BERICHTE DES LEHRSTUHLES FÜR COMPUTERANWENDUNG IM BAUWESEN

PROF. DR.-ING. R.J. SCHERER * TECHNISCHE UNIVERSITÄT DRESDEN

INFORMATION

RESEARCH AND LECTURE ACTIVITIES

1999

December 1998

The research of the institute has - due to historical reasons - two different branches:

Applied Informatics and ***Applied Stochastics***

Applied Informatics is further sub-structured in Data Base Technologies and Artificial Intelligence. Applications are mainly in the design domain but a steady migration in the construction domain has happened during the last years. The scope of research is not restricted to engineering problems only but captures business problems as well. It is focused on computational design and computational enterprises.

The view of the brochure is directed to the future, i.e. what is planned to be done in 1999 based on the results achieved in 1998.

Know how transfer to the industry has indeed a high priority for the institute. In 1998, the head of the institute re-activated the national standardization group of product documentation (DIN-NATG-F.6 "Dokumentation im Bauwesen") and has been vice-chairman since mid 1998. He also was elected vice chairman of the DIN-CALS group and he is about to establish a work group on "engineering workflow in AEC" (Arbeitskreis ewf-bau) as a spin-off from the work group ewf, which is focused on mechanical engineering.

The staff of the institute has undergone an outstanding change, which was triggered off by three PhD candidates who finished their work between July 1997 and March 1998. The first one, Mr Steurer, already left the institute in August 1997. Mr Zsohar and Mr Hauser, who submitted their PhD theses left the institute in early 1998 and received their doctoral degree in the second half of the same year. Triggered by the re-organisation of responsibilities in the research staff three further persons, Mr Rudolf Thomann, Ms Jana Buchwalter and Mr Dirk Hamann decided to leave the institute and went to the industry. Five newcomers, Mr Müller, Mr Bretschneider, Mr Qiu, Ms Oertel and Dr Reul, graduated in civil engineering, mathematics, mechanics and informatics, resp., entered the institute in February, May, April and July 1998, and is going to enter it in January 1999, resp. One combined teaching and research position for a young civil engineer is still vacant. All in all, fluctuation during 1997 and 1998 resulted in a considerable rejuvenation of the current staff and fresh ideas and has triggered off new research directions.

Further information may be found at our homepage *wwwcib.bau.tu-dresden.de,* which will continuously be updated to provide the latest state of our research activities.

Dresden, December 1998

Raimar J. Scherer

Lehrstuhl Computeranwendung im Bauwesen

(Institute of Applied Informatics in Civil Engineering)

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Product Data Server for Concurrent Engineering with Knowledge-Based Architecture

Peter Katranuschkov

Objectives

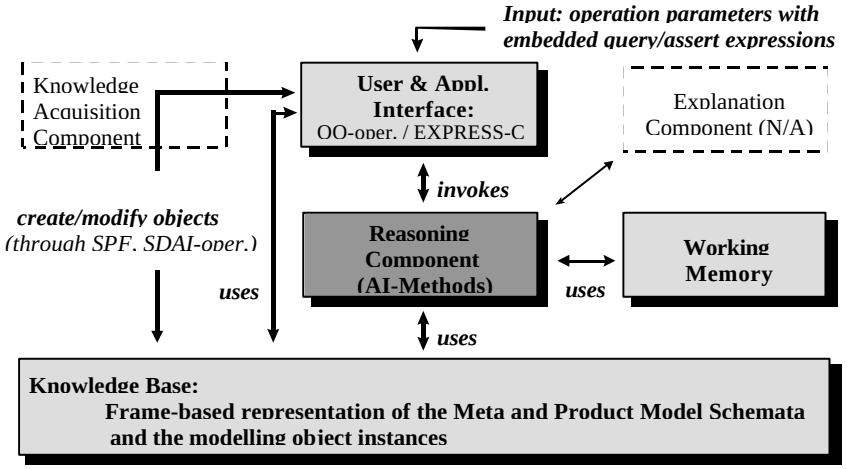
Concurrent engineering in AEC has requirements to product data management which are beyond integration and simple data exchange. These are:

- *collaborative work* of physically distributed teams - requires the use of common product data repositories and distributed client/server architecture,
- *co-operative problem solving* - requires effective information sharing supported by comprehensive data access/retrieval functions and consistent semantic and functional interoperability features,
- *concurrency* - requires multi-user access to the product data, availability of local data models together with methods for effective data transformation from one model to another, evolution and dynamic classification of the modelling objects, version management.

Approach

The above requirements are too complex to be solved with one single IT paradigm. Therefore in this project a *hybrid approach* unifying traditional object-oriented modelling and advanced AI techniques is developed and implemented for the prototyping of a product data server for concurrent engineering.

The underlying modelling framework of the server is based on the ISO STEP methodology, using EXPRESS-C as a common modelling language for all supported models. To enable coherent use of both the object-oriented paradigm based on the EXPRESS-C specification and a set of advanced knowledge-based methods applied in several product data services, such as model transformations, model matching, complex queries on the basis of generic templates etc., the representation of the product data models is done according to the *frame-based modelling paradigm.*



The knowledge-based architecture of the product data management server (PROMISE)

This approach provides the following benefits: (1) capability to accommodate both descriptive and prescriptive computational features, (2) separation of data structures from high-level rule-based data management knowledge, (3) encapsulation of knowledge-based methods within the procedural attachment of operations to the modelling objects, enabling the use of uniformly defined function calls from the outside, (4) full consistence with the conceptual object-oriented modelling approach.

The architecture of the server very much resembles that of a typical knowledge-based system. The dashed-line components in the above figure are given for comparison. The actual implemented components (shown with solid boxes) emphasise the resemblance, but also the difference to a classical KBS. An outstanding feature of the architecture is that input is always provided through the same gateway, independent of the internally used methods. This is realised by uniquely defined for all integrated clients remote procedure calls, supporting both TCP/IP, Java RMI and CORBA connectivity.

