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Paralinguistic Event Detection from Speech using Probabilistic Time Series Smoothing and Masking

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Introduction

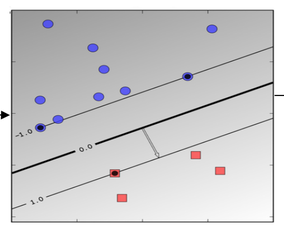
Frame-wise detection of laughters and fillers in telephonic speech

Database: SSPNet Vocalization Corpus
- 2763 audio clips
  - 1583 train, 500 dev, 680 test
  - Each clip 11 seconds long
  - Each clip has at least one vocal event (laughter or filer)

Detection System

- Baseline system

141 Frame – wise features (ex: MFCC+Δ+ΔΔ, F0+Δ+ΔΔ etc.) @ 100 frames/sec



Multi-class SVM Classifier

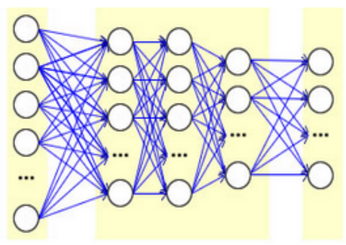
Frame level Decisions @ 100 Frames/sec

$P_1(E),P_2(E) \dots P_{1100}(E)$

E ϵ {Laughter, Filler}

- Applied system

141 Frame – wise features (ex: MFCC+Δ+ΔΔ, F0+Δ+ΔΔ etc.) @ 100 frames/sec



Deep Neural Network

$P_1(E),P_2(E) \dots P_{1100}(E)$

Smoothing

Masking

Frame level Decisions @ 100 Frames/sec

Deep Neural Network

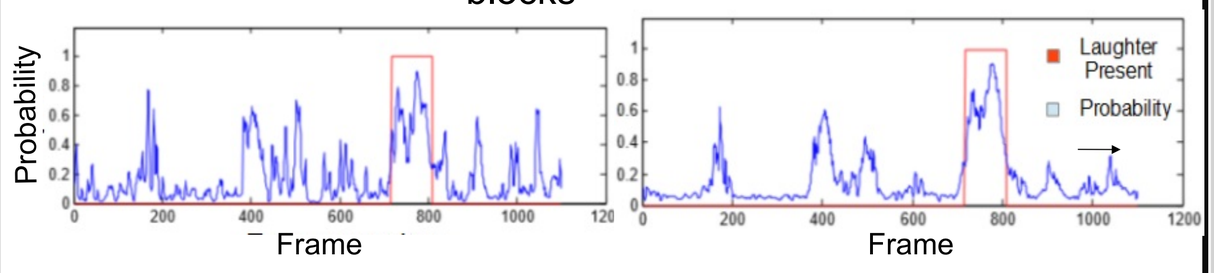
- Better Discriminative model
  - Not necessarily linear boundary as SVM
  - Recent emergence as a strong classifier scheme*

- 4 layers
  - (141 x 47 x 47 x 3) configuration
  - Sigmoidal Activation function

Smoothing

Smooth out time series temporally

$P_1(E),P_2(E) \dots P_{1100}(E)$ → Low Pass Filter H(z) → Delay / Advance blocks (Z^a_1, Z^a_2, Z^a_k) → Logistic Regression → Smoothed Probabilities

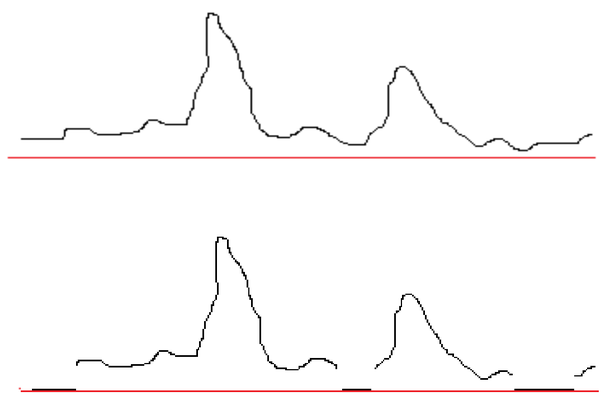


Before smoothing

After smoothing

Masking

Mask the time series to reduce false alarms based on
- Time series properties
- Entropy of output probabilities from an ASR system



- Attenuate probability around low probability Frames

- Increase probability around high probability frames

Results and Future work

System	AUC		UWAUC
	Laughter	Filler	
Baseline System	86.2%	89%	87.6
DNN	90.1%	90.1%	90.1%
Smoothing	94.6%	94.4%	94.5%
Masking	95.1%	94.7%	94.9%

Future work:

- Improve classification system Use better schemes to capture temporal context More features, better classification …
- Use the system For predicting higher level behavioral attributes Emotion Distress Engagement etc..

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