

Managed by Mind over Matter

Brain-powered remote control. Now there's a thought.

And if Dr. Andrzej Cichocki succeeds, our next universal remote control could resemble a hair band or trendy eyeglasses. Cichocki, an expert in biomedical signal processing, and his team at the Laboratory for Advanced Brain Signal Processing at the Institute of Physical and Chemical Research (RIKEN) are exploiting the latest generation of electroencephalographs (EEGs) to capture tiny electrical emissions from the brain, then process them into a reliable method for controlling a computer – a brain-controlled interface.

Cichocki's team has already succeeded in controlling a cursor using brainwaves, and started experiments using a simple computer game, in which users drive a car around a track on the monitor – using their thoughts.

The human brain's huge network of more than 100 billion neurons generates electrical signals to produce thoughts and regulate the body. Some of these signals can be detected from outside the brain, but they are extremely faint and easily masked by other emissions, such as from scalp muscles.

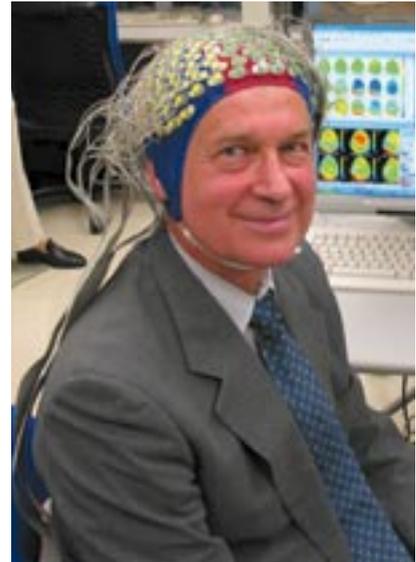
"These signals consist of various component signals, and the information we want is hidden among them. It's like isolating a single voice from a choir," Cichocki says. "And we can do that."

The team uses Blind Source Separation to differentiate the minuscule, microvolt emissions from the storm of electrical brain signals, then amplify them to the millivolt level for feeding into a computer. The team is applying for a patent on the mathematical algorithms that make this possible.

After isolation, the signals are fed into a computer, analyzed, then output as a visual or auditory stimulus, which the user can learn to control during a process known as neurofeedback. Driving the little car around the track is a form of neurofeedback, in which EEG signals are presented as a visual stimulus on the computer monitor. The stimulus can be represented as patterns of color, or auditory "brain music" whose pitch, volume and other qualities can be manipulated. The outcome can sometimes involve actual physical changes to the brain.

The applications sound like science fiction: Thought-controlled televisions, air-conditioners, radios, lights and even prosthetic limbs would be an enormous boon to the elderly and disabled.

Cichocki envisions a day (as soon as five years away) when advanced neurofeedback leads to improved brain self-regulation and training, and could be used to treat or cure some debilitating brain dysfunctions – such as attention-deficit hyperactivity disorder (ADHD), addictions, autism,



ROBERT CAMERON

Dr. Andrzej Cichocki remote-controlling a computer.

dementia, depression, chronic pain, even damage from strokes and head injuries – by training the brain to bypass or rewire the damaged areas. In other words, helping the brain to heal itself, something that was, until recently, considered impossible.

But there's a way to go yet. "For one thing, the technique requires a lot of training, and not everyone can do it. This is an urgent topic of research for our team," Cichocki says.

We can expect great strides in this field in the near future – more than 100 labs around the world are working on some form of this technology.

Robert Cameron is a freelance writer based in Tokyo.