Legal Framework for a Virtual Enterprise in Building Construction

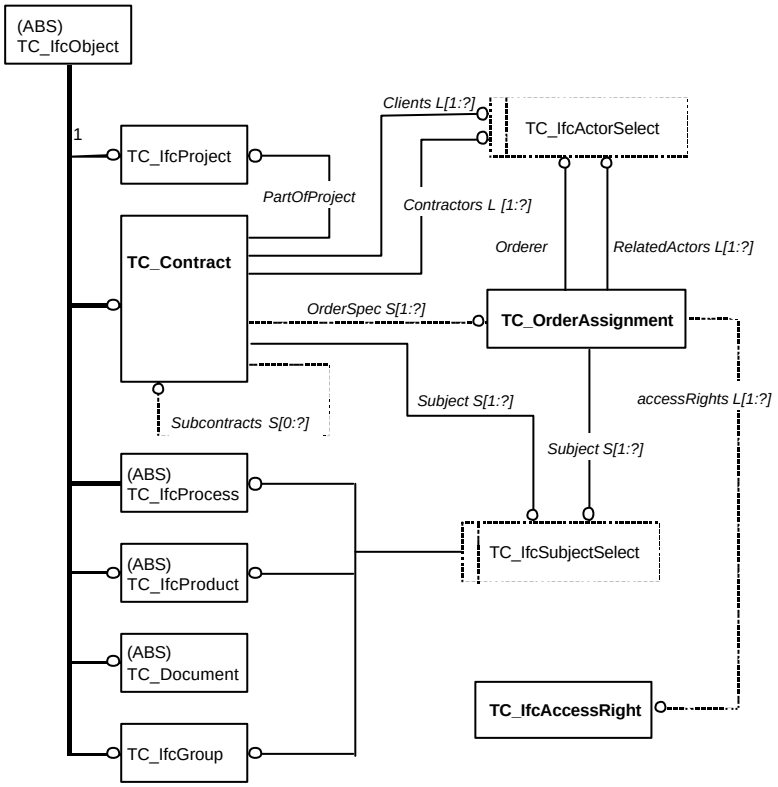
Peter Katranuschkov

Objectives

An integrated IT environment for the Virtual Enterprises in Building Construction requires to support: (1) a high degree of product and process interdependencies, (2) the ability to work independently, and (3) the overall consistency of the information. In the last years several approaches have been proposed to meet these requirements on technical level. Little or no consideration has been given to the legal aspects of construction projects, which are of equal or even greater importance for the effective project and data management in the virtual enterprise. The goal of this research project is to develop a legal framework capable to meet the above requirements from legal point of view. The framework should allow to integrate the legal aspects of construction project information into an overall environment of product, process and document related data, as well as to ensure the legal consistency of the data.

Approach

In the developed approach all legal aspects are considered in their inter-relationship with the technical aspects of a project. As a basis of the framework the current IFC project model version 1.5 is used. This model is considerably extended with several concepts of legal relevance including the explicit representation (in EXPRESS-C) of the actors in a construction project, the roles of these actors in the project processes, their access rights to the project information, the contractual agreements, the rights to give orders to other actors and the approval rights and duties for the developed technical solutions. Such concepts do not appear or are only roughly outlined in the IFC project model and in ISO STEP.



EXPRESS-G schema of the 'Contract-Actor-Access' object structure

A contract management tool is currently prototyped on the basis of the developed framework. It enables: (1) default rights assignment for typical project roles, (2) dynamic rights assignment according to the gradual refinement of responsibilities in the course of a project, (3) checking of the legal consistency of the product and document data, (4) propagation of access rights according to the specified „contract-subcontract" dependencies, (5) tracking of the responsibilities for the approval of technical solutions.

Product Data Management for the Virtual Enterprise in Building Construction

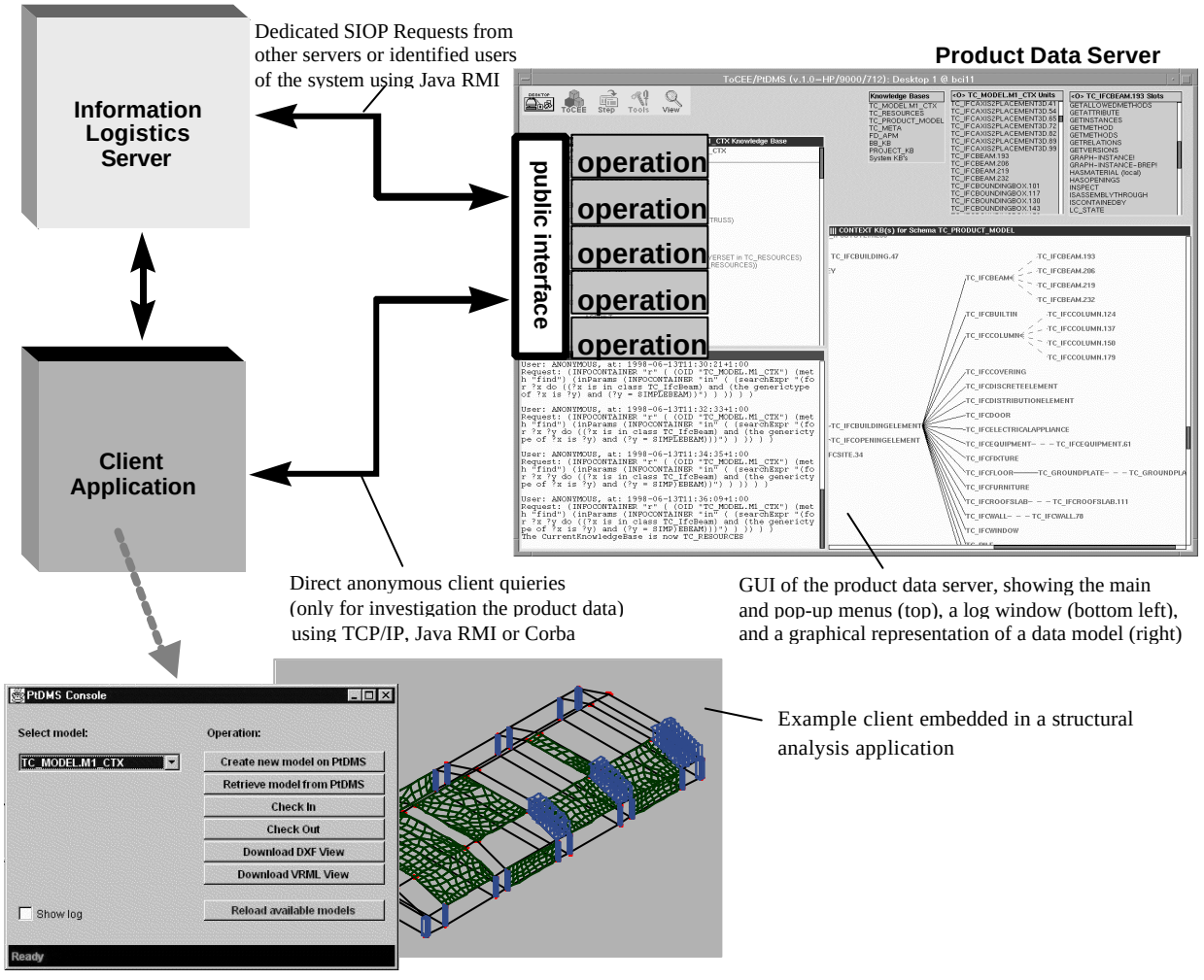
Peter Katranuschkov, Rainer Wasserfuhr

Objectives

Previous research work and accumulated experience in the areas of product and process modelling and concurrent engineering methodology have shown the significance of distributed client/server systems for managing construction project information in the virtual enterprise. The aim of this research is the investigation of appropriate IT methods and frameworks enabling product data management operability within a complex multi-client/multi-server environment.

Approach

The whole environment is comprised of a centralised Information Logistics Server (ILS), maintaining a common consistent project ontology, a set of client adapters for linking specific client applications and a set of servers (product, process, document) providing common project-wide services for the whole virtual enterprise. The product data server commits to the common project ontology through a set of explicitly defined high-level modelling concepts. Product data services are provided on the basis of formally defined operations, conforming to explicit model specifications in EXPRESS-C, and a unique language binding formalism for TCP/IP, Java RMI and CORBA IDL based interfaces. Client applications can access the product data server both directly (through anonymous queries) or through dedicated server interoperability requests (SIOP) using the ILS as a gateway to set up the appropriate user/actor identification and access privileges to the product data and the corresponding services. The concepts and prototyping are done partially with assistance of VTT Building Technology, Finland within the frames of the EU ESPRIT project ToCEE.



