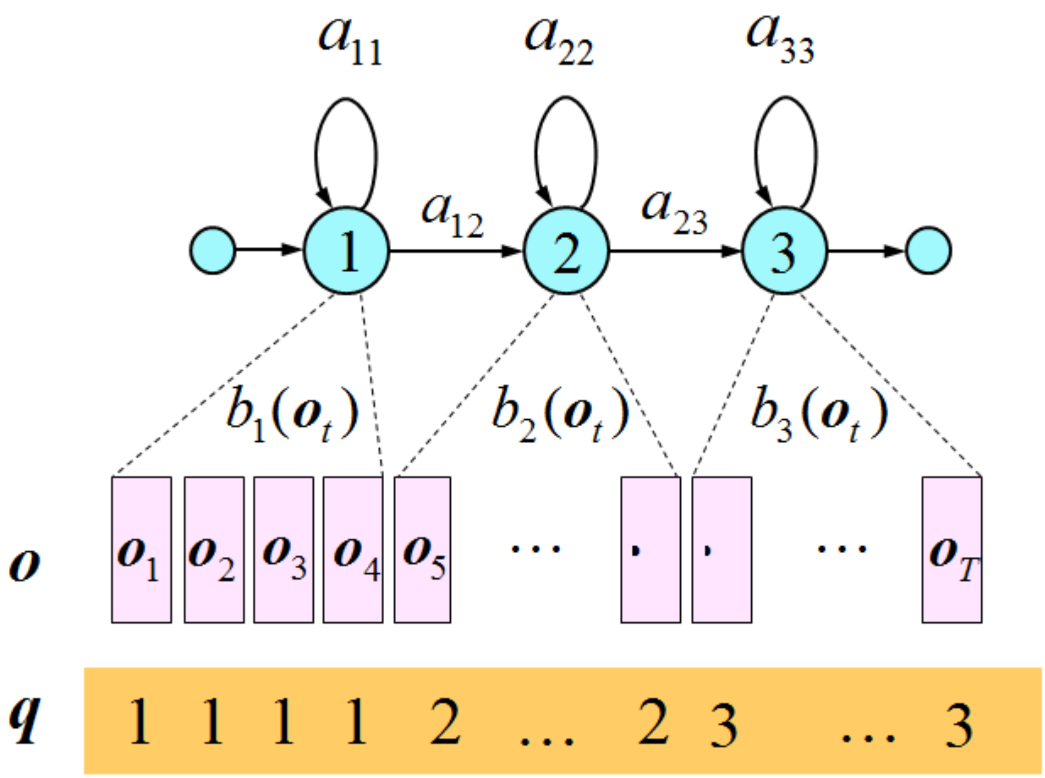
- Language specific
- Ortographic text converted into pronunciation text
- Linguistic context factors (phoneme, syllable, word, phrase, stress, accent, length etc)
- Vowel ‘e’ in ‘mees’ *(‘man’ in Estonian*)
  - preceding consonant ‘m’ (formant trajectories)
  - monosyllabic word (vowel duration and quantity)

Statistical Parametric Speech Synthesis (1/2)

