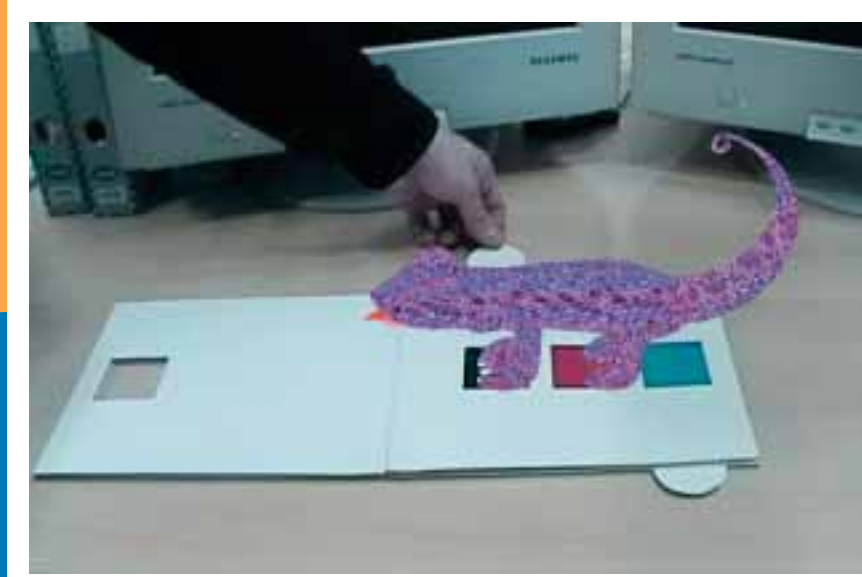


COMPUTER GRAPHIK

# topics

Reports on Computer Graphics

Engineering applications



**EUROGRAPHICS**  
**EG 2004**

EUROGRAPHICS 2004  
Grenoble, France  
August 30 - September 3

Semantic Augmented Reality

CCG/VICOMTech  
GraphiTech  
ISSUE

## Reports of the INI-GraphicsNet

### Editorial Office:

**COMPUTER GRAPHIK topics**  
Fraunhoferstrasse 5  
64283 Darmstadt  
Germany

Phone: +49 (0) 6151 / 155 - 146  
Fax: +49 (0) 6151 / 155 - 446  
Email: Bernad.Lukacin@inigratics.net

### Publisher:

Prof. Dr.-Ing. Dr. h.c. mult. Dr. E.h.  
Hon. Prof. mult. José L. Encarnação

### Issue Editor:

Dr.-Ing. Stefan Noll, Dr.-Ing. Jorge Posada,  
Dipl.-Math. Luís Almeida

### Editor:

Bernad Lukacin

### Art Direction:

Christine Becker, Sylvia Behrens,  
Tina Bernschein, Andreas Dücker,  
Ralph Klepper, Bernad Lukacin

### Translation:

Daniela Lüders

»COMPUTER GRAPHIK topics« is published six times a year. All rights reserved. Not to be reprinted without approval of the editor.

## SEMINARE ZGDV Darmstadt

### Linux Systemadministration 20.-22.09.2004

Das System, der Kernel, Hilfsmittel, Benutzerverwaltung, Administrationstool (YaST2), Hardware einbinden, TCP/IP-Netzwerkbetrieb, Port-Ids und Dienste auf Linux, X Window System, Grafische Benutzeroberfläche KDE, Web-Server, Dateiservice konfigurieren, DNS konfigurieren, MS-Window-Integration mit SAMBA, Installation von Linux SuSE 8.1, LILO

### Java Workshop 23./24.09.2004

Application-Entwurf, Gui Entwicklung mit AWT/SWING, Benutzerdefinierte Dialoge, Dateibehandlung, Serialisierung, Verschlüsselungsalgorithmen, Unterbringung von Nutzdaten in Bildern, Grafikprogrammierung, BMP/PCX Dateiformate, RLE Komprimierung

### Microsoft.NET Grundlagen 25./26.09.2004

Einführung in die .NET Plattform, C#, Visual Basic .NET und die CLR, ASP.NET Web Forms und Web Services, ADO.NET und XML, Mobile Anwendungen, Interoperabilität mit Win32 und COM

### Adobe Photoshop Grundlagen 29./30.09.2004

Programmoberfläche, Farbmanagement, Grundlagen der Bildauflösung sowie deren Neuberechnung, Grundlagen der Farbmodelle und Dateiformate, Bildoptimierung, Auswahltechniken von Bildteilen, Maskierungsmodus, Einführung in die Ebenentechnik, Bildmontage, Ebenenmasken, Einstellungsebenen, Transformationswerkzeuge, Textwerkzeug, Exportformate und Druckereinstellungen

### Professionelle Recherchetechniken 04.10.2004

Die Struktur des Internets, Internetdienste, Unterschiede und Handhabung von Katalogen, Volltext-, Meta- und Spezialsuchmaschinen, Suchanfragen richtig formulieren, Ergebnislisten auswerten, Bildersuche im World Wide Web, Newsgroups, Newsletter und Mailinglisten, Branchenbücher und Nachschlagewerke, Speichern und Weiterverarbeitung gefundener Informationen

## SEMINARE ZGDV Darmstadt

### Repräsentation von Geodaten mit der Geography Markup Language GML3 04.10.2004

XML, Namespaces, Xlink, XML Schema, Hintergrund und Historie von GML3, Überblick über die Bestandteile von GML3, Erläuterung der GML-Packages, Verhältnis zu den Normen der ISO 191xx-Reihe, Zuschnitt von GML3 auf Applikationen, Abbildung von UML-Modellen auf GML-Anwendungsschemata, Beispiel für eine Anwendungsmodellierung

