International Journal of Simulation Modelling – **Volume 14, Number 2**

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DESIGN OF COUPLED SLIDER CRANK MECHANISM FOR ORBITING MOTION

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Abstract
The paper describes development of a novel orbiting mechanism. Target design is a shaking mechanism with a planar figure eight closed loop. Shaking dynamics depends on a cycling frequency as well on a reciprocating displacement. These two parameters are in the focus of preliminary design and analysis. Computational optimization and path definition were interrelated to core engineering work. Crucial novelty is an orbital motion created by a coupled slider crank mechanism. An academic package of the Solid Works Motion 2010 was employed for parts and assembly design, as well as for the subsequent mechanism analysis. The outcome design proved itself in operation with a smooth shaking motion over a closed loop and even more the uniformly distributed acceleration peaks within each cycle. 16 refs.
(Received in January 2014, accepted in January 2015. This paper was with the authors 5 months for 3 revisions.)

Key Words: *Orbiting Mechanism, Shaking Function, Fluid Stirring, Simulated Motion*

Pages 201-214

INCREASING THE EQUITY OF A FLOWER SUPPLY CHAIN BY IMPROVING ORDER MANAGEMENT AND SUPPLIER SELECTION

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Abstract
This work focuses on helping the decision-making process of a microenterprise, the central organisation of a flower-exporting supply chain, to satisfy the objective of increasing its equity value by 300 %, and that of the whole supply chain at the same time. A systems dynamics-based simulation model is developed to evaluate the order management process in the supply chain under study, its financial evaluation and a supplier selection module from the central firm. The objective is to increase the equity value of the central firm and the supply chain under study. The main contribution of this work is to model and simulate a real world supply chain for decision-making. Hence, this paper can be used by other supply chains as a reference for modelling and simulating themselves in order to improve their performance. 29 refs.
(Received in February 2014, accepted in November 2014. This paper was with the authors 4 months for 2 revisions.)

Key Words: *Order Management, Financial Management, Supplier Selection, Systems Dynamics, Simulation*

Pages 215-226

SIMULATION OPTIMISATION FOR OPERATING ROOM SCHEDULING

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Abstract
This paper presents a case study on operating room scheduling in a small hospital in Chile. Patient flow was represented using a discrete-event simulation model that considered the randomness associated with the primary activities of the entire process, which includes pre- and post-hospitalisation, surgery, surgery setup and recovery. A simulated annealing algorithm was implemented and connected to the simulation model to search for better patient schedules. Additionally, three dispatching rules, Shortest Processing Time (SPT), Longest Processing Time (LPT) and First-In, First-Out (FIFO) were used. The results showed that the simulated annealing approach, based on the *Cmax* objective function, obtained schedules that were 18 % better than the hospital's scheduling practices. The utilisation of dispatching rules also has a significant effect in the *Cmax* indicator. The SPT rule performed better than the hospital schedule in two of the three experiments considered in the study. 26 refs.
(Received in March 2014, accepted in January 2015. This paper was with the authors 1 month for 1 revision.)

Key Words: *Simulation Optimisation, Simulated Annealing, Operating Room, Scheduling*

Pages 227-237

VERIFICATION OF STATISTICAL CALCULATIONS IN INTERLABORATORY COMPARISONS BY SIMULATING INPUT DATASETS

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Abstract
In order to introduce a traceability chain into metrology computation, European project EMRP NEW 06 TraCIM was agreed between EC and European metrology association Euramet. One of the tasks of the project is also to establish random datasets and validation algorithms for verifying software applications for evaluating interlaboratory comparison results. Statistical analysis of different types of interlaboratory comparisons is based on numerous statistical quantities, which depend on the form of results reported by the participants, way of determining assigned value and its uncertainty, outliers etc. Complex statistical analysis is normally performed by using different software applications. In order to check the performance of those applications, we have developed validation software, which consists of a user interface, data generator and a module for calculating all standardised statistical quantities used for evaluating interlaboratory comparison results. This article is presenting our approach for verifying the validation software before offering it to the metrology community. The verification is based on simulating different cases of interlaboratory comparisons and on comparing results of statistical calculations between different SW packages like Wolfram Mathematica and Microsoft Excel. 15 refs.
(Received in March 2014, accepted in January 2015. This paper was with the authors 5 months for 1 revision.)

