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EDITORS PREFACE TO ISSUE

Journal of Intelligent Industrial Systems: Preface to Volume no 2 Issue no 1

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The new issue of the Journal of Intelligent Industrial Systems analyses recent findings and advancements in several areas of control and robotics, electric power systems and computer integrated manufacturing. In the area of control methods, the interest is not only in systems described by ordinary differential equations (e.g. components of the electricity grid) but is also extended to systems described by partial differential equations (e.g. heat diffusion). Moreover, the problem of stability of the control loop under model and parametric imprecision, external perturbations and partially measurable state vector is treated. Next, the issue shifts its focus to decision making algorithms and optimized management with application to the electricity grid and to manufacturing systems. The presented results are concerned with decision support for maintenance activities' scheduling in industrial production, with fuzzy rule bases for improved management of spare-parts' warehouses, with bio-inspired optimization methods for coordination of relays in the electricity grid and finally with production scheduling under stochastic parameters and model uncertainty. Such results demonstrate that through intelligent computing and decision making schemes the functioning of industrial systems can become more secure and that production specifications and objectives can be also achieved.

In article "*Control of heat diffusion in arc welding using differential flatness theory and nonlinear Kalman Filtering*" authored by G. Rigatos and P.Siano, control of the heat diffusion in arc-welidng is analysed. This is important for achieving welding of high quality (needed for instance in ship building). The paper proposes a distributed parameter systems' control method that is based on differential flatness theory, aiming at solving the problem of heat distribution control in the arc-welding process. Besides it proposes a nonlinear filtering method, under the name Derivative-free nonlinear Kalman Filtering for reducing the number of real-time control measurements needed to implement the feedback control loop. The stability of the control method is confirmed analytically, while its efficiency is also evaluated through simulation experiments.

In article "*Control of three-phase voltage source converters using the Derivative-free nonlinear Kalman Filter*", authored by G. Rigatos and P. Siano, differential flatness properties of the three-phase voltage source converter (VSC) model are proven and the model's transformation in the Brunovksy (canonical) form is achieved. For the linearized canonical model of the converter a feedback controller is designed. At a second stage, a novel Kalman Filtering method (derivative-free nonlinear Kalman Filtering) is introduced. The proposed Kalman Filter is redesigned as disturbance observer for estimating additive input disturbances to the VSC model. These estimated disturbance terms are finally used by a feedback controller that enables the DC output of the converter track desirable setpoints. The efficiency of the proposed state estimation-based control scheme is tested through simulation experiments.

In article "*An integrated multi-criteria computer simulation-AHP-TOPSIS approach for optimum maintenance planning by incorporating operator error and learning effects*", by Azadeh et al. a solution is proposed for the problem of optimized maintenance activities in a production system, taking into account cost and reliability factors. An

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integrated multi-criteria approach is presented to optimize maintenance planning. Models of maintenance activities are usually of elevated complexity and include various parameters. In this article. production and maintenance functions are estimated by means of historical data. Maintenance activities with different scenarios along with probability of human error and learning effects are discussed. The scenarios are generated from a combination of inputs such as time between preventive maintenance, number of operators and skills. Different outputs such as reliability, machine availability, human errors and cost are obtained from these scenarios. The outputs are analysed to reach an optimized maintenance scenario by using an integrated analytical hierarchy process (AHP) and techniques for order preference by similarity to ideal solution (TOPSIS). The applicability of this approach is shown in an actual production line with four series of machines. The results of this study can be helpful for decision makers to choose the best policy of maintenance planning. This is one of the first studies that optimize reliability and human cost by considering human error and learning effects through an integration of the AHP and TOPSIS approaches.

In article "*Optimum coordination of directional overcurrent relays using modified adaptive teaching learning-based optimization algorithm*", by A. Kalage et al. a solution is proposed for the problem of relays coordination in the electricity grid. This is a highly constrained optimization problem. Heuristic techniques are often used to solve optimization problems. These techniques may converge to a non-optimum solution due to the wide range of design variables. On the other hand, proper initialization of the optimization algorithm becomes difficult when a shorter range of design variables is considered. This paper presents modified adaptive teaching-learning based optimization (MATLBO) algorithm to overcome this drawback of conventional heuristic techniques. The coordination problem is formulated as a constrained nonlinear optimization problem to determine the optimum solution for the time multiplier setting (TMS) and plug setting (PS) of directional overcurrent relays (DOCRs). Initial solution for TMS is heuristically obtained with the commonly chosen widest range for TMS values. The upper bound of TMS range is then substituted by the maximum TMS value in the first initial solution. A next phase of optimization is carried out with the new range of TMS for the pre-determined iterations of teacher phase. Consequent to the completion of the teacher phase, a new upper bound is obtained from the available solution and optimization is carried out for the predetermined iterations of learner phase. This process is repeated to get a close-to-optimum solution. Fixed range for PS is used to obtain the selectivity. Such a strategy of iteratively updating the upper bound of TMS range shows remarkable improvement over the techniques which employ fixed TMS range. This algorithm is tested on different power-grid configurations and has been found quite effective. Four test case studies have been presented in this article. A possible application of the method is in distributed generation (DG) when using superconducting fault current limiters to mitigate DG impact.

In article "*Prioritization of tools in joint production-maintenance environment of auto component manufacturer using AHP-Fuzzy-TOPSIS*" by S. Sharma et al. the problem of optimized management of a tools and spare-parts warehouse is analysed. Maintenance of tools is one of the areas of maintenance which has been less explored. While maintenance of machinery has a number of research works to its cause, the same cannot be said for tools. In this paper, the authors have identified the unique maintenance needs of the tools and the challenges appearing in case of joint production maintenance environment, especially with regard to efficient allocation of resources. Various methods of maintenance planning are reviewed and their suitability is studied. Due to resources' constraints, prioritization of tools for maintenance becomes important. In this work, the environment of an auto-component manufacturer has been considered, where there is a number of tools which needs to be serviced on the basis of time and counter. The approach proposed for prioritization is AHP-Fuzzy TOPSIS, as it provides the best combination of quantitative as well as qualitative parameters. Through the use of this method a final ranking has been reached which can be used by management for deciding on the optimum allocation of resources.

In article, "*A stochastic production scheduling model for VCM systems*", by S. Dao et al, a new stochastic production scheduling model is proposed and a Virtual Computer Integrated Manufacturing (VCIM) system is developed. This is an integrated VCIM production scheduling model with uncertainties, in which two sub-problems, namely agent selection and collaborative shipment scheduling, are fully integrated together to explore the opportunity for reducing the overall cost of products in a VCIM system. First, an explicit mathematical formulation of the proposed model is presented and then an innovative method to solve the problem, based on Monte Carlo simulation and optimisation solver, is proposed. Next, a comprehensive case study is provided to demonstrate the effectiveness of the proposed model. Finally, other aspects of the proposed model and optimisation solution method are discussed.

Through the above articles it has been demonstrated that industrial systems technology can result into a more effective and reliable functioning of machines and devices that constitute production systems and the electricity grid. The considered application examples have confirmed that elaborated schemes for control and decision making can significantly improve the performance of production processes and can optimize several industrial tasks, such as robotic welding, AC to DC electric power conversion, maintenance of machines in production units, coordination of relays in the

electric power transmission and distribution system, management of spare-parts in warehouses, and finally production planning. Convergence to optimality, despite model uncertainty and missing sensory information, is a feature of intelligent industrial systems. Methods and algorithms which achieve such optimality are among the topics of high importance for the Journal of Intelligent Industrial Systems.