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ASR Performance Prediction on Unseen Broadcast Programs using Convolutional Neural Networks

Zied Elloumi, Laurent Besacier, Olivier Galibert, Juliette Kahn, Benjamin Lecouteux

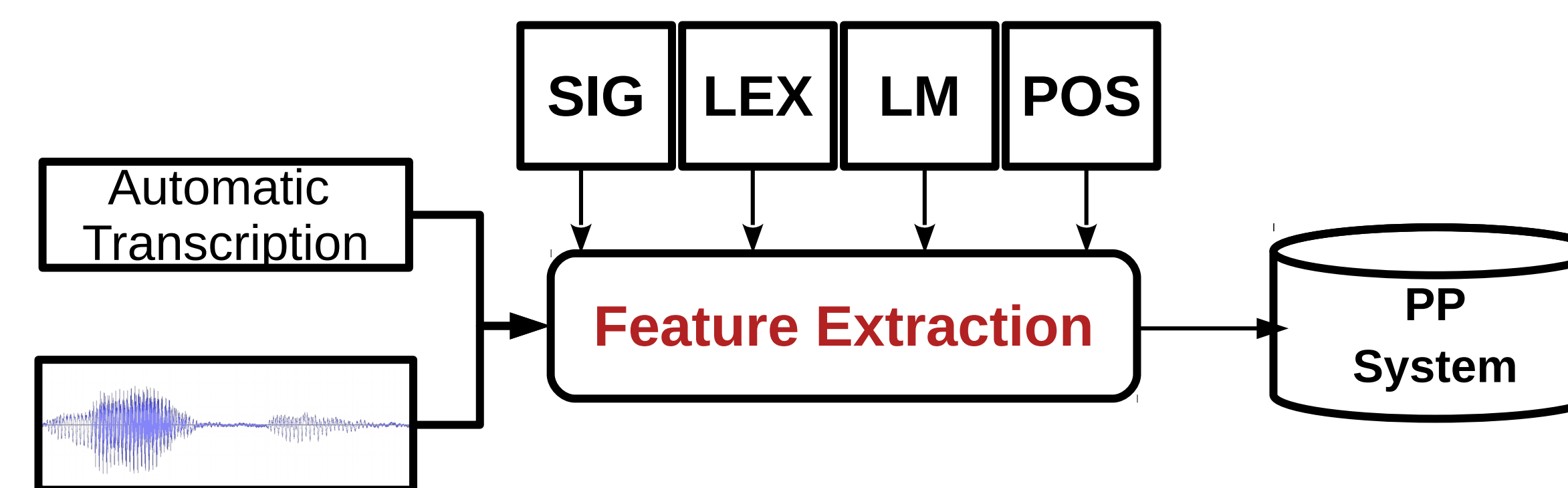


Abstract

- Propose an heterogeneous 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

Regression Baseline

