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# Numerical Simulation of the Neural Response in Cochlear Implants

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## ABSTRACT

The auditory system is composed of three principal parts: external ear, middle ear, and inner ear. The cochlea is a spiral shaped structure, placed in the inner ear and responsible of transforming sound into electrical impulses through the movement of hair cells located in the Organ of Corti. The problem comes when the cochlea is damaged and causes neurosensorial hearing loss. When this happen, the solution is a cochlear implant (CI) which is a device that replaces hearing loss by stimulating the auditory nerve.

A computational model is built with real patient data by the neural response telemetry (NRT) amplitude. The aim of this model is to predict the behaviour of auditory nerve stimulated by a CI [1]. The NRT is a clinical routine which measures the evoke compound action potential (ECAP) registered in the recording electrode when neurons are activated by the stimulated electrode. The computational model is divided into two types of FEM models. One calculates the current densities that reach to the virtual neurons (VNs) when an electrode is stimulated. The other calculates the potential that reach the electrode when a membrane current intensity is propagated along the neuron, being the simulated NRT. After that, the differential evolution (DE) algorithm adjusted the parameters that minimize the error between the values of real and simulated NRT.

The numerical experiments present the capacity of the model to reproduce the neural response provided by the patient's data.

In the future, it is intended to complete a database that will calibrate the model with more precision. According to the pathology, a classification could be created by the model; for example, it could be useful to determine dead regions of the auditory nerve.

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## REFERENCES

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