Spectral Plane Investigation for Probabilistic Features for ASR

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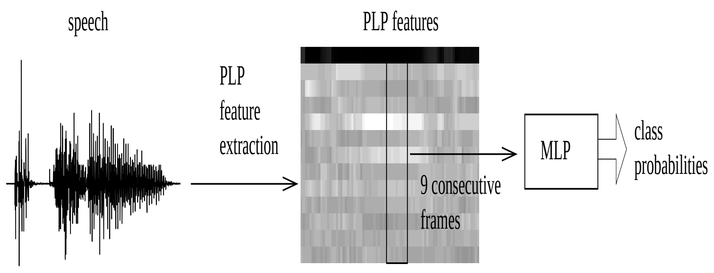
Abstract

This poster discusses effect of different frequency and time context of input critical band spectrogram block in two stage TRAP-TANDEM feature extraction. Best performance was observed when splitting input spectrogram into rather narrow frequency slices with long time context.

1 Probabilistic features

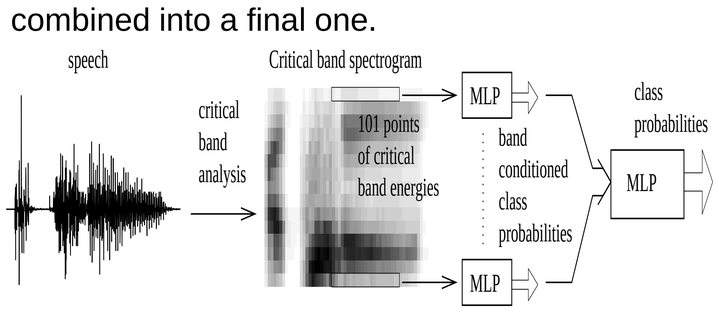
- Probabilistic features are class probabilities transformed to the form suitable for the GMM/HMM recognizer.
- Class probabilities are estimated by a nonlinear classifier – feed-forward multi layer perceptron (MLP).

TANDEM – estimates class probabilities from several consecutive frames of standard features.

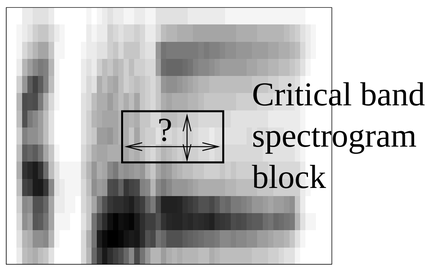


TRAP – estimates class probabilities from critical band spectrogram. This is two stage process:

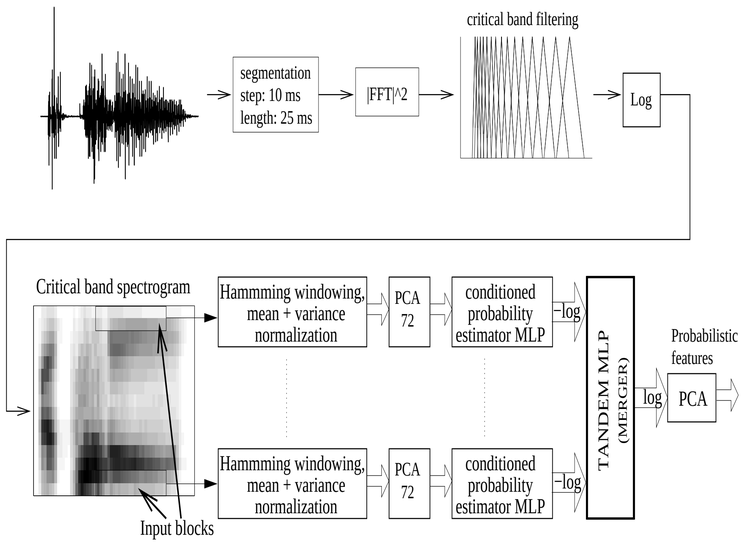
1. Class probabilities are estimated for each critical band.
2. Critical band conditioned class probabilities are combined into a final one.



