VIRTUAL DESIGN AND AUTOMATION CENTRE

FACULTY OF MECHANICAL ENGINEERING AND MANAGEMENT

POZNAŃ UNIVERSITY OF TECHNOLOGY

3rd International Conference

VIRTUAL DESIGN AND AUTOMATION

Innovation in Product and Process Development

28 - 29 June 2007

Poznań, Poland
Organized by

VIRTUAL DESIGN

AND AUTOMATION CENTRE

In collaboration with

Virtual Research Lab
for a Knowledge Community in Production

Network of Excellence "Production Processes" - ProNet

Wielkopolska Chamber of Industry and Commerce

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Ministry of Science and Higher Education
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Polish Academy of Sciences
The Committee on Machine Building
and Division of Technological Fundamentals
Preface

The 3rd International Conference “Virtual Design and Automation” presents the development in the area of virtual design of products and processes with the focus on “Innovation in Product and Process Development”.

The Conference programme embraces three plenary sessions and eight parallel sessions. The 1st plenary session touches the integrated design approach based on system and physical reliability models and on complexity in product development. The 2nd plenary session presents the knowledge supply chain and innovation management, innovation in middle-size companies and remanufacturing through Life Cycle Management. The 3rd plenary session pays attention to the risk analysis problems during industrial system design, managing processes in distributed manufacturing and presents the state of the art, industrial implementations and development directions of product life cycle management (PLM).


The accepted papers are included in the conference abstracts brochure with the full texts on the conference CD.

The accepted papers (after discussion during the Conference) will be edited and published as Conference Book after Conference as well.

I would like to express my particular appreciation to the keynotes Speakers: Prof. Serge Tichkiewitch, Prof. Tetsuo Tomiyama, Prof. Niek Du Preez, Prof. Albert Albers, Prof. Alain Bernard, Prof. Michael Abramovici, Dr Christoph Hermann and Dr Tomasz Romanowski as well as to the all other Speakers for their significant contribution to the Conference.

Special thanks for the Members of Program and Organizing Committee for their contribution to the Conference.

Prof. Zenobia Weiss
Chair of Conference Program Committee
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CONFERENCE AIM

The Conference intends to present the development in the area of virtual products and processes design at all of the stages of the product life cycle. The purpose is to gather the presentation of various approaches and solutions concerning methods and tools used in research and industry for solving different problems during design processes.

The Conference will be the forum for exchange of information between R&D sectors, companies and other business organizations in these areas.

Many papers presented at the Conference are based on results of VIDA Centre’s international cooperation, in particular between members of the Network of Excellence VRL-KCiP (Virtual Research Lab for a Knowledge Community in Production).

During the Workshop "Supporting Programs for Innovation Entrepreneurship", accompany to Conference, organised together with Wielkopolska Chamber of Industry and Commerce, the thematic areas concerning formation of cooperation networks in the area of innovation will be discussed.

Workshop "Networks of Excellence Production Processes" will enable the presentation and discussion on new projects proposals for the 7th Framework Programme, with emphasis on the areas of virtual design and automation as well as modelling and simulation processes.
CONFERENCE PROGRAMME

Thursday 28th June 2007

09.00 – Registration and Welcome – coffee

10.00 – Welcome and introduction

Plenary Session I

10.30 – prof. SergeTichkiewitch (3S-INPG - Institut National Politechnique de Grenoble)
Integrated Design Approach Based on System and Physical Reliability Models for the Elaboration of the Detail Design

prof.TetsuoTomiyama (Delft University of Technology)
Complexity of Multi-Disciplinary Product Development and Design Inference Detector

12.00 – Lunch

Plenary Session II

13.30 – prof. Niek Du Preez (University of Stellenbosch)
The Knowledge Supply Chain and Innovation Management

prof. Albert Albers (IPEK- Institut fur Produktentwicklung Karlsruhe)
Innovation in Middle-Size Companies -A Key Factor Enhancing Success

Dr Christoph Herrmann (Technische Universitat Braunschweig)
Supporting Successful Remanufacturing Through Life Cycle Management

15.00 – Coffee brake

15.30 – Parallel Thematic Sessions I

1. Applications of Virtual and Augmented Reality In Design, Manufacturing and Assembly
2. Product and Process Development
3. Simulation for Design, Manufacturing and Exploitation

17.00 – Coffee brake, Exhibitions, Posters

17.15 – Workshop 1: Network of Excellence "Production Processes" - ProNet

20.00 – Social Event: Piano Bar – Stary Browar

Addresses: Speeches and addresses on the occasion of Profesor Zenobia Weiss retirement

20.30 – Dinner
Friday 29th June 2007

Plenary Session III
08.30 – prof. Alain Bernard (Ecole Centrale de Nantes)
   Human Model Based on the Barrier Concept for Risk Analysis During Industrial System Design

   dr Tomasz Romanowski (ALSTOM)
   Managing Processes and IT Systems in Distributed Manufacturing Environment

   prof. Michael Abramovici (Ruhr Universitat Bochum)
   State of the Art, Industrial Implementation and Development Directions of Product Lifecycle Management (PLM)

10.00 – Coffee break

10.30 – Parallel Thematic Sessions II
4. Applications of Virtual and Augmented Reality in Design, Manufacturing and Assembly
5. Product and Process Development
6. Product Life Cycle

12.00 – Lunch

13.00 – Parallel Thematic Sessions III
7. Product and Process Development
8. CAD/CAE Techniques in Material Technology

13.00 – Workshop 2: Wielkopolska Chamber of Industry and Commerce – WIHP
   "Support actions for innovation in production"

14.30 – Keynote "Future of VIDA Centre"

15.00 – End of the Conference
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STATE OF THE ART, INDUSTRIAL IMPLEMENTATION AND DEVELOPMENT DIRECTIONS OF PRODUCT LIFECYCLE MANAGEMENT (PLM)

Abstract

Over the last decade PLM has become one of the key technological and organisational approaches and enablers for the effective management of product development and product creation processes. The first part of the paper summarises the current PLM state of the art. The second part of this contribution shows the degree of PLM implementation based on an industrial survey conducted by ITM Bochum and IBM. Last but not least the main expected PLM trends are described by showing some examples of PLM research projects carried out by ITM Bochum in cooperation with different industrial partners.

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INNOVATION IN MIDDLE-SIZED COMPANIES – A KEY FACTOR ENHANCING SUCCESS

Abstract

For middle-sizes companies innovation is not only a process, Innovation is a challenge. This means, that the development of a new product is an essential problem for being successful in a global market. The approach is a problem oriented process and method toolbox called SPALTEN for the efficient control of Development process in companies. SPALTEN is a holistic product development approach, which combines system engineer-ing, the phases of the product development process and a systematic problem solving to one successful approach to handle complex product development processes. The SPALTEN-Matrix is the process backbone and an efficient cooperation, coordination and information platform for the product development process. This approach provides a long term planning and situation oriented problem solving during the product development.

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Alain BERNARD, Mahmoud SHAHROKHI

HUMAN MODEL BASED ON THE BARRIER CONCEPT FOR RISK ANALYSIS DURING INDUSTRIAL SYSTEM DESIGN

Abstract

This paper aims to introduce a straightforward barrier modelling technique for using through the design processes of the industrial systems. In this model, the role of the barriers is separated based on their effects on the elementary human risk analysis entities. Risk indexes are calculated to allow the designer to evaluate the alternative design configurations. Based on this model, a barrier analysis workbench is embedded in an industrial design application. As a direct benefit, the human risk analysis information is shared directly with the design model, which increases the facility and effectiveness of the human risk prevention.

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Niek Du PREEZ, Louis LOUW

THE KNOWLEDGE SUPPLY CHAIN AND INNOVATION MANAGEMENT

Abstract

Sharing appropriate knowledge throughout the product- and service value chains fuels innovative design. As this knowledge itself has an enormous supply chain and results in the rapid proliferation of information and derived knowledge, one of the challenges in manufacturing research today is how to deal efficiently with this knowledge supply chain.