The C/S Environment

Dynamic Process Modelling for Distributed Concurrent Engineering

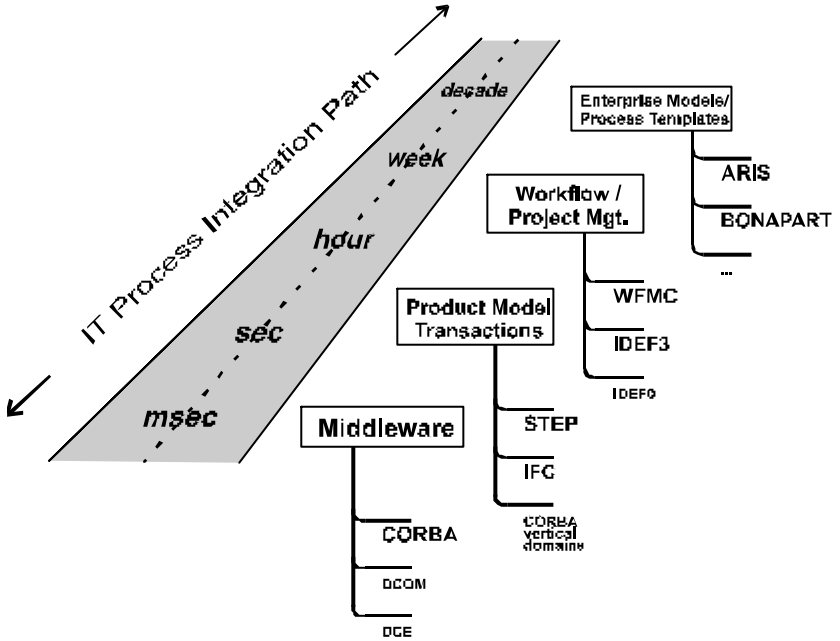
Rainer Wasserfuhr

Objectives

Advanced IT solutions for concurrent and co-operative engineering are organized as distributed multi-level (n-tier) client/server architectures, where currently time and process related information is collected and processed on various levels of time abstractions (sorted by frequency of execution):

- ***milli-seconds - seconds:*** *Requests* and *Responses* as atomic process events for communication between distributed objects, performed by a middleware layer (object request broker).
- ***seconds - minutes*****:** *Data Transactions*, triggered by requests, as the atomic operations on object oriented product and project date, which can be grouped, nested and rolled-back.
- ***minutes -days:*** *messages* and *workflow activities* as units of interpersonal communication between project actors, related to aggregations of transactions on project data
- ***weeks- years:*** *process templates* and *business rules*, defining ways of working for a team or enterprise. They are changed only as the result of long-term strategic considerations

However, nowadays, the connection of those levels is not supported in an *integrated* and *redundant-free* manner nor with appropriate retrieval and visualisation services for time and process related information. Our goal is to develop an infrastructure and a visualisation tool to enable dynamic retrieval and visualisation of those information processes on any relevant level of temporal abstraction. The main challenge of this approach is the efficient just-in-time creation of views of large time series and the combination with user specific filtering parameters.



Typical Frequency of IT Processes in Integrated Environments for Concurrent Engineering

Approach

A common representation for date and time will be specified, whichs allows to integrate the following main components of an existing distributed environment into a common time and process model:

1. a request broker of a central middleware service
2. a transaction processing monitor (TP monitor) for transaction processing and concurrency control
3. a workflow engine
4. an enterprise template repository.

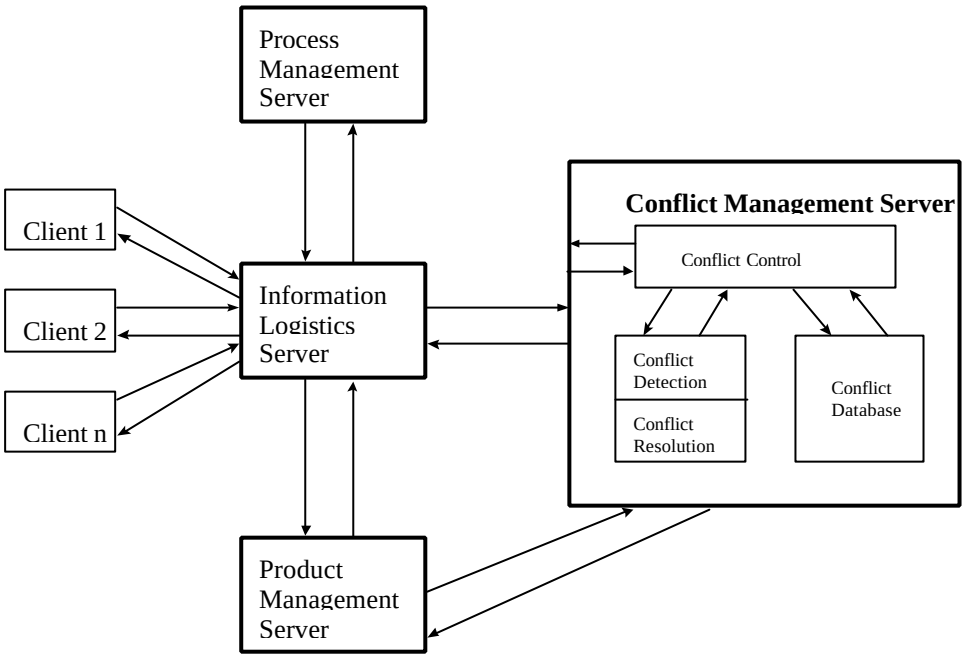
These components will be modified to use common objects for date and time, which are then organized as a central B-Tree model with additional property constraints, e.g. for access rights or semantics of related objects. A process visualisation window with logarithmic scalability will be the main component of the user interface, so that information can be uniformly visualised for all units of time, ranging from seconds to years. Filtering mechanisms for objects will be included according to object semantics and access rights to those objects.

Conflict Management in a Concurrent Engineering Environment

Jutta Oertel

Objectives

Within an environment of design and construction of buildings and engineering structures, an underlying product model is steadily affected by several parallel processes. By this, a large number of physical and logical conflicts can occur. Conflicts are, for instance, spatial collisions, topological deficiencies, and functional lacks. The support for the detection and management of these conflicts is an important aspect in concurrent engineering.



Conflict Management within the ToCEE concept

Approach

For the continuous management of arising conflicts, a software architecture is developed which allows the concurrent, asynchronous work of several client processes on partial models of the whole product model. The information flow is managed by an Information Logistic Server, whereas the product model is stored in the Product Management Server. The product model is organized hierarchically and divided into several aspects and applications. This structuring is very beneficial for the propagation and management of conflicts. The object concept is extended by roles, responsibilities, and priorities according to the requirements of the conflict management. Each process manages local, i. e. domain and process specific, conflicts on its own. For conflicts, which are beyond the local domain, a central server can be consulted to carry out a global conflict management across several processes. The Conflict Management Server consists of a control part, a database, and a knowledge base. Conflicts can be stored in the database and retrieved by all processes and participants again later on, on demand. The knowledge base contains generic knowledge to support conflict detection and resolution. Conflict detection tests constraints or searches for certain substructures, whereas conflict resolution determines whether to go back to earlier states or to perform additional necessary actions.

