

Effect of Timbre on Detection and Speech Comprehension in Auditory Alarms

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Our team has found in a previous studies (Foley et al., 2022) that tones w

amplitude envelope are more detectable and less annoying than standard We use the triangle instrument as a temporally varied, and harmonically

Does a temporally and harmonically complex tone improve alarm efficier

Purpose

that would increase alarm efficiency



Fig. 1 (Folev et al., 2022)



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Figure 1. A 3D representation of a flat tone, x axis is Time (in seconds), y axis is intensity, z axis is each harmonic component. The flat tone (left) and have 100% harmonic fundamental component over time, and 50% harmonics in components 2 to 5.

Methods



1.0 1.5 Time (s)

b) Triangle Full

Coordinated Response Measure (CRM)







Figures a) and b) are spectrograms of each auditory stimuli with frequency in the y axis, and time (in seconds) in the x axis and the relative amplitude is shown farthest right. Underneath it shows the waveform (y = relative amplitude, x = time in seconds). a) represent the Standard Flat tone with the fundamental at 261 Hz and four additional harmonics. Stimuli b) represents the synthesized triangle tone. Figure c) represents the CRM paradigm for experiment 1 (measuring detection and speech comprehension), where the tone present in the experiment was the triangle tone, flat tone, or silence. Figure d) represents the perceived annoyance task as a two alternative forced choice task, comparing both the flat and triangle tones together.





Signal-to-Noise Ratio (dB)

Silence

ifidence interval



ot Mean Squared (RMS) npared to standard flat tones. Plot f) top right, represents performance at the CRM task m, measures perceived annoyance of Triangle Full compared to standard flat tones.

nce -27dB -24dB -21dB -18dB

Conclusions

- · Triangle tone has high stable detection in all conditions compared to flat tones.
- Triangle tone, was perceived as marginally more annoying compared to the standard flat tone.
- · Implicating that temporally varied harmonically complex tones could provide a greater balance of annoyance and detection.
- · However, this detection stability negatively affects speech comprehension.

Acknowledgements & Selected References

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