EPSRC iCASE Studentship:

Engineering and Physical Sciences Research Council

Analog Neuromorphic Processing for Biosensor

This project will engineer a low-power wearable device consists of electrocardiography (ECG) and photoplethysmography (PPG) sensors with on-chip neuromorphic sensing processor. Given the potential of the ECG+PPG system with machine learning, the main concerns are the power, accuracy and computing efficiency. Such novel multi-sensory architecture usually requires more power in the wearable computing unit. Traditional solutions mostly pursued the trade-off between power duration and computing capability. In this project, we proposed a neuromorphic processor for cognitively processing the fusing PPG and ECG signal in real-time. Based on our existing experience on sensor, microelectronic design and neuromorphic processor, this project aims to remove energy-hungry digital components and use fully analogue neuromorphic building blocks instead. The expected processor will significantly reduce the power and large volumes of noisy and largely redundant spatiotemporal data as well as increase speed of biomedical wearable devices.

Delay-based reservoir computing (DRC), a strong candidate of physical implementation among all the topologies of neural network, is chosen as the hardware architecture in this project. It can be classified into reservoir computing and recurrent neural network. By introducing a delay line to the reservoir, the DRC dramatically reduces the number of nonlinear neurons. The delay-coupled virtual nodes create a complex reservoir dynamic to map the input to high dimensional space for classification, which is similar to the normal reservoir. Since the architecture is highly achievable by hardware, this network is chosen as the main ECG+PPG processing core in this work. The design of this neuromorphic includes modelling, implementation and chip design. This processor is expected to be a strong alternative of existing AI edge processor. Our previous research has proved the feasibility of using DRC model to process ECG signal. The model can recognize and classify different signal morphologies while the building blocks of the model are achievable by hardware.

This project is based on an iCASE PhD studentship at the University of Glasgow. We have a strong collaboration with our industrial partner, with excellent design and fabrication capabilities. Through this collaboration, we are in a unique position to design and develop a neuromorphic processor for the next generation wearable devices.

Funding notes

This project is fully funded by EPSRC iCASE PhD studentship at the University of Glasgow.

As an EPSRC iCASE project it is available only to UK/Home students. This position offers a competitive Salary with generous research fund for travel and consumables.

More information: www.melabresearch.com

Contact: hadi.heidari@glasgow.ac.uk