Assistant-System for the Preliminary Structural Design Process

Dietmar Müller

Objectives

The conceptual design of the load-bearing structural system is a cognitive task that has a great influence on the quality and the costs of a building and the effectiveness of the whole design process. An appropriate overall structural system has to be developed and divided into substructures to enable a preliminary dimensioning and an approximate design in consideration of the load transfer and constraints due to the system behaviour and the material properties. Using prefabricated structural members has to be taken into account.

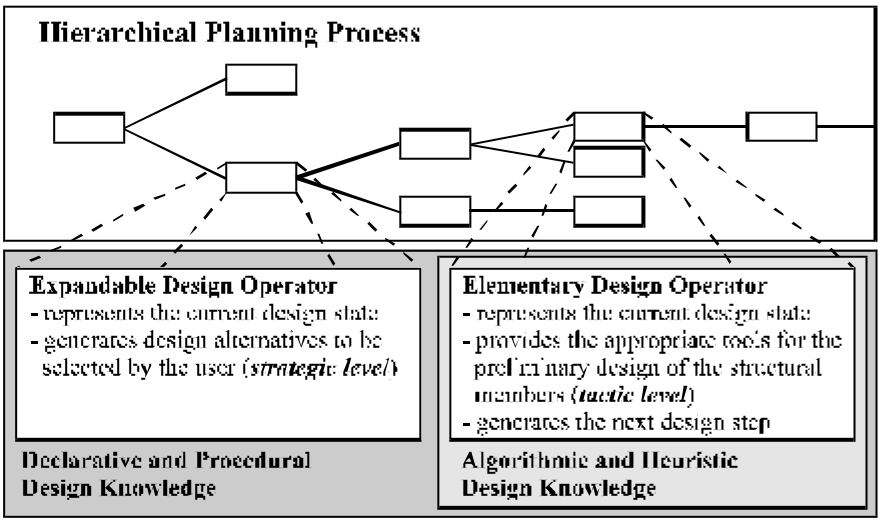
The assistance of these activities by a software tool concerns the following human abilities:

- basic mechanical expertise about the topology and the behaviour of structural systems,
- heuristic knowledge like rules of thumb that are gained through experience and used to make approximations that allow a flexible further development,
- cognitive behaviour like recognising, imagining, reasoning, assuming, learning and planning.

The implementation of an expert-system that provides all these skills and represents a substitute of a structural engineer is neither possible nor desirable. Hence the goal of this research project is to find ways how an engineer can be assisted efficiently by an intelligent software tool in an interactive way.

Approach

The application of Artificial Intelligence methods is studied exemplarily on the assistance of the routine conceptual structural design of R.C. industrial buildings consisting of frame, plate and wall structures. A cognitive architecture, which integrates rule-based design knowledge, constraint techniques and a hierarchical planning method, enables the support of a preliminary design process that takes into account the strategic, tactic and reactive behaviour of a structural engineer.



Hierarchical Planning Tool with Knowledge Representing Design Operators

The user navigates through a hierarchical planning tree that models the design process. Expandable design operators which generate alternative structural system types assist the user to make strategic design decisions. Elementary design operators provide the appropriate tools for the definition and the dimensioning of structural members in the current design state. These tools support tactic design decisions. Geometrical and mechanical conflicts are recognised and solved by the program.

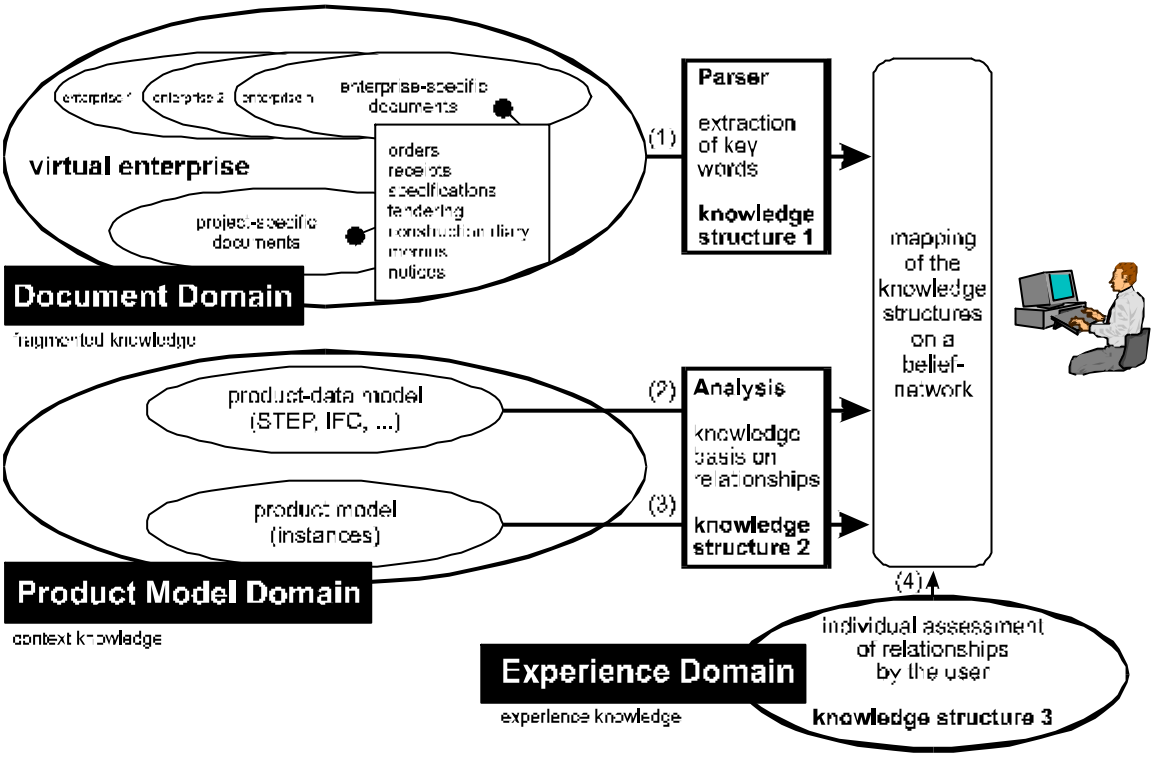
The appropriate expertise of the assistant software can be divided into declarative (factual) knowledge, procedural knowledge to generate the design process and algorithmic and heuristic knowledge for the preliminary design of the structural members.

Retrieval of Project Knowledge from Heterogeneous AEC Documents

Sabine Reul

Objectives

Although recorded in civil-engineering documents (such as construction diary, order forms, delivery notes, discussion memos, etc.), most of the knowledge experienced from a project turns useless without the interpretation by those people who were directly involved in the project, because they are the only ones who remember the context and inter-connections between the single elements of documents. Indeed, the single civil-engineering documents are fragmentary. If a way were found to retrieve all the context knowledge from the single stored documents, the entire knowledge and experience or at least a great amount of it would be available to everyone and could be used for planning and carrying out of future projects. Hence, the digital storage of the civil-engineering documents would be the long-term storage of the project experience as well.