### ZOPE Grundlagen 15.10.2004

Nutzung des Zope Management Interface (ZMI), Zope Objekte, Ordner, Bilder, Dateien, Versionierung, Dynamische Inhalte mit der DTML, Variablen und Formulare, Dynamische Inhalte mit Zope Page Templates, Zope Sicherheit, ZCatalog, Integration von relationalen Datenbanken

### Reihe Darmstädter Kongresse

### 2. Kongress Barrierefreies E-Government: auch sicher? 14.10.2004

Barrierefreiheit – der ungehinderte Zugang zu Informationen im Internet für behinderte Internetbenutzer, BITV, Sicherheitsaspekte für barrierefreie Internetseiten

## Information and Registration

### ZGDV Darmstadt

#### Abteilung Aus-, Weiter- und Fortbildung

Ute Articus, Alexandra Ohly,  
Hugo Kopanitsak  
Phone ++49 (0) 6151/155-160+161+163  
Fax ++49 (0) 6151/155-440+199  
Email awf@zgdv.de  
http://www.zgdv.de/

### ZGDV Rostock

#### Abteilung Aus-, Weiter- und Fortbildung

Eva Mahnke  
Phone ++49 (0) 381/4024-159  
Fax ++49 (0) 381/44 60 88  
Email awf@rostock.zgdv.de  
http://www.rostock.zgdv.de/

## SEMINARE ZGDV Rostock

### Eclipse Entwicklungsumgebung 04./05.10.2004

Workspace, Java-Projektverwaltung, Javaprogrammierung, CVS, Automatisierung mit Ant, JUnit-Unterstützung

### .NET Framework – Konzepte und Technologien 06.10.2004

Verteilung, Entwicklung, Sicherheit, CLR, Klassen, Sprachen, Tools, WebServices, ADO.NET, ASP.NET

### E-Learning – Einführung in die Praxis 14./15.10.2004

Konzeption, Umsetzung, Methoden, Autorenwerkzeuge, Drehbucherstellung, Modularisierung, Standardisierung

### Neues Recht für Neue Medien 15.10.2004

Onlinerecht, Internet-Marketing, Webseiten und Recht, Datenschutzrecht, Urheberrecht

### ZOPE Grundlagen 20.10.2004

Dynamische Inhalte, Anwendungen erstellen, Zope Sicherheit, ZCatalog, relationale DB

### Windows-Programmierung mit den MFC 21./22.10.2004

Architektur, Programme, Menüs/Zeichenbefehle/Interaktion, Grafikausgabe, Drucken, Dialogfelder, Steuerelemente

### Usability Engineering Gebrauchstaugliche Anwendungen 25.10.2004

Prozess, Phasen, Gestaltungs-/Bewertungskriterien, Kosten-Nutzen-Analyse, Anwenderbeteiligung

### Linux Sicherheit 28./29.10.2004

Linux-Systeme »härten«, Rechte delegieren, Programme »einsperren«, SSH, SSL u. v. m.

### MS Projekt

#### Projekte planen und kontrollieren 01./02.11.2004

Vorgangsorientierte und ressourcenorientierte Terminplanung, Konfiguration, Multiprojektmanagement



## Join the new technology

Computer Graphics is one of the key technologies of a modern information and knowledge society. The INI-GraphicsNet develops market-oriented, state of the art technology to foster and to support the innovation process of enterprises as well as the social development. Numerous businesses use our know-how to implement sustainable products and services. We achieve this with, for example:

- 3D Interaction and Visualization
- Agent Technologies
- Animation
- Augmented Reality
- Computer Supported Cooperative Work (CSCW)
- Database Services
- Geometric Modeling / CAD-Model
- Graphical Information Systems (GIS), Facility Management
- GUI / Interaction Technology
- Image Analysis, Image Quality
- Imaging
- Internet- & Intranet-Solutions
- IT-based Learning and Training
- Medical Data / Image Processing
- Mobile Computing Technology
- Modeling and 3D-Reconstruction
- Multimedia and Hypermedia
- Multimedia User Interfaces
- Perceptual Computing
- Product Data Management
- Rendering
- Scientific Visualization
- Secure Image Communication
- Semantic Modeling
- System Integration
- Telecommunications
- Ubiquitous Computing
- Usability and Utility Engineering Technologies & Methods
- Virtual Prototyping
- Virtual Reality

Our expertise allows us to work on a multitude of industry-related topics which include, amongst others:

- eApplications
- eServices
- eBusiness
- Medical Information Technology
- IT Security and IT for the security in our society
- Visualization and Interaction in traffic technology and traffic telematics
- Ambient Intelligence
- Games and Edutainment
- Usability and Utility Engineering
- Software for the product and production development

### Computer Graphics

Computer graphics is the **technology with which pictures, in the broadest sense of the word (synthetic graphics as well as grayscale and color images), are captured or generated, presented, manipulated, digitally processed in the appropriate form for the respective application and merged with other, nongraphical application data.** Computer graphics also includes the computer-supported integration and manipulation of these pictu-

res with other kinds of data, such as audio, speech and video **(to create multimedia systems)** as well as corresponding advanced **dialogue and interactive technologies.** Concepts which characterize the important topics of computer graphics are, to name a few, visualizing information, visual data mining, visual computing, virtual reality (VR), augmented reality (AR), interactive Internet services and secure image transmission and communication.