This paper describes the landscape and characteristics of the Knowledge Supply Chain, and Integrated Knowledge Networks (IKN) [1] as a means of enhancing its efficiency.

In spite of the bottlenecks and limitations, the pragmatic use of IKN fosters the rapid exchange of applicable knowledge that supports innovative designs. Consequently, the Global Competitiveness Centre in Engineering and the Enterprise Engineering group uses the following concepts in its practice:

- Formalised networks with flexible frameworks
- Proactively built repositories for public domain knowledge
- Information structured around life cycle and knowledge matrix roadmaps
- The context of information as the common denominator
- The integration of knowledge over different innovation projects using a three dimensional coordinate system
- KM part of every working day to foster the growth of community maturity.
- A collaborative platform to support Innovation Management

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SUPPORTING SUCCESSFUL REMANUFACTURING THROUGH TOTAL LIFE CYCLE MANAGEMENT

Abstract

Remanufacturing has the goal to bring obsolete products into an as-new state and, thereby, qualify for a second use cycle. However, obstacles for an economically successful implementation of remanufacturing today are less of a technological nature, when already considered in the product development, but due to a lack of support in management and insufficient integration in business processes. Total Life Cycle Management as a holistic approach seems to be a promising framework to support the implementation of remanufacturing and to develop the potentials of renewed usage of obsolete products. Challenge for companies and goal of research works is to align all phase related and phase spanning disciplines and to anchor remanufacturing in structures, activities and the people’s behavior in a company. The paper presents exemplary research approaches and identifies further working fields.

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MANAGING PROCESSES AND IT SYSTEMS IN DISTRIBUTED MANUFACTURING ENVIRONMENT

Abstract

The following trends are to be observed on all international markets and, in particular, on power generation and power distribution markets:

- Customers are imposing increased and diverse demands regarding product and its capabilities
- Product life cycle is shortening due to acceleration in technical development/progress
- Globalisation and internationalisation of global competition is increasing
- Prices for power plants have decreased by 50%

The only certain thing is constant change; therefore, it is necessary to produce faster, better and more cheaply. In such a case, it is crucial to constantly develop in scope of product engineering, production, logistics and IT systems.

ALSTOM has carried out a number of thorough market analyses concerning future demand from our customers for turbines. Analyses of processes in place have also been performed. Evaluation of state-of-the-art achievements in scope of turbine manufacturing process engineering has been made.

The objectives which were formulated for the authors of modernisation programme of design and manufacturing processes were extremely radical and included the following tasks:

- Shortening of design and manufacturing cycles of leading turbine components by 50%
- Reduction in manufacturing costs by 30%
- Achievement of maximum process quality.

Due to individual character of production, the only opportunity to obtain economies of scale for respective localisations of the Group is to become specialised. In this manner, respective factories were assigned specialization in scope of static and rotating components of turbines and generators.

In order to manage such distributed production efficiently, it is necessary to provide centralisation and standardisation of product life cycle management, ERP integrated systems as well as unification and full integration of CAD/CAM/CAE system platforms.

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INTEGRATED DESIGN APPROACH BASED ON SYSTEM AND PHYSICAL RELIABILITY MODELS FOR THE ELABORATION OF THE DETAIL DESIGN

Abstract

The engineering industry is dealing more and more with the challenge issue of designing in a global context innovative and reliable systems. The evaluation of their reliability during their design process is thus a crucial task (analysis) but the elaboration of a solution for the optimization of the reliability arise new challenges (synthesis). They require the implementation of multidisciplinary approaches to assure that the various design choices meet the reliability objectives defined by the decision-makers, from the start of a new product development to the end.

We present in a first part the necessity to take into account in such a problem the three different methods that are compulsory to the construction of the solution: the qualitative reliability models proposed since a long time by Villemeur [Vil88], the quantitative system without physics interpretation proposed by Raussand and Høyland [Rau04] and the physical without system proposal of Lemaire [Lem05]. Any of these approaches accompanies the design efforts in an optimal way and do not motivate the necessary interactions between the designers and the reliability engineers. Hähnel recently proposed the unification of the system and the physical interpretations of the failures of mechanical devices [Häh07].

In the second part, we demonstrate how a cooperative organization using multi-views design modeller will allow multi-actors to apply the Hähnel concept, method and tools to built a specific reliability view and permit to take into account the reliability as a new constraint during the design process. In such organization, each actor defining his own specific view use translation and propagation concepts to participate in the construction of the reliability view. Refining the reliability model as long as the process reaches its goal, the choices of solutions may be influenced to assume the objectives fixed during the failure scenarios study.

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Tetsuo TOMIYAMA, Valentina D’AMELIO

COMPLEXITY OF MULTI-DISCIPLINARY PRODUCT DEVELOPMENT AND DESIGN INFERENCE DETECTOR

Abstract

This paper proposes a method to deal with complex design problems typically found in multi-disciplinary design such as mechatronics design. First, it explains two different types of complexity, namely complexity by design and intrinsic complexity of multi-disciplinarity, typically found in mechatronics design, from the viewpoint of knowledge structure. Second, a mechatronics design case illustrates how these types of complexity lead to undesired and unpredictable interactions that cause destructive decoupling of subsystems. Third, we present a technological way to detect such undesirable interactions at an early stage of design based on a qualitative reasoning technique.

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REALLY AND VIRTUAL ELECTRO HYDRAULIC SERVO DRIVE CONTROLLED WITH SLIDING MODE CONTROL

Abstract

In this article algorithm based on sliding mode control has been described and the process of electro hydraulic servo drive control with the aid of this method has been showed. In the further part of this article a chattering reduction method based on the combination of SMC with proportional control has been described. Next, the results of research of electro hydraulic servo drive with a proportional valve controlled of a combined SMC-P algorithm have been showed: first in virtual reality, than on real control system.

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SIMULATION AND EXPERIMENTAL CONDITIONS OF SOLIDIFICATION OF SILUMINUM PLATE CASTING

Abstract

In the paper it was presented the results of simulation tests of the filling and solidification process for the horizontally and vertically plate casting position. It was determined the influence of the running gate position on the velocity of liquid alloy movement in the mould and temperature distribution after mould filling. It was presented the results of experimental cooling curves and Niyama criterion for the plate casting of hypoeutectic modify alloy EN AC-AlSi7Mg solidifying in mold of different intensity of heat abstraction.

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autoPW DRIVING SIMULATOR AS A TOOL FOR DRIVER-VEHICLE-SURROUNDINGS SYSTEM RESEARCH

Abstract

In the paper the autoPW driving simulator will be presented. The autoPW Automobile/Truck Driving Simulator was built at the Warsaw University of Technology. It has been a main tool at the Laboratory for Simulation Tests of the Vehicle Motion and Dynamics at the Faculty of Transport. The simulator was introduced in research and didactic process at the Faculty.

The characteristic (structure, parameters) of the device will be presented. Possible applications in driver-vehicle-surroundings system research will be depicted. The applications deal problems where the role of the driver is important. A lot of pictures will be included to illustrate the above mentioned features.

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MODELLING AND SIMULATION OF THE FINAL ASSEMBLY USING THE FLEXSIM SOFTWARE

Abstract

This paper will be presented the task of balancing the final assembly of chosen example. The precedence constraint graph and the algorithm for optimization number and loading of assembly cells and the results and conclusions from the analysis using the FlexSim simulation software will be presented.

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CONTINUOUS PRODUCT QUALITY IMPROVEMENT IN MASS PRODUCTION

Abstract

In the actual economic situation of most developed countries, quality is an important factor of competitiveness of each business and a key performance indicator of the companies. The companies should build their competitiveness on Total Quality concepts, starting with Customer Satisfaction to involvement of each employee in the manufacture and delivery of high quality products. Total Quality may be achieved with small steps of continuous improvements at each level of an organization in every field of activity by every department.

