W22a: CCI-MOBILE PLATFORM FOR COMBINED ELECTRIC AND ACOUSTIC STIMULATION

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A large population of hearing impaired listeners are fitted with combinations of hearing-aid(s) (HA) and cochlear implant(s) (CI) devices. There exists compelling evidence to support benefits obtained by bimodal hearing (i.e., CI in one ear and HA in the contralateral ear) for improved speech recognition in quiet and in noise, as well as for lateralization and localization issues [1, 2]. Furthermore, individuals with residual hearing who use hybrid implants are able to receive a combined benefit of electric and acoustic stimulation (EAS) (i.e., CI and HA in the same ear with partially inserted electrode array). Scientific studies support the preservation of acoustic hearing, as combined EAS aids speech understanding in complex listening environments as well as in identification of musical structure and content [3, 4]. As medical interventions for hearing loss have evolved, the complexity of sound processing solutions for assistive hearing devices have also increased. This has created unique opportunities for researchers to design and perform complex experiments that involve combinations of electric and acoustic stimulation modalities. However, there is a severe lack of research tools and systems capable of supporting the growing needs of the research community. In our previous work, we developed a mobile research interface (CCi-MOBILE) for studies involving CI devices alone. In the present work, we have extended the functionality of our platform to include dual channels of synchronized acoustic stimulation in addition to the electrical stimulation. With this unique versatility, the platform can be configured to drive two hearing-aids and two cochlear implants simultaneously. Functional working of the system is as follows. The acoustic signal is first acquired from BTE units and is sampled digitally by an on-board stereo codec. The sampled signal is transmitted to the computing platform via USB-serial interface. The computing platform, which could either be a personal computer (PC) or a portable device, such as a smartphone/tablet, receives packets of stereo acoustic data, and processes them simultaneously through CI and HA sound processing strategies on a frame-by-frame basis. The processing generates electric stimulus profile for the implant and processed acoustic data for HA. The stimulus data is transmitted back to the interface board where it is streamed to CIs and acoustic transducers concurrently. Parallel architecture of the FPGA-based CCi-MOBILE platform ensures delivery of acoustic signal and electric pulses with precise timing, which ensures time-synchronized EAS.

The CCi-MOBILE research interface offers researchers excellent opportunities to explore new research paradigms in this emerging field. It should also be noted that plans are underway to make this research platform available in an open-source-like scenario to the community for research use.

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[3] Gantz, B.J., Turner, C., Gfeller, K.E., Lowder, M., “Preservation of hearing in cochlear implant surgery: advantages of combined electrical and acoustical speech processing”, Laryngoscope, vol. 115, pp. 796–806, 2005.

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