PennState College of Engineering | GRADUATE PROGRAM IN ACOUSTICS

The Graduate Program in Acoustics

announces the

Ph.D. Dissertation Defense

of

Edward Zechmann

Thursday, October 25th

9:30 AM

203 Applied Science Building

CHARACTERIZATION OF NOISE WITH FRACTIONAL-OCTAVE-BAND FILTERS AND THE VARIANCE AND KURTOSIS OF THE SOUND PRESSURE

ABSTRACT

Approximately 22 million workers in the United States have been exposed to hazardous occupational noise within the previous year. Current noise exposure metrics are not adequate for impulsive noise. For the same A-weighted sound pressure level, noise with a higher kurosis value has a greater risk of causing hearing impairment. A signal processing methodology which completely characterizes the sound pressure time waveform at a worker's ear is needed. The signal processing methodology needs to produce a set of predictors which can be used to a model hearing loss. This dissertation describes the effects which substantially influence hearing loss caused by hair cell death resulting from metabolic damage to the hair cells. One method of modeling the effects influencing hearing loss uses probability models with a theoretical foundation of stochastic process theory. This dissertation describes the theoretical foundations for a stochastic process model with the aim of satisfying all of the underlying assumptions. This dissertation proposes a signal processing methodology which simultaneously considers both time and frequency dependency in a systemic way optimized for how humans perceive sound. In the proposed time-frequency analysis, the same number of wave periods, and the same number of samples. The sound pressure distribution in each frame is characterized by the method of moments. The number of samples for each time-frequency is based on simulations with five types of sound sources with several sample sizes. The number of samples was chosen so that the P-values and Power values are approximately equal to 1. The proposed signal processing method with fifth order one-third-octabeband Butterworth filters was tested on simulations, and noise exposure recordings from data sets of chinchillas and from data sets of workers in China. The results show that the mean, variance, skewness, and kurtosis are sufficient statistics to describe the first ten moments. The sound pressure level and kurtosis level are generally adequate to describe sound pressure distributions for peak sound pressure levels less than 130 dB.

Advisor: Dr. Dan Russell & Dr. Ingrid Blood