A study by Goupell and Hartmann (2007) measured incoherence detection for 100 reproducible narrowband noise-pairs within the context of the cross-correlation (CC). It was found that the detection of incoherence (0.99 vs. 1) varied greatly for individual noise-pairs, implying that the value of CC was not adequate to describe the results. Subsequent modeling showed that a model that used the time-varying interaural phase difference (IPD) and interaural level difference (ILD) could describe the data much better. However, so could a more sophisticated CC model that included physiologically-relevant stages of signal processing.

This work aims to further explore the use of interaural phase and ILD in describing incoherence detection for reproducible noise-pairs, and improve upon the methods of Goupell and Hartmann (2007).

**INTRODUCTION**

The normalized cross-correlation function including peripheral compression: a case of mistaken identity? Matthew J. Goupell Acoustics Research Institute, Vienna, Austria and University of Wisconsin-Madison, USA e-mail: goupell@waisman.wisc.edu

**MOTIVATING MODELING RESULT**

This modeling result shows that adding MAX amount of compression (p) to the envelope or voltagewise to the CC model will yield a noticeably good correlation described on the y-axis versus a model that uses ILDs and IPDs (dashed line).

The commonly accepted value of compression in p = 0.4. The inability of the modeling result to be a curve showing this value is due to a factor that helped produce a good description of the detection data. This factor was further investigated. Other processing stages were included in the CC model used in Goupell and Hartmann (2007). Specifically, they were critical interaural, half-wave rectification, and temporal weighting. It was found the components weighted to increase the amount of variance in the detection data described by the CC model were the same factor that produced the results observed in the study.

**METHODS, STIMULI, AND SETS**

**STATISTICAL RELATIONSHIPS**

**NORMALIZED CROSS-CORRELATION FUNCTION**

Normal cross-correlation function with envelope compression

\[
\rho(\Delta t) = \frac{1}{\sqrt{2\pi\sigma_1\sigma_2}} \int_{-\infty}^{\infty} \frac{1}{\sigma_1\sigma_2} \exp\left(-\frac{(x_1 - \mu_1)^2}{2\sigma_1^2} - \frac{(x_2 - \mu_2)^2}{2\sigma_2^2}\right) \, dx_1 \, dx_2
\]

**MODELS**

Model 1: ST - Sum of Interaural Differences

The standard deviation of the cross of the IPD and ILD is weighted by a factor, \( \alpha \), which was varied between 0 and 1.

Fluctuations of IPD and ILD are defined as

\[
\left(\Delta \phi_1^2 \right) = \left(\Delta \phi_2^2 \right) = 20 \log_{10} \left( \frac{1}{2} \left( \frac{1}{\pi} \right)^2 \right)
\]

Model 2: ST infinitely Sum of Interaural Differences with Psychological Transformations

This model includes two scale transformations that were found to be useful in modeling the data from Goupell and Hartmann (2007). The transformations of IPD and ILD are described by the equation, \( \alpha y = \frac{1}{\sqrt{2\pi\sigma_1\sigma_2}} \int_{-\infty}^{\infty} \frac{1}{\sigma_1\sigma_2} \exp\left(-\frac{(x_1 - \mu_1)^2}{2\sigma_1^2} - \frac{(x_2 - \mu_2)^2}{2\sigma_2^2}\right) \, dx_1 \, dx_2
\]

Model 3: CC - Normalized Cross-Correlation function

This model is similar to the CC function described in the way of the stimulus.

\[
\rho(\Delta t) = \exp\left(-\frac{(x_1 - \mu_1)^2}{2\sigma_1^2} - \frac{(x_2 - \mu_2)^2}{2\sigma_2^2}\right)
\]

Model 4: CCcomp - Normalized CC function with envelope compression

The Normalized Cross-correlation Function including Peripheral Compression: A Case of Mistaken Identity?

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**CONCLUSIONS**

For incoherent noise-pairs, the cross-correlation with compression (\( \rho(\Delta t) \)) was shown to be highly correlated (0.85) with the fluctuations in the IPD (\( \phi_1^2 \)) and IC (\( \phi_2^2 \)) for any target value of compression. Since these two statistics are closely related, one might easily mistake the ST-type and CC-type models for each other. (Note that adding peripheral compression to a CC model for noise stimuli may not be physiologically supported (Recio-Spinoso et al., 2007; see also Poster Q21: 835).)

**REFERENCES**
