Soft Computing: Theory Innovations and Problem Solving Benefits Minitrack

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The term soft computing is used in reference to a family of preexisting techniques, namely evolutionary computation, fuzzy logic, probabilistic reasoning, neuro-computing, and so on. Taking profit from the main advantages of each individual technique, they can work in a cooperative way 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. However, more complex systems arising in biology, health, economy, digital world, 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, which can better deal with large-scale, fast, and unstructured changes that occur as part of the digital world.

This minitrack aims to attract researchers with an interest in the research area described above. Specifically, not only contributions on theoretical innovations are welcome, but also those describing different problem-solving benefits by using soft computing-based methodologies in the fields of digital world, digital coaching, digital health, digital economy, and cognitive computing. This minitrack is interested in contributions in which 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, "A Rule-Learning Approach for Detecting Faults in Highly Configurable Software Systems from Uniform Random Samples", proposes to address the challenge of detecting faults in highly configurable software systems by working with a representative sample of the configurations, that is, a uniform random sample, and by processing the results of testing the sample with a rule induction system that extracts the faults causing the tests to fail. This paper gives a concrete implementation of the approach, compares the performance of the rule learning algorithms AQ, CN2, LEM2, PART, and RIPPER, and provides empirical evidence supporting the proposed procedure.

The second paper of this minitrack, "Smart Contract-based Consensus Building for Collaborative Medical Decision-Making", presents a collaborative medical decision-making platform using a consensus building mechanism implemented by using blockchain-based smart contracts to address the challenges associated with safeguarding, the privacy, security, and consent of all contributors, assuring integrity of the process. In such a way, it gives the participants confidence that both the decision-making process and the outcome can be trusted. This paper also presents a proof-of-concept implementation using the private Ethereum blockchain to demonstrate practicability.

The third paper of this minitrack, "A Granular Computing-Based Model for Group Decision-Making in Multi-Criteria and Heterogeneous Environments", introduces a new granular computing-based model for group decision-making processes defined in multi-criteria and heterogeneous environments that can improve with minimum adjustment both the consistency associated with individual decision-makers and the consensus related to the group. Unlike the existing granular computing-based approaches, it can consider a higher number of features when dealing with this kind of decision-making processes.

The fourth paper of this minitrack, "Review of Ultra-Wide Band (UWB) for Indoor Positioning with Application to the Elderly", presents a review of some previous works related to ultra-wide band (UWB) and indoor positioning systems (IPS) with the aim of proposing a new IPS design with UWB for the elderly that is evaluated in an intelligence laboratory environmental and in a residential center for the

URI: https://hdl.handle.net/10125/79593
978-0-9981331-5-7

elderly. It uses different IPSs, such as the time difference-of-arrival and fingerprinting methods in a hybrid IPS to improve the accuracy in locating elders.

The fifth paper of this minitrack, "Distance Transformations Based on Ordered Weighted Averaging Operators", attempts to solve one of the most critical problems in the application of distance transformations to real problems: their oversensitivity to certain spurious pixels which, even if having a minimal visual impact in the binary images to be compared, may have a severe impact on their distance transforms. With this aim, the authors combine distance transformations with ordered weighted averaging operators, a well-known information fusion tool from fuzzy set theory.

The sixth paper of this minitrack, "On the Role of Context-Awareness in Binary Image Comparison", creates a context-aware comparison measure for binary images. More precisely, the authors intend to design an ultrametric that quantifies the dissimilarity between any two images within the context of comparison. The quantified distance between two images not only depends on their coincidences and divergences, but also on the characteristics of the remaining images within the context. By including the context of comparison, the proposed measure brings the process closer to how humans perform comparisons.

The seventh paper of this minitrack, "Bayesian Augmentation of Deep Learning to Improve Video Classification", aims to explore blending of the connectionist and Bayesian tribes to classify videos and images with the goal of allowing the classification model to measure its uncertainty in each prediction. The approach taken herein consists of a convolutional neural network for image classification, a recurrent neural network for sequences of images (video) classification, with a Bayesian neural network incorporated to measure uncertainty. Comparisons are made against the baseline, non-Bayesian equivalent, algorithm. Results show a significant improvement in classification accuracy when using the hybrid approach.

The eighth paper of this minitrack, "Combinations of Affinity Functions for Different Community Detection Algorithms in Social Networks", proposes to use novel combinations of affinity functions, which are designed to capture different social mechanics in the network interactions. The authors use them to extend already existing community detection algorithms (Lovaine algorithm, the Greedy modularity algorithm, and Girvan-Newman algorithm) to combine the capacity of the affinity functions to model different social interactions than those exploited by the original algorithms.

Finally, the ninth paper of this minitrack, "Linear Hybrid Shrinkage of Weights for Forecast Selection and Combination", introduces Linear Hybrid Shrinkage (LHS), a novel method using information criteria from statistical learning theory to select forecasters and then shrinks the selection from their in-sample optimal weights linearly towards equality, while shrinking the non-selected forecasts towards zero. Simulation results show conditions (scenarios) where LHS leads to higher accuracy than LASSO-based Shrinkage, Linear Shrinkage of in-sample optimal weights, and a simple averaging of forecasts.