The objective (the problem to be solved) of this paper is the improvement of the quality of the compression moulding process used in manufacture of plastic closures.

Considering the specificity of the product and the manufacturing process, together with the experience gained in the use of different models, methods and tools used in quality assurance and management in the manufacture of plastic closures for the beverage industry, the obvious option was to use TQM, Problem Solving method with the application of the PDCA storyboard and Statistical Process Control. For measurements we used a coordinate measuring machine with automatic data transfer into SPC software and data analyse with MINITABTM.

The proposed methodology to improve the quality of the compression moulding process used in the manufacture of plastic closures made of polypropylene, was to collect all the relevant data on the performance of the closures manufacturing process, identification of the closure dimensions with a significant impact on their performance on the bottling lines and to modify the closure dimension measurement data analysis methodology in order to obtain the right information’s which can help us to take decisions that will lead to overall improvement of the closure manufacturing process.

In the problem definition we used process diagrams, cause and effect diagrams and Pareto diagram. After collecting the data the specialized statistical software generates control charts, which showed us the necessity to modify the existing methodology and set-up of new standards of quality for the colouring masterbatches used in the manufacture of plastic closures.

Through the application of statistical control of the products dimensions and correlation of these data with the manufacturing machine parameters and the events occurring on the compression-moulding machine it may be assured constant quality of the products made with this process. In the same time, it can be forecasted with a several weeks’ precision, the optimum timing for the schedule of preventive maintenances and the optimum frequency of those maintenances. The recommended and applied methodology gives us the possibility to identify materials, which would give more constant characteristics of the final product.

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EFFECTS OF ERGONOMICS KNOWLEDGE TRANSFER TO ENTERPRISE’S PRACTICE

Abstract

To gain competitive advantage on the market, enterprises must sell unique products and services that are made with qualified employee with unique education and experience. Enterprises are focused on increasing competitiveness, through their attractive products, but they are preoccupied to offer modern and better work conditions for their employees. Those companies and their managers, who can create sustainable working conditions, gather the most valuable people around themselves. Maintaining such people in the company for a long period of time requires the implementation of a human resources policy that would enable a reasonable managing of the employees’ psycho-physical and intellectual abilities and capital. These have to be linked with the company’s management systems and have to affect the whole organization performance.

In this context, the paper presents the Integrated Work System (IWS) as an approach and methodology for creating an efficient work environment in organization. IWS was developed based on the progresses of ergonomics knowledge in areas like work safety and hygiene, quality management and work environments. The effects of ergonomics knowledge transfer to organization’s practice have developed new “weapons” for workplace and work organization optimization. After describing the IWS, in the paper should be given some examples of virtual ergonomics applications (simulation of real workplaces) that sustained the way of implementing the methodology at the organizational level.

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VIRTUAL INTERFACE WITH ACCESS TO REMOTE COMPUTER SYSTEMS

Abstract

The paper presents a solution regarding a virtual interface enabling management and remote sharing of devices as well as functionality of actual labs using computer systems. Also technical devices equipped, for example, with PLC controllers, may be shared following similar principles, taking into account all principles of network security, including transferred data confidentiality. Modular construction of a remote access platform provides for a possibility of using the presented system in various application areas, e.g. for training purposes in PLC controllers programming.

One of the existing solutions in this area is the remote laboratory access system: NetLAB by NDG. NetLAB platform, next to several advantages, has also numerous drawbacks, the system’s high costs being the most significant one. The costs include the system as such and its maintenance as well as the elements generated by additional hardware, necessary for reaching the system’s full functionality. Additional hardware would include mainly a router and serial port modules, remote power management panels, one or several network switches with VLAN support, WAN Adtran simulator. Such system, used for training purposes, requires a set of network hardware to build networks with various topologies. Such solution enables managing several predefined topologies; however, dynamic creation of configuration, depending on current need, is not possible.

Having taken into account the present evaluation of the current status and the current needs of the CISCO network academy operating at the Section of Information Technology, works have been commenced, the objective of which being the creation of proprietary, owned solution of a network lab remote access. It was assumed that the new solution should have a possibility of a new functionality and new modules adding, with a low implementation cost, scaleability, easiness of management an user-friendly interface. The modular structure is useful in performing the system’s further modification, because further modules increase the probability of the system’s being used in specialized applications and the module appending as such has been simplified to a maximum degree. One of the main assumptions is the thesis that the designed system can be used also in other lab types or as a remote management platform for computerized process equipment.

Due to the need of quick development and implementation of such solution, the basic focus area included the issues related with the hardware and basic software elements. The selected base for the developed platform was Linux Gentoo, fully compilable from sources, running on a typical PC closed in rack 4U – the targeted system is 1U, allowing for better space utilization in an IT rack.

Due to significant costs of serial port cards, an individual solution was chosen, using a set of USB/RS232 converters (FTDI and Atmel Atmega16), which allows for scaleability of up to 128 managed devices, also parallel testing od multi-port cards (Digi Channel). During the tests it turned out that the most stable and reliable solution would be USB/RS converters using FTDI chipsets. The cheapest solution, using Atmega microcontrollers, does not fulfill the stability conditions, however, due to high potential, shall be still developed. The designed platform in its basic form is also in the test phase and providing the assumed functionality can be detected as early as at this stage.

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TOWARD INNOVATION CAPABILITY MATURITY

Abstract

What may seem ambiguous in the title of this paper is essentially the imperative of every organisation functioning within the competitive domain. Where organisational maturity and innovativeness were traditionally considered antonymous, the assimilation of these two seemingly contradictory notions is fundamental to the assurance of long-term organisational prosperity. Organisations are required, now more than ever, to grow and mature their innovation capability.

This paper describes research conducted to consolidate the principles of innovation and identify the fundamental components that constitute innovation capability. The process of developing descriptive generic and evolutionary plateaus for accumulating these constituents of innovation capability is described.

This research has lead to a first-cut Innovation Capability Maturity Model (ICMM) serving two purposes: to establish the innovation capability maturity of an organisation; and to facilitate establishing an improvement path that is best suited to the organisation’s innovation capability maturity status quo.

The model was implemented in a case study to establish the innovation capability maturity of a South African organisation in the insurance industry. The outputs of the case study are used to implement refinements to the model and to suggest areas for future research and improvement.

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RAPID TOOLING APPLICATION IN MANUFACTURING OF THE INJECTION MOULDS

Abstract

Rapid Tooling methods continue to find wider areas of application in manufacturing tools for the plastics processing industry. Increasing number of solutions cover methods of fast manufacture of low-costs tools dedicated for short batch production and methods of building advanced injection moulds used in mass production. In this way RT becomes an alternative to traditional solutions of manufacturing tools with milling. The paper presents investigations of direct and indirect Rapid Tooling methods including Metal Spray, aluminium filled epoxy tooling and selective laser melting of metal powders. Discussed are features of tools manufactured with those technologies, possibilities for modifying tool properties and limitations and benefits resulting from their applications in injection moulding processes.

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ANALYSIS OF GEOMETRICAL ACCURACY OF PHYSICAL MODELS BUILT WITH THE POLYJET TECHNOLOGY

Abstract

This article shows results of comparing shape and dimensions of physical models built with a polyjet machine with their source CAD models. Comparison was done on the principle of geometric inspection with an optical measuring system. The selected Reverse Engineering system delivers high density point data and enables the direct comparison with the CAD data or generated primitives. Using the best-fit alignment method, the scanned data was registered into the CAD data to calculate and display deviations between digitalized physical models and their source geometry. The paper discusses the results when shapes and dimensions are unexpectedly different from the CAD data and proposes technical explanation of the differences.

