Editorial

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Biographical notes: Ioannis K. Nikolos received the BS Degree in Mechanical Engineering and the PhD Degree in fluid mechanics from the National Technical University of Athens, Greece, in 1990 and 1996 respectively. He is an Assistant Professor with the Department of Production Engineering and Management, Technical University of Crete, Greece. His research interests and his published work are in the fields of turbomachinery design, fluid mechanics and engineering design optimisation. He has published two books on Internal Combustion Engines and more than 55 papers in international refereed journals and conferences. He is a member of the ASME, IEEE, and AIAA.

This Special Issue on Artificial Intelligence (AI) Driven Engineering Design Optimisation of the *International Journal of Advanced Intelligence Paradigms* (*IJAIP*) includes five papers, which present AI-based methodologies to solve real-world engineering design optimisation problems from different disciplines. The papers are more oriented towards the engineering applications of the AI methodologies and demonstrate their applicability in completely different technological areas.

In the paper entitled 'Evolutionary-fuzzy scheduling of WIP inventory in manufacturing systems', by Professor N.C. Tsourveloudis, the main question that is faced is the following: how robust and generic is the controller that comes out of an evolutionary process? The large size of real production systems along with the effects of random failures occurring in such systems, do not allow for an analytic treatment. Therefore, AI-based treatments have been employed for many important problems, such Work-in-Process (WIP) minimisation. Fuzzy logic was particularly introduced in this area by Professor N.C. Tsourveloudis and his co-workers in cases of production lines and networks with unpredicted failure prone behaviour. But how much reliable, robust and generic an AI/fuzzy logic solution can be? How well a heuristic scheduling controller accommodates situations different than the ones used in its design? These and more questions are faced in the paper by Professor N.C. Tsourveloudis in the context of manufacturing systems that must produce in an unstable and highly changing environment.

The paper entitled 'Ant Colony Optimisation solution to distribution transformer planning problem', by E.I. Amoiralis et al. proposes a methodology based on ant colony optimisation for the optimal choice of transformer sizes to be installed in a distribution network. The optimal transformer sizing in a multi-year planning period is the selection of the transformer sizes and the years of their installation in order to serve a distribution substation load at the minimum total cost. Over-sizing a transformer may result in higher no-load losses, while its under-sizing may result in higher load losses. The Optimal Transformer Sizing problem is solved by means of a heuristic Ant System method using the Elitist strategy. It belongs to the family of Ant Colony Optimisation algorithms, biologically inspired meta-heuristics methods, in which a colony of artificial ants cooperates in finding good solutions (optimal paths) to difficult discrete optimisation problems. The possibility to upgrade the transformer size one or more times throughout the study period results to different sizing paths, and ant colony optimisation is applied in order to determine the least cost path, taking into account the transformer capital cost as well as the energy loss cost during the study period.

The next paper entitled 'Improved design of a centrifugal pump impeller using CFD and numerical optimisation tools', by V. Grapsas et al. investigates the possibility of improving the design and increasing the hydraulic performance and efficiency of a centrifugal pump, by means of Computational Fluid Dynamics (CFD) tools and an optimisation procedure. The task of designing a pump impeller is a very challenging procedure, as the role of internal flows and the viscous effects in centrifugal impeller blades are fundamental and should be taken properly into account in the design process. The developed methodology is based on the combination of a parameterisation code, used to create the 3D impeller geometry, an evolutionary based optimisation algorithm, and a commercial CFD software. The results verified that an optimal blade shape can considerably increase the impeller efficiency, and that a more elaborate optimisation can be achieved by increasing the number of design parameters (from 3 to 6). With the use of the evolutionary based optimisation methodology this gain can be achieved at almost no additional computational cost, since the algorithm converges in both cases at about the same number of flow field evaluations.

In the paper of Professor M. Ficko et al., entitled 'Solving of Floor Layout Problem in Flexible Manufacturing System by Genetic Algorithms', a Genetic Algorithm (GE) based methodology is utilised for the solution of a Floor Layout Problem (FLP), within the context of Flexible Manufacturing Systems (FMS). FMS is a manufacturing system which has the ability to react in the right way in case of changes, while FLP is the determination of the relative locations for, and the allocation of, the available space among a number of workstations, which is an NP-hard problem. The work presented in this paper deals with searching for the optimal placing of devices and machines so that the handling costs of the materials, semi-finished products and products within the system are the lowest possible. The proposed methodology is described and its application to a system consisting of 15 different machines is finally presented.

In the last paper, entitled 'Artificial Neural Network and Differential Evolution methodologies used in single- and multi-objective formulations for the solution of subsurface water management problems', by Professor I.K. Nikolos et al. a single- and a multi-objective Differential Evolution (DE) algorithms are combined with an Artificial Neural Network (ANN) to find the optimal operational strategies for covering the water demand in the northern part of Rhodes island in Greece. The simulation and management of an environmental physical system, such as the hydraulic response of an aquifer to an extent pumping activity, is a very challenging problem. The use of the ANN as an approximation model to such a physical system allows for the fast and easy testing of different optimisation scenarios, concerning different optimisation constraints, as the ANN does not need any retraining. In this paper a single-objective DE algorithm is initially used to run different optimisation scenarios for different sets of environmental constraints, using the same ANN model as an approximation to the physical system. Secondly, a multi-objective DE formulation is utilised to address the same problem and last, the comparison between the single and the multi-objective formulations is presented. It is demonstrated that the use of the multi-objective DE algorithm is very useful for providing a set of optimal solutions for different degrees of constraint violations in a single run, instead of a single optimal solution per run, provided by its single-objective counterpart.

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