



## 1. INTRODUCTION

• **THE ACT OF SPEAKING:** It usually occurs at **noisy acoustical environments**

- ❖ **HUMAN BEING:** It has a high capacity of recognition in such ones
- ❖ **AUTOMATIC SPEECH RECOGNITION (ASR) SYSTEMS:** We need to adapt ASR systems to such conditions

• **SOME APPROACHES TO IMPROVE MATCHING:**

- ❖ Model adaptation
- ❖ Hidden Markov Model (HMM) decomposition
- ❖ Feature enhancement or feature compensation

• **OUR GOAL:** Improve the performance of an ASR system, trained with clean data, by feature enhancement

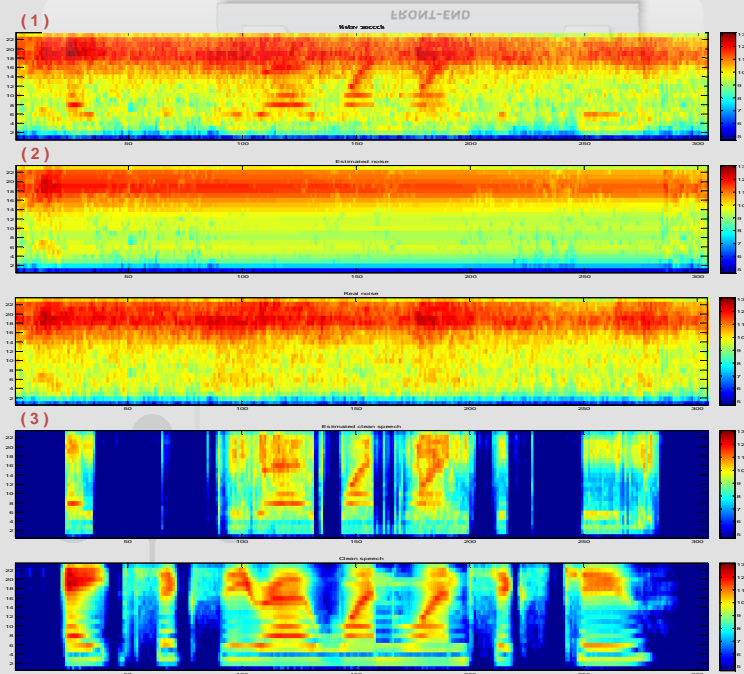
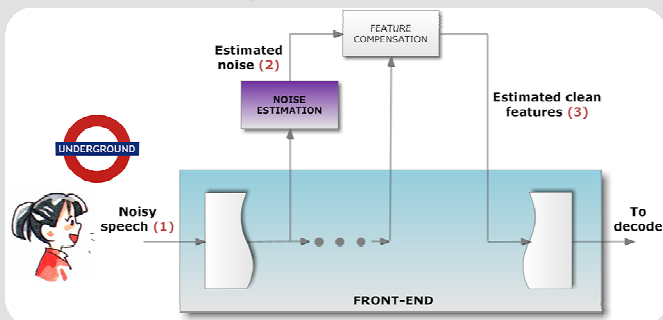
## 2. LINE OF WORK

• Some of feature enhancement algorithms need an estimation of the noise present in the noisy utterance

• **MAIN LINE:** Research and development of **new noise estimation algorithms** for feature enhancement

• **OBJECTIVE:** Overcome the state-of-the-art in this topic

### ❖ Framework and example

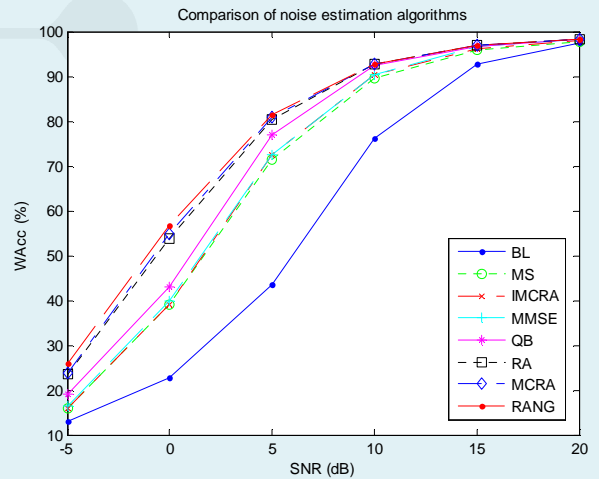


## 3. A COMPARISON OF SOME STATE-OF-THE-ART

• We evaluate some noise estimation algorithms on test sets A and B from Aurora-2 database:

- ❖ Minimum statistics, IMCRA, MMSE (Hendriks), quantile-based, recursive averaging, MCRA and Rangachari's algorithm

• The **noise estimates** are used in **zeroth-order Vector Taylor Series expansion (VTS-0)** in order to enhance noisy log-Mel features



Method / SNR (dB)	-5	0	5	10	15	20	clean	Avg. 0-20
Base-Line	12.94%	22.88%	43.44%	76.18%	92.85%	97.40%	99.10%	66.55%
Minimum Statistics	15.83%	39.00%	71.38%	89.63%	95.93%	97.84%	98.95%	78.76%
IMCRA	16.03%	38.97%	72.58%	90.32%	96.13%	97.90%	99.08%	79.18%
MMSE Hendriks	16.43%	39.84%	72.46%	90.47%	96.72%	98.22%	99.08%	79.54%
Quantile-Based (Pow.)	18.98%	43.14%	76.89%	92.41%	96.80%	98.31%	99.07%	81.51%
Rec. Av. (Mel)	23.43%	53.85%	80.50%	92.67%	97.05%	98.22%	99.08%	84.46%
MCRA (Mel)	23.89%	54.89%	80.80%	92.67%	96.86%	98.17%	99.03%	84.68%
Rangachari (Mel)	25.82%	56.77%	81.46%	92.73%	96.87%	98.24%	99.13%	85.21%

## 4. CONCLUSIONS

• Feature enhancement techniques, that try to estimate the clean features, increase the performance of an ASR system that is trained with clean data

• It is important to have an appropriate noise estimation in order to improve the performance of the used feature enhancement method

• The obtained results give us some cues to get deep in the research and development of new noise estimation algorithms that are based in those aspects that produce a good performance

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