A BRIEF HISTORY OF COCHLEAR

The first multi-channel cochlear implant was an Australian innovation, designed and implanted in the first patient in 1978, under the leadership of Professor Graeme Clark. The implant device then went on to become the first multi-channel commercial cochlear implant in 1981 [1]. 200,000 individuals around the world now benefit from the Cochlear Nucleus implant.

PRINCIPLES OF NORMAL HEARING

In the case of normal hearing, the sound waves move through the ear canal and strike the eardrum. Vibrations from the eardrum are transmitted via the middle ear bones into the fluid filled cochlea. The minute fluctuations in fluid pressure in turn activates tiny hair cells along the cochlea. These hair cells then trigger neural activity in the underlying hearing nerve. The hearing nerve then sends the information to the brain along the neural pathway where they are interpreted as sound.

HOW THE COCHLEAR IMPLANT WORKS

Hair cells inside the cochlea are vulnerable to damage from factors such as age, ototoxic drugs, physical trauma, disease and congenital abnormalities. Hearing loss associated with the loss of hair cells is referred to as sensorineural hearing loss. Individuals with severe to profound sensorineural hearing loss may be candidates for a cochlear implant. The cochlear implant system is comprised of, i) an external sound processor and ii) an implanted device (shown below). The external sound processor analyses acoustic signals and then sends this inductively to the implant beneath the skin. This information is then converted by the implant to electrical stimulation pulses. These pulses are delivered to an electrode array positioned in the cochlea. The electrode array bypasses the damaged hair cells and instead stimulates the cochlea’s hearing nerve directly. The resulting activity in the hearing nerve is then interpreted by the brain as acoustic perception.

PROJECT GOALS

The goal of this project was to deliver an audio visual simulation of the Cochlear Implant system operating in a variety of real life listening environments. The link between what we see and what we hear was explored using the first person perspective. The objective was to capture a variety of listening environments during the project. These would be processed and edited to provide:

- a large database of audio visual recordings for internal research use
- videos to highlight how commercial and research processing perform in the real world

COLLECTING AUDIO VISUAL MATERIAL

Videos were captured using a GoPro camera mounted to the body, to create a first person sensory experience. Audio was recorded using Cochlear’s commercial behind the ear processor, thereby creating an exact replica of an implantee’s listening environment. The recorded audio was then processed offline using Simulink models of Cochlear’s commercial processing algorithms.

An example of the first person nature of the collected material is shown in the figures above. This project focused on recreating common real life scenarios patients would experience in their day to day lives.

BENEFITS & OUTCOMES

INTERNAL DEMONSTRATIONS OF COCHLEAR TECHNOLOGY

Cochlear is a commercial entity. It is important for a company to understand how its product relates to its customers in every area, from research & development to management & marketing. Being able to demonstrate such a complex piece of technology is of great utility to many aspects of the company.

EXAMINING HOW SOUND PROCESSING ALGORITHMS PERFORM OUTSIDE CLINICAL CONDITIONS

Validation of the clinical performance of Cochlear’s system requires significant applied testing of the various processing algorithms within acoustically controlled sound booths. Whilst these booth tests are instrumental to quantifying clinical performance there is acknowledgment that these results may not always be indicative of real-world performance. Audio visual recordings provide a means of bringing the outside world into the booth to better understand real-world clinical performance.

CREATING A DATABASE OF COMMON DAY TO DAY SIMULATIONS FOR FUTURE RESEARCH

The technology behind the Cochlear implant is constantly evolving. Driving this evolution is cutting edge research which aims to improve clinical benefit. These audio visual recordings will be employed in a large number of future projects, to further hone and improve the capability and clinical benefit of the system.

References: