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Pages 5-15

## DECISION SUPPORT SYSTEM FOR GENERATING ERGONOMIC TOOL-HANDLES

Harih, G.
University of Maribor, Faculty of Mechanical Engineering, Laboratory for Intelligent CAD Systems, Maribor, Slovenia
E-Mail: gregor.harih@um.si

**Abstract**
Tool-handle design research has been previously limited to determination of diameters of cylindrical handles to increase performance, comfort and avoid acute and cumulative traumatic disorders. However, there is still lack of correct shape determination and systemization of the ergonomic design knowledge. To overcome these limitations, methodology to develop optimal sized and shaped tool-handles for a target population previously developed has been integrated into an existing ergonomics and aesthetics decision support system. The system allows a correct determination of tool-handle size and shape according to the target population and provides general ergonomics knowledge. Resulting handles consider optimal diameters for each finger to maximize maximum voluntary contraction, comfort and contact area, which can lower the risk of acute and cumulative trauma disorders. The system allows development of ergonomic tool-handles with almost no prior ergonomics knowledge and without iterative design process, which decreases the designing time. 42 refs.
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**Key Words:** *Ergonomics, Tool-Handle, Material Choice, Finite Element Method, Decision Support System*

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Pages 16-29

## IMPROVEMENT OF A DISTRIBUTION NETWORK OF A DIRECT SALE COSMETICS SUPPLY CHAIN

Diez, M.; Mula, J. & Campuzano-Bolarin, F.
Coordinador de Logística, Amcor Rigid Plastics Ecuador S.A., Guayaquil, Ecuador
E-Mail: marco.diez@amcor.com

**Abstract**
Consistent studies assessing the impact of the strategic decision of distribution nodes with no-financial key performance indicators are lacking. This work focuses on studying how the distribution system of a direct sale cosmetics supply chain behaves and on generating decision-making scenarios relating to the definition and size of distribution nodes. A systems dynamics-based simulation tool deals with a strategic decision and size of distribution nodes in a reduced direct sale supply chain of cosmetic products. The methodological approach presented herein allows to analyse how existing facilities operate and to verify their performance. Finally, this work provides a reference conceptual model for the strategic definition of distribution nodes. 27 refs.
(Received in October 2012, accepted in June 2013. This paper was with the authors 3 months for 3 revisions.)

**Key Words:** *Supply Chain Management, Distribution Management, Logistics, Simulation*

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Pages 30-41

## MODELLING OF A TURNING PROCESS USING THE GRAVITATIONAL SEARCH ALGORITHM

Hrelja, M.; Klancnik, S.; Balic, J. & Brezocnik, M.
University of Maribor, Faculty of Mechanical Engineering, Maribor, Slovenia
E-Mail: marko.hrelja@um.si

**Abstract**
This paper proposes the modelling of a turning process using a gravitational search algorithm (GSA). GSA is an optimization algorithm based on Newton's law of universal gravitation and mass interactions. In order to sufficiently describe the turning process, at least three independent variables are required: cutting speed, feed-rate, and cutting depth. Independent variables have impacts on dependent variables, which were in our case cutting force, surface roughness, and tool-life. The values of independent and dependent variables obtained by measurements serve as a knowledge database for feeding the GSA optimization process. During our research the GSA was used for optimizing the numerical coefficients of predefined polynomial models for describing the observed output variables. The accuracies of the obtained prediction models were proved by means of a testing data set that was excluded from the training data. The research showed that the obtained results were comparable with the other optimization algorithms such as particle swarm optimization (PSO). However, the optimization time required for GSA optimization was, in certain cases, significantly shorter. 33 refs.
(Received in December 2012, accepted in August 2013. This paper was with the authors 2 months for 2 revisions.)