# Contents

Developing applications for the Portuguese footwear Industry	5
@rtec: Art and Technology in the Cultural Industries	8
TORGA.net: The »Trans Portugal-Galicia« Communication Network	10
WAVE – A Virtual Audio Environment: An immersive musical instrument using a low cost technological system	12
HIZKING21 – Human Language Technologies to help the scientific-technological, business and social areas	14
Lip-synch and motion capture technologies in the animation of 3D characters	17
TARVITEK – Virtual Reality technologies and applications	18
MIROWALK-SEM – Development of advanced techniques for interactive 3D navigation in large CAD models using semantic tools	20
Augmented Reality-based welding simulation system for technical training	22
Development of an advanced 3D graphic simulation system for milling and lathe CNC machining operations	23
SPORT-LIVE – Improving the performance of soccer players through the use of new visual technologies	24
VIP-TV – 3D synthesis and visual tracking that enhances broadcast TV retransmission of sport events	26
ColliMatrix – Simulation of multi-leaf collimated fields for radiotherapy planning	28
Visual End-User Authoring of Complex Workflows	29
SIMI-Pro – A Semantic-based Information Management system to support Innovative Product Design	32
AIM@Shape – A Network of Excellence on semantics of digital objects	34
Using Automatically Inferred Geometric Context for Shape Analysis	36
Mobile AR Sketching (MARS)	38
Play Acting Enhanced by Augmented Reality	40
Opal – Online Partnership Lens	42
VERBOSE – Voice Enabled Recognition Based On Semantic Expansion	44
communitrust – IP Video Conferencing	46
ELIN – The Electronic Newspaper Initiative	48
<b>RUBRICS</b>	
News	50
Trade Fair	52
Events	53
StudINI	54
Graduations	55
Study and Diploma Thesis	56

Dr.-Ing. Jorge Posada, Dr.-Ing. Stefan Noll, Luís Almeida

Dear Reader,  
Welcome to this COMPUTER GRAPHIK Topics issue. This co-edition by Centro de Computação Gráfica (CCG), VicomTech, and GraphiTech, presents some of the most recent R&D projects and results of these institutions. The articles presented in this issue cover a broad range of application areas, all of them very topical and of special interest in terms of research fields.

#### **CCG: Reinforced focus on national industry**

For CCG, the reinforcement of the cooperation with the national industry is an objective to be pursued in several sectors. An example is the »TECNOMOLDE« project, which aims for the development of innovative work and solutions for the thermo-plastics mould-making industry. Another article presents the »Mobile Added Services«, taking advantage of the most recent mobile technologies for location-based services. A set of services are presented that enable access to information, recently only with the Internet using a PC, available in the context of a specific environment. The third contribution from CCG exemplifies another ongoing consortium work in the field of Polymer extrusion research, the E-xtruder.net. Being one of the most important technologies used to produce plastic parts, the article presents the work to be performed in the project,

which aims at the implementation of software for modeling, optimization, monitoring, and training in the polymer extrusion process, implementing a powerful and efficient tool which is able to support this industrial sector during the development and production of new products.

#### **VICOMTech: A consolidated R&D Technology Centre**

In its 3rd. year of operation in San Sebastian, VICOMTech has consolidated at the local, national, and European levels. With several projects covering our 5 application areas (Digital TV, Medical Applications, Entertainment, Cultural Heritage, and Industrial Applications), and about 30 staff researchers and students, VICOMTech is now pursuing 3 strategic objectives: Advanced laboratories infrastructure, to be active in the EU 6th. Framework Program, and to increase industrial contacts.

VICOMTech presents here a project of each area. TRAC introduces Augmented Reality techniques to aid surgeons in liver operations. SEITV focusses on the R&D of leisure and educational applications in Digital TV. ASEDUC uses avatar technologies to improve the e-Learning process. IGARTUBEITI is an advanced Cultural Heritage virtual walkthrough of an old farm in the Basque Country. BIOSEK is an industrial application project that introduces a Biometrics Lab.

#### **GraphiTech: Wins first European Projects**

Graphitech successfully started in its first European projects as a full partner: AIM@SHAPE, IMPROVE, and AMI-SME. In cooperation with Fraunhofer, GraphiTech also works for the EU projects ELIN and OPAL. For its 2nd year of operation, the participation in five European projects is a big step forward.

One of GraphiTech's first results is »The Book of Colours« (see cover photo). Valentina Giovannini developed together with the GraphiTech team an augmented reality application for children: The computer automatically generates virtual images and media according to the text and icons in a book for children by scanning the current page and content of the book with a camera.

# Developing applications for the Portuguese footwear Industry

Sofia Gameiro, António Freitas, Pedro Pereira, Luís Almeida

## Introduction

As an attempt to respond to the new market demands and the growing competition in the sector, the Portuguese Shoe Industry has for some years been introducing innovative technologies and thus enabling an optimistic look into the future. In fact, this industry is more and more considered a successful example of sustained modernization of industrial processes, if compared to other Portuguese industry sectors, which still rely on more conventional production and management systems.

The investment in the modernization of all production phases started with the FACAP project (1996-2000). It ranges from the conception of new products and models to prototyping and large scale production, management and administration. One of the main objectives of this project was the creation of a »spirit of mobilization« in the sector, which aimed at better production with higher flexibil-

ity, and the creation of an organizational level better adapted for small series production, which characterizes the sector demands more and more.

The FATEC project (2002-2005) appeared as a logical continuation and complement to the FACAP concept. Its main objective is to focus on aspects as »how to sell better« and »how to increase the products added value«, as well as consumer satisfaction.

In this context, the Centre of Computer Graphics (CCG) has been a member of the FACAP and FATEC consortium. It has been actively participating in the development of CAD/CAM applications, visualization, analysis and presentation systems, and of an information management system for the support of styling and prototyping tasks (of new shoe and new shoe components models) and related information.