Key Words: *Interlaboratory Comparison, Validation Software, Performance Metrics, Verification, Simulation*

Pages 238-249

BUOYANCY-INDUCED FLOW AND HEAT TRANSFER OF POWER LAW FLUIDS IN A SIDE HEATED SQUARE CAVITY

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Abstract
This paper details the numerical study of laminar natural convection in a square enclosure filled with a non-Newtonian fluid. Thermal boundary conditions of the Dirichlet type are applied on the vertical walls of the enclosure while the horizontal ones are assumed adiabatic. A Power-law model is used to characterize the viscous behaviour of the purely viscous non-Newtonian fluids. The governing differential equations have been solved by the standard finite volume method and the hydrodynamic and thermal fields were coupled together using the Boussinesq approximation.

The effects of Power-law index (n) in the range $0.50 \leq n \leq 1.50$ on the heat and momentum transport are investigated for the values of Rayleigh number (Ra) in the range $10^1 \leq Ra \leq 10^4$ and a Prandtl number of $Pr = 10$.

We report accurate results of a systematic study with a focus on the most important buoyancy- induced flow and heat transfer characteristics. It is shown that the mean Nusselt number values increases with the increasing values of Rayleigh number for Newtonian as well as Power-law fluids. However, shear-thickening fluids ($n > 1$) are characterised with smaller $\overline{Nu}$ values. Finally, the onset of convection dominated heat transfer mechanism is shifted towards lower values of Ra for the shear-thinning fluids ($n < 1$). 29 refs.
(Received in April 2014, accepted in January 2015. This paper was with the authors 4 months for 2 revisions.)

Key Words: *Laminar Natural Convection, Differentially Heated Cavity, Mean Nusselt Number, Critical Rayleigh Number, Numerical Modelling*

Pages 250-264

SIMULATION OF LASER TRIANGULATION SENSORS SCANNING FOR DESIGN AND EVALUATION PURPOSES

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Abstract
Nowadays, computerized dimensional inspection is included in most manufacturing processes. Industrial vision systems, laser triangulation sensors (LTS) in particular, are responsible for ensuring dimensional and geometrical tolerance compliance. Computer-aided design / computer-aided engineering (CAD/CAE) plays an important role in the manufacturing process. However, in the design and engineering of LTS, there is no equivalent computer-aided tool to provide assistance to the process definition. This paper presents a simulation environment to assist with this issue. Based on the CAD files of the parts, all the parameters of an LTS sensor and its scanning strategy can be simulated in a virtual Direct3D environment. This simulation provides a re-creation of the camera acquisition, allowing collision and occlusion detection and ensures complete and effective digitalization. Furthermore, the capability of the process of tolerance compliance evaluation can be verified. Once the effectiveness of the process is proven, the simulation can be employed for continuous performance improvement and the incorporation of new parts. 28 refs.
(Received in May 2014, accepted in December 2014. This paper was with the authors 1 month for 1 revision.)

Key Words: *Sensors, Scanning, Digitalization, Industrial vision, Simulation*

Pages 265-277

EXPLORING THE CONTEXT AND PRACTICES OF EXPERT SIMULATION MODELLERS

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Abstract
Simulation modelling lacks a rich body of literature on practices of modellers in the real world. We study the context and some generic practices of expert simulation modellers to discover how the context of modellers may affect the practice of modelling and simulation. The results highlight that simulation modellers develop their models under a variety of contexts and their practices may be affected by their context. The problem area, the scope and the breadth of a problem, simulation software and the size and complexity of the model are some of the contextual factors which may affect a modeller's practices such as model development, documentation, maintenance and evaluation. For example, model maintenance is required only for large scale models developed for long term use. Similarly, varying level of documentation may be required depending on the client requirements and project needs. Our study is a valuable addition to the research investigating simulation practice in the real world. 24 refs.
(Received in May 2014, accepted in November 2014. This paper was with the authors 2 months for 2 revisions.)

Key Words: *Simulation Practice, Simulation Context, Contextual Factors, Modelling Process*