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OPTIMIZATION OF SOLDERING PROCESS USING DESIGN OF EXPERIMENTS

Abstract

An industrial innovation comes about as the result of an investigation requiring a sequence of experiments. The research and development is a process of dynamic and adaptive learning. The mean by which the objective can be reached is discovered by investigation processes, each subset of experimental runs supplying a basis for deciding the next ones. Also, the objective itself can change as new knowledge is brought to light.

In an investigation sequence of experiments, different experimenters can take different routes and begin from a different starting point, but always they arrive at similar solutions. The scientific iteration tends to be self-correcting.

The purpose of this paper is to improve the wave soldering process of electronic components. In the wave soldering process the number of the defects (insufficient soldering and short-circuits) have been too great.

A wave solder machine is used in the manufacturing process. The machine cleans the boards in a flux, preheats the board and then moves them along a conveyor through a wave of molten solder. The solder process makes the electrical and mechanical connections for the leaded components on the board.

The defective boards require manual retouching which increase the manufacturing costs. In order to improve the soldering process it was used design of experiments to determine which machine parameters are influential in the occurrence of solder defects and which setting of the parameters should be made to reduce solder defects.

The wave solder machine has several control factors (parameters). They include: solder temperature, preheat temperature, conveyor speed, flux type, flux pressure, solder wave depth and board angle on conveyor.

In addition to these controllable factors, there are several others uncontrollable factors (noises factors) that cannot be controlled. They include: thickness of the circuit boards, type of electronic components, layout of the components, operators, production rate, etc.

To design an experiment with so many control factors imply a big number of the runs. By past experience of the technical staff it was decided that the most important control factors with great influence upon soldering defects are: flux-pressure, conveyor speed and board angle on conveyor.

In the first stage of the experiments was designed a screening experiment 23 with 3 replicates. After data analyzing, a control factor was eliminated and in the second stage was designed a central composite design with 2 control factors. By analyses of the experimental data the wave soldering process was optimized and so were minimized the soldering defects. The paper will include all these analyses.

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VALIDATION OF CELLULAR AUTOMATON FINITE ELEMENT SIMULATION RESULTS FOR SOLIDIFYING CYLINDRICAL Al-Si CASTING

Abstract

The Cellular Automaton – Finite Element method was applied to simulate the Al-Si alloy microstructure and is shortly described in the paper. This method was adopted to predict the pseudo-dendritic grain microstructure formation during solidification process of cylindrical casting. Testing of this casting was connected with an attempt of temperature (times of solidification) and microstructure validation of the Calcosoft system. To predict of grains size, columnar-to-equiaxed transition (CET) zones for hypoeutectic Al-Si alloys for cylindrical castings solidifying in homogeneous sand mould or mould containing the chill to ensure the partly oriented alpha phase structure in Al-Si casting, the appropriate investigations were made. Simulation studies concerning validation problem has been preceded by identification and determining the conditions of real experiment.

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TRENDS IN COLLABORATION APPLICATIONS FOR VIRTUAL DESIGN

Abstract

Today multilateral cross-domain collaborations play an increasingly important role with regard to virtual design. In order to increase the efficiency of virtual design processes, they need to be supported with powerful IT tools, integrated in the collaboration environment of virtual companies.

The characterisation of different collaboration aspects will be the first part of the paper. Typically, there are two main reasons needed for synchronous collaboration tools: prearranged design reviews and spontaneous ad-hoc teleconferences. With special reference to integration and cross-domain aspects, the technological environment for collaborative virtual design and product development will be described. One prototype especially developed to support virtual design with ad-hoc teleconferencing will be presented by a description of its integration into a collaborative product development environment. On the basis of this tool, concepts for distributed design reviews with Virtual Reality support and ad-hoc teleconferences from the workplace are discussed. The utilisation potentials of grid technology for virtual product development will be also discussed.

Closing the paper future trends of collaborative engineering are described based on a roadmap for the future development of collaborative engineering tools. This roadmap includes the results of a study, which was carried out by the Berliner Kreis. As input for the study industrial representatives were interviewed concerning the future development. Contact:

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FRAMEWORK FOR THE DYNAMIC AND LIFE CYCLE ORIENTED EVALUATION OF MAINTENANCE STRATEGIES

Abstract

Increasing cost pressure and operation requirements are forcing manufacturers and operators of production systems to develop new strategies to maintain their competitiveness. Generally, purchasers and planners of manufacturing companies focus more on low acquisition costs than on the overall life cycle costs. Life cycle costs not only depend on manufacturing devices’ quality, but also on maintenance strategies, spare part costs, and operation processes. Therefore, the calculation of specific life cycle costs and the identification of optimal maintenance strategies is a complex planning task for most operators. Due to the multiplexed interdependencies, a holistic assessment of the systems life cycle costs and the effects of maintenance measures cannot be achieved by using static calculation methods while these methods do not reflect the complexity and stochastics of the problem.

Against this background this paper presents a five-phase framework for the dynamic evaluation of life cycle costs that represents these complex interdependencies and particularly integrates the effects of different maintenance strategies. Simulation is used to cope with the dynamic and stochastic behaviour. Through conducting simulation runs with certain maintenance and failure scenarios, the evaluation of life cycle costs and thus the derivation of optimal maintenance strategies is enabled. In a next step, the approach was exemplarily applied for a concrete example whereas it enables operators to evaluate and compare maintenance alternatives. To facilitate usability, this also involved the development of an interactive graphical user interface.

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LIFE CYCLE ORIENTED DESIGN OF LEAN PRODUCTION SYSTEMS

Abstract

Production companies are faced with shortened product and production life cycles, increasing product variant diversity, and increasing legal restrictions. These changing external conditions lead to dynamic and complex market structures and consequently to complex company-internal structures. To overcome the resulting challenges and to maintain competitiveness a continuous adaptation of production systems is necessary.

In particular small and medium sized enterprises (SME) are faced with this challenge, as their small production systems react very sensitive to changing capability demands. Moreover, the continuously adaptation and maintaining of SME production systems to new capability demands is often impeded by limited resources.

This paper presents a framework for life cycle oriented design and adaptation of SME production systems. Based on the concepts of decomposition and modularization, production system elements are described in terms of process modules. Process modules include process and capability related attributes and capability tolerance ranges. Current capabilities are assessed and compared with future capability requirements that are derived by an integrated analysis of the production strategy, the product life cycle phases, and external change drivers. Capability gaps and required capability tolerance ranges of the process modules are derived and prioritized. Thus, the framework supports SME to identify suitable production system design parameters with respect to their current situation.

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A METHOD FOR EFFECTIVE SUBSTITUTION OF LINEAR ROLLING BEARINGS IN FEM MODELS OF ASSEMBLIES

Abstract

The reason of performing simulations of real systems is to provide the possibility of "virtual experiments" on their models - prediction of the systems behaviour at the stage of its design. For building accurate models and providing valid results we need to use mathematical representation that have identical physical meaning as properties of real structures.

A widely used tool for simulations of mechanical structures is FEM and with sufficiently fine mesh of appropriate elements we can get accurate models of bodies with known geometry and material properties.

The problem is often caused by either nonlinearities (such as contact) or geometrical details that would significantly increase the number of nodes, elements and resultant "size of the problem". This often leads to unfeasibility of solving the problem with standard hardware and many geometrical simplifications must be made.

The paper deals with strategies that produce still very accurate structural FEM models but use as simple mathematical representation as possible. An example of a particular component – rolling linear bearing track is used in the paper. These components usually connect two parts and provide their relative linear motion. Although they are very small in comparison with mating parts, they usually provide significant structural compliance within the assembly. Therefore their accurate mathematical representation is crucial for building accurate model of the whole structure. Nevertheless it is usually not possible to make detailed model of each track including contact nonlinearities of rolling elements. This is because of its demands of additional nodes and elements, which is normally impossible to satisfy in large assemblies.

Normal approach of simplification of the problem is using translational spring elements as a substitution of the track. Translational stiffness in two directions (deflection characteristics respectively) provided by manufacturers are used for adjusting the element stiffness. Nevertheless this approach does not consider rotational stiffness properties and coupling rotations with translations – off diagonal terms in stiffness matrix of real track.

