MEASURING SPEECH PERCEPTION WITH RECOVERED ENVELOPE CUES USING THE PERIPHERAL AUDITORY MODEL

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1. INTRODUCTION

- **Issues:** Listening tests, which relies on subjective feedback under laboratory test conditions, can be expensive, time consuming, and may present inconsistencies with test/re-test reliability.
- **Issues:** Speech perception can be degraded at high levels for both normal & impaired listeners [2].
- **Auditory Nerve (AN) models** are useful to detect, analyze, and segregate dynamic acoustic stimuli in complex environments [1].
- **Spectral Envelope (ENV)** is sufficient for understanding speech in quiet whereas the **Temporal Fine Structure** (TFS) is necessary for speech segregation in noisy conditions [3].

2. METHODS

- **Predicting speech Intelligibility under different types of noises and distortions**
- **Comparing predicted scores with subjective scores and scores from existing metrics**

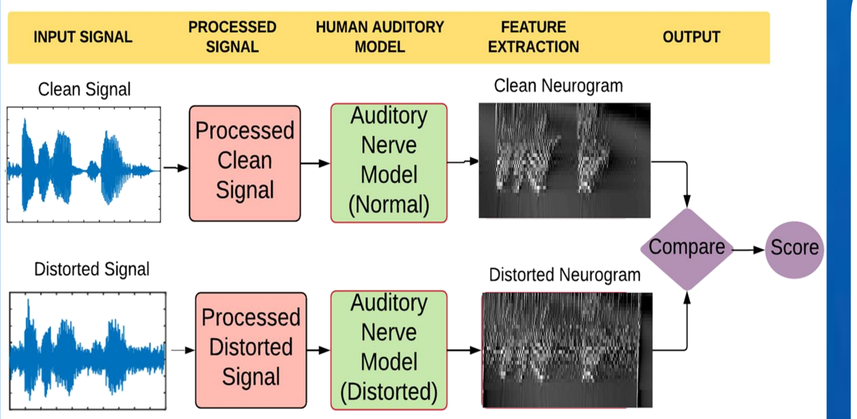


Fig.1. Basic block diagram of proposed method.

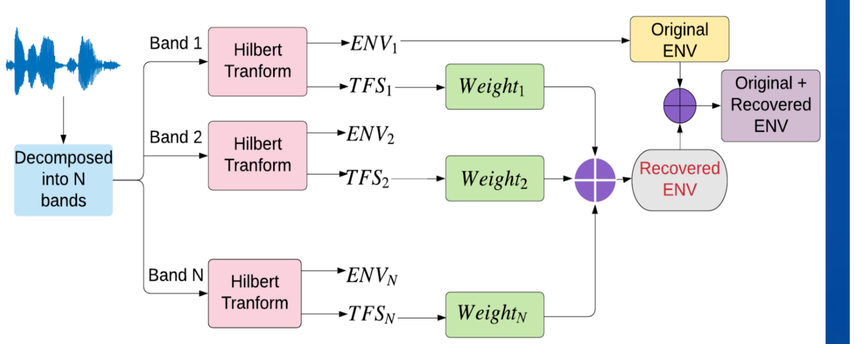


Fig. 2. Signal processing steps for generating original and recovered envelope.

3. METHODS

Test Corpora:

- Databases: IEEE sentences, NU#6 words.
- SNR: -20 to 30 dB; dB-SPL: 65~ 95 dB.
- Noise: Babble, Speech shape, Interrupted, Car.
- Distortions: Phase jitter, Peak clipping, Center Clipping.
- Subjective Data Studies: Dubno [4], Studebaker [5]

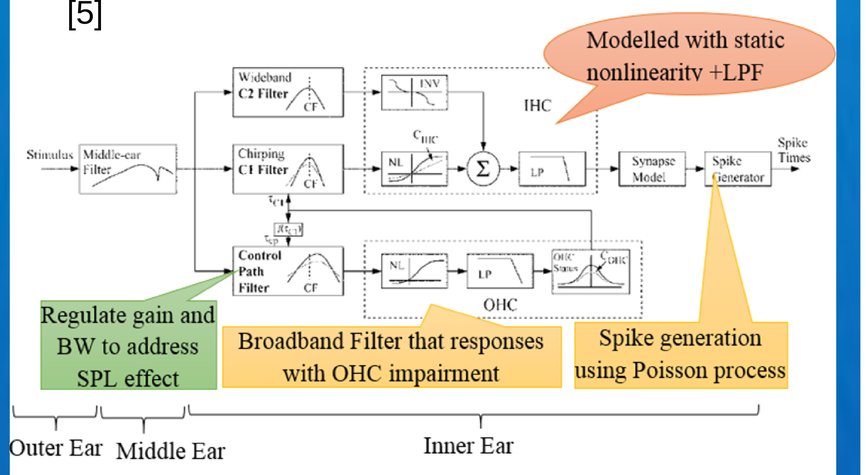
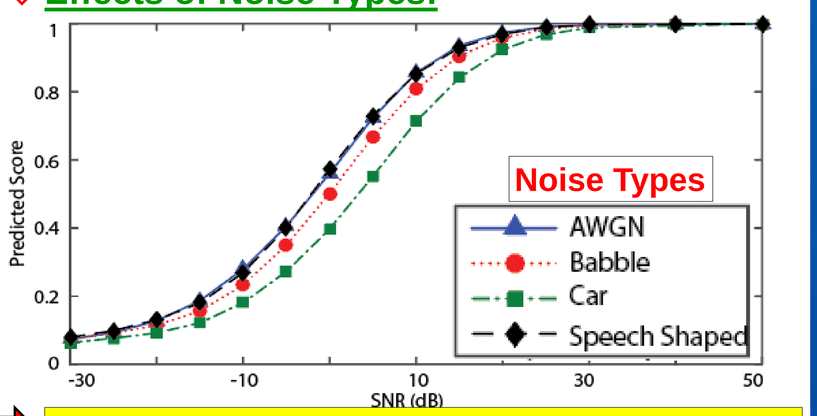