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



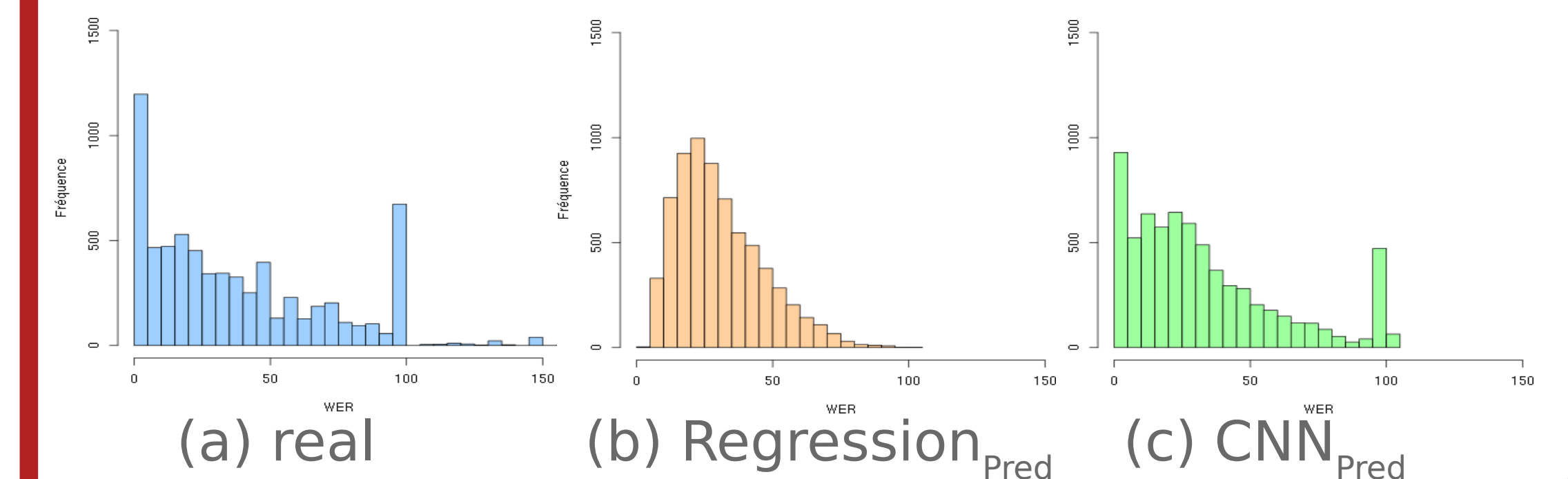
Results & Analysis

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

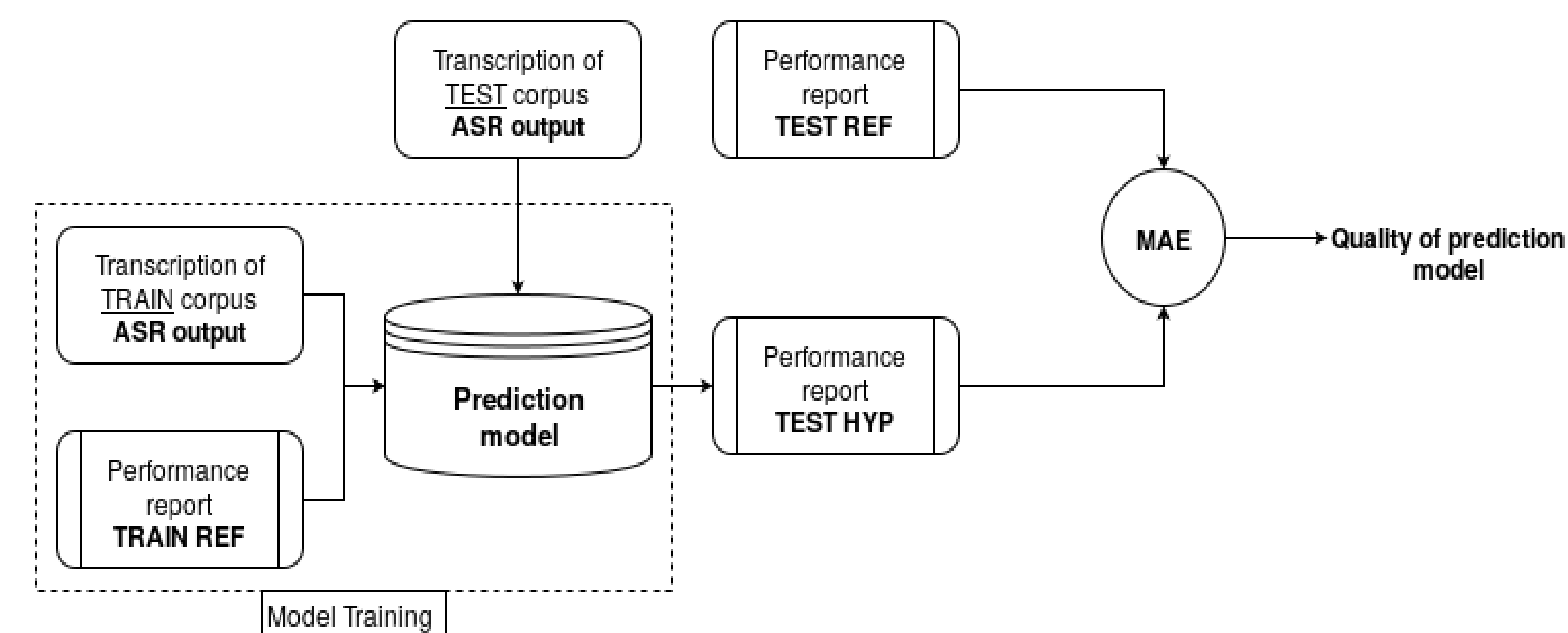
- Analysis of predicted WERs

	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

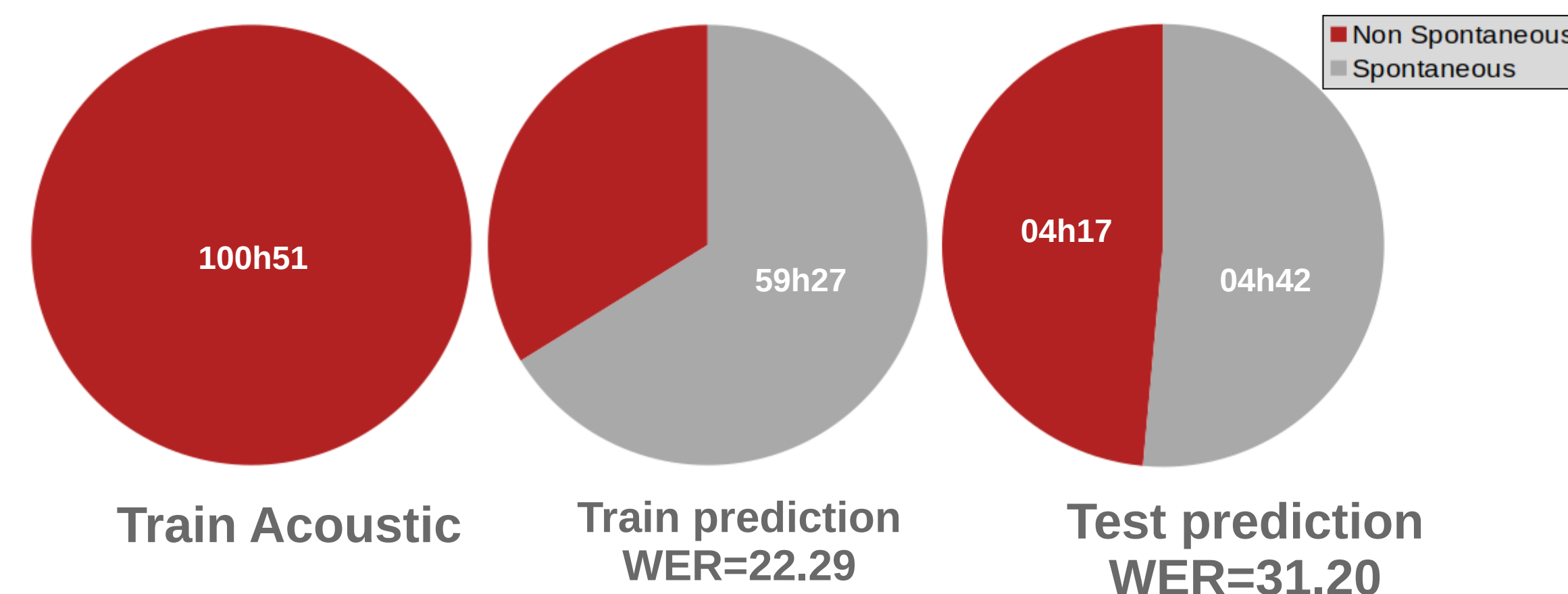
- Distribution of speech turns according to their WER



Evaluation framework