The three-level architecture of the retrieval system

Approach

The method chosen comprises three sequential levels: On level 1, a preliminary object-oriented knowledge network should be extracted from the documents by applying general text analysis methods combined with clustering techniques. The necessary lexicons should be examplarily extended for the specific domain of AEC (Architecture, Engineering, Construction). On level 2, context knowledge should be provided, which has to be extracted from the knowledge structure of the product and product data model. It should be mapped onto the preliminary document knowledge network to refine this network and enhance its reliability. Nevertheless some uncertainty and fuzzyness will remain. This should be attached on level 3 by modelling this uncertainty explicitly by belief network methods. This allows that uncertainties are explicitly propagated during reasoning and that the user gets aware of these uncertainties. The final result of a query will be a list of documents representing this requested project knowledge, ranked by their reliability. The relationship between the documents can be visualized by knowledge maps, taking the reliability values as zoom factors, for instance.

Decision Support System for Re-Adjustment of Site Operations

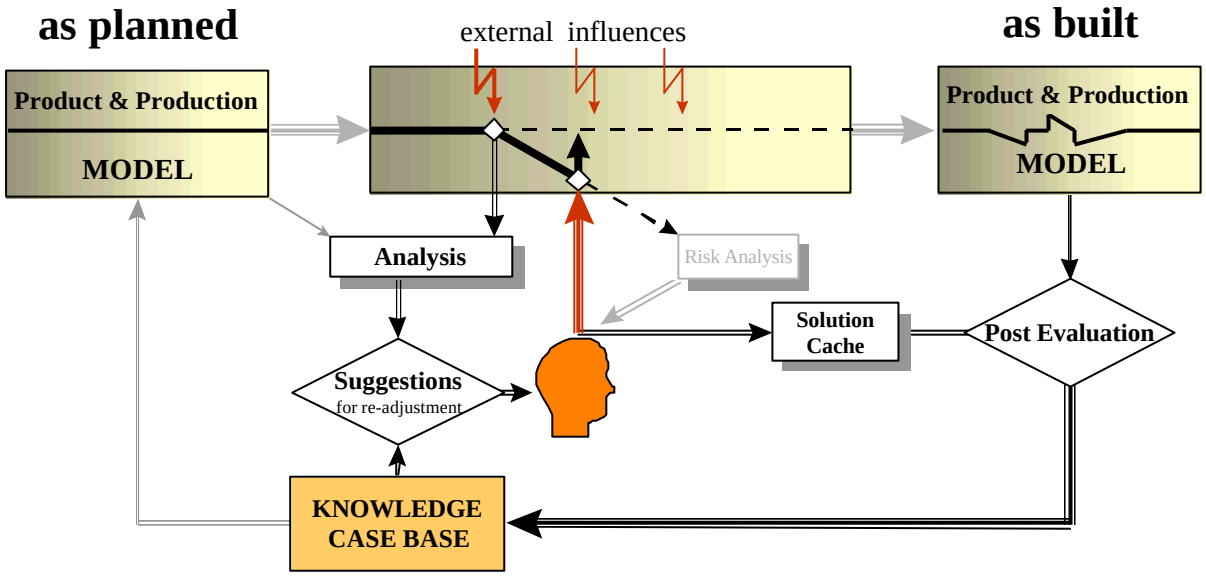
Steffen Scheler

Objectives

Today great attention is paid to the facility management after the construction phase. On the other side usually the management of the *site facilities* is underestimated. For small to medium buildings, i.e. up to 6 million US$, only the principle *site facilities* layout according to a typical case is carried out. Consequential costs are hard to be forecasted. Using the knowledge of successful past projects would improve the estimation of these costs considerably.

Our goal is to develop an assistant system which models dynamic process flows and supports decision making, taking into account also hidden costs which depend on the interrelationship of man-machine-material and past experience.

The basic task of *site facilities* management is to tackle the man-machine-material problem, i.e. the production logistic problem, which is strongly influenced by external, unforeseeable events. Fast reaction to such influences in order to rebalance the production process is most desirable.



Architecture of the 'Decision Support System' for Site Operations Adjustment

Approach

Fast decision making should be achieved by an assistant system for site operations adjustment. The system should monitor the actual situation, detect events which are not in the plan, and assist by finding appropriate possible solutions.

The executed process will be monitored by measurable parameters like costs, time and quantitative characteristics. If parameters diverge from the planned parameter range, the system gives a warning and prepares useful instructions for re-adjustment of the production process with the support of past experiences stored in a knowledge case base. The final decision will be done by the user based on a risk analysis. This analysis extrapolates past trends to forecast the final result with and without alterations. The selected and adapted case to re-adjust the production process will be saved as a potential new valuable case in a temporary storage, the *solution cache*. After finalization of the project, the cases in the *solution cache* are re-evaluated. Past decisions have been based on assumptions, expectations and hypothesis which now can be more objectively judged in retrospect of the settled project. Based on this post evaluation it can be decided upon which cases are really valuable and are to be copied in the permanent knowledge case base, thus preventing ineffective solutions to be transferred in the knowledge case base.

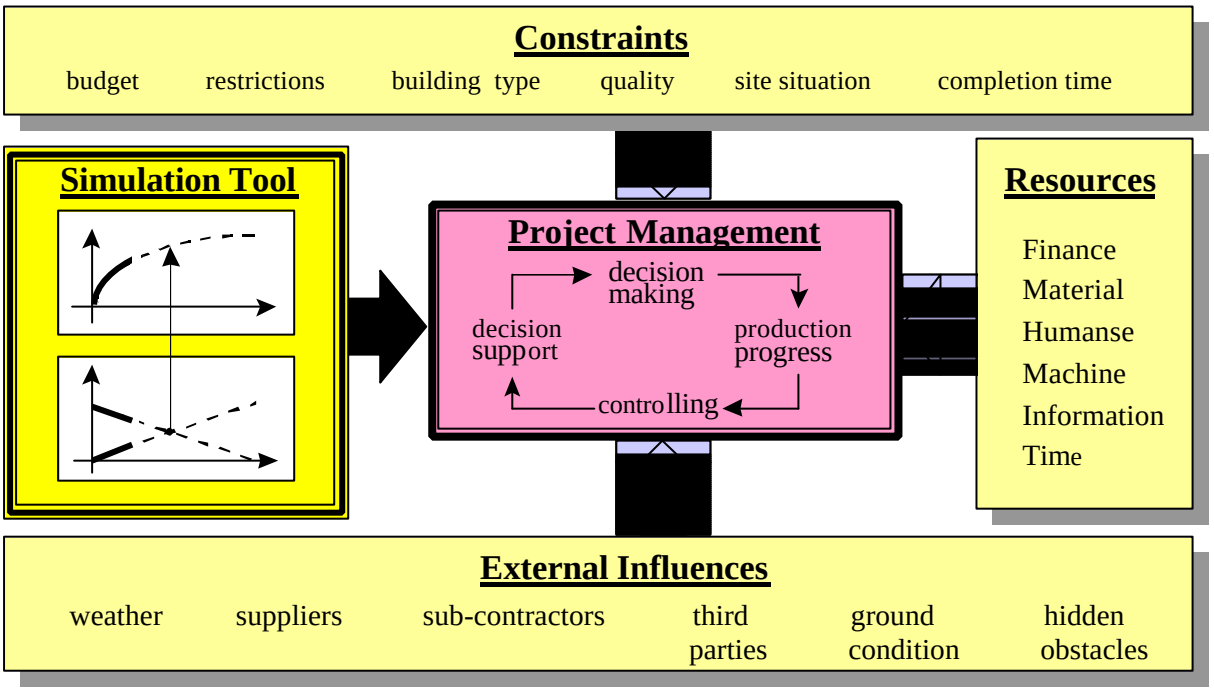
Methods applied are *case based reasoning* and *dynamic classification* for solution search and selection and *incremental sustained learning* for the appropriate storage case in the base.