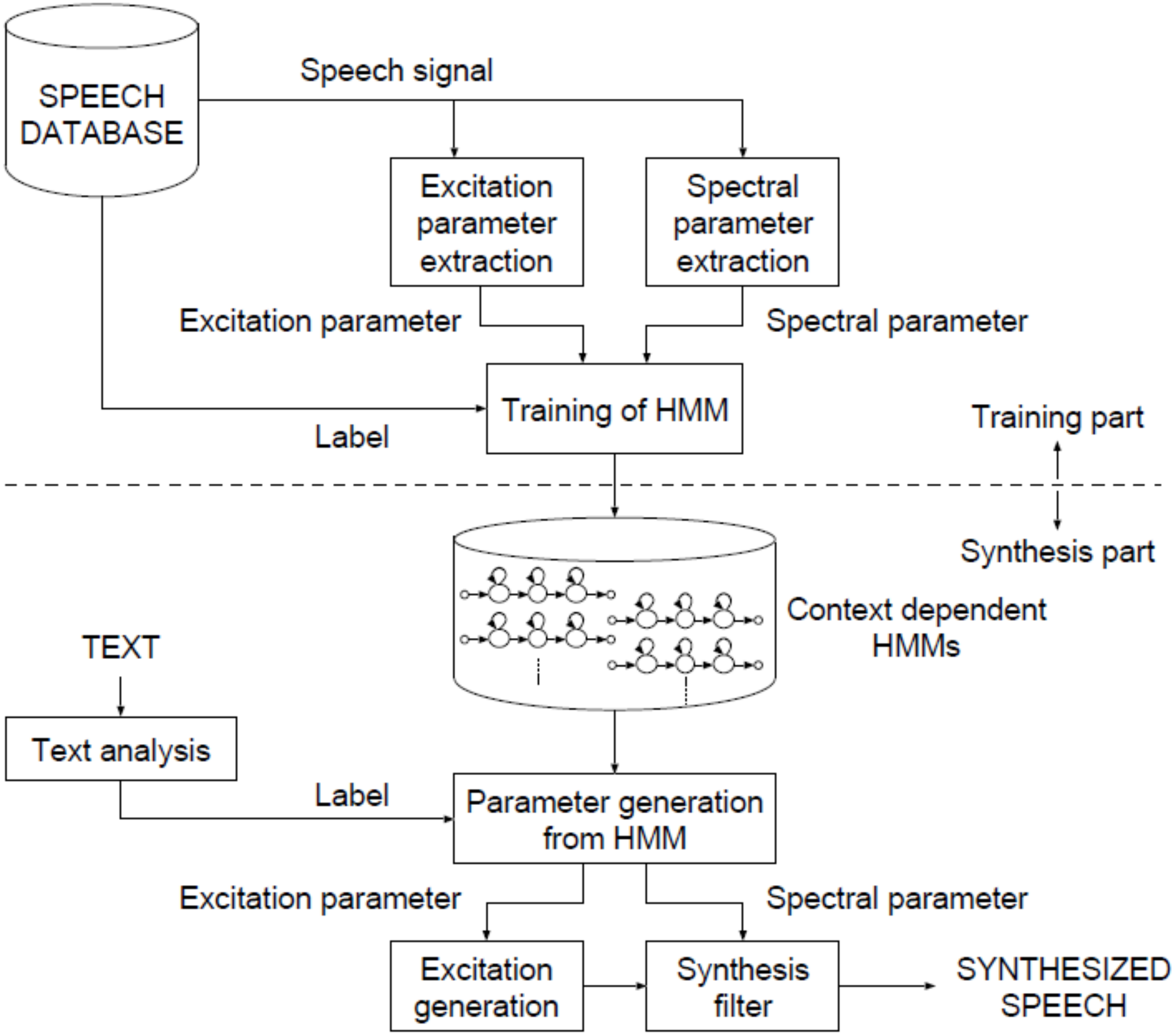
- Based on hidden Markov models
- Speech described using parameters, rather than stored examples
- Parameters described using statistics (e.g., means and variances of probability density functions)

Statistical Parametric Speech Synthesis (2/2)

- HMM of a speech segment:



Overview of System HTS



Properties of Statistical Parametric Speech Synthesis

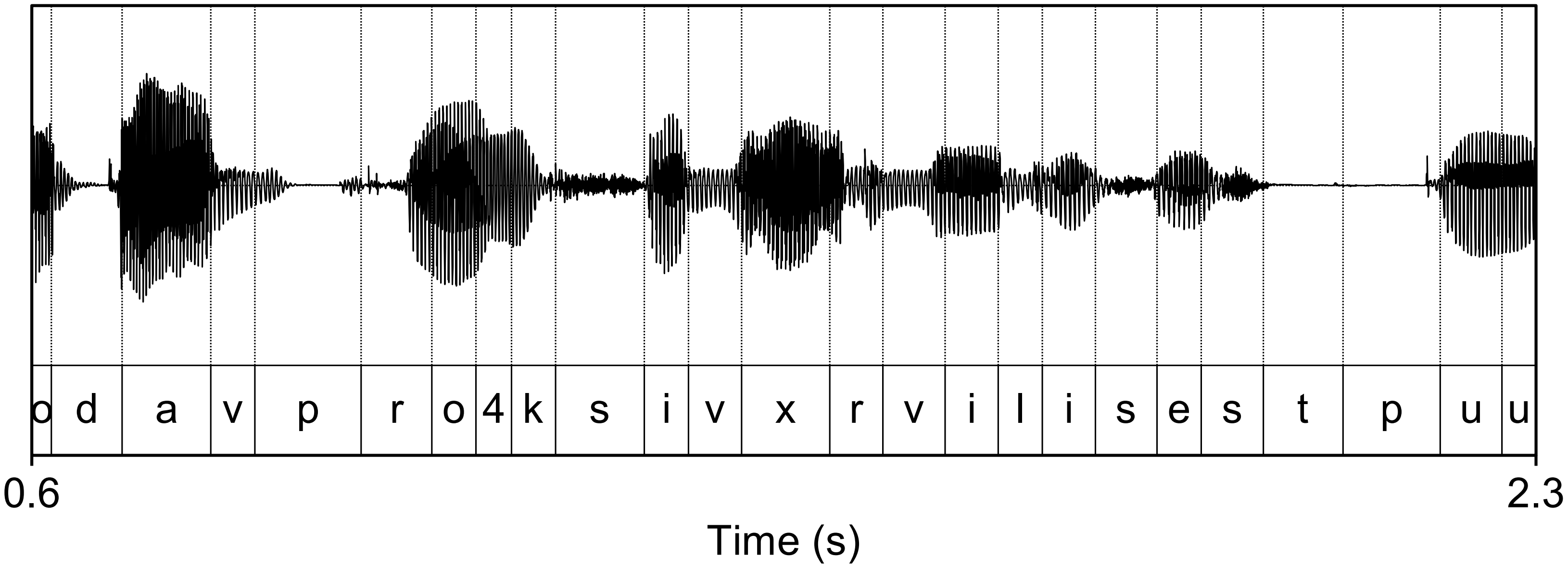
- Advantages
  - flexible (voice characteristics, speaking styles, emotions, speaker adaption)
  - robust against sparse data
  - small footprint, low computational resource need
- Drawbacks
  - low quality (vocoder, accuracy of acousting modelling, over-smooting)

Speech Corpus

- Necessary for training speech model
- Contextually labelled
- Phonetically rich and balanced
- Transcribed automatically
- Large amount of training data provides high-quality synthesized speech
- IEL’s Speech Corpus (ca 17 hours of speech from 5 speakers)

Linguistic Processing Unit

- Linguistic specification of the speech model must correspond to the capabilities of text analysis module.
- Text analysis modules developed under Festival



Creation of Speech Model

- Adapting HTS to Estonian
  - phonetic and phonological context factors (phoneme, syllable, word, phrase, stress, accent, length etc)
- Choosing training corpus
  - amount of data
  - phonetically balanced
- Test corpus
- Compatible with text analysis module

Evaluation of Speech Models

- Listening to synthesized test sentences
- Sentences of test corpus don’t contain in training corpus
- Different training corpora (from 100 to 2000 sentences)
- Different linguistic specifications (better results with smaller number of phonemes)

Quality of Synthesized Speech

- Intelligibility
- Pronunciation errors (mistakes by text analysis unit)
- Speech model quality is dependent on
  - high quality training corpus
  - text analysis unit
  - phonetic and phonological context factors

Examples

- Training corpus of 100 sentences – barely understandable
- Training corpus of 500 sentences – understandable
- „Harjumaa kolmeteistkümnes tulemus geograafias on kõva tase.“
  - Liisi_lyh_250
  - Liisi_lyh_487
  - Liisi_500
  - Liisi_2000
  - Liisi_lyh_2000
  - Tõnu

Conclusion

- Statistical parametric speech synthesis is effective in synthesizing acceptable speech.
- Relatively small corpus to train a model on
- Speech models adaptable
- Future prospects