Guest Editorial Preface

Special Issue on Advanced Metaheuristic Computing for Engineering Applications

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Heuristics are considered well-known problem-solving techniques that have a significant role in several domains including engineering, economics, social science, and psychology. It is mainly involved to solve situations that have incomplete information and/or insufficient knowledge about the problem under consideration particularly in the optimization context. These heuristics-based techniques became popular till the early decades of the twentieth century. Consequently, metaheuristics are considered the upper-level heuristics that perform superior performance compared to heuristics. Metaheuristics exhibit several properties, such as parallelizability, simplicity, and applicability to different optimization problems including real parameter optimization, mixed integer optimization and combinatorial optimization (Dey et al., 2014; Dey et al., 2015; Naik, Satapathy, Ashour, & Dey, 2016; Satapathy, Raja, Rajinikanth, Ashour, & Dey, 2016; Kausar, Palaniappan, Samir, Abdullah, & Dey, 2016; Karaa et al., 2016; Karaa et al., 2016; Sghaier, Farhat, & Souani, 2018; Virmani, Dey & Kumar, 2016; Hore et al., 2016). These properties increase the use of the metaheuristics in different domains to solve complex optimization problems. Many optimization problems in engineering require solutions in a short time with high accuracy. Such engineering problems include the synthesis of distillation columns and the synthesis of heat and mass exchange equipment, and static/dynamic bioreactors optimization.

OBJECTIVE OF THE SPECIAL ISSUE

Advancement of different metaheuristics becomes an emerging domain to support various engineering applications. This special issue provides cutting-edge research procedures in associated computational intelligence areas and their applications in real-world engineering processes. The goal of this special issue is to bring together researchers in metaheuristics and engineering applications. It addresses innovative researches along the five studies dealing with metaheuristics in different applications.

ORGANIZATION OF THE SPECIAL ISSUE

The special issue is organized into seven manuscripts with the following brief description:

1. Enhanced Directed Differential Evolution Algorithm for Solving Constrained Engineering Optimization Problems

An enhanced DE algorithm has been proposed, where the mutation scheme sorts all the individuals ascending due to their constraint violations (cv) values, then two random selected vectors have been used on the top and the bottom 100p% individuals in the studied population of size NP while the third vector is selected randomly from the middle (NP-2(100p %)). The evaluation results have been conducted on two test problems' sets having different features, where the first set have a 24 well-known benchmark test functions and the second set have five constrained engineering design problems. The results established the competitiveness of the proposed method in some cases and superiority in other cases in terms of quality, efficiency and robustness.

2. Analysis of Precipitation Variability using Memory based Artificial Neural Networks

A memory based ANN models (GMNN) and genetically optimized GMNN (GMNN-GA) for downscaling precipitation series have been applied to analyze the precipitation variability on the Barak river basin. The proposed method used the advantages of both the GMNN and the GMNN-GA, namely having adaptive memory depth and the performance improvement; respectively. The model performances have been analyzed by using statistical criteria, such as the root-mean square error and mean error. A comparative study with the standard SDSM model has been conducted. The experimental results on 24 years of daily data sets established that GMNN-GA is efficient in downscaling daily precipitation series with maximum daily annual mean error of 6.78%. In addition, the GMNN-GA model execution is superior to the GMNN and similar to the standard SDSM.

3. Cross-Project Change Prediction Using Meta-Heuristic Techniques

A hybrid decision tree genetic algorithm and oblique decision tree with evolutionary learning have been applied in various intra-project and cross-project change predictions using distributional characteristics of dataset. The effectiveness of meta-heuristic decision trees has been analyzed in generating rules for successful cross-project change prediction. The proposed meta-heuristic algorithms' performance has been compared with C4.5 decision tree model. The results established 73.33%, 75.00% and 75.56% accuracies of the C4.5 decision tree, the hybrid decision tree genetic algorithm and the oblique decision tree; respectively.

4. Bounded, Multidimentional, Integrated Memetic Evolution for Character Recognition Based on Predictive Elimination Theory and Optimization Techniques

In this work, various optimization parameters of a heuristic approach have been considered for an improvised algorithm to integrate the self-learning technique of Memetic algorithm (MA). Variety of problem domains ranging from discrete optimization, continuous optimization, constrained optimization and multi objective optimization using MAs have been successfully implemented. The results established that the proposed technique has good performance for solving combinatorial optimization problems.

5. A Generalized and Robust Anti-Predatory Nature-Inspired Algorithm for Complex Problems

A novel nature-inspired algorithm that adapts the anti-predatory frog's behavior has been applied. The proposed optimization algorithm has been evaluated on sixteen benchmark functions with compared to the results of six well-known algorithms under different unconstrained mathematical

benchmark functions based on best and worst values as well as mean and standard deviation of the computed results. For statistical analysis, the Friedman rank test and the Holm-Sidak test have been used. The proposed algorithm ranks first in the case of 'best result' and scores second rank in the case of 'standard deviation'.

