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Virtual Prototyping Simulation for the Design of Two-Wheeled Vehicles

In this paper, a CAD system and a multi-body kernel have been integrated using a neutral top-down design environment. In particular, a parametric 3D functional scheme is developed as entry-level model to specify mechanism composition and to give starting values to positions and dimensions for all main components. The system uses CAD models to calculate mass and inertia properties, and the description of nominal geometries for visualization. Mechanism definition is based on the following steps: creation of a schematic multibody system, extraction of part properties from solid models, assembly modelling, multibody mechanism generation. As examples, virtual prototyping applications are presented in the context of vehicle design.

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New Surface Fitting Approach in Reverse Engineering of Sheet Metal Parts

The paper is focused on surface reconstruction techniques, developed to enhance the capability of a measurement system set up for analysing sheet-metal parts.
It presents an alternative technique to get accurate results in shape reconstruction in terms of deviation and smoothing. The matrix-like structured data, output of the measure, allows to reconstruct the surfaces following two approaches: Fit curves to sets of aligned points and then blend a surface onto them; fit surfaces on the whole point data set. The first approach is easier to perform because of the wide diffusion, also in the CAD systems, of many robust routines for 2D-curve fitting. The second approach requires a more complex algorithm to surface the 3D point cloud directly but allows to take into account a smoothing factor on the whole data set, that is very useful when more noise is expected on the point cloud.

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The Eraser Pen: A New Interaction Paradigm for Curve Sketching in 3D

In this paper we present a new interaction technique for curve sketching in 3D which integrates the two tasks of creating and editing into one paradigm: the 3D-eraser pen. The eraser pen allows drawing and deleting curves in 3D without mode switching just by changing the direction of the hand movement. In that way we have combined the creation and deletion process, rewriting the pencil and rubber metaphor in just one tool. The aim is to support the user to create the intended shape from the beginning.As a proof-of-concept we have developed our concept in a semi-immersive virtual environment for 3D-curve sketching in free space.

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Towards Context-Sensitive Modeling Tools

During the design of industrial products, designers perform multiple switches between different contexts. Their task could be greatly facilitated by assisting them with constraints and/or parameters specific to the contexts they encounter. Preliminary considerations for the realisation of context-sensitive modeling tools are discussed in this paper. A number of shape contexts with their implications are analysed via a case study performed in a computer-aided industrial design environment. Critical aspects encountered during this study are presented and improved modeling tools based on shape contexts are discussed.

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Surface Design in Virtual Reality as Industrial Application

The authors present SpaceDesign, a computer-aided styling application addressed to the early stages of the design process. Virtual Reality devices are used for expressing first design ideas in an unconstrained and natural way, like e.g. sketching shapes. The creative phase is supported by means of intuitive generation of surface functions in a semi-immersive environment. The industrial requirements are fulfilled by means of importing standard CAD file formats and keeping the mathematical representation of the models. Innovative features are provided: real time preview during the surface sketching, the navigation tool and 3D-constrained-interaction techniques with visual feedback. This combination of features makes our approach unique in comparison to similar systems.

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A Feature Based Approach for Conceptual Design

Early phases of design process still lacks of the computer support, although it has been recognised as an important part of design process. Paper introduces an approach towards a feature-based product model incorporating representation scheme for capturing product semantics handled in the conceptual design phase. Features are then the information carriers that allow modelling the relationships between requirements of a product, its functional descriptions and physical solutions. They will also bring this information to the downstream applications and will allow, for instance, to keep track of the consistency between the concept, the design, and the manufacturing of a product.

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A Methodology Supporting the Preparation of 3D-CAD Data for Design Reviews in VR

In recent years a range of different VR applications have been developed for the purposes of design review and analysis. The typical data source for a design review of complex models using VR technologies is an underlying 3D-CAD system or 3D styling tool, that provides geometric and topological information of the digital model. The time to adequately prepare 3D-CAD data for a design review session using VR is inherently influenced by the underlying methodology of product modelling, data acquisition, the quality of the conversion and complexity of the digital model. To manually prepare the data without an automated mechanism is tedious and cumbersome. Thus, we describe an efficient methodology and architecture to automate the process of data preparation for the purposes of a design review session in VR.