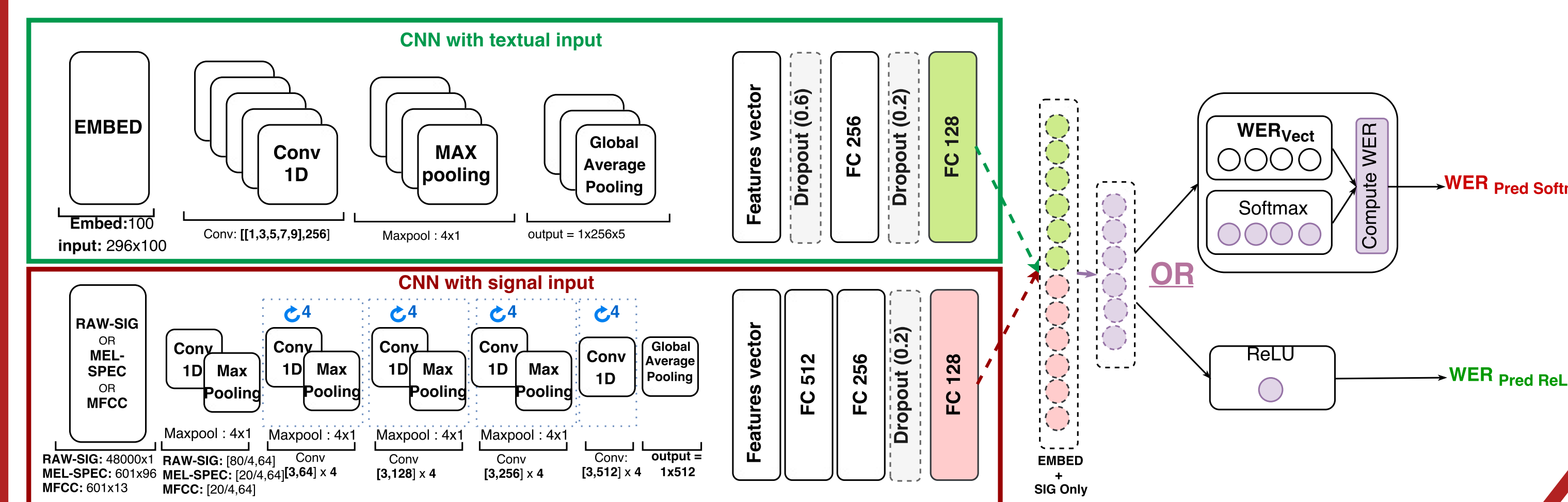


- We built our own French ASR system based on the KALDI toolkit
- We used a French data from different broadcast collections: ESTER, ETAPE, REPERE, Quaero



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 continuous value (CNN_{Softmax} and CNN_{ReLU})



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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