Pages 278-288

THE EFFECT OF LOSS-AVERSE BEHAVIOUR ON CAPACITY PORTFOLIO PLANNING FOR POWER SYSTEMS

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Abstract
A decision maker seldom behaves completely rationally when deciding on the investment in capacity portfolio for a power system. Thus his decision will certainly show some bias when compared with a truly risk-neutral one. In order to provide an in-depth analysis of such bias, this paper studies the issues influencing capacity portfolio planning for a power system when the decision maker is loss-averse. The investment decision is the result of the decision maker aiming to maximize utility, and the effect of this is investigated using a modified newsvendor model, in which the probability of abnormal electricity demand is considered. Theoretical proofs and numerical simulations are also presented to provide explanations of some counterintuitive findings. We find that bias in the capacity portfolio occurs whenever underage losses are greater than overage losses. Even where significant flexibility is installed, the loss-averse decision maker values dedicated capacity to a greater extent when building redundancy into the system capacity, and all of his decision bias will go towards building-in dedicated capacity rather than flexibility. The most interesting finding is that the probability and variance of abnormal demand are likely to be overestimated, and this will result in investing more dedicated capacity, not only for providing higher service levels in abnormal situations, but also for delivering greater operational profit. 27 refs.
(Received in July 2014, accepted in January 2015. This paper was with the authors 2 months for 1 revision.)

Key Words: *Capacity Portfolio, Loss-Averse, Uncertain Demand, Newsvendor Model*

Pages 289-298

A NEW APPLICATION MODEL OF LEAN MANAGEMENT IN SMALL AND MEDIUM SIZED ENTERPRISES

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Abstract
Although Lean management has been implemented by Vietnamese small and medium sized enterprises (SMEs) for more than ten years, the success rate as well as the sustainable effectiveness achieved by these firms remains limited. As revealed by the survey, the current model of implementation mainly focuses on Lean management tools such as 5S, Kaizen (continuous improvement) and Mieruka (visual management). A better implementation model is proposed with the focus laid on the central factor of "Tam the" – a Vietnamese word refers to the deep understanding of employees and managers about the benefits of their tasks and Lean management for themselves. A simulation model run by Crystal Ball software confirms the higher effectiveness of the proposed model, which provides scientific evidence to persuade practitioners to swiftly employ the new model of implementation. 33 refs.
(Received in August 2014, accepted in October 2014. This paper was with the author 1 month for 1 revision.)

Key Words: *Lean Management, Simulation, SMEs, "Tam the"*

Pages 299-312

A DECISION SUPPORT SYSTEM FOR CAPACITY PLANNING IN EMERGENCY DEPARTMENTS

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Abstract
In this article, we present a decision support system (DSS) for improving patient flow in emergency departments (EDs). The core of the system is a discrete-event simulation (DES) model that aims to support capacity planning in the ED, in view of controlling patients' length of stay (*LOS*). Conceptually, it regards the patient *LOS* as the result of different queueing systems, the behaviour of which is influenced by different types of capacities. Taking inputs from ED patient record data, the DSS allows to analyse the impact of different capacity changes on patient flow, and to detect efficient capacity combinations using data envelopment analysis (DEA). We report on the insights obtained from a case study in a large regional hospital in Belgium. 30 refs.
(Received in December 2014, accepted in March 2015. This paper was with the authors 2 months for 1 revision.)

Key Words: *Healthcare Management, Emergency Department, Patient Flow, Capacity Planning, Decision Support System*

Pages 313-324

AN AGENT-BASED SIMULATION MODEL FOR SUPPLY CHAIN COLLABORATIVE TECHNOLOGICAL INNOVATION DIFFUSION

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Abstract
Despite the wideness of the literature on technological innovation, the diffusion of the supply chain collaborative technology innovation has not still received much attention. This paper is an attempt to answer the question that how the supply chain collaborative technological innovations emerge and diffuse. An agent-based model of collaborative supply chain technological innovation including the supplier agents, manufacture agents and customer agents is established in this paper, and the simulation experiments are conducted in terms of two kinds of the competitive technology innovation diffusion process under four scenarios. The results show that the supply chain collaborative supply chain technological innovation diffusion is different from the traditional technology innovation diffusion, and the relationship between suppliers and manufacturers has important influence on diffusion speed and efficiency. 30 refs.
(Received, processed and accepted by the Chinese Representative Office.)

Key Words: *Agent-Based Model, Collaborative Technological Innovation, Supply Chain, China*

Pages 325-334

MULTIPLE TRAFFIC JAMS IN FULL VELOCITY DIFFERENCE MODEL WITH REACTION-TIME DELAY

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Abstract
A full velocity difference model for traffic flow, including driver's reaction time delay is considered. The uniform flow and traffic jams are interpreted through stability and bifurcation analysis. Specifically, the uniform flow is represented by the equilibrium of the model. Linear stability reveals that when the equilibrium loses its stability, local bifurcation turn up through Hopf bifurcations. To analyse the behaviour of the model after bifurcating, numerical continuation techniques are employed. Branches of oscillating solutions and the corresponding stabilities are obtained. It is shown that bifurcating oscillations can coexist and correspond to different traffic patterns. To visualize the spatial patterns, numerical simulations are performed, which are presented by velocity time histories and spatio-temporal diagrams. Analysing the characteristic features, these oscillating solutions are classified into three types, and further correspond to three types of traffic jams: almost traffic jams, width-equal traffic jam and width-alternated traffic jam. The obtained results provide an explanation of how multiple jams induced by driver's reaction time delay occur. 22 refs.
(Received, processed and accepted by the Chinese Representative Office.)