**Key Words:** *Machining, CNC Turning, Artificial Intelligence, Modelling, Gravitational Search Algorithm*

Pages 42-53

## ADIABATIC FLOW SIMULATION IN AN AIR-CONDITIONED VEHICLE PASSENGER COMPARTMENT

Zvar Baskovic, U., Lorenz, M. & Butala, V.
University of Ljubljana, Faculty of Mechanical Engineering, Ljubljana, Slovenia
E-Mail: zvar99@gmail.com

**Abstract**
Dispersion and flow of air in passenger compartments of vehicles are important to assure a comfortable environment for passengers, driver concentration and safe driving conditions. The article describes numerical adiabatic flow simulations for the „mute“, an electric car. Air streams in its passenger compartment were simulated; air velocities were compared while using different turbulence models. The turbulence models were selected upon being screened for best-suiting characteristics. The eddy-viscosity standard, RNG $k$-$\varepsilon$ and SST $k$-$\omega$ models were used. Near-wall approaches (standard wall functions, scalable wall functions and enhanced wall treatment) were checked against a test case from “European Research Community on Flow, Turbulence and Combustion" to determine the best choice for „mute“ passenger compartment air velocity simulations. 17 refs.
(Received in March 2013, accepted in September 2013. This paper was with the authors 3 months for 2 revisions.)

**Key Words:** *Air-Velocity Field, Electric Vehicle, CFD Simulation, Near-Wall Numerical Approaches, Turbulent Flow Modelling, Geometry, Thermal Comfort Model*

Pages 54-65

## MODELLING OF DYNAMIC COMPLIANCE OF FIXTURE/WORKPIECE INTERFACE

Todorovic, P.; Vukelic, D.; Tadic, B.; Veljkovic, D.; Budak, I.; Macuzic, I. & Lalic, B.
University of Kragujevac, Faculty of Engineering, Kragujevac, Serbia
E-Mail: petar@kg.ac.rs

**Abstract**
In this paper, the compliance of interface between fixture elements and workpiece is theoretically and experimentally investigated. The proposed theoretical model allows modelling of the behaviour of all kinds of interfaces between fixture elements and workpiece, under arbitrary dynamic loads. Workpiece displacement relative to fixture element was determined by analytical solution of the Lagrange differential equations of motion. Interface stiffness and damping coefficient were determined experimentally. The results of experimental investigation confirm the claims of theoretical model. 37 refs.
(Received in April 2013, accepted in July 2013. This paper was with the authors 1 month for 1 revision.)

**Key Words:** *Fixture, Modelling, Compliance, Stiffness, Damping, Dynamic Load*

Pages 66-78

## VIRTUAL FACTORY AS AN ADVANCED APPROACH FOR PRODUCTION PROCESS OPTIMIZATION

Debevec, M.; Simic, M. & Herakovic, N.
Laboratory for Handling, Assembly and Pneumatics, Faculty of Mechanical Engineering, University of Ljubljana, Ljubljana, Slovenia
E-Mail: miha.debevec@fs.uni-lj.si

**Abstract**
This paper demonstrates a new methodology for designing a virtual factory model and model execution on the basis of a real schedule plan. The main characteristic of the developed method is that the inputs are regarded as one of the main parameters of the production process, and the main objective is to create a low-cost production process model. The methodology is adjusted for use in SMEs (Small and Medium-Sized Enterprises) with individual or unique type of production. For such companies, the method represents an ability to optimize existing production processes through detecting and eliminating possible errors and disturbances before the real production process is executed at an acceptable cost. The applicability and suitability of the developed method for virtual production performance has been proven with the verification process, where the input data for the simulation was obtained from a real company. The simulation results have shown that the presented methodology is a useful tool for the optimization of the production process. 26 refs.
(Received in June 2013, accepted in September 2013. This paper was with the authors 1 month for 1 revision.)

**Key Words:** *Virtual Factory, Unavailability of Resources, Modelling, Simulation, Optimization*

Pages 79-92

## MODELLING AND SIMULATION ON RECYCLING OF ELECTRIC VEHICLE BATTERIES – USING AGENT APPROACH

Liu, S. & Gong, D.
School of Economics & Management, Beijing Jiaotong University, Haidian District, Beijing, China
E-Mail: shfliu@bjtu.edu.cn

**Abstract**
This study investigates electric vehicles battery recycling problem. In this study, based on Agent theory and Anylogic platform, Agent model of battery recycling is built. We have done simulation for electric vehicle batteries recycling: this paper analyses the influence that factors (battery renovation rate, quantities of electric vehicles, electric vehicle lifetime, battery lifetime, battery renovation time) have on recycling (quantities of wasted batteries, quantities of reused batteries, optimal quantities of batteries). Through simulation, this study shows that factors' influence on recycling depends on the relative life RL greatly. When renovation rate changes in the interval [0.7, 0.8], the results fluctuate greatly, such as optimal quantities of batteries will decrease about 10 %, quantities of reused batteries can increase about 30 %, and quantities of wasted batteries will have a sharp decline by about 40 %; the model is optimal until battery renovation times are increased to three. 33 refs.
(Received, processed and accepted by the Chinese Representative Office.)