The proposed method uses a detailed FEM model (including contact and nonlinearities) of rolling track and derivation of a complete linearized stiffness matrix for particular load case (gravity, pretension, etc.). This stiffness matrix, as a single user-specified element, can be used in large models of assemblies. It can be assumed as very accurate representation of the original component loaded in close neighbourhood of the load case used in derivation stage.

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COMPLEX MODEL OF TWO-AXIS TELESCOPIC COVERS: DIMENSIONS AND COVER DEFLECTION AVOIDANCE

Abstract

This paper describes a design of two-axis telescopic covers of machine tools. It also describes a mathematical model of dimensions of two-axis covers, static model of cover deflection and model of strip stiffener.

Two-axis cover is system of movable plates allowing movement of two perpendicular axes. Relative movement of plates is assured by four scissor mechanisms guiding corners of all plates. Design of scissor mechanism also allows mutual preload of all plates essential for proper sealing effect of polyurethane wipers.

Model of dimensions calculates optimal dimensions (to achieve minimal space necessary for covers to move) and avoids collisions of cover plates.

Preload of plates and reaction forces of wipers cause unwanted deflection of plates that can result in gap between sealing wiper and plate. This situation is predicted by a static model of cover deflection.

This situation can be avoided by a rounded strip stiffener welded onto cover plate. This process creates contrary deformation of cover cancelled by the preload of covers during assembly. Correct shape of rounded stiffener is calculated by a model described in this paper.

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NON-HOMOGENEITY PROBLEMS IN DUCTILE IRON HEAVY CASTING IDENTIFIED BY VIRTUAL AND EXPERIMENTAL WAY

Abstract

Status quo of the modelling advancement phenomena represented in foundry simulation codes refers in different ways to their complexity. For the two periods of casting quality creation (during pouring and solidification), the numerical algorithms are based on physical or empirical models. Often, it is only by experimental validation that their efficacy can be estimated. The undesirable structural deviations can be predicted on the basis of post–processing parameters (non-metallic inclusions, porosity discontinuities and sometimes the perlite/ferrite proportion with local mechanical characteristics cause non-homogeneities). Certain validation procedures were realised using special foundry calculation codes (Virtual Prototyping systems). For Ductile Iron castings with big thicknesses (to 240 mm), experimental validation by real cooling curves in the casting–mould system accompanied by some NDT control and metallographic study has been effectuated.

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PROGRAMMING AN INDUSTRIAL ROBOT IN VIRTUAL ENVIRONMENT

Abstract

This paper presents a computer simulator of the KUKA KR 125 industrial robot, developed at Szczecin University of Technology. The main task of this application is to aid the process of learning how to program the robot in on-line mode. By implementing additional features, the simulator also allows for programming the robot in off-line mode. The simulator was written in C++ programming language, in Microsoft Visual C++ 6.0 environment, using the MFC (Microsoft Foundation Class) and the graphical OpenGL library.

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JOYSTICKS WITH ADJUSTABLE FORCE OF MOVEMENT RESISTANCE

Abstract

In this article a construction of linear and rotary joysticks with adjustable force of movement resistance were introduced. The measurement sensors of position and force in these devices and actors used to change force of movement were presented. The electronic equipment of joysticks and mode of communication with internal devices are described.

The aim of usage a joysticks with adjustable force of movement resistance in machines’ and devices’ control systems is the improvement of the control techniques by implementation of position-force feedback between machine and man, i.e. the influence of a machine on an operator informing him about e.g.: achievement of actuator end position, collision with different object, etc. This type of control solution improves the impression of real and significant influence of a man on a controlled machine. These devices can also make better interaction between a computer creating a virtual reality and a man. They would make it possible to feel forces affecting virtual objects. Joysticks with adjustable force of movement resistance cooperating with electropneumatic and electrohydraulic actors can be used in manipulators, remote operators, working machines and designer tools.

In the joysticks construction a damper with magnetorheological liquid, designed to direct the change of force of movement resistance, was used. The joysticks contains also an electric element (motor or electromagnet), that generates active force which counteracts to operator’s force on shoulder. This elements are electrically controlled by change of voltage applied to coils. This allows almost any formation of the course of joystick force of movement resistance, according from needs.

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MODELING OF A MACHINE TOOLS SPINDLE USING A HYBRID MODEL

Abstract

The paper describes modeling of machine tools spindle using a hybrid model. The model connects the FEM modelling and analytical methods together. The spindle geometry is created and then meshed in FEM (using software Ansys and programming language APDL). The mesh is reduced and mass and stiffness matrices are exported. The exported matrices are imported into Matlab. Then the analytical model of bearings is joined in Matlab. The model of bearing describes bearing stiffness in dependence on outer bearing deformations. Damping ratios are obtained from the statistical evaluation of lot of the experimental measurements. The modal properties and the transfer functions of damped system are computed. Verification of the model is shown. As shown, the model is useful for cutting stability prediction or spindle geometry tuning.

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APPLICATION OF VIRTUAL REALITY TECHNIQUES FOR VISUALIZATION OF THE WORK STAND ENVIRONMENT CONDITIONS

Abstract

Within the confines of working group organized at Centre of Excellence VIDA (Virtual Design and Automation) the presented work was carried out with main focus on methods of virtual model creation and it’s application in work stand environment design. Especially stress of the work was to create an easy to use and user friendly interface. Such interface was created with using of human natural analysis. Other important issue was to involve in the research the ergonomics and immersion – using i.e. stereoscopy projection of 1:1 scaled model and applying the tracking station and data glove manipulation. Authors of this paper presents the partially effect of the work as well ideas for further development of research in area of virtual reality application in mechanical engineering.

In this study an industrial example is described. Work was carried out at the model of the sheet metal shears machine. CAD model of the machine was made and translated to virtual reality projection system. In this paper the equipment of VR Laboratory at Faculty of Mechanical Engineering and Management of Poznan University of Technology is also described.

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REAL TIME DRIVING SIMULATORS

Abstract

The paper presents a general structure of driving simulator and a review of selected driving simulators ideas and designs. Three types of driving simulator are presented: simple training simulators, mid-level simulators as well as world-class driving simulators. The most important problems associated with driving simulator development were described. “TRAINER” simulator – European concept of training driving simulator is also presented. Particular attention was paid to mid-level driving simulators because they characterize good relationship between application effect and design and construction costs. The presentation will be supported by number of images as well as movies presenting described simulators and their exemplary applications

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THE MEASUREMENT OF FREE-FORM SURFACES ON A CNC MACHINE TOOL.

Abstract

The purpose of the article is to present the essence of the measurement of free-form surfaces by using the coordinate measuring technique. The measurement was conducted in production conditions on the CNC machine tool (DMU 80P duoBLOCK) by using the measurement probe (MP700) mounted in the spindle. The article mainly presents the method of the free-form surfaces measurement. It showed the way of choosing the measuring points on the basis of the local surface curvature of the measurement object. This criterion allows a higher point density at locations of high curvature of the measurement surface. The measuring points are also chosen from CAM (Computer Aided Manufacturing) data. It allows to integrate the CAD/CAM/CAI data.

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RELATION BETWEEN CASTING'S COOLING RATE AND SOLID FRACTION CURVE IN ASPECT OF SIMULATION OF DIVERSIFIED WALL THICKNESS CASTING SOLIDIFICATION

Abstract

The paper concerns the latent heat extraction $L$ during simulation of alloy solidification and its modelling (in macro-scale) using the solid fraction curve $f_s=f(T)$ depending on casting’s cooling rate. The fundamentals of solidification kinetics described with mentioned solid fraction curve and methods of numerical experiment has been discussed. It has been estimated the sensibility of simulation results on solid fraction changeability, determined by the cooling rate of the alloy. Presented works has consisted on series of solidification simulations of the plate casting, poured into sand mould and mould with the chills. The study of the influence of cooling rate and solid fraction curve have proved, that these values considerably influence kinetics of casting solidification, others results of solidification simulation and generally – the casting quality forecast. It is important to analyze those problems for the following aspects: the location of the analyzed region in the casting, thickness of the casting, mould material, the calculation temperature of post-processing quality criteria.

