Biomedical Applications of Fuzzy Sets
Tuesday, August 4, 2:40PM-4:10PM, Room: Galata, Chair: Mohammad-Reza Akbarzadeh-T.

2:40PM Developing a Novel Multi-fusion Brain-Computer Interface (BCI) System with Particle Swarm Optimization for Motor Imagery Task [#15076]
Tsung-Yu Hsieh, Yang-Yin Lin, Yu-Ting Liu, Chieh-Ning Fang and Chin-Teng Lin, National Chiao Tung University, Taiwan

In this paper, we develop a novel multi-fusion brain-computer interface (BCI) based on linear discriminant analysis (LDA) to deal with motor imagery (MI) classification problem. We combine filter bank and sub-band common spatial pattern (SB CSP) to extract features from EEG data in the preprocessing phase, and then LDA classifiers are applied to classify brain activities to identify either left or right hand imagery. To further bolster the performance of the proposed system, a fuzzy integral (FI) approach is employed to fuse information sources, and particle swarm optimization (PSO) algorithm is exploited to globally update parameters in the fusion structure. Consequently, our experimental results indicate that the proposed system provides superior performance compared to other approaches.

2:58PM Analyzing Gene Expression Data: Fuzzy Decision Tree Algorithm applied to the Classification of Cancer Data [#15092]
Simone Ludwig, Domagoj Jakobovic and Stjepan Picek, North Dakota State University, United States; University of Zagreb, Croatia

In data mining, decision tree algorithms are very popular methodologies since the algorithms have a simple inference mechanism and provide a comprehensible way to represent the model in the form of a decision tree. Over the past years, fuzzy decision tree algorithms have been proposed in order to provide a way to handle uncertainty in the data collected. Fuzzy decision tree algorithms have shown to outperform classical decision tree algorithms. This paper investigates a fuzzy decision tree algorithm applied to the classification of gene expression data. The fuzzy decision tree algorithm is compared to a classical decision tree algorithm as well as other well-known data mining algorithms commonly applied to classification tasks. Based on the five data sets analyzed, the fuzzy decision tree algorithm outperforms the classical decision tree algorithm. However, compared to other commonly used classification algorithms, both decision tree algorithms are competitive, although both do not reach the accuracy values of the best performing classifier.

3:16PM Hybrid Approach in Recognition of Visual Covert Selective Spatial Attention based on MEG Signals [#15241]
Seyyed-Abed Hosseini, Mohammad-Reza Akbarzadeh-T. and Mohammad-Bagher Naghibi-Sistani, Department of Electrical Engineering, Center of Excellence on Soft Computing and Intelligent Information Processing (SCIP), Ferdowsi University of Mashhad, Mashhad, Iran., Iran

This paper proposes a reliable and efficient method for recognition in two different orientations (either left or right) by Magnetoencephalograph (MEG) signals. The brain activities are measured using different approaches with different spatial and temporal resolutions. The MEG signals are usually used for brain computer interface (BCI) applications due to high temporal resolution. The MEG signals were recorded from different brain regions of four different human subjects during visual covert selective spatial attention task. The hybrid method proposes preprocessing; feature extraction by Hurst exponent, Morlet wavelet coefficients, and Petrovsky fractal dimension; normalization; feature selection by p value; and classification by support vector machine (SVM) and fuzzy support vector machine (FSVM). The results show that the proposed method can predict the location of the attended stimulus with a high accuracy of 91.62% and 92.28% for two different orientations with SVM and FSVM, respectively. Finally, these methods can be useful for BCI applications based on visual covert selective spatial attention.

3:34PM Which Bio-Diversity Indices Are Most Adequate [#15062]
Olga Kosheleva, Craig Tweedie and Vladik Kreinovich, University of Texas at El Paso, United States

One of the main objectives of ecology is to analyze, maintain, and enhance the bio-diversity of different ecosystems. To be able to do that, we need to gauge bio-diversity. Several semi-heuristic diversity indices have been shown to be in good accordance with the intuitive notion of bio-diversity. In this paper, we provide a theoretical justification for these empirically successful techniques. Specifically, we show that the most widely used techniques -- Simpson index -- can be justified by using simple fuzzy rules, while a more elaborate justification explains all empirically successful diversity indices.

3:52PM A Parameter Free Nurse Scheduling [#15152]
Ohki Makoto and Yokoyama Takashi, Division of Information and Electronics, Graduate School of Engineering, Tottori University, Japan; Department of Electric and Electronic Engineering, Faculty of Engineering, Tottori University, Japan

This paper describes a technique of a parameter free nurse scheduling. This technique is implemented by using a cooperative genetic algorithm with a penalty weight adjustment to be applied to the nurse scheduling problem. In this algorithm, coefficients and thresholds for each penalty function are automatically optimized. Therefore, this technique provides a very complex task, because many requirements must be considered. These requirements are implemented by a set of penalty function in this research. In real hospital, several changes of the schedule often happen. Such changes of the shift schedule yields various inconveniences, for example, imbalance of the number of the holidays and the number of the attendance. Such inconvenience causes the fall of the nursing level of the nurse organization. Reoptimization of the schedule including the change is very hard task and requires very long computing time. We consider that this problem is caused by the solution space having many local minima. We propose a technique to adjust penalty weights and thresholds through the optimization to escape from the local minima.

Fuzzy Modeling and Identification II
Tuesday, August 4, 2:40PM-4:10PM, Room: Amfi, Chair: Benoit Marx