

**SIMULATION OF THE HEXAPOD ROBOT PTINTO WALKING ON IRREGULAR SURFACES**

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**Abstract**

In this article we present our recent work on the simulation of a hexapod robot called PTinto. This robot is a prototype that has been designed to test the six legs locomotion system in the surrounding areas of the Tinto River (Huelva-Spain), which scientists have considered that could potentially have many similarities to the Mars surface. This kind of robots represents a great advance in the planetary research that overcomes the performance of the usual rover when operating in rocky and cumbersome areas. We are developing some of the software PTinto requires to autonomously control it and, in particular, the program that simulates its movements on any surface. Up to now we have a graphic computer program, developed in MATLAB, that represents the robot and allow us to check its movements in a lot of detail. We present in this paper all the elements and resources we use for the simulation and control of PTinto walking on irregular surfaces. Thanks to this simulation program, we could test different autonomous control strategies for the PTinto robot. 13 refs.

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**Key Words:** *Walking Robots, Hexapod, Movements Simulation, Irregular Surfaces*

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**STAGED IMPROVEMENT OF DELIVERY-ORIENTED PRODUCTION**

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**Abstract**

This study proposes a system dynamics (SD) model to deal with the staged improvement of delivery-orientated production plan. The situations, such as the cycle time affected by total input of human resource, unit transportation cost influenced by amount of delivery quantity, unit penalty (shortage) cost affected by amount of shortages, and the time delay among customer demand, production demand, order quantity, material demand, and inventory are discussed. A dynamic approach to adjusting enterprise's policy for conforming customers' satisfactions is a practical problem, but past studies lack discussions. Therefore, this work aims to construct a dynamic approach for conforming the customers' satisfactions. Research results reveal that the increment of production capacity and replenishment material policy could lead the shortage reduction, but do not achieve the complete improvement "none shortage". Decreasing the affection of time delay would bring the production reaching the complete improvement. 38 refs.

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**Key Words:** *Delivery-Oriented, System Dynamics, Improvement, Shortage*

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**OPTIMIZING THE ROBOT ARM MOVEMENT TIME USING VIRTUAL REALITY  
ROBOTIC TEACHING SYSTEM**

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**Abstract**

Robots play an important role in performing operations such as welding, drilling and screwing parts in manufacturing. Optimizing the robot arm movement time between different points is an important task which will minimize the make-span and maximize the production rate. But robot programming is a complex task whereby the user needs to teach and control the robot in order to perform a desired action. In order to address the above problem, an integrated 3-dimensional (3D) simulation software and virtual reality (VR) system is developed to simplify and speed up tasks and therefore enhance the quality of manufacturing processes. This system has the capability to communicate, transfer, optimize and test the data obtained from the VR and 3D environment to the real robot in a fast and efficient manner. In addition, this system eliminates the need for robot programming, and thus it is easily implemented by users with limited engineering knowledge. The optimization model is tested on a test case, in which the data are extracted from the VR system. The results show an increase in production rate and a decrease in cycle time when the make-span is minimized. The virtual reality robotic teaching system (VRRTS) offers several benefits to users, and will therefore surpass complex and time-intensive conventional robot programming methods. 20 refs.

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**Key Words:** *Robot Traveling Time, Virtual Reality, Robotics, Teaching System, Optimization, Flexible Manufacturing System*

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**GENETIC BASED APPROACH TO PREDICTING THE ELONGATION OF DRAWN ALLOY**

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**Abstract**

This paper describes a genetic based approach for the modelling of elongation in cold drawn copper alloy. Genetic programming is one of the most general genetic based methods and was used in our research. It is an automated evolutionary computation method for creating a working computer programme from a problem's high-level statement. Genetic programming does this by breeding a population of computer programmes genetically using the principles of Darwinian's natural selection and biologically inspired operations. In our research, material was formed by drawing using different process parameters and then determining elongation of the specimens. On the basis of a training data set, various different genetic models for the elongation distribution were developed during simulated evolution. The accuracies of the best models were proved by a testing data set and comparison between the genetic and regression models was carried out. 21 refs.

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**Key Words:** *Genetic Programming, Prediction, Metal Forming, Elongation, Copper Alloy*

**SIMULATION ANALYSIS OF SHUTTLE BASED STORAGE AND RETRIEVAL SYSTEMS**

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**Abstract**

In this paper, a simulation-based performance evaluation of shuttle-based storage and retrieval system (SBS/RS) is presented. In comparison with well-known automated storage and retrieval systems, SBS/RSs can substantially increase the throughput capacity of the system. The objective of this study is to exploit the benefits of SBS/RS system design for reducing the mean cycle time of transactions and consequently increasing the throughput capacity of the system. Performance comparison of the studied SBS/RS is contrasted with alternative storage rack configurations, velocity profiles of the shuttle carriers and velocity profiles of the elevators' lifting tables in the system. The results show that SBS/RSs are effective in reducing the mean cycle time and also show large improvement by increasing throughput capacity. 22 refs.