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MODELLING OF PIEZO BENDER ACTUATOR WITH HISTERESIS

Abstract

Piezoelectric actuators are more and more commonly used in many mechatronic devices. These transducers are able to change electrical signals into mechanical ones. On the market there are available 2 main types of piezoelectric transformers: stack and bending. The first of them are able to produce displacement about 0.1% of their length and forces till few kN. Bending transformers are able to generate much bigger displacements, which can reach fractions of mm, but the forces are not bigger than a few N. The very important advantage of piezoelectric transducers is their high maximum frequency which can reach few kHz. One of their most serious disadvantages is hysteresis, which make difficult their control and positioning accuracy. The piezoelectric hysteresis can be reduced by usage of special control methods and algorithms. In the design process of such controllers it will be very useful to have a good simulation model of piezoelectric transducer.

In the Institute of Mechanical Engineering a controlled by piezo bender actuator electrohydraulic servo valve is designed and investigated. In the paper a theoretical description of such transducer will be proposed. Based on it a computer simulation model will be build. In this model most important non-linearities will be included. The model will be implemented in Matlab-Simulink software. In the paper investigation results will be included and discussed. Simulation results will be compared with laboratory investigation results.

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ADAPTIVE CONTROL IN MANUFACTURING BETWEEN THEORY AND APPLICATION

Abstract

The adaptive control, as an automation methodology for technical systems is known since the ‘50s. An explosive development of such approaches has happened in the ‘60s in the electronic field and then in the ‘70s also in the machine industry. Theoretical and especially practical application are known in this direction, with respect to adaptive control of lathes having one (feed rate - f), two (f and v - speed) or even three work parameters (f, v and ap – depth of cut) as adjustable variables adaptive controlled.

The algorithms of adaptive control were in most of cases based constraints (ACC) and less based on optimization techniques. The reason of these was thanks to difficulties of transfer functions identifications which can model the cutting processes, in such a manner that the phenomenon can be reasonable enough across the reality.

The existence of CNC/DNC machine-tools was seen as an important step to carry out the autonomic factory of the future. What has happened in this field in the last decade with all this scientifically preoccupations? Were they abandoned?

The paper’s aim is to retrospect on the theoretical and practical achievements related to adaptive control of machine-tools, to analyze the reasons for which the research in this field is at the moment in shadow, and to bring out the arguments for and against adaptive control and finally to decide upon new directions of inquiry which are open to improvements of machine-tools real time controlled and monitoring.

It’s time to reopen the old books. Who knows, maybe will have a happy end this time.

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THE COOPERATION BETWEEN MULTIAXIAL HAPTIC DEVICES AND VIRTUAL REALITY SYSTEMS

Abstract

In this article methods of connecting multiaxial haptic devices to the virtual reality systems based on the personal computer are presented.

It is a natural choice to use force feedback devices in virtual reality systems. These devices make accessible an additional channel of information flow from system to operator, which makes simulation more real. The simplest solution to the problem of connecting a haptic device to the system is to use multi input/output cards. This solution is, however, inconvenient because of the multiplicity of cables and difficulties involved in programming software drivers. The next architecture described in the text is free from the difficulties involved in physically connecting the device to the VR system since it is based on available communication interfaces e.g., RS232C or USB. The building of the system drivers and of the library for VR software that includes nodes is required in both cases. The last architecture presented in this article solves this problem. It involves a dedicated microcontroller with USB on board, which simulates the multiaxial force feedback controller recognized by the system automatically.

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STRATEGIES OF THE LIFE CYCLE PROLONGATION OF THE SUSTAINABLE PRODUCT

Abstract

The paper presents some consideration about the methods, procedures, and strategies related to the prolongation of the life cycle of the product, particularly the future sustainable products. The typical repair, renovation and modernization are described in form of the algorithms. The modernization of the sustainable product especially the machine, requires different strategy and is closely connected with the conceptual and design processes of the product.

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PRODTECT ECO – A TOOL COMBINING LCA, DFR AND CONSUMER REQUIREMENTS FOR AUTOMOTIVE ENGINEERING

Abstract

With ProdTect Eco KERP develops and offers a tool for developers of complex technical products. A life cycle assessment will compare specific effects on individual product life stages (raw materials extraction, production, use, recycling), analyze weak points and present conflicting goals during the various stages – all of which is possible at an early stage of the development process. That supports the decision making process for the product design. With the Eco-Qfd and the Eco Means End Chain method also the consumer requirements can be integrated in the product design. All these facts increase the acceptance and use in the industry and consequentially lead to more products being designed with focus on environmental impacts.

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EXTENDED PRODUCT LIFECYCLE MANAGEMENT FOR THE MANAGEMENT OF CUSTOMER SATISFACTION

Abstract

Increasingly shorter product lifecycles, cost pressures and the demands for customer orientated products require producing companies to react flexibly towards to changed market conditions. However, engineering approaches like PLM still do not include customers as a know-how capacity for the product development. The results are product flops on the market, because products are either over-engineered or show fundamental deficits. At ITM, Ruhr-University Bochum, a new solution approach for the integration and management of customer satisfaction information into product development was developed. For this a methodology was developed, which offers the possibility of acquiring customer feedback, extracting customer satisfaction indices and mapping these onto technical product structures. The acquired customer feedback, satisfaction indices and favoured product configurations by the customer are integrated into PLM-IT-environment. The core of the integration concept is the extension of PLM functions, processes and metadata models, whereby technical product data, customer requirements and customer satisfaction can be linked context sensitively. The feedback integration approach enables an early product validation before the production/market launch and an analysis of dynamic customer requirements across several product generations.

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EXPERIENCE CONCERNING KMES QUALITY SYSTEM IMPLEMENTATION FOR CHOSEN DATA EXPLORATION IN SREM FOUNDRY.

Abstract

In the paper, main assumptions, algorithms and functions of author’s KMES Quality System it discuss. Its working version is tested in Srem Foundry by near 2 years. This system serves to explore chosen technological data during foundry processes. The data can be introduced by means of keyboard directly in the fields present on the PC screen according to program commands (instead of report-manuscripts containing measured results) or from the automated measurement recording system by direct data import to KMES Quality System. In the paper, a way of technological data transmission with their further integration in main foundry databases and their processing (with taking into consideration kind of casting assortment, current time, sequences of measurements), was presented. Also the capabilities of linking KMES Quality system with superior SAP R/3 system existing in Srem Foundry oriented to global quality control was show.

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THE DEVELOPMENT OF IA WITH LOCAL SEARCH APPROACH FOR MULTI-OBJECTIVE JOB SHOPS SCHEDULING PROBLEM

Abstract

The paper for job shop problem with multiple performance criteria is addressed. Many researches have neglected setup times on each machines or included setup times to operation times or dealt with setup times on each machine independent of the job sequence. In the paper sequence dependent setup times are proposed. The Immune Algorithm (IA) is promising method for multi-objective optimisation problems because of it ability to maintain equilibrium between solution space and solutions’ diversity. IAs outperform other evolutionary method such as Genetic Algorithms (GAs).