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Simulation on Multiple Dimensions for the Evaluation of New Designs. A Practical Experience

Our application problem is the study of the radiation, by simulation, into several greenhouse structures typologies. One of our initial decisions was using the most specific tools. We used a space/time distributed schema. First, we proposed to discretize the time axis, in order to model the evolution of the radiation at a given place. Secondly, we proposed the discretization of the surfaces on finite elements, using them as sources of radiation. Third, we evaluate the absorption of the radiation into the greenhouse by alternative configurations of the canopy. Input data of the simulation system are the greenhouse structure parameters, time period and interval time to simulate, cover and soil characteristics, and radiation absorption model into the greenhouse. Main conclusions include the interest of multidimensional finite element treatment and module distribution.

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Assembly Configuration and Appearance Changes in VRML Environment

3D CAD models provide a natural way of sharing design information among designers. VR emerged to be a popular technology for human-computer interface in product design fields. VRML is a tool specifically designed for creating 3D virtual worlds on the Web where these synthetic worlds give us the ability to visualize objects. This paper describes the system for VRML model visualisation that enables changes in configuration file, written in XML, and automatically reviewing of the model including functional behaviour defined as sensors and scripts. The main benefit of using XML technology is in a hierarchical structure that is easier to search or rearrange and is very useful for application programming.

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Digital Space Design with the Applicable Database of Interactive Avatar Behavior

The presence of the digital space has a considerable effect on the whole of the society and culture, and is now being risen as a medium which has an upcoming infinite expandability. As human is the spatial subject of real life, avatar is that of the digital space. And, by its digital nature, the variables representing a wide variety of the spatial experience could be extracted from the subjective data. More advanced space can be created if it is used to the space establishing oppositely. This research is to extract a form of avatar as a subject of the space creation in order to produce its database, and to propose the design of the digital space for experience in accordance with the interaction between avatar and the space.

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Interdisciplinary Methods and Tools for the Design of Mechatronic Products

The mechanical engineering scene has increasingly incorporated electrics and electronics for the control of mechanical systems. With the growing importance of design automation and an increasing need for integrating engineering disciplines, new methods and tools for mechatronic engineering should be provided. In this paper, the meaning of design methodology will be discussed as fundamentals for engineering work. Computer aided methods and tools which have been developed at the Department of Computer Integrated Design (DiK) will be presented. A prototype implementation shows how these methods and tools could enhance engineering tasks in mechatronic product development.

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Colibri - A Collaborative Design System for Product Data Integration

An extended parametric information model is presented in order to integrate product data based on parameters and constraints for design process reasons. Constraints represent parametric relations between CAx models and allow to share data across design teams and activities. A collaborative design system, which is called Constraint Linking Bridge (Colibri), was implemented in order to assist engineers exchanging product data and working on engineering information in a cooperative way. A use case shows the application of the software for the development of an integrated wheel suspension.

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Design and Evaluation of Metal Construction Manufacturing System

The logistics simulation of the manufacturing production system is the main purpose of the present paper. The simulation for the new configuration of the production process was achieved using the discrete event simulations. The simulation model, which is corresponded with the actual state of production process was established. The new model was proposed, which is found to be superior to the current model of manufacturing system. The result of the analysis indicated essential reduction of total logistics costs.

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An Interface Specification for Principle Solutions Supporting the Cross-Domain Design of Mechatronic Systems

Starting from the principle solution of a mechatronic system its components are usually worked out in detail decentralised within the envolved engineering domains. With the increasing design progress the interactions between the components become more and more important. They must be considered at any time to ensure the system integration and a total product optimum. Furthermore these interactions can change due to new customer requirements or proceeding component specifications. In order to manage the interactions a cross-domain interface specification is presented. It helps that engineers can work independently based on well-defined interfaces between related components. Modifications and their effects become transparent and controllable.

