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Intelligent approaches to complex systems

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Abstract

Availability of large amount and variety of information and decision making problems in various complex systems ranging from transportation, supply chain, energy to logistics; have placed the need for the development & successful application of advanced intelligent approaches. It is argued that intelligent approaches such as analytics and optimisation techniques drive smarter decisions, faster actions and optimise outcomes in this era. However, there are no single best analytical or optimisation technique to deal with the challenges in various complex systems. It is due to the fact that a technique/approach may show a better performance for a given problem instance; but, it does not guarantee better solution when applied to decision making problems in other areas. Hence, the development of new solution techniques or modifications of existing techniques are very much needed to suit the decision making problem at hand. This special issue focuses on fast-growing and promising area of intelligent approaches applied to complex systems that have drawn great deal of attention from researchers over the years.

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Intelligent Approaches to Complex Systems

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Availability of large amount and variety of information and decision making problems in various complex systems ranging from transportation, supply chain, energy to logistics; have placed the need for the development & successful application of advanced intelligent approaches. It is argued that intelligent approaches such as analytics and optimisation techniques drive smarter decisions, faster actions and optimise outcomes in this era. However, there are no single best analytical or optimisation technique to deal with the challenges in various complex systems. It is due to the fact that a technique/approach may show a better performance for a given problem instance; but, it does not guarantee better solution when applied to decision making problems in other areas. Hence, the development of new solution techniques or modifications of existing techniques are very much needed to suit the decision making problem at hand. This special issue focuses on fast-growing and promising area of intelligent approaches applied to complex systems that have drawn great deal of attention from researchers over the years.

One particular focus of this special issue is to bring together different aspects of nature inspired computing research work on neural networks, support vector machines, fuzzy logic and evolutionary computation. This special issue cover a wide range of applications from pattern recognition and system modelling, to intelligent control problems and biomedical applications. These methods in itself or combined with others can inform each other for better accuracy, computational time, and computational cost. The anticipated areas of application for this research theme are transportation systems, manufacturing & industrial systems, logistics and supply chain, healthcare systems.

One of the major methodological areas which have received considerable attention in past decade is nature inspired evolutionary optimisation approaches. These methods have been successfully used in resolving optimisation problems in variety of areas such healthcare [1], transportation [2, 3], logistics ([4, 5]), industrial planning [6], scheduling [7-9], manufacturing [10-14], and service systems [15, 16]. Das *et al.* [17] have tried to link different phases of Product Life cycle (PL) such as design, manufacturing and service via surrogate modelling and multi-disciplinary optimization (MDO) approach. Prakash et al., [18] proposed a constraint-based simulated annealing (CBSA) approach to solve the disassembly scheduling problem. Prakash et al., [19] presented approach for metrology site selection in semi-conductor industry using Forward Component Site Selection (FSCA). Shukla

et al., [4] presented a novel approach by using portfolio of algorithms to address logistics problem considering stochastic demands and mobility allowance. Tyagi et al. [20] proposed an evolutionary sticker based DNA algorithm to solve an optimal part orientation problem in layered manufacturing. Tyagi et al. [21] developed a fuzzy goal programming model for optimization of lead time and cost in an overlapped product development using a Gaussian Adaptive Particle Swarm Optimization-based approach. Further, a non-discrete ant colony optimisation (NdACO) has been proposed by Tyagi et al. [22] in order to find out the optimal lead time and cost in a product development project.

Another area is data mining and machine learning where several intelligent approaches have been used to resolve real life problems. Such examples include rainfall prediction [23], wastewater influent flow prediction [24], wastewater quality prediction [25, 26], over-temperature prediction [27] where authors have developed/utilized advanced neural network approaches to develop long term prediction models. Shukla, et al., [28] have used fuzzy- neural network approach for solving trave mode choice prediction for large scale urban transportation systems simulation and planning. Another approach based on pattern mining has been applied to the radio frequency identification dataset in hospital for staff and patient movements analysis [16].

We are happy to edit this special issue and believe that it brings together the some of the cutting edge research in multi-disciplinary domain. The special issue on intelligent approaches to complex systems is a compilations of some of the cutting-edge research going in different domains by utilizing advance analytics and optimization tools from decision sciences to address the problems in manufacturing processes, inventory management, weather prediction, and supply chain. The guest editors would also like to thank Professor Nickolas S. Sapidis, Editor-in-chief of International Journal of Intelligent and Engineering Informatics and, for his invitation to edit the special issue. Special thanks are herewith extended as well to all contributors and anonymous referees for their valuable time and efforts in the review process.