In the initiation step of IA the temperature parameter is proposed to find promising search direction which is valuated using the quality of the initial population. The IA consists of two stages; solutions of the first stage are divided into sup-populations of second stage. Each sub-population for different objective function is separately evolved. Moreover, an extra sub-population takes part in evolutionary process with scalar fitness function for evaluating sub-population quality. In the paper the development of IA with a genetic local search algorithm equipped with elite strategy, reproduction operators and preservation of dispersion to intensity search in certain regions is proposed. In order to increase the search ability of the algorithm and to explore new pattern of genes permutation, the crossover operator is used. In the article various operators such as: order crossover (OX), position-based crossover, job-based order crossover and linear order crossover (LOX) for genes permutation encoding are tested. Some mutation operators for permutation encoding in the paper are used, such as: sift mutation, insertion mutation, displacement mutation and reciprocal exchange mutation. The extra sub-population is subject to a hypermutation. Some parent solutions are modified depends on their affinity value. In the inner structure of hypermutation, sift mutation is embedded. Mutation operators help to maintain a reasonable level of diversity of solutions. Moreover mutation operator is a mechanism that enables to escape from a local optimum.

The IA is applied to job shop scheduling problem with objectives: makespan, total idle time of machines, total tardiness. The IA applies a weighted sum of objectives as a fitness function. In order to enable IA to various search direction in multi dimensional objective space objectvie’s weights are randomly generated. In the algorithm a pathogen represents the scalar objective function and antibodies represent solutions of the job shop scheduling problem. Antibodies are evolved using principles that control the immune system: clonal selection and affinity maturation. The improved IA with former one are compared and computational results are stated.

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TOC IN IMPLEMENTATION FOR MULTI – PROJECT SCHEDULING

Abstract

This paper presents an adaptation of the Theory of Constraint (TOC) method to the multi – project scheduling problem. The Theory of Constraints is a management philosophy developed by Eliyahu M. Goldratt in the early 1980s. It is a systems approach based on the assumption that every organization has at least one constraint. TOC use the global safety time to schedule the project and stresses that a system has to have a constraint. In TOC a constraint is anything that limits a system from achieving its goal. The interpretation of TOC and constrained – based scheduling is a solution to maximize the number of project, which the enterprise is able to implement concurrently. Known techniques of project management used for project scheduling such as Critical Path Method (CPM), Program Evaluation and Review Technique (PERT) were originally conceived for use on large single projects. These techniques allow for the minimization of project completion time. About 90% of projects are realized in the multi – project environment. Scheduling problems arise in situations where a set of activities has to be processed by a limited number of resources during a limited period of time. The scheduling problem consists of resources allocation and resources scheduling - ordering of activities on each resource. In this paper the Critical Chain (CC) approach is proposed to maximize the number of projects that may be implemented concurrently in one organization and minimization of project completion time. CC improves the project plan by ensuring that it is feasible and resistant from disturbance, i.e. uncertainty or statistical fluctuations. The Critical Chain scheduling aggregates the time buffer into a project buffer. Application of the fuzzy logic to project scheduling is proposed.

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KNOWLEDGE PROCESSING IN TEAMWORK

Abstract

Knowledge is of particular importance in Quality Management since it allows recognizing inconsistencies in processes, prevents creation of faults and improves organization. Explicit and tacit knowledge create dispatched base of organizational knowledge. A set of social processes through which workers in organizations create and integrate their knowledge is knowledge processing. Organization of teamwork is especially conducive to externalization of knowledge. If this knowledge is used in teamwork, an enterprise gains new kind of competence, described as team knowledge.

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COMPLEX MODEL OF A REAL MACHINE TOOL FEED DRIVE AXES WITH BALL SCREW

Abstract

In the model of servoregulation loop it is not possible to replace the dynamic behaviour of generally compliant structures, resp. that of systems of more compliant bodies, which represent e.g. model of mechanical part of a machine tool, with transfer functions derived analytically based on the simplified two-mass model of machine tool structure. Such simplification leads to inexact simulation of attainable set-up of controller parameters, which are influenced above all by the value of first amplitude depression of the frequency response function between the angular displacement of motor shaft and motor torque.

Inclusion of dynamic properties description of a complex FEM model of compliant machine tool structure into the mathematical form which can be employed in the model of regulation loop is enabled by the transformation into the State-Space. However, FEM programs usually do not work with the transformation of basic equation of motion into the State-Space and thus do not offer direct possibility of State-Space matrixes composition. Recently, in RCMT the technique of model description transformation into the State-Space based on modal decomposition began to be exercised. Equation of motion is interpreted in modal coordinates and the task of finding the eigenvectors and eigenfrequencies is solved.

Advantage of this procedure lies in the possibility of choosing of only such eigenvectors, which significantly influence certain transfer function. Next to it the State-Space description can be based only on FEM-nodes, between which transfer functions are to be found. Thanks to it small-size State-Space matrixes are obtained, whereby the quality of original FEM model, which is not reduced in real coordinates, is kept.

Description of dynamic properties of mechanical part of feed drive with ball screw is composed separately based on the model with discrete parameters and consequently transformed into the independent State-Space. Connection between the model of feed drive and machine tool structure is realized in the beforehand defined nodes. Separation of feed drive description from that one of the machine tool structure gives the advantage of performing e.g. sensitivity analysis of feed drive parameters and their influence to the feed drive dynamic properties.

Above mentioned procedure of building of a complex machine tool model connected with feed drive regulation model has been applied on the model of a real machine and verified by means of measurements. Based on the frequency response of velocity loop very good accordance of simulation model results with experimental ones is found. Simulation model shows also the influence of modal damping of the machine tool structure on the frequency response of feed drive velocity loop and sensitivity analysis of feed drive parameters is performed.

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SIMULATION AND MODELATION CONDITIONS OF THE GEAR TRANSMISSIONS BEHAVIOUR IN NOISES AND VIBRATIONS

Abstract

One of the major requests of the machine-tool proper operation is related to the level of noise and vibrations that they generate during runner order.

Of all the factors which have an influence on the level of noise and vibrations during working, gear transmissions represent a special category under quantitative, but most importantly, under qualitative aspect.

Although in the modern construction of the machine-tools little use is made of mechanisms with gear wheels, the existence of even one gearing with an abnormal working may lead to a level of noises and vibrations that induces unacceptable operating conditions for the machine-tool operating performances.

In such reasons, this paper aims to draw up a simulation program for the behaviors of gear transmission noises and vibrations, through a mathematical simulation and on the basis of some theoretical considerations, including a mechanical module.

The expressed model takes into account silent working conditions that a gear drives must satisfy, such as:

- kinematical accuracy;
- tooth line deviation accuracy;
- adjacent profile deviation accuracy
- accuracy classes of allowance fields

On the basis of this program, constructive constraints and criteria may be established since the design phase of the gear drive, in order for the requirements concerning functionality and the degree of silenced to be satisfied.

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FUZZY LOGIC ALGORITHM FOR PRISMATIC WORKPIECES CHOOSING IN EARLY DESIGN STAGE

Abstract

Manufacturing and product design experts consider the product early design stage as the most important stage of the design process, because it influences all stages of the product life cycle. A bad decision in the early design stage will have serious consequences. This is the reason why a lot of recent papers were dedicated on the development of approaches regarding the decision-making in the early design stage.

In early design stages of a product, a lot of information is not available in a crisp manner. Often qualitative knowledge is available from experts, which could be transferred into the modeling process. One of the main advantages of fuzzy logic is the possibility to formalize knowledge related to manipulated variables and their handling in a manner that is similar to a human expert, based on the inference rules. The variables and rules representation in a fuzzy logic model is very similar to natural language and therefore very well suited to integrate human knowledge into a decision making process.

In the field of manufacturing and design optimization there are three main applications of fuzzy logic technique:

- The first one is decision making. The appropriate manufacturing method is chosen by an expert system which needs a data base of all manufacturing methods to be considered. The designer uses information from established manufacturing methods, and from his past experience.
- The second one is the rating of suitability of a part for a certain manufacturing method. Mainly linguistic rating is used, like “bad”, “middle” and “good”. This can be done with different levels of detail. For a part optimization the number of different criteria depends on the manufacturing method. For example the applicability for a prismatic steel part can be determined vs. the maximum dimensions, the ratio between the part dimensions and part complexity.
- The third application is the modeling of rough values with fuzzy logic. For example mechanical properties or costs depending on design variables are important. Often only expert knowledge is available for such approximations.