## German Abstract

Als Antwort auf die Anforderung des neuen Marktes und des wachsenden Konkurrenzkampfes, hat die portugiesische Schuhindustrie seit einigen Jahren neue innovative Technologien eingeführt, welche ihnen einen optimistischen Blick in die Zukunft ermöglichen. Tatsächlich wird diese Industriebranche mehr und mehr als erfolgreiches Beispiel für die nachhaltige Modernisierung der industriellen Prozesse erachtet, vor allem im Vergleich mit anderen portugiesischen Industriebranchen, welche immer noch auf die konventionellen Produktions- und Managementsysteme vertrauen. Dieser Artikel präsentiert drei beispielhafte Applikationen, die für die Schuhindustrie von Portugal entwickelt werden.

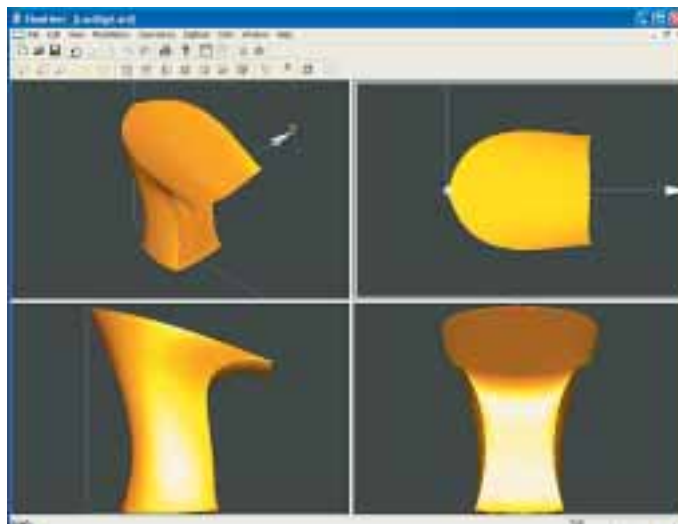


Figure 1:  
The ShoeHEEL  
3D System

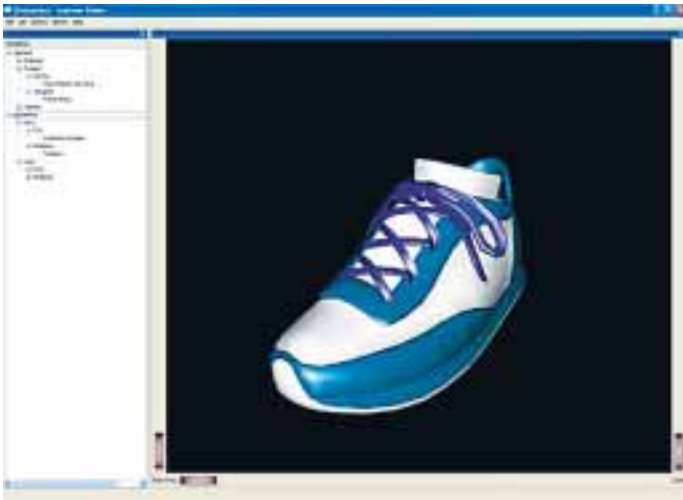


Figure 2:  
The ShoeCave  
System

### The ShoeHEEL 3D

Taking advantage of the existing know-how and aiming at extending the CAD solutions developed under the FACAP project, CCG is now implementing a new modeling system for shoe heels and other shoe components – the ShoeHEEL 3D. The application presents the following macro functional goals: Digitizing existing physical heels, the automatic creation of heels by defining a set of general dimensions, the manipulation of the main dimensions that characterize the heel, interactive heel modeling, automatic scaling for the different numbers of footwear, the conversion of the geometrical information for standard CAD/CAM formats, the association of alphanumeric information for production, the visualization of the shoe heel together with the corresponding shoe last, the automatic creation of the heel cover protection, and others.

A specific software module was conceived for digital model information management based on a hierarchic tree structure, oriented towards the creation, edition, and update of items like the material properties, color, etc. The objective was to allow association of all kinds of alphanumeric information with the 3D CAD model. The idea was to ensure that all information associated with the conception and production processes (client and supplier identification, the material used for production, produc-

tion costs, etc.) is available for future re-utilization and other goals like marketing and sales.

In this way, it is possible for ShoeHEEL 3D to communicate with other systems such as ShoeCave (see below), which allows the joint realistic visualization of alpha-numerical information together with the 3D CAD model, using stereo visualization.

Furthermore, it is the intention of CCG to go beyond the usual mouse-based modeling interaction by aiming to provide the system with an interface for three-dimensional interactive modeling. The designer will control an equivalent modeling tool on the screen by manipulating a mechanical arm in the 3D space, thus reflecting the 3D movements and performing the corresponding operations over the CAD model surface. Other surface deformation functionalities will be performed by manipulating precise curves over the surface.

This interface is still in an initial implementation phase awaiting the necessary validation by the designers. In this initial phase, the development is based on the mechanical arm MicroScribe – 3DLX from Immersion Corporation as a 3D input device. Other commercially available hardware solutions that might prove to be more suitable will be integrated after the validation of this modeling interface.

### The ShoeCave system

The marketing activities, based on new shoe prototypes and model presentations in both national and international exhibitions, are of fundamental importance to the shoe industry to realize new commercial trading and to attract new clients.

The ShoeCave aims at developing a system complementary to the traditional photography-based catalogues, which facilitates the realization of »shoe fashion exhibitions«. As the system has to be portable, it needs to be of small dimensions and suitable for installation in relative small spaces such as fair booths. Visitor interaction also has to be provided.

Furthermore, the system utilization in an industrial environment is also required for 3D model-based analysis and virtual prototyping operations. Two different versions are therefore under implementation:

- An industrial environment that supports the conception of new prototypes and models, and
- commercial exhibitions (and fairs) for the presentation of new models and seasonal collections.

The first version, now in its final development stage, consists of a desktop kiosk that allows the realistic visualization of 3D models, 3D interaction through a joystick device, access to a set of enquiry and analysis functions, and the association and visualization of additional information related to the model. The system is able to import 3D model files from ShoeHEEL 3D and to visualize with high level of realism, which enables testing and analysis procedures.

