New method manages and stores data from millions of nerve cells in real time

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Recent developments in neuroscience set high requirements for sophisticated data management, not least when implantable Brain Machine Interfaces are used to establish electronic communication between the brain's nerve cells and computers. A new method developed by researchers at Lund University in Sweden makes it possible to recode neural signals into a format that computer processors can use instantly. The method has now been published in the respected scientific journal, Neuroinformatics.

The Lund researchers used simulated recordings from nerve cells to evaluate the method. They were able to show that they can simultaneously collect data from over one million nerve cells, analyse the information and provide feedback within a few milliseconds.

"The method will enable us to optimise the way we utilise the high-quality stable recordings that we can carry out with electrodes developed at the Neuronano Research Center", says Jens Schouenborg, Professor of Neurophysiology at Lund University and one of the researchers behind the study.

Progress within brain research in recent years has given rise to considerable handling challenges regarding the volume of information generated when "listening to" and communicating with a large number of the brain's nerve cells, with applications in basic research, clinical diagnosis and treatment.

Whether it concerns using the signals from the nerve cells of a paralysed patient to control a robot arm, or using information from the nerve cells to reveal an imminent epileptic seizure, there is a need for extremely fast handling and interpretation of the large volume of generated biological data.

Recode into computer language

The method that the researchers at the Neuronano Research Centre at Lund University have developed enables simultaneous communication in real time with millions of nerve cells.

"Recoding the nerve cell signals directly into bitcode dramatically increases the storage capacity. "However, the biggest gain is that the method enables us to store the information in a way that makes it immediately available to the computers' processors", explains Jens Schouenborg.

In addition to the large number of nerve cells and the volume of information in the signals from each cell, the challenge is that information must be simultaneously translated in order to facilitate meaningful communication with the brain.

Listening to individual nerve cells

Martin Garwicz, one of the researchers behind the study, outlines how their method differs from other ways of analysing nerve cell activity based, for example, on EEG, in which electrodes are positioned on the outside of the scalp.

"Imagine that you want to hear what ten people in the room next door are talking about. If you listen by putting your ear against the wall you will just hear murmurs, but if you put a microphone on each person in the room, it transforms your ability to understand the conversation. And then think about being able to listen to one million individuals, find patterns in what's communicated and instantly respond to it – that's what our new method makes possible", says Martin Garwicz, Professor of Neurophysiology at Lund University.

Required new forms of data handling

The method developed by the researchers enables two-way communication with individual nerve cells.

"A considerable benefit of this architecture and data format is that it doesn't require further translation, as the brain's signals are translated directly into bitcode. This means a considerable advantage in all communication between the brain and computers, not least regarding clinical applications", says Bengt Ljungquist, lead author of the study and doctoral student at Lund University.

More information: Bengt Ljungquist et al. A Bit-Encoding Based New Data Structure for Time and Memory Efficient Handling of Spike Times in an Electrophysiological Setup, *Neuroinformatics* (2018). DOI: 10.1007/s12021-018-9367-z

Provided by Lund University

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