- Optimal size of critical band spectrogram block for TRAP-TANDEM feature extraction – **?**



2 Computation of probabilistic features

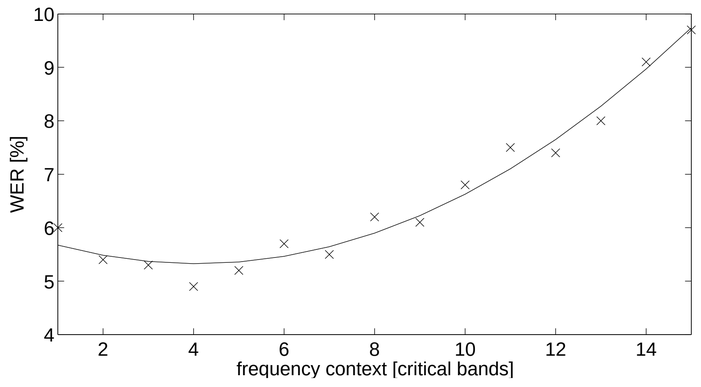


3 Experimental setup

- Recognition of eleven concatenated digits.
- Test on the testing part of OGI Numbers database.
- HTK based GMM-HMM recognition system.
- Context independent phoneme models used.
- HMMs are trained on a training part of OGI Numbers database
- A training part of OGI Numbers database was also used for training the merger probability estimator.
- A subset of OGI Stories database was used for training the band conditioned probability estimators.
- 29 phoneme targets (phonemes in numbers).

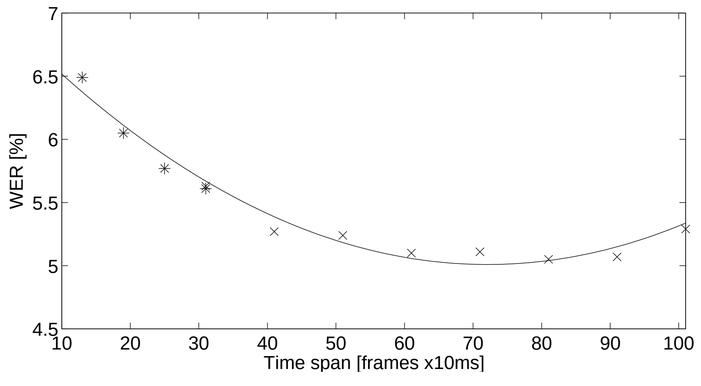
4 Changing frequency context

- Frequency context (K) vary from 1 to 15 bands
- Frequency shift between two neighboring critical band spectrogram blocks is 1 band.
- Number of band conditioned MLPs is $15 - K + 1$
- TRAP-TANDEM reduced to TANDEM when frequency context of critical band spectrogram block was 15 bands (no band conditioned estimators).
- Temporal context fixed at 101 frames.



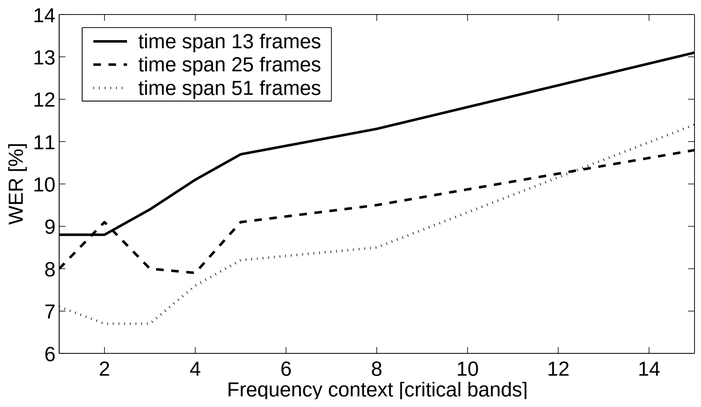
5 Changing time context

- Frequency context is fixed at 3 bands.
- Frequency shift between two neighboring critical band spectrogram blocks is 1 band.
- Temporal context 31 to 101 frames → PCA returns 72 elements.
- Temporal context 13 to 31 frames → PCA returns 36 elements.



6 Changing time and frequency context

- PCA was not used in probabilistic features computation.
- Critical band spectrogram blocks do not overlap.



7 Conclusion

- Word error rate has a wide and flat minimum for both time and frequency contexts.
- Best performance was observed when splitting the critical band spectrogram into blocks with narrow frequency context around 4 bands.
- Beneficial to use temporal context between 50 and 90 frames ($\sim 0.5 - 1$ second).

Acknowledgement

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References

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