The second sub-system is intended to be a stereo projection system, oriented towards the presentation and visualization of 3D virtual models and multimedia presentations (video, sound, image, and text composition) for groups visiting the booths during exhibitions and fairs.

This system architecture comprises two different modules: Firstly, the Configuration Module for the creation of multimedia sequences such as footwear collection presentations. Such sequences can include textual information like model designation. The application runs over a database

implemented with MySQL for the storage of the presentations. The second module is the Presentation module, which is based on a high performance multimedia projector connected to the computer.

### The GestCAM system

GestCAM is a web-based system for task support and associated human resources management, in the context of the footwear and footwear components design and conception processes, as well as prototyping.

The platform allows the centralization of information, which is accessible from everywhere. It thus improves communication between different companies involved in the prototyping process, which can be geographically distant. More than a co-operative working tool, GestCAM is an information system for project and team work management that takes into consideration all specific tasks and typical activities that characterize the footwear prototyping processes.

The system's main characteristics are information centralization, the management of multiple user profiles, project task management and associated working teams, different information access levels according to the user profile, security in accessing the system through a user authentication process, information security guaranteed by data encryption and association of documents (Word, Excel, CAD, etc.) to the corresponding tasks, etc.

GestCAM's last requirement concerns mobility in accessing the information. This is of particular importance for directors and project managers who are constantly traveling. As a result, GestCAM has two different interfaces:

- Access through a web browser available on any desktop or work place connected to the Internet,
- access using a Pocket PC mobile device, taking into consideration specific characteristics of this hardware.

Specific user interfaces were implemented for the two types of client hardware. The server automatically detects the type of hardware accessing the information providing the corresponding interface.

### Conclusions and Future work

The innovative aspects for the work presented are not in terms of state-of-the-art contributions, but rather as technological applications, made in Portugal, for the modernization of the Portuguese footwear industry (one of the main goals of the FATEC project).

The use of mobile devices for information access and management, considered in the GestCAM platform, is largely innovative for the Portuguese industry. Besides fulfilling the typical functional goals expected for this kind of system, the applications mentioned above aim at achieving a higher integration level for information share provision among

all technicians responsible for the footwear conception and production processes. As for the next steps, CCG will integrate new interaction modalities, which are different from those usually adopted in the shoe industry, such as the three-dimensional modeling interface intended for ShoeHEEL 3D and the ShoeCave systems.

All systems under development for the FATEC project currently exist as functional prototypes, and we foresee their industrial installation in the next months. Functional tests under real conditions will be performed for validation and improvement.

### Acknowledgements

To the consortium partners: CTC – Centro Tecnológico do Calçado, SIACO and CEI – Companhia de Equipamentos Industriais.

A special reference is also due to the Portuguese Ministry of Economy for the supporting Programs funding the realization of FACAP and FATEC: PedipII and POE/Prime.

### Point of contact

Dipl.-Math. Luís Almeida  
Centro Computação Gráfica  
Coimbra, Portugal  
Email: luis.almeida@coimbra.ccg.pt



Figure 3:  
The GestCAM System

# @rtec: Art and Technology in the Cultural Industries

Ana L. Lima, Rui Castro, Henrique Silva, Prof.-Ing. Paulo Dias,  
Prof. Dr.-Ing. Adérito Marcos

## Introduction

Regions furthest from the national decision-making centres and consequently from the hub of economic and cultural activity believe that they suffer from continuing disadvantages. This situation has created a feeling of being abandoned that has led to a growing mobilization against further isolation on the part of the populations the Northern region of Portugal and of Galicia.

The @rtec project – Art and Technology in the Cultural Industries – is co-financed by InterReg IIIA and its partners are the Bienal de Vila Nova de Cerveira (Biennial of Vila Nova de Cerveira), the Centro Cultural de Deputación de Ourense (Cultural Centre of the Municipal Council of Ourense), the Universities of Minho and Vigo, the Câmara Municipal de Vila Nova de Cerveira (Municipal Council of Vila Nova de Cerveira), and the Centro de Computação Gráfica (Centre of Computer Graphics). The aim of the project is to strengthen and accomplish their objective of cultural cooperation and development, both technological and formative, in order to reduce the disparity between the border regions and the big urban centres.

## The Project

This project can be defined by three words: Education, production and dissemination. It is an ambitious project that requires the participation of specialists in various areas of the arts and technology, but also the co-operation of people who hold the power of territorial administration, both local and business-related, in order to allow the setting up of methodologies for attaining the following objectives: The development and re-population of Alto Minho and Galicia, e.g. the creation of an environmentally-friendly industrial base that allows for a balanced and high quality development of tourism.

## Cultural Events

In this area, some events of the 12th Biennial of Cerveira in 2004 took place in the Centro Cultural de Ourense (Cultural Centre of Ourense) and in the Faculdade de Belas Artes de Pontevedra (Faculty of Fine Arts of Pontevedra) with representatives of Portuguese artists and discussion forums on the subject of »O Artista e a globalização – o seu papel como actor social« (The artist and globalization – his role as a social participant).

In the other direction, a number of Galician artists physically participated as guests in the Biennial in Cerveira, as much in the exhibition areas with music and dance shows, as in art workshops that have been a constant in all the biennials and which will be dedicated in the 12th Biennial of Cerveira exclusively to the exchange of experiences and discussions between Galician and Northern Portuguese artists.

In this respect, in 2004 an exhibition of contemporary Galician artists will take place in the Fórum Cultural de Cerveira (Cultural Forum of Cerveira) followed by other cultural activities e.g. street theatre, a series of conferences, and a painting and sculpture workshop.

