A Robotic Sensing System for Cochlear Implant Electrode Array Insertion

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Background:
Insertion of the cochlear implant electrode array is the most crucial step in cochlear implant surgery. The insertion progress is a pierce event and often damages the cochlear structures, such as the basilar membrane, hair cells, and cochlear lateral wall. Thus, it is essential to preserve residual hearing and improve clinical outcomes by reducing the electrode array insertion trauma.
Objective:
Currently, the insertion of an electrode array has been done by hand, and the tools used by surgeons do not provide any force feedback or other means of sensing. The work presented in this paper is to develop a robotic sensing system during to discriminate among certain insertion patterns. This will help to maximise the performance of cochlear implant and reduce trauma of the insertion.
Methods:
Electrode bipolar capacitances are measured during the insertion process. An actuation insertion device was setup for consistent data collection of the capacitance measurements. Finally principal component analysis is applied for pattern recognition.

Results:
Experiment results show the success rate is over 94% to distinct between buckling and smooth insertion process.
Conclusions:
This result demonstrates a significant improvement for sensing electrode behaviour and will helps surgeons to avoid misplacement of the electrode array inside cochlea.