The special issue starts with bibilometric analysis on two most utilized methods in decision sciences analytic hierarchy process (AHP), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) and their hybrid methods [29]. The issue presents a novel knowledge driven approaches to solve sensor placement problem in assembly processes [30]. An approach for capacity planning is proposed under price and demand uncertainty using inter programming or optimization and Markowitz mean-variance model for risk assessment [31]. To address one of the complex predictive problem of weather forecasting recurrent neural network is proposed and validated by [32]. To enhance the classification capability, Iquebal and Pal, [33] have proposed integration of the Mahalanobious Taguchi transformation with Artificial Bee Colony Optimization. To further enhance the autonomous

decision making capability at different stages in the lamb supply chain a multi-agent architecture based framework is proposed by Mishra *et al.* [34].

References

1. Buscema, M., et al., *An optimized experimental protocol based on neuro-evolutionary algorithms: Application to the classification of dyspeptic patients and to the prediction of the effectiveness of their treatment.* Artificial Intelligence in Medicine, 2005. **34**(3): p. 279-305.
2. Lau, H.C.W., et al., *A fuzzy guided multi-objective evolutionary algorithm model for solving transportation problem.* Expert Systems with Applications, 2009. **36**(4): p. 8255-8268.
3. Shukla, N., et al., *Hybrid agent based simulation with adaptive learning of travel mode choices for university commuters (WIP)*, in *Proceedings of the Symposium on Theory of Modeling & Simulation - DEVS Integrative M&S Symposium*. 2013, Society for Computer Simulation International: San Diego, California. p. 1-6.
4. Shukla, N., et al., *Algorithm portfolios for logistics optimization considering stochastic demands and mobility allowance.* International Journal of Production Economics, 2013. **141**(1): p. 146-166.
5. Shukla, N., M.K. Tiwari, and D. Ceglarek, *Genetic-algorithms-based algorithm portfolio for inventory routing problem with stochastic demand.* International Journal of Production Research, 2012. **51**(1): p. 118-137.
6. Kim, Y.K., K. Park, and J. Ko, *A symbiotic evolutionary algorithm for the integration of process planning and job shop scheduling.* Computers & Operations Research, 2003. **30**(8): p. 1151-1171.
7. Burke, E.K. and J.P. Newall, *A multistage evolutionary algorithm for the timetable problem.* Evolutionary Computation, IEEE Transactions on, 1999. **3**(1): p. 63-74.
8. Hindi, K.S., Y. Hongbo, and K. Fleszar, *An evolutionary algorithm for resource-constrained project scheduling.* Evolutionary Computation, IEEE Transactions on, 2002. **6**(5): p. 512-518.
9. Marchiori, E. and A. Steenbeek, *An Evolutionary Algorithm for Large Scale Set Covering Problems with Application to Airline Crew Scheduling*, in *Real-World Applications of Evolutionary Computing*, S. Cagnoni, Editor. 2000, Springer Berlin Heidelberg. p. 370-384.
10. Gonçalves, J.F. and M.G.C. Resende, *An evolutionary algorithm for manufacturing cell formation.* Computers & Industrial Engineering, 2004. **47**(2–3): p. 247-273.
11. Fleming, P.J. and R.C. Purshouse, *Evolutionary algorithms in control systems engineering: a survey.* Control Engineering Practice, 2002. **10**(11): p. 1223-1241.
12. França, P.M., et al., *Evolutionary algorithms for scheduling a flowshop manufacturing cell with sequence dependent family setups.* Computers & Industrial Engineering, 2005. **48**(3): p. 491-506.
13. Moon, C. and Y. Seo, *Evolutionary algorithm for advanced process planning and scheduling in a multi-plant.* Computers & Industrial Engineering, 2005. **48**(2): p. 311-325.
14. Verma, A.S., N; Shankar, R; Tiwari, M K, *Solving machine loading problem of FMS: an artificial intelligence (AI) based random search optimization approach*, in *Handbook of Computational Intelligence in Manufacturing and Production Management*, P.L. Mandal, D, Editor. 2008, IGI Global. p. 19-43.
15. Canfora, G., et al., *An approach for QoS-aware service composition based on genetic algorithms*, in *Proceedings of the 7th annual conference on Genetic and evolutionary computation*. 2005, ACM: Washington DC, USA. p. 1069-1075.
16. Shukla, N., J. Keast, and D. Ceglarek, *Modelling variations in hospital service delivery based on real time locating information.* Applied Mathematical Modelling, 2014. **38**(3): p. 878-893.
17. Das A., F.P., Prakash PKS, Ceglarek, D., *Transfer function of assembly process with compliant non-ideal parts*, in *24th CIRP Design Conference*. 2014: Milano, Italy.

