Soft Computing: Theory Innovations and Problem Solving Benefits Minitrack

Enrique Herrera-Viedma
University of Granada
viedma@decsai.ugr.es

Francisco Javier Cabrerizo
University of Granada
cabrerizo@decsai.ugr.es

Ignacio Javier Pérez
University of Cádiz
ignaciojavier.perez@uca.es

The term Soft Computing is usually used in reference to a family of several preexisting techniques (fuzzy logic, neuro-computing, probabilistic reasoning, evolutionary computation, etc.) able to work in a cooperative way, taking profit from the main advantages of each individual technique, in order to solve lots of complex real-world problems: those for which more conventional methods have not yielded low cost, analytic, and complete solutions. Earlier computational approaches could model and precisely analyze only relatively simple systems. More complex systems arising in biology, medicine, the humanities, management sciences, and similar fields often remained intractable to conventional mathematical and analytical methods. Therefore, the advances in soft computing techniques play an important role in analyzing and modeling more complex systems. Soft computing deals with imprecision, uncertainty, partial truth, and approximation to achieve computability, robustness and low solution cost.

The objective of this minitrack is to attract researchers with an interest in the research area described above. Specifically, not only contributions on theory innovations are welcome, but also those describing different problem solving benefits by using soft computing based methodologies. In such a way, we are interested in the contributions where the applied/defined methodologies used are either analysis- or systems-oriented. They may have an experimental or empirical focus. Innovative studies are favored, which combine innovative theoretical results with a careful empirical verification, or good empirical problem solving, planning or decision making with innovative theory building. A common denominator for all studies is the building and use of soft computing based models.

The first paper of this minitrack, "Applying Feature Selection to Improve Predictive Performance and Explainability in Lung Cancer Detection with Soft Computing", focuses on one of the most important problems in medical diagnosis, i.e., the detection of lung cancer. To this end, genetic data extracted using liquid biopsy technology are selected, which allows to have genetic information of almost 5,000 different characteristics of the genome of each sample or patient. To obtain quality solutions, the authors carry out a thorough experimental study to contrast the behavior of different techniques for feature selection. In particular, univariate techniques, recursive feature elimination, and a selection based on different learning models such as Random Forest, are used. In addition, both a Gaussian Naïve Based and Random Forest classifiers are used for prediction.

The second paper of this minitrack, "Rough Sets: A Bibliometric Analysis from 2014 to 2018", provides a comprehensive overview of the research published for the last five years on rough sets. To do so, the authors analyze 4,038 records retrieved from the Clarivate Web of Science database, identifying the most prolific authors and their collaboration networks, the countries and organizations that are leading research on rough sets, the journals that are publishing most papers, the topics that are being most researched, and the principal application domains.

The third paper of this minitrack, "An Approach Toward a Feedback Mechanism for Consensus Reaching Processes Using Gamification to Increase the Experts' Experience", focuses on group decision making problems and consensus reaching processes. Usually, the consensus reaching process in group decision making is a challenging task for the people who are in charge of the final choice (generally called experts). Firstly, the consensus is defined as a convergent and iterative process. This implies that it is necessary to keep the experts' attention during the whole process, even if it is longer than expected. Secondly, some of the experts tend to be rigid and they do not change their minds to help in the negotiation process easily. Therefore, the authors propose in this paper a new feedback mechanism that uses some gamification rules, designed as a reward distribution system, in order to transform that task into a game.

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This change can improve the consensus reaching process in both situations: keeping the experts' attention on the process and motivating those experts that should adjust their preferences.

The fourth paper of this minitrack, "Similarity-based and Iterative Label Noise Filters for Monotonic Classification", focuses on monotonic ordinal classification, which has received an increasing interest in the latest years. Building monotone models from these problems usually requires datasets that verify monotonic relationships among the samples. When the monotonic relationships are not met, changing the labels may be a viable option, but the risk is high: wrong label changes would completely change the information contained in the data. In this work, the authors tackle the construction of monotone datasets by removing the wrong or noisy examples that violate monotonicity restrictions. In particular, the authors propose two monotonic noise filtering algorithms to preprocess the ordinal datasets and improve the monotonic relations between instances. The experiments are carried out over eleven ordinal datasets, showing that the application of the proposed filters improve the prediction capabilities over different levels of noise.

The fifth paper of this minitrack, "Determining Project Contingency Reserve Using a Fuzzy Arithmetic-Based Risk Analysis Method", proposes a fuzzy risk analysis model that uses fuzzy arithmetic to analyze risk and opportunity events and determine construction project contingency reserve. Traditional techniques for estimating contingency reserve fail to capture subjective uncertainties and expert knowledge, and they rely on historical data. However, the fuzzy risk analysis model allows experts to use natural language to assess the probability and impact of risk and opportunity events by employing linguistic scales represented by fuzzy numbers, thus addressing the data reliance problem of probabilistic methods. It enables experts to customize linguistic scales and fuzzy numbers for different project types and stages. The fuzzy risk analysis model also deals with the challenges associated with deterministic approaches by addressing measurement imprecision and the subjective uncertainty of experts' opinions. Moreover, the fuzzy risk analysis model allows analysts to estimate contingency at different levels of confidence. This paper also illustrates Fuzzy Risk Analyzer© (FRA©), software that implements the fuzzy arithmetic procedure of the fuzzy risk analysis model.

Finally, the sixth paper of this minitrack, "Adaptive and Concurrent Garbage Collection for Virtual Machines", focuses on an important issue for concurrent garbage collection in virtual machines, that is, to idenfity the gargabe collector that should be used during the collection process. For instance, Java program execution times differ greatly based on the employed garbage collection. It has not been possible to identify the optimal garbage collection algorithms for a specific program before exhaustively profiling the execution times for all available garbage collection algorithms. In this paper, the authors present an adaptive and concurrent garbage collection technique that can predict the optimal garbage collection algorithm for a program without going through all the garbage collection algorithms. The authors implement this technique in the Java virtual machine and test it using standard benchmark suites. The proposed technique learns the algorithms' usage pattern from different training program features and generates a model for future programs. Feature generation and selection are two important steps of this technique, which creates different attributes to use in the learning step. The experimental evaluation shows improvement in selecting the best garbage collection. Additionally, the proposed approach is helpful in finding better heap size settings for improved program execution.