This paper has been accepted for presentation at 2010 American Academy of Audiology April 14-17, San Diego, CA USA

Noise Measuring Audiometers: An Innovative Technology in Audiometric Evaluations

Tao Jiang, MicroDSP Hearing & Speech Lab; **Qinxiu Zhang**, Chengdu TMC University; **Jian Peng**, MicroDSP Hearing & Speech Lab; **Yu Xiao**, MicroDSP Hearing & Speech Lab; **Yining Jiang**, MicroDSP Hearing & Speech Lab

Abstract:
This study intends to evaluate an innovative approach to monitoring ambient noise levels while conducting audiometric testing. Traditionally, testing and noise surveillance are separated both physically and temporarily despite that threshold measures are susceptible to even a small amount of unwanted sound. A new digital audiometer with a built-in SLM can identify any ongoing noises and then alert audiologists for instant threshold adjustment. The results and methods of this evaluation will be shared in detail.

Summary:

The accuracy of audiometric testing depends upon many factors; among all, three are most critical: the cooperation of patients, the calibration of audiometers and the control of ambient noise. Patients can be trained by experienced audiologists while the last two factors are vigorously regulated by specific standards for the reliability and control of equipment. Although existing audiometers are unlikely to malfunction, if well maintained, the real problem is the influence of background noise upon thresholds, especially in situations where sound rooms are either not available, such as at school or factory, or not good enough. Therefore, there is a need to design an audiometer that should be electroacoustically and pyschoacoustically responsive to intruding noise.

The authors carefully examine a PC based audiometer that meets the requirements for Type I clinical audiometers. MDSP ZD-71 audiometer can perform standard and extended frequency audiometry with resolutions up to 1 Hz. For speech testing, it is preloaded with word lists for

both SRT and WD. However, what is unique about the audiometer is the built-in sound level meter, MDSP NM-60. This is a Type 3 SLM with a 1/2” pressure microphone aligned at 0°front. It has frequencies from 20 to 8K Hz and 60 dB dynamic ranges up to 105 dB SPL. Two time constant modes are available: 25 ms in the fast mode and 1000 ms in the slow mode, thus able to capture both continuous noises and fluctuating noise like speech. The SLM of the audiometer has two weightings, A and C scales and a linear scale.

Unlike traditional SLMs, the noise data captured is processed by the microchip of ZD-71 audiometer with special consideration of output of sound levels at each frequency. Therefore, any excessive noises can be electroacoustically adjusted by the audiometer according to calibration values. This in situ response can either reduce or increase SPL associated with each frequency specified by ANSI S 3.6 standards. In cases where noise levels are too high for electroacoustic adjustments, psychoacoustic responses are needed. The audiometer generates a calibration value chart for the specific noisy background, allowing the audiologist to manually add the values to thresholds obtained. In a preliminary study, puretone thresholds of ten normal hearing subjects were obtained by MDSP ZD-71 audiometer in quiet and noise. The comparison of the thresholds obtained in both environments reveals average differences of 7 dB, indicating the audiometer with built-in SLM can maintain the relative accuracy of testing after proper adjustments as soon as it has identified unacceptable ambient noise. Another positive response is that the live noise demonstration in the screen of the audiometer can immediately alert the audiologists for proper control. For example, while voices from nearby people are common, the immediate reduction of speech levels in the audiometer can be seen once they stop talking. Therefore, ZD-71 audiometer can also be a good counseling tool. Of course, the value of this innovative technology can make hearing testing more accessible at any time in any places even without sound treated rooms.