**Practical non-invasive brain-machine interface system for communication and control.**

Kenji Kansaku, M.D., Ph.D.

Systems Neuroscience Section,

Department of Rehabilitation for Brain Functions,

Research Institute of National Rehabilitation Center for Persons with Disabilities (NRCD)

The Brain-Machine Interface (BMI) or Brain–Computer Interface (BCI) is an interface technology that utilizes neurophysiological signals from the brain to control external machines or computers (Birbaumer and Cohen, 2007). We have developed EEG based BMI systems for helping persons with physical disabilities. We first applied the P300 paradigm for communication and environmental control. We prepared a green/blue flicker matrix, and showed that the new matrix was associated with a better subjective feeling of comfort than was the conventional white/gray flicker matrix, and we also found that the new matrix was associated with better performance (Takano, et al., 2009). We further proposed an advanced system by adding Augmented Reality (AR), in which we applied an agent robot as a moving remote controller (Kansaku, et al., 2010).

For clinical purposes, we have developed an in-house environmental control system, which consists of hardware (e.g., EEG amplifier) and software. We also developed peripheral devices: a non-adhesive solid-gel EEG electrode (Toyama, et al., 2012), a soft cap with electrode holders. The P300 BMI system was successfully operated by patients with amyotrophic lateral sclerosis (ALS) and cervical spinal cord injury (SCI) (Ikegami, et al., 2011).

To support arm and finger movements of quadriplegic patients, we have developed in-house robotic exoskeletons, and the steady-state visual evoked potential (SSVEP) paradigm was used for their asynchronous control. The system allowed cervical SCI patients to successfully perform reaching and grasping movements. We also developed a real-time MEG system, which applies beamforming technique and imaginary coherence analysis, aiming to further develop new BMI and neurofeedback technologies (Ora, et al., in press). Researches along these lines may help persons with disabilities to expand the range of activities (Kansaku, 2011).

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