Construction Simulation for Decision Support in Project Management

Ingrid Gerk

Objectives

Construction processes are always cost-intensive and of high complexity. As there are often unforeseen deviations from what was planned, short-term changes of subsequent processes can get necessary. For the representation of the technical an economical dependence and management consequences, a graphic-interactive simulation tool is needed. It should provide the responsible engineer with an overview of inter-dependences of sub-processes and their effects on the final result so that he receives the necessary information basis for his decision-making and subsequent activities.



Main interrelationships and influences on the construction process

Approach

The simulation tool shall visualize the technical process in their inter- and intra-relations between input and output and help optimize them by means of numerical methods. First, the focus is on the earthwork and erection. Examples are the earthwork with excavator and removal of the masses of earth, the movement of one or several cranes, and movement of an elevator on a building site. Using these examples potentials are presented of how to simulate complex production processes, as they occur in practice, by numerical and product models. There are plans to extend these examples and to integrate them in complex procedures as well as to optimize them by means of setting constraints to input data.
The decision support system is implemented in the programming language C++ based on extensive use of the graphical representations, databases and on open architecture for later extension for knowledge-based methods and a heuristic rule basis.

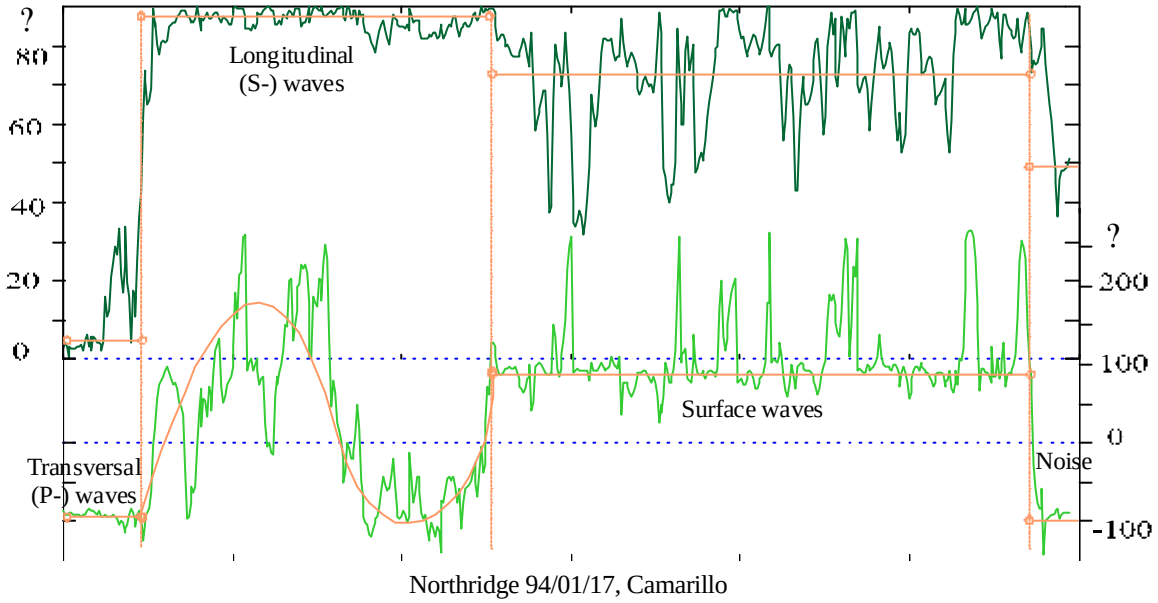
Stochastic Identification of Earthquake Wave Entities

Jörg Bretschneider

Objectives

Prediction of possible loads on structures caused by earthquakes is essential for construction and design of earthquake-resistant buildings. One of its important basics is consistent analysis, i.e., comparability of the components of strong motion measurements and simulations at different places. In statistical sense this means a unique and physically transparent definition of the correlation of the three-dimensional stochastic process of ground acceleration, e.g. via reference components.

Modelling earthquakes by stochastic processes which are stationary in wide sense, as usual in common load models, is contradictory to the existence of different types of body and surface waves, which sum up to the whole process, as well as to their transient character. In order to take into account the different wave types as statistically independent entities within a nonstationary model, identification methods for their occurrence in accelerograms are in urgent need.



Rotation angles ? and ? of the stochastic principal axis with wave phases

Approach

Identification of the wave phases in strong ground motion accelerograms by the course of the stochastic principal axes over time gets reliable, besides the well known vertical angle, by information of a second angle, which we made visible by correctly defining its periodic image domain. By the course of both angles the stochastic vector process gets more transparent than by its component correlation functions or cross power spectrum. In contradiction to these skills the stochastic principal axes do have a direct physical reference — they can be identified with the time-dependent principal direction of the nonstationary ground acceleration — and allow the definition of nonstationary reference components as well, because they are based on a consistent definition of the correlation of the spatial components. By definition, most relevant seismic energy of all wave types is incorporated into one principal axis component

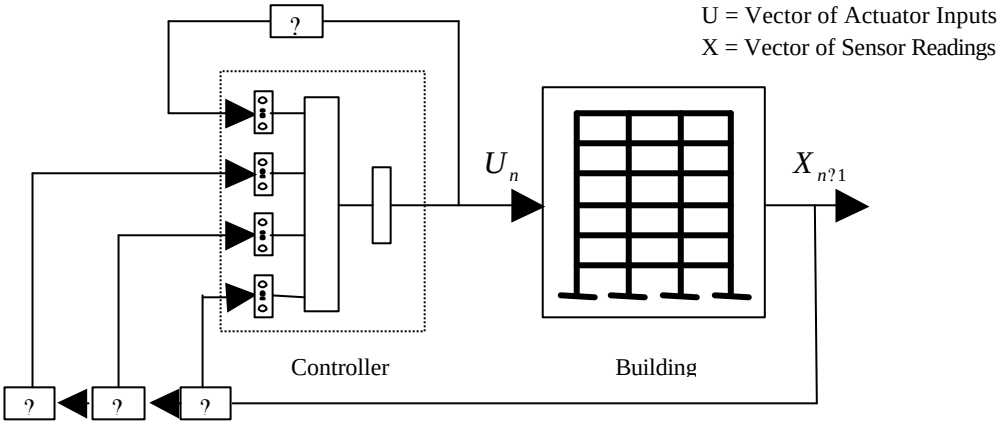
This approach to a seismic load model as stochastic nonstationary vector process will be verified empirically with data of the Northridge 1994 and other Southern California earthquakes.

Seismic Response Control of Flexible Buildings Based on Fuzzy Logic and Neural Networks

Shumin Qiu

Objectives

To ensure and enhance the safety and reliability of buildings against various environmental loads, e.g. strong wind or earthquake, is one of the most important and difficult tasks for civil engineers today. Structural control as an integral part installed in modern buildings is not only attractive to meet this problem, but will have special significance for civil engineering in future, would be potentially revolutionary, since this novel approach elevates the structural concepts from static passive level to one of dynamism and adaptability. The aim of this research is to develop an active control system of buildings against earthquake loads based on the theory of fuzzy logic and neural networks. Herein, fuzzy logic theory is used to treat the uncertainties concerted with input data from the seismic ground motion, structural models and parameters.



