IET Travel Award Report

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Conference: IEEE's Conference on Engineering in Medicine & Biology (EMBC 2023)

At the end of July, I attended the IEEE's 45th Annual International Conference on Engineering in Medicine & Biology (EMBC) in Sydney, Australia, thanks to funding from the IET Travel Award scheme. EMBC is the flagship conference for the IEEE's Engineering in Medicine and Biology Society (EMBS), the world's largest international society of biomedical engineers. Given its scale, the conference covers a range of topics, such as biomedical signal processing, informatics, sensors and wearable systems, biorobotics, among many more. In recent years, the COVID pandemic has highlighted fragilities of worldwide healthcare systems, therefore, the conference theme this year was "Engineering Better and More Resilient Healthcare for All".

I was delighted to have a full contributed paper accepted for EMBC, as well as for the research to be accepted for oral presentation. The work presented and discussed during the conference involved preliminary studies on applying machine learning (ML) techniques to more efficiently and robustly remove noise from recordings of peripheral nerves. My research focuses on implantable devices that electrically stimulate the nervous system, such as vagus nerve stimulators to treat conditions like epilepsy or depression. Despite there being commercially available stimulators for the vagus nerve and other parts of the body, stimulation parameters are typically adjusted manually by a physician, and can be a trial-and-error process. Given the physiological variability between different people, or even the same person under different conditions on different days, electrical stimulation is not always efficacious. Researchers in this field are therefore very interested in what is referred to as "closing the loop" in these implants; in other words, incorporating recordings, or measurements, of the nerve activity to inform the automatic selection of new stimulation parameters. In short, if the incorrect response is seen in the nerve, an algorithm could automatically select different stimulation parameters.

A crucial barrier to achieving this goal is that noise levels and interference can vary significantly over time, making these recordings difficult to filter using conventional approaches, such as bandpass filtering. This is the gap that the work I presented at EMBC aims to address. To achieve this, two novel ML models for unsupervised denoising in other domains were applied for the first time to spontaneous electrical recordings from the vagus nerve. In addition to nerve recordings, blood pressure data was also collected and incorporated to better inform what the ML models should optimise towards, given the absence of an absolute ground truth. Initial results show that ML models offer promising performance in terms of denoising these recordings in a more flexible manner, yet these findings require further validation on larger and more diverse datasets, and more in-depth analysis.

Photo: Presenting my research during the Neural and Rehabilitation Engineering oral session on 27th July 2023

Beyond my own presentation, I also had the chance to see leading researchers and academics from around the globe present their work. There were several interesting sessions related to my own field of research, on topics such as brain interfaces, ML in biomedical research, and neurostimulation and neuroimaging. I particularly enjoyed a keynote by Prof. Gari Clifford from Emory University and Georgia Institute of Technology on the barriers and potential solutions for the use of ML in biomedical applications. This highlighted important issues that arise when using ML in the biomedical field, namely model interpretability, generalisability, the use of incorrect metrics, over-testing, and the reliance on single-institution databases. It was also interesting to hear about the potential for physics-informed ML models for improving some of these issues. Beyond these talks, there were also extremely valuable sessions set up by the IEEE EMBS Student Activities Committee on carrying out research in industry and start-ups. The panellists for this session each worked in different, but equally fascinating research areas, and it was great to hear about their career trajectories as well. In all, attending the technical presentations and these career development sessions were invaluable not just for my PhD research, but for obtaining different perspectives on career opportunities beyond it.

Finally, EMBC was a brilliant opportunity for networking, both in terms of catching up with existing collaborators but with meeting new ones. The technical presentations, poster sessions, and evening receptions all presented several opportunities to engage with researchers, clinicians, and engineers in my field and beyond. These conversations were once again invaluable for my PhD research, as I was introduced to potential research directions I could look into, and techniques or tools to extend and improve the work I presented at the conference.

All of this would not have been possible without an IET travel award. I am nearing the end of my PhD, so given my remaining funding, I would not have been able to afford the costs for attending this conference in Australia. Attending EMBC has been an invaluable experience, not only for presenting my own work and having discussions about it with other leading academics in my field, but also for learning first-hand what other researchers are working on and forging new collaborations with research groups I might not have had the chance to meet

otherwise. I therefore strongly encourage PhD students and early career researchers to apply for the IET Travel Award.