Measure Tones in Noise using MATLAB

Robert Bosch Engineering and Business Solutions Private Limited
Tone-to-Noise Ratio

Agenda

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How do you define Noise?

**Noise** is a variety of sound. It means any unwanted sound. Sounds, particularly loud ones, that disturb people or make it difficult to hear wanted sounds, are noise

(Source: Wikipedia)

Noise can be defined as "disagreeable or undesired sound" or other disturbance. From the acoustics point of view, sound and noise constitute the same phenomenon of atmospheric pressure fluctuations about the mean atmospheric pressure; the differentiation is greatly subjective. What is sound to one person can very well be noise to somebody else

(Source: Dictionary)
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Noise – Data Sources & Statistics

<table>
<thead>
<tr>
<th>Industry</th>
<th>Workers Exposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>323000</td>
</tr>
<tr>
<td>Mining</td>
<td>400000</td>
</tr>
<tr>
<td>Construction</td>
<td>513000</td>
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<tr>
<td>Manufacturing and Utilities</td>
<td>5124000</td>
</tr>
<tr>
<td>Transportation</td>
<td>1934000</td>
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<tr>
<td>Military</td>
<td>976000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9270000</strong></td>
</tr>
</tbody>
</table>

Industrial Machinery & Processes

Workers Exposed to daily Noise > 85 dB(A)
Why TNR?

Some components across various domains usually generate annoying noise.

Even though if the sound level is not high, it causes discomfort since the noise is constituted by many pure tones.

Need of Data analytics to assess the existence or presence of pure tones.

Problem Statement

Cost Effective Solutions??

Engineering Solutions??

Customizations??

Pain Areas
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About ECMA-74

ECMA-74 specifies methods for the measurement of airborne noise emitted by information technology and telecommunications equipment.

ECMA-74 Standard simplifies many comparisons and is the basis for declaration of the noise emission level of information technology and telecommunications equipment.

ECMA-74 Standard describes two procedures for determining whether or not noise emissions contain prominent discrete tones: the tone-to-noise ratio method and the prominence ratio method.

Tone-to-Noise Ratio

Approach

Concept -> Data Analytics -> Evaluation
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Workflow

FFT analysis [Configurable Parameters]

Calculate Discrete Tone Level

Determination of Tone-to-noise ratio

Determination of Masking noise level
Tone-to-Noise Ratio

Software Demo
Tone-to-Noise Ratio

Results

Time Data

Results: Visuals
Tone-to-Noise Ratio

Results

TNR : Single Tone

TNR : Multiple Tones
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Tone to Noise- Infrastructure

- MATLAB R2015b
- Signal Processing Toolbox
- MATLAB Compiler
- Statistics & Machine Learning Toolbox
- Database Toolbox
### Benefits

- One platform to perform Data Preprocessing & post processing
- Easy to identify & configure threshold parameters as per ECMA standard.
- Performance improvement in the validation of the components
- Results suggest that background noise level has an effect on perceptions of annoyance
- Reduces tool development effort & Time
Future Scope of Work

- One Platform for determining whether or not noise emissions contain prominent discrete tones
- Flexibility to read raw measurement data from multiple file formats
- Interfacing with database & managing data
- One Common layer for Visualization & Analysis Data
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