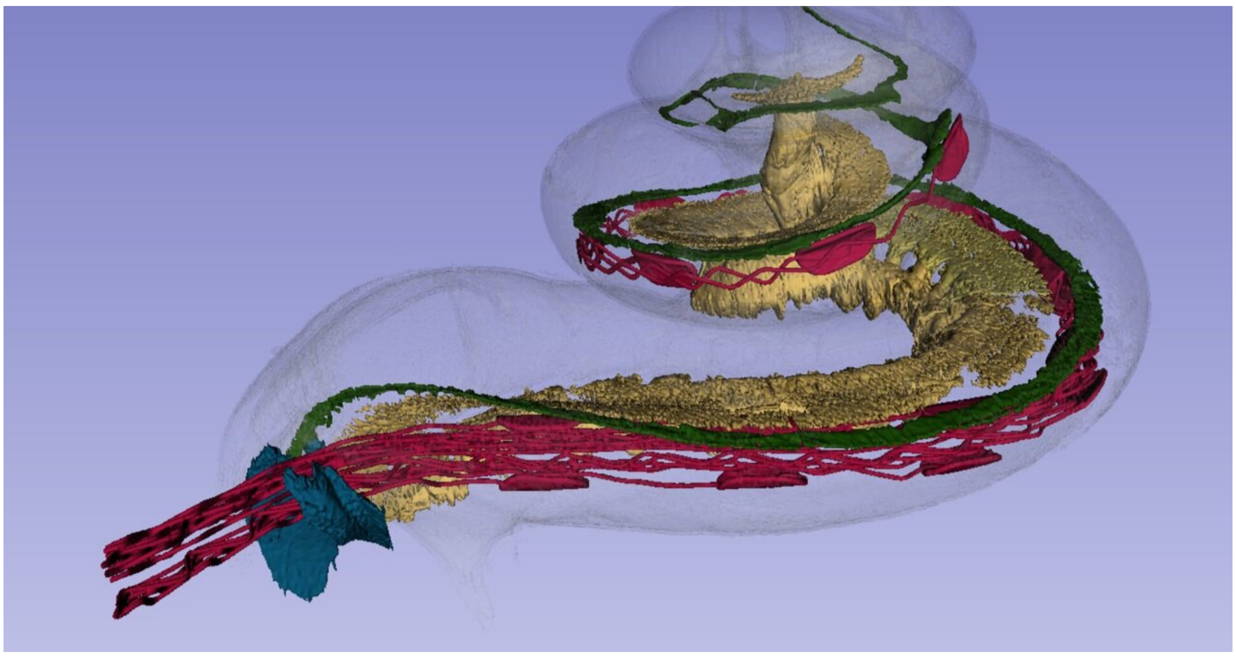
Using imaging and machine learning to customize cochlear implants

June 17 2022, by Antwayne Stewart and Joel Eckel



Rendering of a 3D synchrotron-based image of an implanted cochlea. The red in the image is an implanted cochlear implant electrode array. Credit: University of Western Ontario

The inner ear is a complex and highly individualized structure. So it should be no surprise that a one-size-fits-all approach to cochlear implants doesn't produce the best results for listeners.

This is why a team that includes Western electrical and computer engineering professor Hanif Ladak and his surgical collaborator, otolaryngologist, Dr. Sumit Agrawal, created a tool that would fine tune cochlear implants to ensure that anatomical variability would be less of an obstacle for patient hearing.

Their research includes collaborators at Uppsala University Hospital in Sweden.

Cochlear implants are surgically implanted devices that work by placing an electrode along the length of the cochlea, the part of the inner ear responsible for converting sound to neural signals. The implant bypasses the damaged part of the ear by stimulating the sensory cells directly to restore the sense of sound.

Prior to last year's mapping tool, understanding which cells to stimulate was far more challenging. The implant was often programmed to fit "average" ear anatomy, said Ladak, jointly appointed in the department of medical biophysics with the Schulich School of Medicine & Dentistry.

"The outcome was that speech and music did not sound natural to some patients and hampered speech communication and music enjoyment. By introducing imaging and using machine learning to estimate cell distribution, we are now able to tune an implant to each patient's specific anatomy to achieve high-quality sound rendering," he added.

Using imaging data gathered with a tool they pioneered last year, Ladak and his team are now taking the research one step further. In addition to tuning the placement of the electrodes to each patient's anatomy, they will optimize the physical design of the implant's electrodes to best use their discoveries about cochlear micro-anatomy.

"By using our unique database of images, we'll be able to design highly detailed computer models and once they are validated, they can be used to optimize the shape and sizing of the electrodes on an individual basis," shared Ladak.

This new development means cells can be better targeted for electrical stimulation and this will result in improved hearing for cochlear implant recipients.

The World Health Organization estimates that by 2050, over 700 million people—or one in every ten people—will have disabling hearing loss.

As the criteria expand for individuals who can receive a cochlear implant , Ladak's work becomes more crucial. "I'm hoping that some of the technology that we've developed just over the last five years will be translated to practice within the next three or four years."

"Individuals who have a profound loss of hearing and for whom hearing aids and other technologies don't work will be positively impacted by our research in terms of access to education, future employment, and social activities," he added.

Provided by University of Western Ontario