**Key Words:** *Electric Vehicle, Battery Recycling, Agent, Modelling, Simulation*

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Pages 93-101

## BATCH TASK SCHEDULING-ORIENTED OPTIMIZATION MODELLING AND SIMULATION IN CLOUD MANUFACTURING

Jian, C. F. & Wang, Y.
Computer Science and Technology College, Zhejiang University of Technology, Hangzhou, China
E-Mail: jiancf@zjut.edu.cn

**Abstract**
Batch task scheduling in cloud manufacturing has dynamic, real-time characteristic and the presence of big data concurrency and exchange requirements, while traditional workshop tasks scheduling models and algorithms can't fit. In order to effectively save the time and reduce the cost of workshop production, an optimization model is put forward at first. And then improved cooperative particle swarm optimization algorithm with fast convergence and strong ability to avoid local optimization is used to solve the tasks scheduling problems. At last simulation experiment analysis results prove its effectiveness. 15 refs**.**
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**Key Words:** *Cloud Manufacturing, Batch Task Scheduling, Improved Cooperative Particle Swarm Optimization*

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Pages 102-115

## PROJECT-BASED SUPPLY CHAIN COOPERATIVE INCENTIVE BASED ON RECIPROCITY PREFERENCE

Wu, G.-D.
Jiangxi University of Finance and Economics, Nanchang, Jiangxi, China
E-Mail: gd198410@126.com

**Abstract**
Within project-based supply chain inter-organizational cooperative innovation, the achievement of project value-adding reflects by factors such as effect level of project-based organizations, the relationship between construction project cooperative innovation objectives. Therefore, based on the assumption of equal cooperation between project-based organizations, considering the relationship of effect cost between knowledge input and innovation stage, and the reciprocity preference of project-based organizations, the collaborative incentive model for project-based supply chain cooperative innovation was established, and the digital simulation was presented. The results show that, the project-based supply chain cross-organizational cooperative innovation is in the most favourable position to be realized when rising project-based organizations' effort level at one stage can reduce the effort cost of another stage. The reciprocity preference of project-based organization does not automatically lead to the achievement of the project-based supply chain cross-organizational cooperative innovation, but can enhance the incentive outcome of project value-adding sharing and knowledge collaboration. 24 refs.
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**Key Words:** *Project-Based Supply Chain, Reciprocity Preference, Cooperative Innovation*

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Pages 116-127

# THE ELECTRIC VEHICLE ROUTING OPTIMIZING ALGORITHM AND THE CHARGING STATIONS' LAYOUT ANALYSIS IN BEIJING

Lu, X. C.; Chen, Q. B. & Zhang, Z. J.
School of Economics & Management, Beijing Jiaotong University, Beijing, China
E-Mail: zhjzhang@bjtu.edu.cn

**Abstract**
With the development of economy, energy dilemma and environment protection give urgent pressure on automobile industry. More and more countries are making new energy vehicle policy. How to choose a proper routing when driving an electric vehicle? Does charging stations layout in a city meet the demand of electric vehicles? This paper gives out the electric vehicles' routing optimizing algorithm. The algorithm focus on decision policy before an electric vehicle starts. There are 3 kinds of situations: the situation moving to destination, moving to a charging station and staying origin. Each situation has its judgment and it is discussed in detail. Except that, the electric vehicles' routing optimization is solved in this paper. By applying routing optimizing algorithm, a multi-agent simulation model is build and the model is running with real data of charging stations in Beijing. The simulation results show that this model is valid. Through analysis of simulation data, this paper concludes that the layout of charging stations in Beijing is not reasonable, because charging stations are not visited by electric vehicles equally. 4 charging stations have higher visiting frequency. More charging stations should be built near these areas. 16 refs.
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**Key Words:** *Electric Vehicles' Routing Optimizing, Multi-agent Simulation Model, Charging Stations Layout*