6. Local search strategy embedded ABC and its application in cost optimization model of project time schedule

An artificial bee colony (ABC) metaheuristic algorithm has been developed by embedding the local search strategy in the basic structure of ABC. The proposed scheme, called LS-ABC has been tested with comparative study with state-of-art algorithms over 12 benchmark functions. The results demonstrated the efficiency of the proposed modified variant of ABC to solve several applications.

7. Environmental Adaption Method: A Heuristic Approach for Optimization

In this study, a novel Environmental Adaption Method (EAM) optimization algorithm is proposed to reduce the overall processing time while solving the optimization problems. The comparative results with the particle swarm optimization (PSO-TVAC), and differential evolution (SADE) on benchmark functions established the superiority of the proposed EAM algorithm along with its robustness and superior stability in nature.

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REFERENCES

Ahmed, S. S., Dey, N., Ashour, A. S., Sifaki-Pistolla, D., Bălas-Timar, D., Balas, V. E., & Tavares, J. M. R. (2017). Effect of fuzzy partitioning in Crohn's disease classification: A neuro-fuzzy-based approach. *Medical & Biological Engineering & Computing*, *55*(1), 101–115. doi:10.1007/s11517-016-1508-7 PMID:27106754

AlShahrani, A. M., Al-Abadi, M. A., Al-Malki, A. S., Ashour, A. S., & Dey, N. (2017). Automated system for crops recognition and classification. In Applied Video Processing in Surveillance and Monitoring Systems (pp. 54–69). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-1022-2.ch003

Azzabi, O., Njima, C. B., & Messaoud, H. (2017). New Approach of Diagnosis by Timed Automata. *International Journal of Ambient Computing and Intelligence*, *8*(3), 76–93. doi:10.4018/IJACI.2017070105

Ben Abdessalem Karaa, W., Ben Azzouz, Z., Singh, A., Dey, N., & Ashour, S, A., & Ben Ghazala, H. (2016). Automatic builder of class diagram (ABCD): An application of UML generation from functional requirements. *Software, Practice & Experience*, *46*(11), 1443–1458. doi:10.1002/spe.2384

Chatterjee, S., Hore, S., Dey, N., Chakraborty, S., & Ashour, A. S. (2017). Dengue Fever Classification Using Gene Expression Data: A PSO Based Artificial Neural Network Approach. In *Proceedings of the 5th International Conference on Frontiers in Intelligent Computing: Theory and Applications* (pp. 331-341). Singapore: Springer. doi:10.1007/978-981-10-3156-4_34

Chatterjee, S., Sarkar, S., Hore, S., Dey, N., Ashour, A. S., Shi, F., & Le, D. N. (2017). Structural failure classification for reinforced concrete buildings using trained neural network based multi-objective genetic algorithm. *Structural Engineering and Mechanics*, *63*(4), 429–438.

Dey, N., Ashour, A. S., Beagum, S., Pistola, D. S., Gospodinov, M., Gospodinova, E. P., & Tavares, J. M. R. (2015). Parameter optimization for local polynomial approximation based intersection confidence interval filter using genetic algorithm: An application for brain MRI image de-noising. *Journal of Imaging*, *1*(1), 60–84. doi:10.3390/jimaging1010060

Dey, N., Ashour, A. S., Shi, F., & Sherratt, R. S. (2017). Wireless Capsule Gastrointestinal Endoscopy: Direction of Arrival Estimation based Localization Survey. *IEEE Reviews in Biomedical Engineering*, *10*, 2–11. doi:10.1109/RBME.2017.2697950 PMID:28459696

Dey, N., Samanta, S., Chakraborty, S., Das, A., Chaudhuri, S. S., & Suri, J. S. (2014). Firefly algorithm for optimization of scaling factors during embedding of manifold medical information: An application in ophthalmology imaging. *Journal of Medical Imaging and Health Informatics*, *4*(3), 384–394. doi:10.1166/jmihi.2014.1265

Hemalatha, S., & Anouncia, S. M. (2017). Unsupervised Segmentation of Remote Sensing Images using FD Based Texture Analysis Model and ISODATA. *International Journal of Ambient Computing and Intelligence*, *8*(3), 58–75. doi:10.4018/IJACI.2017070104

Hore, S., Chatterjee, S., Sarkar, S., Dey, N., Ashour, A. S., Balas-Timar, D., & Balas, V. E. (2016). Neural-based prediction of structural failure of multistoried RC buildings. *Structural Engineering and Mechanics*, *58*(3), 459–473. doi:10.12989/sem.2016.58.3.459

Jagatheesan, K., Anand, B., Baskaran, K., Dey, N., Ashour, A. S., & Balas, V. E. (2018). Effect of nonlinearity and boiler dynamics in automatic generation control of multi-area thermal power system with proportional-integral-derivative and ant colony optimization technique. In *Recent Advances in Nonlinear Dynamics and Synchronization* (pp. 89–110). Cham: Springer. doi:10.1007/978-3-319-58996-1_5

