Avenues for improvement in hearing aids

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Despite the advances in signal processing in hearing aids over the past 20-30 years, hearing aids are still far from restoring “normal” hearing. This partly reflects limitations of impaired auditory systems, such as reduced frequency selectivity and reduced sensitivity to temporal fine structure, but also reflects limitations in the hearing aids themselves. Some very basic limitations are:
(1) The gains achieved on real ears are often substantially different from those programmed into the manufacturer’s software, even when averaged over many test ears. In other words, something is systematically wrong in the calibration of the fitting systems. A very common problem is a failure to meet target gains for frequencies above about 3 kHz.
(2) The compression ratios obtained on real ears are often substantially different from (usually below) those programmed into the manufacturer’s software. As a result, soft sounds remain inaudible and strong sounds are too loud.
(3) Despite claims of wide bandwidth, most hearing aids are unable to meet the fitting targets of methods like NAL-NL2 or CAM2 for frequencies above about 4 kHz.
(4) The output of many hearing aids often falls off markedly for frequencies below a few hundred Hz. This does not create severe problems when listening to speech, but produces severe degradations of sound quality for music.
More subtle problems arise as side effects of the signal processing in hearing aids. Processing such as multi-channel amplitude compression, noise reduction, and adaptive directionality changes the amplitude modulation patterns of the signal and this can have adverse effects on speech intelligibility and sound quality. For listening to music, many hearing-impaired people prefer a linear amplifier with high-quality headphones to their hearing aids. There is increasing evidence that the intelligibility of speech in background sounds is strongly affected by the amplitude fluctuations in the background sounds, even for “steady” noise. Improved models for predicting the intelligibility of speech in fluctuating background sounds are needed to assess the deleterious effects of the processing in hearing aids, and to select parameters of the processing that minimise these deleterious effects.
Much work is being conducted to develop “cognitively controlled” hearing aids, that selectively enhance the voice of the talker who the listener wishes to hear. The prospects for such devices will be discussed.