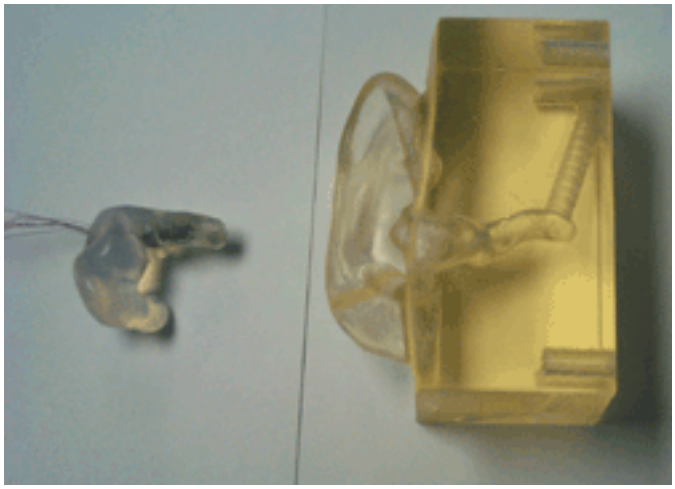
Development of Hearing Protection for High-Noise Environments

Problem: The AFRL (Air Force Research Laboratories) was seeking hearing protection improvements for use in high-noise environments. While protection of hearing is essential, communication is also essential to safety. Engineers developing improved hearing protection had to take both objectives into consideration.



Model of Ear and Custom Earpiece

SDL was recently awarded a Phase II SBIR contract by the AFRL to develop improved hearing protection equipment with integral communication for high-noise military environments such as flight lines and aircraft carrier flight decks. This innovative study accounts for both the acoustic and bone conduction pathway contributions to cochlear response, and evaluates the feasibility of actively attenuating the cochlear response attributable to both mechanisms.

Deep insertion, communication earplugs (Attenuating Custom Communication Earplug - ACCES) combined with earmuffs are the current, state-of-the-art equipment. Through a separate Program Research and Development Announcement (NR:01-01-HE, "Active Noise Reduction Earplug System") the Air Force solicited approaches to add active noise reduction capability to the ACCES earplugs to improve the low frequency noise reduction. Regardless of the reduction in acoustic pressure that can be achieved near the eardrum by any means, the factor limiting the reduction in perceived loudness (cochlear response) is bone conduction of acoustic energy directly to the cochlea.

Solution:
SDL has developed custom deep-insert earpieces that include instrumentation for active noise cancellation of both the acoustic and bone-conducted pathways. These earpieces are being used as part of the ongoing research into the broadband cancellation of noise and into bone conduction of sound. High noise environments such as those on military flight lines present interesting challenges in the area of hardware and algorithm design. Currently, SDL is testing ANC schemes in simulation and on two acoustic testbeds, such as the one pictured above, in preparation for tests on a human subject at full noise level. In addition, SDL is designing a belt mounted unit that contains the data acquisition as well as the digital signal processing needed to run the mathematical canceling algorithm.

To learn more, visit our tutorial at:
http://www.sdltd.com/_tutorials/noise_cancellation.htm

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