## German Abstract

Der entstehende Globalisierungsprozess von Kommunikationsnetzwerken im Kontext der Informations- und Wissensgesellschaft stellt neue Herausforderungen für die Entwicklung von multikulturellen und multilingualen Gemeinschaften der Grenzregionen von Nord-Portugal und Galicien, vor allem in der Förderung von Innovationen und der Kooperation im kulturellen Bereich, dar. In diesem Kontext werden die Prozesse der Identitätsbestätigung und besonders in der Aufwertung kultureller Aktivitäten der Grenzregionen präsentiert. Die Zielsetzung des @rtec Projekts ist das Zusammenfügen der Verbindungsglieder zu einem Gesamtbild von voranschreitenden Initiativen im Bereich der Kunst und der sozio-ökonomischen Entwicklung durch Förderung der kulturellen Industrien in den Grenzregionen.



Figure1: @rtec project website  
(<http://artec-dev.ccg.pt>)





Figure 2: Brochure of Bienal de Vila Nova de Cerveira



Figure 3: Example of virtual room in the virtual museum



Figure 4: An example of a PDA as mobile guide

### Virtual Museum

The exhibitions of Contemporary Art provide a valuable and large number of works that have a high value for the citizens from both sides of the border, who cannot benefit from the potentials generated by digital means for access to this cultural information.

These general events, however, are subject to a lack of means for digitally capturing sensitive art objects, as well as the lack of a platform (a digital repository) that supports the storage and subsequent publication of these artistic works on the Internet. The main objectives of the Virtual Museum, therefore, are:

- The development of a web platform adequate for the requirements of the Biennial and the Centro Cultural de Ourense. This task includes the development of a portal (as a unique access point to the digitized collections of the partners), a back office (to insert the data in a fast and easy way), repositories (for storage and searching of cultural information), and virtual exhibition rooms (to hold a permanent exhibition of the art objects in the repositories),
- the training of museum technicians in the fields of digitisation and treatment of digital images.

### Mobile Guide for visitor assistance

Currently, mobile technologies are undergoing a massive dissemination process, as they are available anywhere and in almost every situation. The purpose of this project is to explore these new capabilities in order to create a mobile guide to assist visitors to the Biennial of Vila Nova de Cerveira, Portugal. The main goal is to create innovative ways of visiting the museum, thus enabling the visitor to discover a world full of culture and so that the type and quantity of information should be of the personal choice of the visitor.

### Virtual workshops

The virtual workshops are an implementation of innovative forms of work using technologies developed in recent I&D projects in the context of Computer Graphics. These workshops take the following forms in the context of the present project:

- A virtual workshop as an environment for teaching and training,
- a virtual environment as a material demonstrator and virtual prototyping system.

In the context of this project the scenarios are presented as an experimental and simulation tool for the manual tasks that most times take up a lot of time and are highly costly.

The Virtual Reality System offers the following advantages:

- Cost reduction in the areas of training and experimentation,
- the possibility of repeating sequences in a short period of time,
- an independence of actions, i.e. the carrying out of an action does not imply that the previous ones also have to be carried out, and
- almost no need for informatics knowledge.

### Professional Training

This project also aims at creating a set of basic initiatives that sustain the development of the border territories of Galicia and the North of Portugal. The final objective is to create new opportunities for their citizens with the purpose of improving the peripheral economies of cross-border regions. In this respect, Professional Training will play an important role for the accomplishment of this objective.

### Project co-ordinator

Prof. Henrique Silva  
 Bienal Internacional de Arte de Vila Nova de Cerveira.  
 Email: info@bienaldecerveira.org

### Points of contact

Prof. Dr.-Ing. Adérito Marcos  
 Dipl.-Ing. Ana L. Lima  
 Rui Castro  
 Centro Computação Gráfica  
 Guimarães, Portugal  
 Email: aderito.marcos@ccg.pt  
 ana.lima@ccg.pt  
 rui.castro@ccg.pt

Prof.-Ing. Paulo Dias  
 University of Minho  
 Guimarães, Portugal  
 Email: paulodias@nonio.uminho.pt

# TORGA.net: The »Trans Portugal-Galicia« Communication Network

Ana L. Lima, Rui Castro, Alexandre Santos, Prof. Dr.-Ing. Adérito Marcos

## Introduction

The Trans Portugal Galicia Network Project, TORGA.net, was a proposal to the Program Interregional IIIA, Galicia – North of Portugal sub-program with the following partners: University of Minho, University of Vigo, Centro de Supercomputación de Galicia and the Centro de Computação Gráfica in Guimarães. It has as its main objective the creation of infrastructures and the organization and development of the space beyond borders.

The project proposes to establish a broadband communication network with reduced operational costs that links the campuses of the Universities of Vigo and Minho, as well as their associated Technological Centers, which are the Supercomputación de Galicia and the Centro de Computação Gráfica in Guimarães.

Using this telecommunications infrastructure, Access Centers will be installed in a Technology Access Grid, which will allow distance work sessions such as seminars, lessons, or discussion meetings.

## The Project

The general objective is to improve the indispensable tele-communication networks to enable the development of suitable access conditions for several applications of the information society. By using this communication infrastructure, it is intended to achieve the following specific objectives:

- The development of an R&D pilot project to be executed in the network as an eLearning platform,
- the promotion of common activities such as:
  - Initial training and post-graduation courses,
  - works related to the completion of careers including graduate and licentiate theses,



- access to specialized jobs,
- joint projects,
- scientific and technological meetings with companies,
- meetings of researchers from similar investigative areas, and
- access to cross-border job offers.

## Technical Description of the Network

TORGA.net intends to adopt a communication network system with circuits of interconnection of great capacity and with IP (Internet Protocol) support and reduced operational costs.

