ASR performance prediction on unseen broadcast programs using convolutional neural networks

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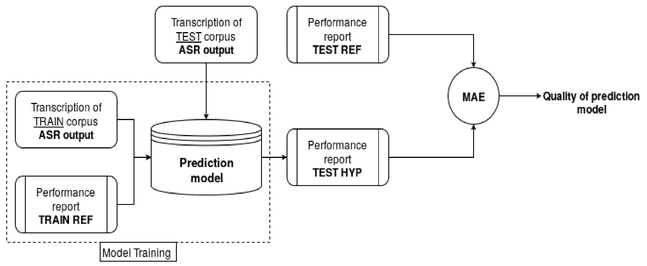
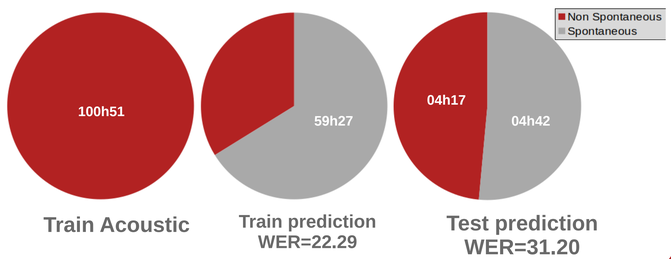
Abstract

- Propose an heterogenous French corpus dedicated to performance prediction task
- Compare two prediction approaches : regression **(engineered features)** based vs a new strategy based on convolutional neural networks **(learnt features)**.
- The joint use of textual and signal features did not work for the regression baseline while the combination of inputs for CNNs leads to the best WER prediction performance.
- CNN prediction predicts the WER distribution on a collection of speech recordings

Evaluation framework

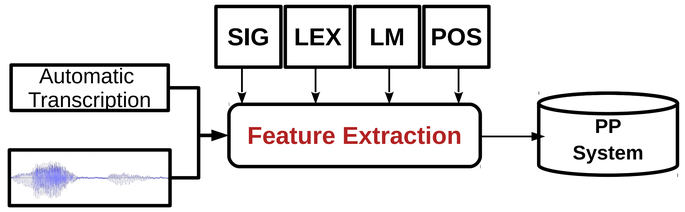


- We built our own French ASR system based on the KALDI toolkit
- We used a French data from different broadcast collections : ESTER, ETAPE, REPERE, Quaero



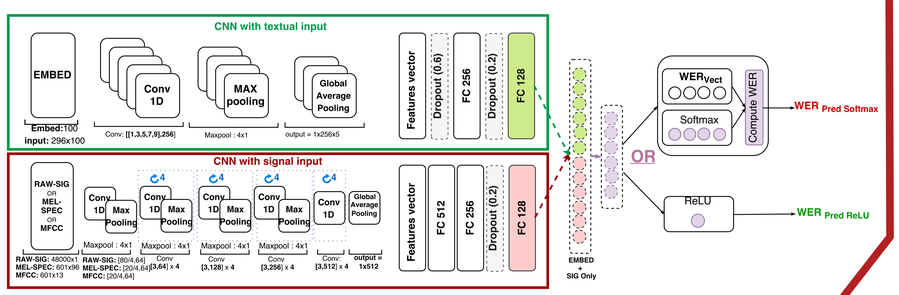
Regression Baseline

- We used an existing tool named TranscRater for baseline regression approach
- We adapted the TranscRater tool from English to French that requires **engineered features** to predict the WER performance



Our proposed approach

- We proposed a new End-to-End performance prediction system based on CNNs.
- Several approaches to encode speech signal
- **Input** : textual, speech signal or the both textual+ speech signal
- **Output** : two proposed methods to predict a continous value ($CNN_{Softmax}$ and CNN_{ReLU})



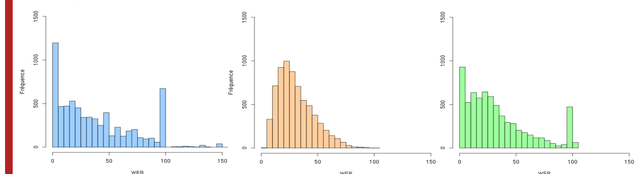
Results & Analysis

Model	Input	MAE	τ
Textual features			
Regression	POS+LEX+LM	22.01	**44.16**
$CNN_{Softmax}$	EMBED	**21.48**	38.91
CNN_{ReLU}	EMBED	22.30	38.13
Signal features			
Regression	SIG	25.86	23.36
$CNN_{Softmax}$	RAW-SIG	25.97	23.61
CNN_{ReLU}	RAW-SIG	26.90	21.26
$CNN_{Softmax}$	MEL-SPEC	29.11	19.76
CNN_{ReLU}	MEL-SPEC	26.07	24.29
$CNN_{Softmax}$	MFCC	**25.52**	**26.63**
CNN_{ReLU}	MFCC	26.17	25.41
Textual and Signal features			
Regression	POS+LEX+LM+SIG	21.99	45.82
$CNN_{Softmax}$	EMBED+RAW-SIG	**19.24**	**46.83**
CNN_{ReLU}	EMBED+RAW-SIG	20.56	45.01
$CNN_{Softmax}$	EMBED+MEL-SPEC	20.93	40.96
CNN_{ReLU}	EMBED+MEL-SPEC	20.93	44.38
$CNN_{Softmax}$	EMBED+MFCC	19.97	44.71
CNN_{ReLU}	EMBED+MFCC	20.32	45.52

- Analysis of predicted WERs

	NS	S	NS + S
WER_{REF}	21.47	38.83	31.20
WER_{Pred} Regression	**22.08**	28.72	25.82
WER_{Pred} $CNN_{Softmax}$	18.93	**33.99**	**27.37**
#Utterances	3,1k	3,7k	6,8k
$\#Words_{REF}$	49.8k	63.3k	113,1k

- Distribution of speech turns according to their WER



(a) real (b) $Regression_{Pred}$ (c) CNN_{Pred}

Conclusion

- We presented an evaluation framework for evaluating ASR performance prediction on unseen broadcast programs
- CNNs were very efficient encoding both textual (ASR transcript) and signal to predict WER.
- **Future work :** Analyze the learnt representations of our performance prediction system

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