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**Key Words:** *Automated Warehouse, Shuttle Based Storage and Retrieval System, Discrete Event Simulation, Performance Analysis*

**IN-PLANT LOGISTICS EFFICIENCY VALUATION USING DISCRETE EVENT SIMULATION**

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**Abstract**

The purpose of this paper is to present an applicable approach for the valuation of in-plant logistics efficiency. Therefore, we developed a time-based efficiency concept that considers all relevant time losses when executing production logistics processes. The occurring delays are captured in real-time using modern auto-ID-technologies. For the valuation and improvement of in-plant logistics efficiency, we propose to use simulation modelling to investigate the cause-effect relations in the production system in advance. Thus, a discrete event simulation model has been constructed to model the workflow of a production system with discrete manufacturing processes and its in-plant logistics processes. The aim of the provided simulation study is to prove the functionality and to verify the applicability of the current approach in business practice. 23 refs.

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**Key Words:** *In-Plant Logistics Efficiency, Efficiency Valuation, Discrete Event Simulation*

## ROBOTIC APPLICATION IN NEUROSURGERY USING INTELLIGENT VISUAL AND HAPTIC INTERACTION

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### Abstract

Today, the complexity and high technical requirements of neurosurgical operations are so demanding that modern robotic achievements and advances of accompanied technologies appear as the immanent means, which can significantly improve neurosurgical practice. A novel robotic system (RONNA –RObotic NeuroNAvigation) for application in neurosurgery is presented. The RONNA consists of two conventional articulated robot arms with a total of 13 degrees of freedom. A rigid and accurate robot is used for precise targeting of planned operating points and a compliant robot is used as operative assistant. A distinctive marker was developed for the purpose of precise localization and registration of the patient's head. A novel visual calibration method is presented. The developed dual arm neurosurgical system enables flexible and reliable application with embedded behaviour based control providing intuitive interaction with surgical team and new possibilities compared to the existing surgical robot solutions. 22 refs.

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**Key Words:** *Neurosurgery, Robotics, Preoperative Planning, RONNA*

## ONE-STEP DISTORTION SIMULATION OF PULSED LASER WELDING WITH MULTI-PHYSICS INFORMATION

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### Abstract

The pulsed laser welding technique involves complex physical mechanisms, which demand a multi-physics welding simulation for reliable computational analysis. Although the multi-physics simulation provides high accuracy in detailed welding information, it is difficult to apply in practice, as it requires vast computational resources for systematic analysis. We propose a highly efficient and reliable simulation technique based on multi-physics analysis and mechanical analysis. The developed technique is used to efficiently and reliably simulate a complete model of a nuclear fuel spacer grid by introducing a virtual welding distortion that exports the thermo-mechanical information. This study has the potential to develop the computational analysis and optimization of a sequence of pulse laser welding in a nuclear fuel spacer grid. 17 refs.

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**Key Words:** *Pulsed Laser Welding, Multi-Physics Analysis, Welding Distortion, Nuclear Fuel Spacer Grid, Finite Element Analysis*

## MULTI OBJECTIVE OPTIMIZATION FOR SUSTAINABLE MANUFACTURING, APPLICATION IN TURNING

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### Abstract

As manufacturing converts raw materials into products, environmental wastes and emissions are simultaneously generated from the consumption of materials and energy during the manufacturing processes. Then, sustainable manufacturing is defined as the creation of manufactured products using processes that minimize negative environmental impacts, conserve energy and natural resources and that are safe on employees, communities and consumers. Such an approach requires a compromise between ecological and economic aspects to meet the pillars of sustainable development.

This paper presents the implementation of particle swarm tool in order to solve multi-objective optimization for sustainable manufacturing. Hence, this study might serve as part of a global approach to model sustainable manufacturing. The main objective of this approach is to develop operations that allow production with respect of ecological, economic and technological constraints. We developed a case study on the cutting conditions during turning at the end of our study. 25 refs.

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**Key Words:** *Sustainable Manufacturing, Multi Objective Optimization, Particle Swarm Optimization, Turning*

## ASSESSING MOTORCYCLIST PROTECTION SYSTEMS USING FINITE ELEMENT SIMULATIONS

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### Abstract

The impact of motorcyclists against the posts of the roadside barriers is one of the most frequently and harmful accidents. In order to avoid or minimize impact effects, different safety systems are being installed in many roads in the world. These safety systems should conform technical standards. European Technical Specification 1317-8 defines how it should be the testing procedure and placement of systems to prevent such accidents. The full-scale crash test with a dummy requires certain values not exceeded in neck forces, moments and Head Injury Criterion (HIC). This paper applies computer simulations (using Finite Element Method) in order to develop a virtual testing program to assess the safety system and evaluate the weaknesses of the mentioned standard. 24 refs.

