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AUDITORY NEURO-ENGINEERING

Age-related hearing deficits entail an important social, economic and health-related problem. The Ghent Auditory Science Platform (GASP) is a tight collaboration between half a dozen of research groups from the faculties of Medicine and Health Sciences, Engineering and Architecture, and Psychology and Educational Sciences conducting joint research in auditory science. The additional professorship should bridge the gap between machine listening and medical interventions at the auditory neurological level by boosting a new research field that results in personalised devices directly influencing neural processing of sound signals for perfect quality of hearing experience.

Leading scientists:

Faculty of Medicine and Health Sciences: Prof. Dr. Ingeborg Dhooge, Prof. Dr. Hannah Keppler, Prof. Dr Bart Vinck. Faculty of Engineering: Prof. Dr. ir. Dick Botteldooren, Prof. Dr. ir. Sarah Verhulst all participating in an interdisciplinary research group Ghent Auditory Science Platform (GASP)

 # new professorships: 1

Project description

The human ear and hearing organ have been studied for many decades yielding a vast amount of literature on its functioning and deficits. Advanced measurement techniques allow a functional quantification of key auditory processes, while prosthesis and implants can partially replace the sensory function. At Ghent University, both diagnostics and rehabilitation of peripheral hearing deficits have been well studied and brought to practice at Ghent University Hospital. However, a major challenge still lies in the mitigation of hearing deficits caused by deficiencies of the neural pathways connecting the inner ear, or the implant replacing it, to the central auditory brain. In recent years, these challenges have been highlighted in medical literature. At the same time, important advances have been made at the interface between biology and electronics.

The Ghent Auditory Science Platform (GASP) is a tight collaboration between half a dozen of research groups from the faculties of Medicine and Health Sciences, Engineering and Architecture, and Psychology and Educational Sciences conducting joint research in auditory science. The core team of this consortium has a strong research background on assessing the status of the hearing organ, and develops models that are connecting the acoustic stimulus to electrophysiological signals and to perception of sounds. Apart from assessment, the team also has the skills and experience in the field of auditory prosthesis such as hearing aids and cochlear implants, innovative hearing aids relying on neuro-feedback, hearing protection and rehabilitation. The core team is supported by research groups with expertise in bio-electronics, bio-photonics, and psychology and has a strong connection to imec.

The GASP consortium has identified a number of challenges for the road ahead in hearing research:

- biological strategies for use in inner ear therapeutics: gene therapy, stem-cell therapy and molecular therapy;
- auditory nerve fiber stimulation, resynchronizing, brain-computer interfacing;
- stimulating brain plasticity (e.g. post deafness, in tinnitus and/or decreased sound tolerance cases) and individualized interventions;
- cochlear nerve sensing and brainstem processing (auditory processing on implanted chip);
- neuro-acoustic phenotype determination allowing for personalized hearing deficit treatment.

To tackle some of these challenges, the GASP consortium wants to appoint a new professor to address the interaction between the auditory neural pathway and electronic and opto-electronic devices and implants.

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Proposed impact

The aging population in Western Europe will become one of the main challenges of this century. With age come burdens such as hearing loss. In adults living in developed countries, 10% to 20% of the hearing loss burden is attributed to noise while most of the rest is associated with aging. In Belgium, average life expectancy amounted up to 80.9 years in 2015 (FOD Economie, 2016) and in the future, the middle-aged working population will also increase (Federale Pensioendienst, 2016). Therefore, hearing deficits related to aging entail an important social, economic and health-related problem. If untreated, hearing impairment has functional and psychosocial consequences such as sick leave and consequently, loss of overall quality of life. In Belgium, there is a partial reimbursement by health insurances for the purchase of hearing aids every five years (RIZIV, 2015). Nevertheless, the effectiveness of hearing aids varies considerably, especially in first-time hearing aid users.

New technologies that will be developed by the GASP-team and the appointed professor in auditory neuro-engineering will allow restoring hearing far beyond what is possible today to yield a significantly improved quality of experience. The benefit for society will thus be very high. In addition, the team will actively search for economic valorization of the new technologies through collaboration with existing companies or by starting a spin-off company.