## German Abstract

Momentan arbeiten die Bildungs-, Forschungs- und Entwicklungseinrichtungen von Galicien und dem Norden von Portugal nur gelegentlich und auf einzelne Projekte beschränkt zusammen, obwohl sich längst herausgestellt hat, welche Synergien aus dieser Kooperation entstehen. Auf Grund dessen sieht das Torga.net Projekt die Implementierung einer Breitband-Kommunikations-Infrastruktur vor. Diese wird die Problematik, die durch die geringe Zusammenarbeit beider Regionen entsteht, reduzieren und den Zugang und das Teilen von Wissen erleichtern. Aufbauend auf dieser Kommunikationsplattform sind Lösungen der kooperativen Arbeit vorgesehen. Videokonferenzen und E-Learning dienen dabei als Unterstützung für die Zusammenarbeit zwischen den Institutionen beiderseits der Grenzen.

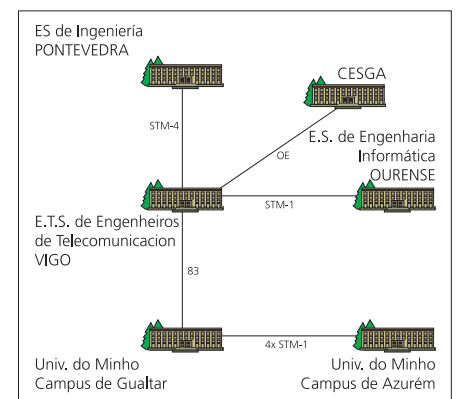


Figure 1: Example of the network with several lines of communication

The infrastructure of the broadband network will allow an international link between the University of Minho in Braga, and the University of Vigo, which operates initially at 155 Mbps and with an available Gigabit Ethernet (1000 Mbit) interface, which will allow for the growth of capacity of this link, as the needs of Torga.net develop.

The network interconnection, which enters the University of the Minho Campuses at Gualtar and Azurém, is carried by an optical fiber with Gigabit Ethernet interface and, initially, will operate at 150 Mbps.

All the other interconnections of TORGA.net, which include Vigo-Orense, Vigo-Pontevedra and Vigo-Santiago, are also carried through an optical fiber with an interface that is never inferior to one Gigabit and with speeds of 155Mbps. The »TORGA.net« network is being established to support the development of a set of important co-operative activities beyond national borders.

### Description of the Access Centers

The essential aspect of the Access Grid is that it is a system for capture and multimedia projections of large format and of high quality that simultaneously allow the visualization of presentations and videoconference in a number of rooms. The capacities of these rooms include:

- High quality video and multi-channel audio,
- a large format visualization screen,
- integrated presentation technologies,
- recording of sessions for a post-session reproduction,
- integration with »Globus« middleware for access to other Grid services such as directories, security, network management, etc.,
- accomplishment of multiple sessions.

The TORGA.net project plans the set up, management, and exploration of seven Access Grid Centers – two being located in the University of Minho and the other five being sited in Galicia.

All of these Access Grid Centers allow real-time multimedia communication between groups of dispersed users at a variety of locations.

### Description of the eLearning pilot project

Based on the proposed infrastructure to be created and in order that the implementation of courses is possible and practical actions undertaken at a distance within areas that normally are contemplated for new kinds of eLearning, such as moulds and graphical computation with the inclusion of music, a network will be needed with a large bandwidth, as well as some specific equipment and platforms (videoconference system, specific eLearning platforms, etc.).

With this project, it is on the one hand intended to create new practical forms of education based upon web technology and, on the other hand, to develop contents scientifically evaluated by specialists in the proposed areas. This way, courses could be facilitated of high quality with permanent teachers operating in a digital environment from whence it would be possible to teach to or from any point in both regions.

### Technological platform

In order to enable everyone to benefit from the easy access to the new practical forms of education through the use of the designated rooms, it will be necessary to make use of a



Figure 3: Example of an e-learning teaching and training room

common platform that works with the Internet and takes account of the technologies of the World Wide Web, as well as facilitating a common point of access to didactic and pedagogical contents.

The following practical areas of education will be included within the process of developing didactic contents to be used on the eLearning platform:

- The processes of moulds and polymers,
- Experimental Music,
- Graphical Computation.

### Project coordinator

Ángeles López  
University of Vigo  
Email: otri@uvigo.es

### Points of contact

Prof. Dr.-Ing. Adérito Marcos  
Dipl.-Ing. Ana L. Lima  
Dipl.-Ing. Rui Castro  
Centro Computação Gráfica  
Guimarães, Portugal  
Email: aderito.marcos@ccg.pt  
ana.lima@ccg.pt  
rui.castro@ccg.pt

Dipl.-Ing. Alexandre Santos  
University of Minho,  
Guimarães, Portugal  
Email: alex@uminho.pt

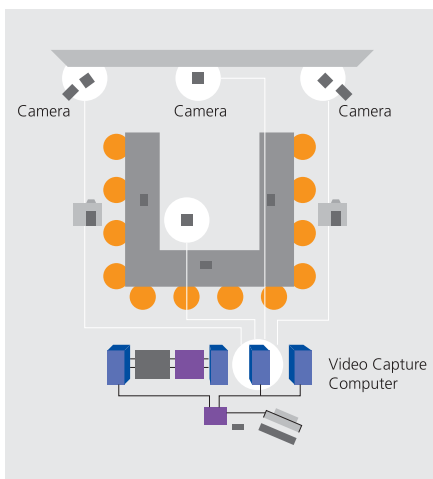


Figure 2: Example of the configuration of a room with the Access Grid system

# WAVE – A Virtual Audio Environment: An immersive musical instrument using a low cost technological system

Leonel Valbom, Christophe Forni, Prof. Dr.-Ing. Adérito Marcos

## Introduction

The rapid evolution of technology has opened up new areas of knowledge and new approaches to age-old issues. Yet, it has fallen short in creating new models of instruments that can respond to the current demands in musical creation and performance.