Active structural control of a multi-story building

Approach

This research will focus on following aspects firstly:

- Estimation and classification of earthquake loads and its characteristics: An attempt will be made in this part to classify and identify various seismic ground motions. The evolutionary power spectral analysis is applied to determine the non-stationary seismic characteristics. Since neural networks are able to recognize patterns and classify complex variables online, they are utilized to discriminate and classify the earthquake ground motion during earthquake event, which are trained by past earthquake records. It is intended to develop an earthquake early predication system that provides early earthquake information for the control system before hazardous parts of the ground motion arrive.
- Design of control algorithms: To express the modeling of structures in a simple, natural-language like form, a knowledge based controller is designed based on fuzzy inference rules. Due to the massive parallel computational capability and the learning ability, neural networks offer many potential advantages over traditional control methods, particularly in solution of large complex nonlinear structural systems. The emulator neural network and neurocontroller is developed and trained on the linear and nonlinear seismic response of a building. A set of training cases is generated by off-line numerical simulation of coupled actuator-structural systems. The quickprop training algorithm is used for the training of the neurocontroller.

Research Contracts 1999

Title: Towards a Concurrent Engineering Environment in the Building and Engineering Structures Industry

Financial Support: EU ESPRIT Project No. 20587: ToCEE

Person Years: **45** (total), 10 (CIB, TU Dresden), Duration: 3.3 years

Approach: A conceptual framework and a supporting environment for concurrent engineering in the building construction industry is under development, using existing and emerging new advanced information technologies. The developed software prototypes will demonstrate the results by supporting coordinated management of product information, resources and document flow. The project contributes to the integration of design, construction and facility management. The workpackages are: *Design Process, Construction Process, Facility Management, Legal Model, Information Logistics, Product Modelling and Interoperability, Document Modelling, Conflict Management, Modelling of Design Standards and Regulations*

Partners: Obermeyer Planen+Beraten (Germany), Building Research Establishment (UK), General Construction Company (Greece), Projekti Insinöörit (Finland), E.Ott Lawyer Office (Germany), VTT Building Technology (Finland), SOFiSTiK (Greece), D'Appolonia (Italy), University of Ljubljana (Slovenia)

Title: Knowledge-based design support for the design of structural systems

Financial Support: DFG Sche223/18-1

Person Years: 2, Duration: 2 years

Approach: Applying AI methods of constraint propagation and planning, where the planning operators contain rule-based knowledge, we support the synthesis of structural systems. The system is structured in three design levels: the strategic level, the tactic level and the reactive level.

Title: Seismic Wave Propagation in stochastic homogeneous layered media

Financial Support: DFG Sche223/23-1

Person Years: 2, Duration: 2 years

Approach: Applying pertubation methods, stochastic differential and integro-differential methods, the statistical moments and the statistical distribution of the particle movement, the amplification function and the resonance frequencies of a layered medium is sought.

Scholarships 1999

Title: Active Control of Buildings

Financial Support: DAAD scholarship

Person Years: 2, Duration: 2 years

Approach: Application of fuzzy and neural methods to characterize the seismic load process and control the active control systems.

Lecture Activities 1998/99

Title: Computer-Aided Solutions of Engineering Problems

Intended Audience: 1st semester, students of civil and structural engineering
Lectures and Tutorials: Scherer / Gerk
Subjects: Besides a general introductory guidance into informatics, this lecture comprise the fundamentals of hardware and software with a special emphasis on the programming language C and focuses on numerical engineering problems. The practical tutorials aim at writing and testing structured programs in the programming language C.

Title: Computer Graphics

Intended Audience: 2nd semester, students of civil and structural engineering
Lectures and Tutorials: Scherer / Gerk
Subjects: This lecture comprise problems of computer-aided graphical representation of two- and three-dimensional objects as well as the implementation in the programming language C as an example. Special emphasis is given to distinguishing between the topological, geometrical and the visualization model. Animation, technical drafting and symbolic visual representations are trained. The accompanying tutorials practise the implementation in the programming language C.

Title: Data structures and data bases

Intended Audience: 3rd semester, students of civil and structural engineering
Lectures and Tutorials: Scherer / Gerk
Subjects: Knowledge of elementary data structures, for instance arrays, concatenated lists, two-dimensional concatenated structures (trees, entity-relationships) and relational data structures as well as of the application of these in data bases are provided. Furthermore, methods of managing memories and special algorithms for effectively storing and processing big amounts of data are taught, such as algorithms for effectively storing symmetrical and band-structured matrices as well as searching and sorting algorithms. The tutorials practise these methods and algorithms in the programming language C.

Title: Computer-Aided Design and Drafting

Intended Audience: 4th semester, students of structural and civil engineering
Lectures and Tutorials: Scherer / Böttcher
Subjects: This course of lectures aims at giving civil engineering students background knowledge of the methodology and techniques of computer-aided design. It discusses basic CAD functionality, as well as advanced methods for the efficient application of CAD technology in civil engineering design, such as data structuring techniques (layers, blocks, symbol libraries), data exchange paradigms and formats (DXF, STEP), user interface and output facilities. The general features of CAD systems are presented on the example of ALLPLAN/ALLPLOT. Attention is given also to specialised systems for building design with examples from the field of reinforcement detailing.

Title: Computer-Aided Engineering: Applications for Structural Engineering

Intended Audience: 5th semester, students of structural and civil engineering
Lectures and Tutorials: Scherer / Müller
Subjects: This course of lectures introduces basic principles and techniques for the effective use of numerical analysis programs in the solution of various structural design tasks. It gives the students an insight into the methods for correct modelling of engineering problems, as well as for the appropriate structuring of the necessary information and the proper interpretation of analysis results. Special emphasis is put on the formulation of FE analysis tasks in terms of the entity relationship modelling

approach. Examples include the modelling and solution of typical FEA problems, such as stress-strain analysis of slabs and shear walls subject to various kinds of loads. The tutorial materials are based on the practical use of a concrete structural analysis package, but are nevertheless general enough so that a principal understanding of the application of any structural analysis program can be gained.

Title: Object-Oriented Modelling - Fundamentals and Application in Structural Engineering

Intended Audience: 8th semester civil engineering students with specialisation in structural mechanics and CAE

Lectures and Tutorials: Scherer / Katranuschkov

Subject: This course aims at giving civil engineering students an understanding of the basic principles and the practical application of the object-oriented modelling methodology as a powerful vehicle for the design and realisation of complex computer-aided engineering tasks. Special emphasis is put on the discussion of advanced product data technology methods on the basis of the international standard STEP and industrial standardisation activities like IAI/IFC. The students will be actively involved in modelling tasks selected from everyday engineering practice with focus on the adequate formal specification of structural design problems and the respective product data representation and product data exchange specification.

Title: Artificial Intelligence Methods and Their Application in Structural Engineering

Intended audience: 9th semester engineering students with specialisation in structural mechanics

Lectures and Tutorials: Scherer / Katranuschkov

Subject: This course of lectures aims at introducing the methods of *Artificial Intelligence* to engineers related to specific problems of their daily practice as mainly design, processing of standards and team work.

