COCHLEAR IMPLANT SPEECH PROCESSING, BASED ON THE COCHLEAR TRAVELLING WAVE

by

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A cochlear implant is a prosthetic device that can provide severe-to-profoundly deaf individuals with partially restored hearing. It emulates the function of a normal cochlea through combined functioning of externally situated electronics and an electrode array surgically implanted into the cochlea. Speech coding strategies implemented in speech processors aim to stimulate the auditory nerve in a way similar to that of a normal working cochlea by modelling the way the cochlea processes sound.

Current speech processing strategies rely on the tonotopicity of the cochlea, i.e. the relation between distance from the base of the cochlea and the specific frequency that causes the highest amplitude of deflection at the specific point. The phenomenon of the travelling wave on the basilar membrane is thus reduced to its point or points of maximal deflection.

In this study, the behaviour along the full length of the basilar membrane will be investigated in the time domain, i.e. the deflection along the whole membrane for any point in time, in order to evaluate the relevance of the travelling wave in coding sound in a cochlear implant system. The additional information acquired by emulating the motion of the fluid and the basilar membrane in the cochlea, will be transmitted to the recipient in

electrical stimulus patterns, to assess whether it provides recipients of cochlear implants with better pitch perception. It will be shown that for the individuals that partook in the experiments, improvement of discrimination around 100 Hz were obtained when compared to current speech coding strategies like the advanced combination encoder (ACE) speech coding strategy in the same recipient.

KOGLEÊRE INPLANTING SPRAAKVERWERKING GEBASEER OP DIE KOGLEÊRE LOOPGOLF

deur

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Sleutelwoorde: Loopgolf, basilaarmembraan, hidrodinamiese model, model, koglea, kogleêre inplanting, spraakprosessering.

′n Kogleêre inplanting is ′n prostese wat ′n mate van gehoor kan herstel vir individue met ′n ernstige-tot-totale gehoorverlies. ′n Kogleêre inplanting beoog om die normale funksionering van die oor te emuleer deur die werking van beide ′n eksterne spraakprosesseerder en ′n sjirurgies-geïnplanteerde elektrode en stimulator. Spraakkoderingstrategieë, wat in die spraakprosesseerder geïmplementeer word, beoog om die ouditiewe senuwee op ′n soortgelyke wyse te stimuleer as die senuwee van ′n normale oor deur so goed moontlik die werking van die koglea te modelleer.

Spraakprosesseeringstrategieë wat tans gebruik word, berus egter slegs op die tonotopisiteit van die koglea. Dit behels dat na mate opwaarts in die koglea beweeg word, die koglea toenemend meer sensitief is vir dalende frekwensies. Hierdie sensitiwiteit spruit uit die maksimale defleksie van die basilaarmembraan op elke punt vir ′n spesifieke frekwensie, wat ooreenstem met die posisie in die koglea. Die loopgolfverskynsel wat op die basilaarmembraan voorkom word dus vereenvoudig na die punt of punte van maksimale uitwyking vanuit die rusposisie.

In hierdie studie word die verplasing langs die basilaarmembraan in die tyd-domein gemodelleer, ge-enkodeer en vir kogleêre inplantinggebruikers gespeel om sodoende die relevansie van die loopgolf in die kodering van klank en veral toonhoogtes in ′n kogleêre inplanting te ondersoek. Resultate word voorgelê wat ′n verbetering in toonhoogtediskriminasie om 100 Hz aandui, wanneer vergelyk word met huidige spraakkoderingstrategieë soos ‘advance combination encoder’ (ACE) in dieselfde gebruiker.

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