Abstract1

Non-Invasive Brain-Machine Interaction

The promise of Brain-Machine Interfaces (BMI) technology is to augment human capabilities by enabling people to interact with a computer through a conscious and spontaneous modulation of their brainwaves after a short training period. Indeed, by analyzing brain electrical activity online, several groups have designed brain-actuated systems that provide alternative channels for communication, entertainment and control. Thus, a person can write messages using a virtual keyboard on a computer screen and also browse the internet. Alternatively, subjects can operate simple computer games, or brain games, and interact with educational software. Researchers have also been able to train monkeys to move a computer cursor to desired targets and also to control a robot arm. Work with humans has shown that it is possible for them to move a cursor and even to drive a wheelchair. In this talk I will review the field of BMI, with a focus on non-invasive systems based on electroencephalogram (EEG) signals. Key elements for a successful BMI are real-time feedback and training, of both the subject and the classifier embedded into the BMI. I will also describe three brain-actuated applications we have developed: a virtual keyboard, a brain game, and a wheelchair. Finally, we discuss current research directions being pursued in order to improve the performance and robustness of BMI systems, especially for real-time control of brain-actuated robots. In particular, I'll mention work on recognizing cognitive states that are crucial for interaction.