Fig. 3. Auditory Nerve Model (Zilany and Bruce et. al. 2006 [1])

4. RESULTS

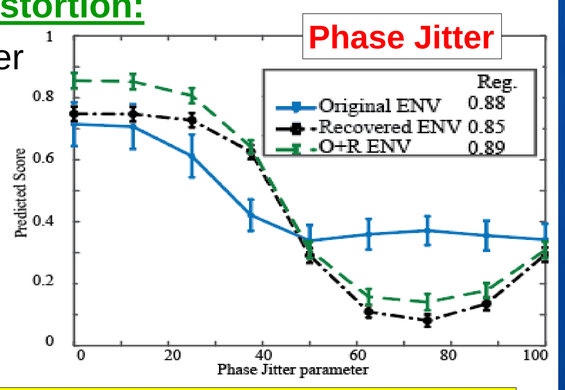
Effects of Noise Types:



Intelligibility Predicted Score increases as SNR increases.

Effects of Distortion:

1. Phase Jitter (PJ)
   - SNR: 5 dB
   - Corpus: 200 NU#6 words

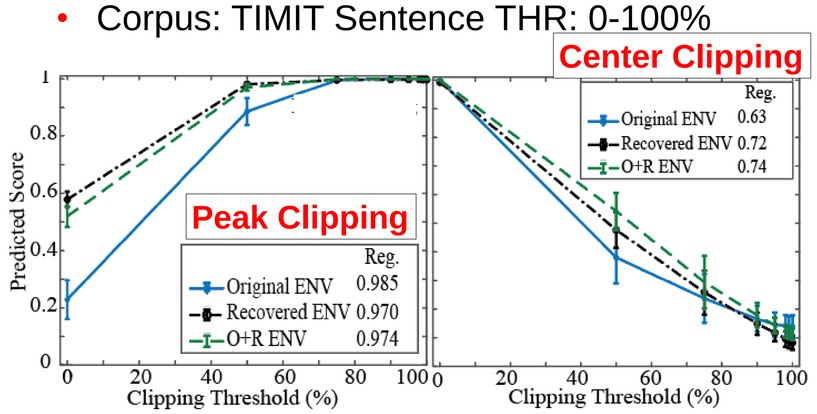


Regression Score shows Fusion of Recovered + Original Envelopes achieves highest accuracy.

5. RESULTS

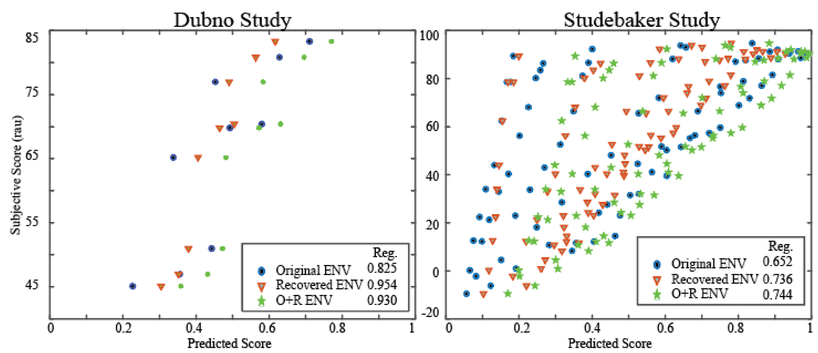
Effects of Distortion (cont.)

2. Peak & Center Clipping (C-C)
   - SNR: 5 dB
   - Corpus: TIMIT Sentence THR: 0-100%



Regression Score shows: Peak Clipping: Orig. ENV Better; Center Clipping: Fusion of Recovered + Original Envelopes best accuracy.

Subjective Study:



Final Correlation with Dubno data: Recovered ENV is best (0.95); with Studebaker data: Fusion of Recovered + Original ENV best (0.74)

6. CONCLUSIONS

- Proposed metric successfully predicts SP under noisy and distorted conditions
- Recovered ENV alone or with original ENV shows better correlation performance
- Comparison with existing metrics:

	P-J	P-C	C-C
Proposed	0.89	**0.98**	**0.74**
SRMR	0.84	0.97	0.64
SII	0.79	0.97	0.43
STOI	**0.96**	0.96	-0.30

REFERENCES

1) M.S. Zilany; I.C. Bruce (**2006**). *Journal of the Acoustical Society of America* **120**, 1446.
2) N. Mamun; W. Jassim; M.S. Zilany, (**2015**) *IEEE/ACM Transactions on Audio, Speech and Language Processing* **23**, 760.
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