IEC fitting: New framework of hearing aid fitting based on computational intelligence technology and user's preference for hearing

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IEC fitting: New framework of hearing aid fitting based on computational intelligence technology, a user's preference for hearing

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We propose an interactive evolutionary computation (EC)-based hearing aid fitting method. Our proposed method optimizes hearing aid parameters using any sounds in our daily life according to how hearing aid users hear, which is completely different from conventional fitting methods.

The biggest and essential problem lays in conventional fitting methods is that an engineer or doctor who cannot perceive the hearing of a hearing impaired person must adjust a hearing aid with the clues from

measured partial auditory characteristics. The second problem is that the conventional fitting is based on auditory characteristic measurement using pure tones or band pass noise. It is hard to believe that the best fitting using non-daily life sounds becomes the best for normal sound in our life; for example, it is easy to imagine that the uncomfortable sound pressure level of noise must be lower than that of music or speech. The third problem is that the conventional fitting based on pre-measured auditory characteristics cannot reflect users' preference that comes from a upper psychological layer than perception into the fitting.

Our proposed IEC Fitting fundamentally solves these problems. Since users cannot adjust their hearing aids in general but evaluate the processed sound, we combine user capability for evaluation and an optimization method for adjusting hearing aids. Most of optimization methods require gradient information of a searching landscape, but a psychological evaluation space, such as hearing landscape, cannot be differentiated. We adopt EC inspired by biological evolution as one of optimization methods requesting no gradient information. The IEC Fitting is an interactive EC system for hearing aid fitting that combines the EC search in a parameter space of a hearing aid and human evaluation based on his/her hearing preference.

Conventional loudness compensation based on a loudness function and new hearing aid filter with the IEC Fitting are compared. The input-output characteristics of our developed filter is formed by combining seven 3-D Gaussian functions, and the IEC Fitting adjusts the shape parameters of the Gaussian functions. In our experimental evaluation with three hearing impaired persons using clean speech, speech with multi-talker noise, and several music, the IEC Fitting was superior to the conventional loudness compensation on VCV syllable articulation test, preference test for speech sound quality with sign test, and preference test for music sound quality with sign test. We are now applying this method to the fitting for commercial hearing aids with several number of hearing impaired persons.