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Complementary results on the feedback path characterization for the Cochlear™ Codacs™ direct acoustic cochlear implant

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In this study, we describe the latest measurements performed on the Cochlear™ Codacs™ implant, an electro-mechanical direct acoustic cochlear implant (DACI) [Lenarz et al., 2014, Audiol Neurotol 2014;19:164-174], in order to better understand the nature of the acoustic feedback problems observed in some acoustic hearing implant recipients [Verhaert et al., 2013, Otology & Neurotology 34(7), 1201–1209]. The measurements were performed on fresh frozen cadaver heads in four measurement sessions, at different stimulus levels, using the exponential sine sweep (ESS) technique.

The reason for carrying out such characterization measurements is threefold: first, to estimate the feedback path frequency response of the DACI, both in the case of a correct and an erroneous actuator position. Second, to investigate the presence of nonlinearities, since these could have a profound impact on the performance of standard feedback cancellation algorithms. Finally, to measure the difference between the impulse response (IR) recorded through a microphone on a standard behind-the-ear (BTE) position and the IR measured with an external, and mechanically decoupled, microphone. This is done to verify whether the mechanical coupling, through the bone and tissue layers, between the actuator and the BTE microphone gives rise to a significant mechanical feedback component.

The measured data complement a preliminary dataset [Bernardi et al., IHCON 2014], by also providing a dB SPL normalization, and confirm the previous findings showing that the DACI is characterized by a mechanical feedback component which is stronger than the airborne feedback component and also has a different frequency spectrum. Additionally, the amount of feedback seems to be dependent on the specific head morphology of the implantee. A strong increase of the feedback signal was also recorded in the case of erroneous implantation. Finally, the DACI did show some limited, level-dependent nonlinear behavior that was quantified by means of a distortion measure.
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