Listening to the music of the brain could be key to treating epilepsy

Thanks to the high-speed GÉANT network and the computing power of the European Grid Infrastructure, researchers in Italy are creating music from electroencephalography data. Listening to these melodies could help researchers forecast impending seizures.

Epileptic spike and wave discharges monitored with EEG. Image courtesy Der Lange, Wikimedia Commons.

Listening to the melody of your mind, the beat of your brain, the symphony of your synapses, or the notes of your neurons may seem like pure fantasy. However, thanks to the high-speed GÉANT network and the computing power of the European Grid Infrastructure (EGI), not only is this becoming a reality, but it's also helping researchers in Italy forecast impending epileptic seizures.

Electroencephalography (EEG) data is obtained by placing electrodes on the scalp, so as to measure voltage fluctuations resulting from ionic current flows within the neurons of the brain. It usually, produces readout in the form of lines on a graph, similar to what one might expect to see in a seismograph. However, by using a data sonification tool to transform the lines and points of graphs into notes and tones, the team of researchers hope to be able to forecast impending seizures, by listening out for a baseline condition or 'marker' which denotes a specific epileptic EEG. Of course, one could look for

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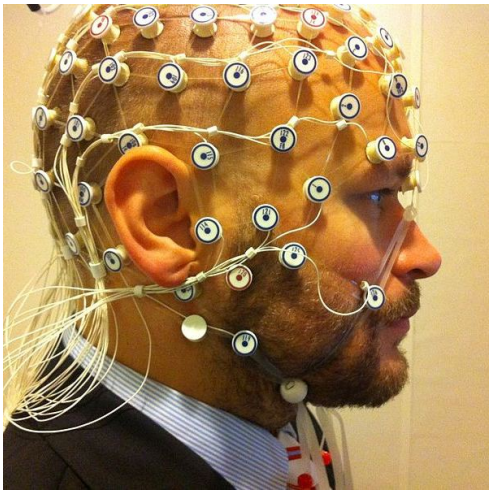
such markers on the EEG graphs themselves, but the researchers explain that this visual identification often proves difficult, especially when dealing with exceptionally large quantities of data. By contrast, say the researchers, nearly everybody can spot a wrong note or blip in a melody without any musical training.

"In order to let neuroscientists involved in epilepsy research use the data sonification tool in a distributed computing environment, a multi-domain web-portal (science gateway) has been set up using the Catania Science Gateway Framework," explains Domenico Vicinanza, a network engineer at DANTE. "Using this portal, researchers working in hospitals could benefit from the data sonification technique we implemented without having to install any software and completely hiding the complexity of using a distributed computing infrastructure."

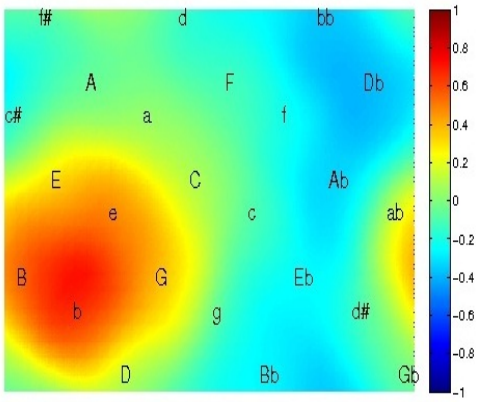


Subject ready for EEG recording at the phonetics lab, Stockholm University, Sweden. Image courtesy Petter Kallioinen, Wikimedia Commons.

In the study, long sequences of data are generated and analysed using different sets of parameters and high quality audio and animation files are created for every EEG data sequence. The huge volume of data this produces relies upon multiple computers combining their processing power using the bandwidth of the super-fast pan-European GÉANT network and its National Research and Education Network (NREN) partners to access, store and transport it.

"Using the GÉANT network we are able to seamlessly transport data to and from scientists all over Europe, enabling a level of collaboration to facilitate medical innovation and scientific research that could have direct implications for the 50 million people worldwide suffering from epilepsy," says Massimo Rizzi of the Mario Negri Institute for Pharmacological Research and ARCEM.

The researchers expect that their novel method of combining data sonification with recurrence quantification analysis will deliver better results and additional data compared with traditional methods for studying epilepsy. Consequently, they hope that



Mapping EEG data to tonal maps.

the research could enable the development of new therapeutic interventions for epilepsy sufferers.

Data sonification is a powerful tool, which is already used in many scientific disciplines. It generates vast quantities of data, requiring the processing power of supercomputers for analysis. "We used the grid so much for this research that it is really difficult imagining it without it," says Vicinanza. "We used it for the availability of its computing resources, the ubiquitous access to processing power, the reliability of the middleware, the robustness of its authentication and authorisation."

He concludes: "Thanks to the grid we successfully implemented a fully-fledged software-as-a-service (SaaS) model and provided a dedicated production quality service for computer-aided diagnosis and research in the field of epilepsy disease."

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