Neural Recording Interface

With real-time spike sorting
Summary
The scalable neural recording interface with real-time spike-sorting technology revolutionizes neural implants and paves way for neuroprosthetics by measuring the signals of individual neurons real-time. This technology was developed by renowned multidisciplinary teams based at three leading Universities; Imperial College London, University of Leicester and Newcastle University.

Background
Neural implants have enabled a deeper understanding of neurological disorders and has helped many thousands of patients worldwide. While considerable advances have been made in the field of electrode technologies and neural implants, devices that measure the activity of individual neurons are limited. The inability to distinguish the small ‘spike’ of individual neurons from background noise adds to the challenge. This has been addressed by the NGNI platform, a scalable neural recording interface that measures real-time spike sorting. Spike Sorting is the process of deinterleaving a recorded neural signal in order to determine the firing patterns of individual neurons from the aggregate spike stream. The NGNI platform is an end-to-end solution for on-node, real-time spike sorting. The technology achieves a low power real-time solution by including a compact, on board (template based) spike sorting engine and an offline training (WaveClus-based) module.

Applications
• Signal acquisition systems for electrophysiology
• Large scale recording applications (multi-probe, multi-channel)
• Real-time brain machine interface applications
• Closed loop low-latency biofeedback enables reorganisation of brain networks

Benefits
• Autonomous, implantable platform enabling the next-generation of devices to monitor the activity of large number of individual neurons in the brain.
• The neural device is a scalable system as it records numerous channels without using large power and/or bandwidth.
• Platform for neuroprosthetics that aid in reconnection between areas in the brain that are disconnected due to injury.
• Revolutionise neurological rehabilitation and improve cognitive function in patients with neurological disorders such as Alzheimer’s Disease and dementia.
Technology
The scalable neural recording and real-time spike-sorting interface technology is the result of the collaborative efforts of teams at Imperial College London, Newcastle University and University of Leicester. The technology comprises of three components: NGNI-v0, NGNI USBridge and a GUI. The NGNI-v0 is configured to send raw data to a computer for offline analysis with WaveClus. The generated templates (up to 4 per channel) are then uploaded to the NGNI-v0 which implements a computationally efficient algorithm to perform real-time spike sorting. The spike sorted data is transmitted via the NGNI USBridge (over SPI and then USB) to a PC. A GUI is provided for data visualisation and system configuration. In addition, the neural device is a scalable system as it records numerous channels without using large power and/or bandwidth. The key features of the technology include:

- 32-channel neural recording/ streaming
- On-node, realtime template based spike sorting
- Proprietary template building engine (based on waveclus)
- Onboard template memory, 18.4 kbit (4 templates/channel)
- Low latency (0.3 ms) spi output
- Low output date rate for wireless communications.
- NGNI-v1 platform (in development)- first compact design targeted at in-vivo testing provides standalone recording solution with wireless access, LFP and spike recording over the same area, sorting and recording of thousands of channels and single SoC solution.

Market
- The global neuroprosthetics market is expected to reach $14 billion by 2020, with a CAGR of 15.8% from 2014 to 2020.
- Within neuroprosthetics devices, motor neuroprosthetics segment are expected to garner the largest market share, owing to numerous applications in Parkinson’s disease, neurocardiac disorders, depression, obsessive compulsive disorder, and epilepsy.
- The growing incidence of neurological disorders and increasing adoption of neural implants by patients and physicians are driving the market.

Team:
- Professor Rodrigo Quian Quiroga- Director of the Centre for Systems Neuroscience and the Head of Bioengineering at the University of Leicester
- Dr. Timothy Constandinou –Senior Lecturer and EPSRC Research Fellow at Imperial college London, and Deputy Director of the Centre for Bio-inspired Technology
- Dr. Andrew Jackson – Senior Research Fellow at Newcastle University

Intellectual Property
A patent application has been filed to protect the scalable neural recording and spike-sorting interface technology (WO/2015/114347). This technology is now available for licensing.