Key Words: *Full Velocity Difference Model, Reaction-Time Delay, Stability, Bifurcation, Numerical Continuation, Traffic Patterns*

Pages 335-348

SUPPLY CHAIN COORDINATION USING REVENUE-SHARING CONTRACT WITH DISTRIBUTOR'S EFFORT DEPENDENT DEMAND

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Abstract
Revenue-sharing contracts are a kind of mechanism aimed at improving performance and achieving precise coordination of the supply chain. In this paper, we analyse and develop the revenue-sharing contract model of the three-level supply chain with distributor's sales effort dependent demand. The paper discusses the impacts of sales efforts on coordination of the supply chain and explains the reasons why traditional revenue-sharing contracts cannot coordinate the supply chain in this condition. In order to coordinate the supply chain, supposing the distributor bears the sales effort costs, the paper proposes an improved revenue-sharing contract based on a quantity discount policy. Three conditions are taken into consideration: the improved contract is only implemented between the retailer and the distributor, only implemented between the distributor and the manufacturer, and implemented both between the retailer and the distributor and between the distributor and the manufacturer. The paper shows that the improved revenue-sharing contract can coordinate the supply chain by carrying it out in one transaction or two transactions of the three-level supply chain. By supposing the effort and the market demand satisfy the multiplication form, we characterize the optimal decision variables (sales effort and inventory quantity). At the end, a numerical example is given to demonstrate the correctness of this paper. 32 refs.
(Received, processed and accepted by the Chinese Representative Office.)

Key Words: *Supply Chain Coordination, Revenue-Sharing Contract, Effort, Quantity Discount*

Pages 349-358

FEEDBACK ANALYSIS OF INTERACTION BETWEEN URBAN DENSITIES AND TRAVEL MODE SPLIT

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Abstract
A feedback simulation model based on radial basis function neural networks is newly developed in this research to analyse the interaction between urban densities and travel mode split. The changes of populations, road mileages, travel mode split, and so on of the enlarging urbanized areas of different cities in China are studied for the trainings of the radial basis function neural networks constituting the proposed feedback model. Furthermore, the effect of different development policies for Beijing on distinct indicators of the urban density and trip shares of various travel modes is also evaluated by the newly developed model. It is found that stopping the quick urban sprawl of Beijing is the most important for the sustainable development of its urban transport. It is confirmed that the newly developed model is able to rationally explain the interactive correlation between urban densities and travel mode split of a city for its different development plans. 34 refs.
(Received, processed and accepted by the Chinese Representative Office.)

Key Words: *Urban Densities, Travel Mode Split, Radial Basis Function Neural Network, Feedback Simulation Modelling, Sustainable Urban Transport Development*

Pages 359-370

MODELLING AND SIMULATION OF QUALITY RISK FORECASTING IN A SUPPLY CHAIN

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Abstract
In recent years, the quality risks in supply chain are frequently encountered by Chinese's manufacturing enterprises, the aim of the paper is to present a manufacturer perspective methodology of forecasting quality risks in supply chain. To do it, firstly, we innovatively propose achieving factors of quality risks by the house of quality of quality function deployment. Secondly, an optimal selection approach regarding support vector machine parameters is suggested based on chaos particle swarm optimization, and then the forecasting model based on support vector machine is advanced. Finally, the experimental simulation of the model should be carried on some sample data. The results show that the forecasting accuracy and generalization ability of the proposed model is higher than particle swarm optimization-support vector machine on the same data sets. Therefore, the proposed method can be considered as a promising alternative method for forecasting quality risks in a supply chain from the perspective of manufacturers in China. 29 refs.
(Received, processed and accepted by the Chinese Representative Office.)

Key Words: *Quality Risks, Chaos Particle Swarm Optimization, Support Vector Machines, Forecast Modelling, Supply Chain, House of Quality, Quality Function Deployment*