In principal the students shall gain an understanding that computer support is not restricted to numerical computation, as e.g. programs for structural analysis, but also can involve manipulation of symbols and thus produce some sort of "intelligent" behaviour. The lecture is intended to introduce AI as a technology for useful programs that might influence the way engineers do their design in the future.

Title: Computer-Supported Information Management in the Building Industry

Intended Audience: 9th semester civil engineering students with specialisation in reinforced concrete structures design and construction

Lectures and Tutorials: Scherer / Katranuschkov

Subject: The effective management of design, construction and facility management information throughout the whole life cycle of a building is a task with strategic importance for the competitiveness of the building industry.

This course discusses basic information management techniques used in current engineering practice (structuring of CAD information, data exchange paradigms, workflow management), as well as emerging new software methods and techniques. On the basis of typical co-operative engineering scenarios, advanced information management methods like Internet-based communication, product, process and document modelling and information sharing are discussed. Emphasis is given to the organisation of concurrent engineering work.

Title: Numerical Mathematics

Intended Audience: 6th semester, students of civil engineering

Lectures and Tutorials: Hauptenbuchner

Subject: This lecture informs on, and consolidates methods of numerical mathematics being used in CAD/CAE-software. After a general introduction to the methods of numerical mathematics, algorithms of solution for linear systems of equations, esp. the Cholesky method, and algorithms of solution for

large band-structured matrices are introduced; this is followed by a survey of algorithms of solutions for eigenvalue problems. Graphical representation of results from numerical methods, which are available in discrete form, is realized by interpolation methods, esp. SLINE-methods.

Title: Informatics in civil engineering
Intended Audience: 6th semester, students of science of the economy
Lectures and Tutorials: Hauptenbuchner
Subjects: This lecture aims at giving a introduction to the specific problems of software in civil engineering, the special requirement to the hardware, the way of work with the software and the future trends. Especially the area of the functionality of CAD- and CAE software will be discussed. The students get a survey of the software used in civil engineering offices and can acquire knowledge that allows them to judge such software products concerning quality and performance. A further aim is to enable the students to assess the expenditures on installation of new software, training of staff to operate it and carrying out of projects by appropriate software products.

Title: Informatics in civil engineering
Intended Audiences: 1st semester, students of architecture
Lectures and Tutorials: Hauptenbuchner
Subjects: The course shall allow the students to acquire knowledge of and proficiency in computerized data processing that will enable them to prepare multi-media documents of up-to-date quality. This requires experienced skills in using operating systems, text and graphic processing software, calculation programs and data bases as well as interfaces between them. Because of their wide-spread use Microsoft Office products are particularly presented. A performance test after the course shall prove the knowledge of and proficiency in the usage of Microsoft Office products incl. of interfaces provided to prepare a document of a subject chosen at liberty but according to well defined criteria.

Publications in 1998

[1] HAUSER, M., SCHERER R.J., A Cognitive Architecture to Support Structural Design Tasks, Computers and Structures 67 (1998) pp. 339 - 346, Elsevier Science Ltd., 1998

[2] SCHERER R.J., ZSOHAR M., Stochastic Wave Propagation Methods as an Important Part of Seismic Hazard Analysis, submitted for the 1st Joint EU - Japan Workshop on Seismic Risk, Chania, Crete, Greece, 24-26 March 1998

[3] SCHERER R.J., ZSOHAR M., Probability of the SH Wave Resonance Frequency of a Random Layer over Half Space, 1st Joint EU - Japan Workshop on Seismic Risk, Chania, Crete, Greece, 24-26 March 1998

[4] SCHERER R.J., NOLLAU C., BUCHWALTER J., SCHELER S., Produktinformationssysteme unterstützt durch dynamische Klassifikation und ähnlichkeitsbasierte Suche, in: Hartmann D. (ed.) Veröffentlichung zum Abschlußkolloquium des DFG-Schwerpunktprogramms 694 "Objektorientierte Modellierung in Planung und Konstruktion", Springer-Verlag, 1998

[5] SCHERER R.J., JULI R., REINECKE W., WASSERFUHR R., Towards a Concurrent Engineering Environment in the Building Contstruction Industry. Proceedings of the XIIIth FIP Congress 8-10-, Amsterdam, May 1998

[6] SCHERER R.J., AI methods in concurrent engineering, in: Ian Smith (ed.) Artificial intelligence in structural engineering, Lecture note in AI, Vol. 1454, pp. 359 -384, Springer 1998, Germany, 1998

[7] SCHELER S., A Product Information System Based on Dynamic Classification in Smith I.F. (Hrsg.), Proceedings of the Workshop 98 of the European Group for Structural Engineering Applications of Artificial Intelligence, pp. 469-473, Lausanne, Switzerland, 1998

[8] SCHERER R.J., KATRANUSCHKOV P., Integrated product model centred design in a virtual design office, in: Proc. of Information Technology for Balanced Automation Systems in Manufacturing, Prague, Czech Republic, August 1998

[9] SCHERER R.J., ZSOHAR M., Time-dependent Stochastic Principal Axes as the Basic Tool to Derive General Shape Functions for Non-stationary Power Spectra, 11th ECEE 06-11 September 1998, Paris, France

[10] WASSERFUHR R., Integrierte IT-Environments für die kooperative Planung im Bauprozeß Proceedings "Forum Bauinformatik", Weimar, VDI-Verlag, Sept. 1998

[11] SCHERER R.J., A Framework for the Concurrent Engineering Environment. Proc. of the 2nd European Conference on Product and Process Modelling in the Building Industry, Amor R., Scherer R.J. (ed.), Building Research Establishment, Watford, Great Britain, Oct .1998

[12] WASSERFUHR R., Shared process models for distributed co-operative engineering, Proc. of the 2nd European Conference on Product and Process Modelling in the Building Industry, Amor R., Scherer R.J. (ed.), Building Research Establishment, Watford, Great Britain, 1998

[13] KATRANUSCHKOV P. AND HYVÄRINEN J., Product Data Server for concurrent engineering in AEC. Proc. of the 2nd European Conference on Product and Process Modelling in the Building Industry, Amor R., Scherer R.J. (ed.), Building Research Establishment, Watford, Great Britain, 1998

Reports

[1] SCHERER R.J., HAUSER M., Archivierung von Entwurfswissen für die Bewehrungsführung, Bericht 1/98 des Lehrstuhls für Computeranwendung im Bauwesen, TU Dresden, Dresden, 1998

[2] SCHERER R.J., NOLLAU C., BUCHWALTER J., SCHELER S., HAUSER M., KATRANUSCHKOV P., Bereitstellung technischer Information und konsturktiver Lösungen für die Planung und Konstruktion im Bauwesen, Bericht 2/98 des Lehrstuhls für Computeranwendung im Bauwesen, TU Dresden, Dresden, 1998

[3] SCHERER R.J., Annual Report 1997, Report on Task K 4.1 of the Workpackage K 'Project Management' (public), EU-ESPRIT project no. 20587 Towards a Concurrent Engineering Environment, March 1998

[4] SCHERER R.J., INGENBLEEK B., The ToCEE STEP Toolbox, Report on Task F 3 of the Workpackage F 'Product Model' (confidential), EU-ESPRIT project no. 20587 Towards a Concurrent Engineering Environment, March 1998