Karaa, W. B. A., Ashour, A. S., Sassi, D. B., Roy, P., Kausar, N., & Dey, N. (2016). Medline text mining: an enhancement genetic algorithm based approach for document clustering. In *Applications of Intelligent Optimization in Biology and Medicine* (pp. 267–287). Springer International Publishing. doi:10.1007/978-3-319-21212-8_12

Kausar, N., Palaniappan, S., Samir, B. B., Abdullah, A., & Dey, N. (2016). Systematic analysis of applied data mining based optimization algorithms in clinical attribute extraction and classification for diagnosis of cardiac patients. In *Applications of intelligent optimization in biology and medicine* (pp. 217–231). Springer International Publishing. doi:10.1007/978-3-319-21212-8_9

Khachane, M. Y. (2017). Organ-Based Medical Image Classification Using Support Vector Machine. *International Journal of Synthetic Emotions*, *8*(1), 18–30. doi:10.4018/IJSE.2017010102

Li, Z., Dey, N., Ashour, A. S., Cao, L., Wang, Y., Wang, D., & Shi, F. et al. (2017). Convolutional Neural Network Based Clustering and Manifold Learning Method for Diabetic Plantar Pressure Imaging Dataset. *Journal of Medical Imaging and Health Informatics*, *7*(3), 639–652. doi:10.1166/jmihi.2017.2082

Li, Z., Dey, N., Ashour, A. S., & Tang, Q. (2017). Discrete cuckoo search algorithms for two-sided robotic assembly line balancing problem. *Neural Computing & Applications*.

Li, Z., Shi, K., Dey, N., Ashour, A. S., Wang, D., Balas, V. E., & Shi, F. et al. (2017). Rule-based back propagation neural networks for various precision rough set presented KANSEI knowledge prediction: A case study on shoe product form features extraction. *Neural Computing & Applications*, *28*(3), 613–630. doi:10.1007/s00521-016-2707-8

Malik, S., & Khatter, K. (2018). Malicious Application Detection and Classification System for Android Mobiles. *International Journal of Ambient Computing and Intelligence*, *9*(1), 95–114. doi:10.4018/IJACI.2018010106

Naik, A., Satapathy, S. C., Ashour, A. S., & Dey, N. (2016). Social group optimization for global optimization of multimodal functions and data clustering problems. *Neural Computing & Applications*.

Saba, L., Dey, N., Ashour, A. S., Samanta, S., Nath, S. S., Chakraborty, S., & Suri, J. S. et al. (2016). Automated stratification of liver disease in ultrasound: An online accurate feature classification paradigm. *Computer Methods and Programs in Biomedicine*, *130*, 118–134. doi:10.1016/j.cmpb.2016.03.016 PMID:27208527

Samanta, S., Choudhury, A., Dey, N., Ashour, A. S., & Balas, V. E. (2016). *Quantum inspired evolutionary algorithm for scaling factors optimization during manifold medical information embedding. Quantum Inspired Computational intelligence: Research and Applications*. Elsevier.

Sambyal, N., & Abrol, P. (2016). Feature based Text Extraction System using Connected Component Method. *International Journal of Synthetic Emotions*, *7*(1), 41–57. doi:10.4018/IJSE.2016010104

Satapathy, S. C., Raja, N. S. M., Rajinikanth, V., Ashour, A. S., & Dey, N. (2016). Multi-level image thresholding using Otsu and chaotic bat algorithm. *Neural Computing & Application*.

Sghaier, S., Farhat, W., & Souani, C. (2018). Novel Technique for 3D Face Recognition Using Anthropometric Methodology. *International Journal of Ambient Computing and Intelligence*, *9*(1), 60–77. doi:10.4018/IJACI.2018010104

Sharma, K., & Virmani, J. (2017). A Decision Support System for Classification of Normal and Medical Renal Disease Using Ultrasound Images: A Decision Support System for Medical Renal Diseases. *International Journal of Ambient Computing and Intelligence*, *8*(2), 52–69. doi:10.4018/IJACI.2017040104

Trabelsi, I., & Bouhlel, M. S. (2017). Feature Selection for GUMI Kernel-Based SVM in Speech Emotion Recognition. In Artificial Intelligence: Concepts, Methodologies, Tools, and Applications (pp. 941-953). IGI Global. doi:10.4018/978-1-5225-1759-7.ch038

Virmani, J., Dey, N., & Kumar, V. (2016). PCA-PNN and PCA-SVM based CAD systems for breast density classification. In *Applications of intelligent optimization in biology and medicine* (pp. 159–180). Springer International Publishing.

Wang, D., Li, Z., Cao, L., Balas, V. E., Dey, N., Ashour, A. S., & Shi, F. et al. (2016). Image Fusion Incorporating Parameter Estimation Optimized Gaussian Mixture Model and Fuzzy Weighted Evaluation System: A Case Study in Time-Series Plantar Pressure Data Set. *IEEE Sensors Journal*, *17*(5), 1407–1420. doi:10.1109/JSEN.2016.2641501