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**Key Words:** *Finite Element, Motorcyclist Protection, Roadside Safety*

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## PROJECT VALUE-ADDING OPTIMIZATION OF PROJECT-BASED SUPPLY CHAIN UNDER DYNAMIC REPUTATION INCENTIVES

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### Abstract

On the basis of equal cooperation between project-based enterprises, the project-based supply chain cross-organizational dynamic reputation incentives model was established in consideration of the implicit reputation factors to the contractor's incentive influence, and the impact between control objective effect level, bargaining power and project value-adding was detailed analysed, especially the effective equilibrium condition for reputation incentive effects. Thus compared the analysis conclusions with project-based supply chain incentive model which single considering explicit benefit incentive, and verified the rationality and applicability of the project-based supply chain cross-organizational dynamic reputation incentives model through related digital simulation. The results reflects that, whether the linear relationship between duration and quality exists or not, the project management enterprise resorting to adjust project object objective incentive intensity and implementing reputation incentive strategy could not only achieve project value-adding maximization, but also realize net earnings Pareto improvement. 22 refs.

(Received, processed and accepted by the Chinese Representative Office.)

**Key Words:** *Project-Based Supply Chain, Reputation Incentives, Project Control Objective, Project Value-Adding*

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## SIMULATION OF CONFLICT CONTAGION IN CUSTOMER COLLABORATIVE PRODUCT INNOVATION

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### Abstract

Customer collaborative product innovation (CCPI) is a novel pattern of new product development (NPD) to integrate customers and their knowledge as the main innovative agents and resources. In CCPI, conflict is an intrinsic and inevitable phenomenon. Conflict contagion, however, is a neglected but crucial issue for the CCPI conflict management. In order to study the mechanism and process of CCPI conflict contagion, this paper uses the idea of SIS epidemic propagation as reference, and develops a Conflict-SIS (C-SIS) model through adopting the cellular automata (CA) method and the SIS epidemic model. Based on the C-SIS model, we simulate the process of CCPI conflict contagion, and verify the influence of different setting and factors on the conflict spreading trend. The simulation result well reflects the conflict contagion characteristics of real CCPI system. 38 refs.

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**Key Words:** *Customer Collaborative Product Innovation, Conflict, Conflict Contagion, Cellular Automata, Conflict-SIS Model*

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## MODELLING AND SIMULATION OF VEHICLE SPEED GUIDANCE IN CONNECTED VEHICLE ENVIRONMENT

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### Abstract

Most previous works on urban traffic efficiency focused on the optimization of signal timings, assuming vehicle speed was fixed or followed a given distribution. In this paper, based on the two way communication between vehicles and signal controller in Connected Vehicle (CV) environment, we developed two vehicle speed guidance methods to decrease delay and number of stops at intersections. By using Visual Basic and VISSIM COM interface, the simulation model consists of three modules: the signal timing, the vehicle speed guidance, and the dynamic optimization. A field intersection of Cao'an Road and Lvyuan Road in Shanghai is employed for simulation tests. Compared with the simulation results optimized by classical signal control method, the proposed methods can significantly decrease delays and number of stops, and improve the efficiency of traffic control. 28 refs.

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**Key Words:** *Traffic Simulation, Speed Guidance, Connected Vehicle, Signalized Intersections*

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## THE LAPTOP SPARE PARTS STUDYING UNDER CONSIDERING USERS' REPAIR WILLINGNESS

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### Abstract

With the development of science and technology, laptop becomes very popular. Laptop manufacturing firms are concerning how much spare parts they shall prepare to meet the demand of repairing. The quantities of spare parts are not only related to laptop life time, but also concern with users' repair willingness. We propose an approach to calculate the repair probability of laptop parts combined Poisson Process with users' repair willingness. In this study, the users' repair willingness relates laptop parts failure frequency. The new approach's verification is carried on by simulation. The significant test results show that simulation data fit theoretical value very well. By survey data and simulation result, we find that after four times broken for a laptop, a user will give up repairing it. The calculation result of new approach shows that spare parts quantities are entirely lower than traditional theory. From this point, if laptop manufacturers know their each parts lifetime, with the help of this paper, they can cut down their spare parts and save their service costs reasonable than before. 32 refs.

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**Key Words:** *Laptop Spare Parts, Users' Repair Willingness, Poisson Process*

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## SOLVING WATER RESOURCE SCHEDULING PROBLEM THROUGH AN IMPROVED ARTIFICIAL FISH SWARM ALGORITHM

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### Abstract

In order to find a novel method for solving the water resources scheduling problem more effectively, the strategies of supply chain management were introduced and the calculation model was established. Then, the artificial fish swarm algorithm was employed to solve this problem. To avoid the premature defect of the basic artificial fish swarm algorithm, the improved adaptive algorithm was proposed. And engineering practice and comparison with other scheduling algorithms show the efficiency of the method. The study provides a novel method for the water resource scheduling. 19 refs.

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**Key Words:** *Water Sources Scheduling, Supply Chain Management, Artificial Fish Swarm Algorithm, Adaptive Strategy*

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