International Journal of Fuzzy Systems: Special Issue

Fuzzy Brain-Computer Interface Systems

The study on brain–computer interface (BCI) was carried out in about thirty years ago, and now is becoming a key research topic in the fields of translational/cognitive neuroscience and neuroengineering. BCI or brain-machine interface (BMI) is usually considered as an effective neuro-pathway connecting the human brain (or animal brain) to a computer which directly translates brain activities into sequences of control commands for an output device. BCI researches seek to achieve the aims of restoring sight, hearing, movement, ability to communicate, and even cognitive function, which are helpful for patients suffering severe motor disabilities. Moreover, BCI systems can also serve as a neuro-feedback mechanism in various applications ranging from clinical assessment, health care, intelligent transportation, education, robotic control to entertainment. Promising examples include diagnosis for major depression and schizophrenia, emotion recognition, arousal state monitoring for drivers, rehabilitation or exoskeleton robot control for stroke/SCI patients, and virtual-reality games. A wide spectrum of users can benefit from this novel technology.

The last decade has witnessed remarkable advances in BCI research. However, there still exist challenges that need to be overcome. For example, nearly all the current BCI studies were conducted in well-controlled laboratory settings. It remains unclear how well the existing BCI technologies work when faced with true patients and implemented in unconstrained environments. Accordingly, many key factors need to be re-evaluated in the transition from laboratory settings to real-world conditions, such as reliability of brain activity sensing devises, robustness of the algorithms for brain-activity signal (e.g., electroencephalography, EEG) processing and translation, generalization ability across users/cultures, and usability (e.g., calibration, training, and re-training speeds). To address these issues caused by the uncertainties in real-world BCI applications, many researchers and groups have started to introduce fuzzy set theory and systems into the BCI research community, and have shown increasing achievements. The objective of this special issue is to explore latest up-to-date fuzzy-set solutions for BCI systems and applications. We invite researchers and experts worldwide to submit high-quality original research papers and survey articles on the following potential topics and their applications, but are not limited to:

- Fuzzy control-based BCI systems
- Fuzzy EEG/f MRI/MEG signal processing
- Fuzzy clustering for EEG/f MRI/MEG signal
- EEG/f MRI/MEG feature evaluation and selection based on fuzzy set-theoretic approach for
- Fuzzy pattern recognition techniques for BCI
- ⋆ Fuzzy kernel learning machines (fuzzy SVM, fuzzy SVDD, fuzzy SVR, etc.) for BCI
- Blind source separation methods by integrating fuzzy set theory and existing methods (ICA, etc)
- Fuzzy set approach for neurophysiological signal fusion
- ⋆ BCI applications related to the above topics

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