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Coding of Electrical Stimulation Patterns for Binaural Signal Processing in Cochlear Implants

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ABSTRACT

Binaural sound coding strategies can improve speech intelligibility for cochlear implant (CI) users. Bilateral cochlear implant (BiCI) users do not benefit as much as NH listeners from binaural hearing. We hypothesize that these limitations arise from the fact that implants do not provide the electrical stimulus at the same time (i.e. synchronized electrical stimulation), but also, when using N-of-M type sound coding strategies, the selected bands used to stimulate in each of the sides will in general differ, limiting the access to binaural cues.

In the first part of this work, we investigate the effect of bilaterally synchronized electrical stimulation on BiCI users in speech perception tasks in a better-signal-to-noise-ratio ear (better-SNR ear) listening scenario [1]. We also propose a Binaural N-of-M (BINOM) sound coding strategy to improve the SNR of the masked ear. The effect of synchronous bilateral stimulation and BINOM is assessed by means of speech-in-noise intelligibility tests. Furthermore, the effect of adding a worse- SNR side is measured by also performing monaural speech in- noise intelligibility tests with each listening side. Finally, speech performance is assessed by selecting the bands that would be selected if no noise was present (ideal band selection). The outcome of this work shows that in a better-SNR binaural listening scenario, bilaterally synchronized stimulation besides the sharing of band selection information provided by the favorable hearing side with the contralateral ear leads to an improvement in speech intelligibility in BiCI users.

In the second part of this work we investigate an audio compression algorithm to transmit the signals from one processor to another as binaural sound coding strategies require a signal transmission between the two CIs [2]. As power consumption needs to be low in CIs, efficient coding of the signals is necessary. In this work it is proposed to code the excitation patterns (EP) of the CI instead of the audio signals captured by the microphones. For this purpose, a differential pulse code modulation codec with zero algorithmic delay to code the EP of the BINOM sound coding strategy is presented. The EP codec was compared to standardized speech codecs using the SNR as well as speech intelligibility and quality measures in bilateral CI users.

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