18.   Prakash, P.K.S., D. Ceglarek, and M.K. Tiwari, *Constraint-based simulated annealing (CBSA) approach to solve the disassembly scheduling problem.* The International Journal of Advanced Manufacturing Technology, 2012. **60**(9-12): p. 1125-1137.

19.   Prakash, P., et al. *Optimal wafer site selection using forward selection component analysis*. in *Advanced Semiconductor Manufacturing Conference (ASMC), 2012 23rd Annual SEMI*. 2012.

20.   Tyagi, S.K., et al., *Optimal part orientation in layered manufacturing using evolutionary stickers-based DNA algorithm.* Virtual and Physical Prototyping, 2007. **2**(1): p. 3-19.

21.   Tyagi, S.K., et al., *Development of a fuzzy goal programming model for optimization of lead time and cost in an overlapped product development project using a Gaussian Adaptive Particle Swarm Optimization-based approach.* Engineering Applications of Artificial Intelligence, 2011. **24**(5): p. 866-879.

22.   Tyagi, S.K., K. Yang, and A. Verma, *Non-discrete ant colony optimisation (NdACO) to optimise the development cycle time and cost in overlapped product development.* International Journal of Production Research, 2011. **51**(2): p. 346-361.

23.   Kusiak, A., et al., *Modeling and Prediction of Rainfall Using Radar Reflectivity Data: A Data-Mining Approach.* Geoscience and Remote Sensing, IEEE Transactions on, 2013. **51**(4): p. 2337-2342.

24.   Wei, X., A. Kusiak, and H. Sadat, *Prediction of Influent Flow Rate: Data-Mining Approach.* Journal of Energy Engineering, 2012. **139**(2): p. 118-123.

25.   Kusiak, A., A. Verma, and X. Wei, *A data-mining approach to predict influent quality.* Environmental Monitoring and Assessment, 2013. **185**(3): p. 2197-2210.

26.   Verma, A., X. Wei, and A. Kusiak, *Predicting the total suspended solids in wastewater: A data-mining approach.* Engineering Applications of Artificial Intelligence, 2013. **26**(4): p. 1366-1372.

27.   Kusiak, A. and A. Verma, *Analyzing bearing faults in wind turbines: A data-mining approach.* Renewable Energy, 2012. **48**(0): p. 110-116.

28.   Shukla, N., Ma, J, Wickramasuriya, R; Huynh, N, *Data-driven Modelling and Analysis of Household Travel Mode Choice*, in *20th International Congress on Modelling and Simulation*. 2013: Adelaide, Australia,. p. 92-98.

29.   Mukherjee, K., *Past, Present and Future of AHP and TOPSIS.* IJIEI, 2014.

30.   Tiwari, P., Tiwari, M.K., *Knowledge driven sensor placement in multi-station manufacturing processes.* International Journal of Intelligent Engineering Informatics, 2014.

31.   Verma, A., Shukla, N; Mishra, N, *Stochastic Modeling and Optimization of Multi-plant Capacity Planning Problem.* IJIEI, 2014.

32.   Biswas, S.S., N; Purkayastha, B, *Weather Prediction by Recurrent Neural Network Dynamics.* IJIEI, 2014.

33.   Iquebal, A., Pal, A, *Artificial Bee Colony Optimization based Enhanced Mahalanobis Taguchi System for Classification.* IJIEI, 2014.

34.   Mishra, N., Morris, W; Singh, A, *A multi-agent architecture for lamb supply chain.* IJIEI, 2014.