The present paper treats the problem of the workpiece choosing for prismatic type pieces. The proposed algorithm is based on fuzzy logic. The main idea is to formalize the knowledge regarding production volume, part complexity, shape and dimensions, materials etc, using fuzzy sets and then to take the workpiece choosing decision through inference rules.

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A VIRTUAL AND AUGMENTED REALITY TOOL FOR SUPPORTING DECISIONS IN MOTORBIKES DESIGN: APRILIA APPLICATION CASE

Abstract

In a highly competitive market as the today’s one, the reduction of the costs and of the time to market is fundamental to maintain the competitiveness. In the motorbikes field especially, it is important to face the continuously changing trends of the market. In the life cycle of the motorbike product, the evaluation of the product’s design is very time consuming because it is composed by sketch selection, 3D model development, “loop” of physical mock-up realisation and evaluation/refining (usually by outsourcing). In this paper, a AR/VR application (called Virtual Mock-up, VM) for virtual mock-up evaluation, developed for Aprilia in the Eureka Project TWO, is presented. VM allows the users (a design team) to examine in a real-time interactive way on a power-wall (optionally stereoscopic), at 1:1 scale, the virtual final mock-up with all its materials, textures, surfaces and optional properties. The improvements and the updates of the mock-up requested by the users are performed virtually by avoiding the physical refining, that is very time and money consuming. In order to validate the realism of the feeling of the virtual mock-up, Aprilia has performed a simultaneous comparison of a virtual prototype with its real corresponding one: virtual lights, virtual observer and position have been setup according with the real ones by using the VM modules and interfaces ad hoc developed. The VM runs on a medium-level PC.

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PROTECT INTELLECTUAL PROPERTY AND PREVENT PRODUCT COUNTERFEITING – THE IT PERSPECTIVE

Abstract

Product counterfeiting is a major challenge for all industry nations world-wide. It must be fought at several levels, ranging from policy, over legal issues up to organization and technical measures. This article concentrates on the technical perspective, especially the challenges and potential solutions in the field of information technology. On the one hand, the internet is a introducing a high risk in collaborative product development. On the other hand, there are many tools and technologies available to protect information. Various concrete solutions are discussed and an outlook to further research and development is given.

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NEW APPROACH TO ASSEMBLY PROCESS VISUALIZATION
AT VIDA CENTRE

Abstract

Presented work was carried out at Virtual Design and Automation Centre at Poznan University of Technology. Authors made a research focused on adaptation of existing infrastructure to integrate in education new methods of assembly process visualization. Described new method base on CAD documentation but allow the end-user to work more easy and intuitive in stereoscopy environment. Presented results are also initial for further development to use in educational process the dedicated hardware for human and machine tracking an neutral interfaces using like data glove.

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PRACTICAL APPROACH TO VIRTUAL MODEL CREATION WITH USING CAD NATIVE FORMATS

Abstract

Authors present results of research in the area of data translation from CAD systems to Virtual Reality environment. Work carried out at Centre of Excellence VIDA (Virtual Design and Automation) described in this paper were focused on the use of popular CAD systems in the phase of geometry modeling and then on the use of native formats preparing the virtual models with the use of EON ICATCHER solution established and developed in VRLab in VIDA Centre. Problems with compatibility between 3D geometry formats are presented and authors propose solutions for better and faster data conversion with the proposition of direct CAD and VR integration.

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INTERACTIVE GUIDE FOR PRODUCT ASSEMBLY AND DISASSEMBLY VISUALIZATION

Abstract

New techniques of image projection, previously assigned for expensive simulations carried out in military or aerospace applications, are now available for standard use in mechanical engineering solutions and stereos-copy, for example, can be used for projection directly from a standard PC or laptop. Techniques such as virtual prototyping (VP), virtual assembly (VA) and virtual manufacturing (VM) have been for many years the target of research work (Jayaram 1997) (Ikonomoc 2004) and virtual applications are in use as interactive training programs, testing solutions and visualization platforms.

The main problem which exist in assembly and disassembly process is a difficult access to the parts and appropriate tool positioning to make an operation. Computer aided assembly and disassembly processes are well known. Virtual techniques are also involved in assembly and disassembly process (Choi 2002). In presented project where washing machine is an assembled and disassembled object designers start to use an interactive guide via internet web service. Problematic aspects of the processes are presented on the visual model of the product and described. Such of solution gives much more knowledge about the assembly and disassembly processes and allow that process can be carried out with better quality. The interactive models of household appliance products where also a subjects of other work carried out in VIDA Centre (Weiss 2005).

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DEVELOPMENT A 3D NON-CONTACT MEASUREMENT SYSTEMS

Abstract

This paper describes the development of a non-contact type system for measuring a freeform surface in industry. The vision and CT inspection systems play an important role in quality control with their accurate dimensional measurement capability. The introduction of several novel techniques enables the system to achieve high robustness in versatile industrial environments, rapid response, and accuracy below 0.1 mm. Some latest solutions and applications of three dimensional inspection in engineering area are presented.

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ANALIZA MONTAŻU SPRĘŻARKI KLIMATYZACJI
Z WYKORZYSTANIEM METODY MTM

Abstract

W artykule przedstawiono analizę pracochłonności operacji montażu sprężarki klimatyzacji z wykorzystaniem metody MTM. Przedstawiono definicję, zastosowanie oraz zalety i wady tej metody. Przeprowadzono analizę porównawczą pracochłonności operacji montażu sprężarki klimatyzacji wyznaczoną metodą MTM i chronometrażową. W końcowej części pracy przedstawione są wnioski z przeprowadzonych badań i analiz.

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MODELOWANIE MONTAŻOWEJ STRUKTURY WYROBU ZA POMOCĄ HIPERGRAFU

Abstract

W pracy podjęto próbę opracowania modelu matematycznego wyrobu z wykorzystaniem hipergrafów. Omówiono podstawowe definicje i zależności dotyczące hipergrafów. W dalszej części przedstawiono modelowanie struktury przykładowego zespołu z wykorzystaniem hipergrafu oraz wnioski z przeprowadzonych badań.

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KONSTRUOWANIE UWZGLĘDNIAJĄCE ZASADY MONTAŻU I DEMONTAŻU WSPOMAGANE KOMPUTEROWĄ BAZĄ DANYCH

Abstract

Ciągła poprawa jakości wyrobów i towarzyszący jej wzrost wydajności produkcji wymusza doskonalenie technik wytwarzania, w tym coraz częściej produkowanie wyrobów z wykorzystaniem konstruowania (projektowania) uwzględniającego procesy technologiczne ich montażu i demontażu. Również ekologiczny punkt widzenia nabiera coraz większego znaczenia jako kryterium oceny wyrobów technicznych. Komponent ten zaczyna być brany pod uwagę w pracach konstruktorów i inżynierów jak również u samego konsumenta. Dlatego tak ważna jest optymalizacja, a przynajmniej racjonalizacja tych procesów.

Odpowiedzialność za skrócenie czasu i zmniejszenie kosztów wspomnianych procesów ponosi także konstruktor. Dlatego koniecznym staje się oddanie do dyspozycji konstruktora odpowiednich środków pomocniczych, stanowiących źródło fachowej informacji (uwzględniające metody i formy organizacji procesów montażu oraz późniejszego demontażu wyrobu), które jednocześnie ułatwiają oraz przyspieszają podejmowanie decyzji w poszczególnych fazach procesu konstruowania.

Celem pracy jest zaprezentowanie koncepcji komputerowej bazy danych jako serwisu internetowego do wspomagania procesu konstruowania uwzględniającego montaż i demontaż w przemyśle elektromaszynowym w oparciu o nowoczesne techniki informatyczne.

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