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New Generation Computer-Aided Design Tools: Two Related Research Projects Investigating the Future Expectations of Designers

The aim of this paper is to add to the debate through the findings of two discrete ongoing research projects, carried out in the Netherlands and in England, following these common aims: to explore the capability of current CAD systems to support conceptual design activity; to identify user expectations of new generation CAID tools. The outcome of these studies will help researchers and software developers to better understand the needs of professions involved in the design process, such as industrial designers and design engineers, and will help to produce improved CAID tools that can be used from concept sketches to final product.

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Towards 'Virtual Clay' Modelling - Challenges and Recommendations: A Brief Summary of the Literature

Over the last decade, the industrial designer's workplace has been changed by CAID tools. The design form could evolve in steps alternating between development with traditional tools and with CAID systems. However, current CAID systems do not allow designers to employ all the skills that traditional tools do. Attempts have been made to overcome this problem using haptics technology. An analysis of the use of haptic modelling tools will help in the implementation of enhanced CAID tools. In this paper, an effort has been made to give a structural framework to the use of haptics technology in 3D modelling in industrial design.

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Information Management for Multi-Technology Products

Software (SW) is an increasingly important part of many types of products. Companies designing and producing mechanical and hardware products have problems integrating the mechanics and hardware design process with the software design process. The different requirements for the information used and the use of separate information systems makes information management a difficult task. Therefore, many companies are facing a strong need to integrate both the processes and the information systems. This paper describes the processes and discusses their information need. An integration is proposed, from a process, information and tool perspective.

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Real Experiences of Virtual Worlds

The JCAD-VR framework is implemented to anticipate the use of VR within the creation phase of the design process. It creates simple parametric 3D-shapes directly in a co-edit VR environment, thus allowing the design to be shared as it evolves.
To allow constant collaboration between several users the entire project is based on client-server architecture where every user accesses the virtual world, interacts with the VE and shares design tasks. The whole framework is organised in an object-oriented fashion, where each module fulfils a certain task and it is independently coded. This approach has allowed the delivery of an initial functioning core of the system, whose capabilities will be expanded in the near future.

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Snapshots and Bookmarks as a Graphical Design History

This paper presents a technique to enhance 3D modelling systems by displaying the design history during a design session. It offers the opportunity to select and annotate various stages of a model. After a short survey of commercial applications, two modelling concepts are introduced: snapshots and bookmarks. A Java implementation was made based on Teddy, a sketch-based 3D modeller. Snapshots are displayed in a storyboard. For analysis purposes, sessions can be visualized as a graph.
Exploratory experiments were performed, which show its use. To conclude, we state that this technique can be useful for both new modelling paradigms and existing CAD systems. Future issues include history visualization, navigation, and collaborative use.

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Freeform Shape Manipulation Using Context-Dependent Constraints and Parameters

A method was developed to investigate which shape modification activities are performed during early design. We compared how designers ideally could create shape, to how they do it in practice, when using clay. With this method we were able to identify parameters and constraints that play a role during individual activities. Further research will be directed to select a set of parameters and constraints that support modeling activities during shape ideation and can be implemented in CAD software.

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Modelling of Means in Conceptual Design

Functional decomposition is proposed as a central element of systematic design, and functions are fulfilled by principle solution elements (means, wirk principles). This paper is concerned with answering how to model means and suggests an information
model from an analysis of the concept generation in student projects. The paper is a scientific preparatory work for a computer-based design support system for conceptual design enabling the generation of concepts with abstract "building blocks" of higher aggregation. The hypothesis is that by using formalised means, solutions of higher quality can be created, and the solution space can be covered better. The goal is to provide suitable support for the designer capable of intuitive steps.

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Part Based Product Upgrade

A procedure for part based product upgrade is proposed. Part based product upgrade means product improvement as a result of improvements of its parts (i.e. changes in the values of part characteristics), which have no effect on product architecture. Preservation of product architecture is emphasized because it enables simple implementation of product upgrades. The procedure is based on product decomposition and extraction of original values of part characteristics. The question of usefulness of the granularity of decomposition for own/supplied parts and more complex building blocks is studied separately.