Therefore, it is necessary to come up with solutions that can bring together the art of music with a new art involving the intelligent manipulation of sound by means of new visual, auditory, cognitive, and interpretative techniques.

The project aims to set up an immersive virtual reality environment, where music and 3D audio play an important role in a virtual musical/sound instrument for performances, education, entertainment, or musical experimentation.

- The inadequacy of traditional musical instruments to cope with the challenges of electro-acoustic music, both at the levels of performance and of conceptualization,
- the relative scarcity of music for solo instruments, since most written and/or recorded music calls for the use of an ensemble of players.

The WAVE project proposes a multi-disciplinary investigation in order to create a model-prototype of a virtual immersive instrument using audio, visual technologies, and virtual reality. This model will open up new horizons for the processes involved in music making by dealing not only with relevant technological issues, but especially with meaningful research in the areas of human-machine interaction and sound.

## German Abstract

Das Projekt »WAVE – A Virtual Audio Environment« realisiert den Aufbau einer immersiven virtuellen Umgebung in der Musik und 3-D-Audio die Hauptrolle in Form eines virtuellen Musik- bzw. Soundinstruments für Performance, Ausbildung, Unterhaltung oder musikalisches Experimentieren haben. Dieses virtuelle Instrument ermöglicht es einfache Gesten in musikalische Klänge umzusetzen, wobei gleichzeitig die Positionierung und Lokalisierung von Sound mit einem großen Freiheitsgrad unterstützt werden. Damit wird dem Benutzer die Fähigkeit gegeben seine Kompositionen durch intuitive Mensch-Maschine-Interaktion zu kreieren. Diese intelligente Vereinigung neuester Technologien mit der Kunst der Musik eröffnet dem Benutzer neue Dimensionen in der Soundbearbeitung. Das Projekt wird in der Abteilung Informationssysteme der Universität von Minho, in Kooperation mit der Forschungsgruppe des Centro de Computação Gráfica in Guimaraes, entwickelt.

## The Project

Two main issues have been identified in the WAVE – A Virtual Audio Environment project that need to be addressed and for which solutions need to be found; namely:

## Expected Results

The expected results are the creation of a model-prototype of an immersive musical instrument that is played with tracking systems and that can include the following features:

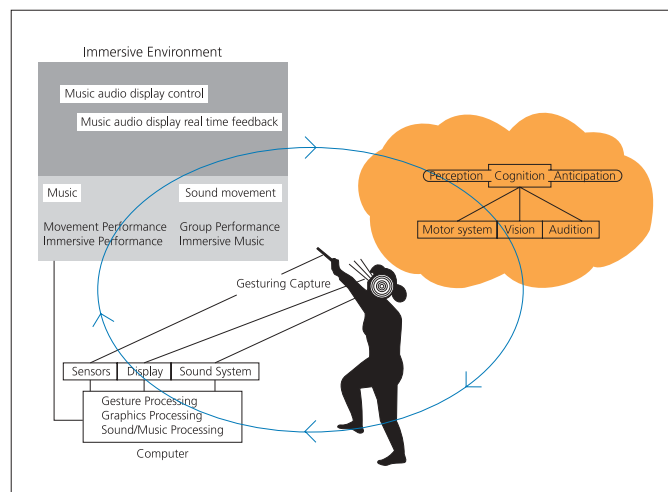


Figure 1:  
Model of interaction  
in WAVE



Figure 2:  
WAVE Screen

- Scalability and mobility of the immersive environment,
- repeatability of musical performance by the user,
- visual feedback of the interaction with musical objects,
- control of musical notes and sound files at the same time,
- three-dimensional sound reproduction including the vertical direction,
- cognitive real-time musical and motor-skill decisions.

The methodology used in the execution of the project is a typical research methodology with the following sequential approach:

- Study of the state-of-the-art technology,
- design and creation of model and concepts,
- implementation of the prototype,
- validation of the prototype,
- correction of the model(s),
- final prototype(s) and final report.

At the time of writing this article, the implementation of the prototype is in its final phase.

The WAVE System is visually based on a big screen that can be viewed with active stereoscopic glasses to give the user a perception of immersion.

The implementation achieved allows the use of different kinds of visualization devices such as CRTs, DLP video projectors, head mounted displays, 3D displays, and high performance projection tables.

One of the requirements defined in the WAVE project was the use of low cost technology, so all of the programming was optimized in order to

use only one Intel CPU computer with a Linux operating system that uses OpenSG and VR Juggler as the basis of the application.

The main reasons why we chose these kinds of resources for the project were that they are easily portable to other platforms and that they are open source.

WAVE can use different kinds of tracking systems at the same time. To test the prototype, the Flock of Birds by Ascension was used along with a wireless USB presenter in order to interact with the virtual musical instrument. However, the system can at same time use open air batons like the Lightning II by Buchla.

Many people use the surround sound systems with computers from four or five years ago. Surprisingly in Linux systems, the open source audio APIs do not yet implement surround sound or 5.1 sound cards. The APIs found with this kind of feature are very expensive and used or licensed as proprietary systems. Even in the world of games, few titles actually use real surround sound.

Faced with this, the OpenAL API was chosen to control the audio sources. However, the OpenAL handles threedimensional sound techniques, but only for stereo sound systems.

This was a significant problem, because there is no really convincing non-expensive technology (for musicians) that can handle sound with three co-ordinates. As a solution, a modified version of OpenAL was utilized that permits the use of four speakers and also allows the location of the speakers to be defined.

Despite these limitations, good quality sound was achieved using standard sound cards with low cost professional near field speakers.

In terms of visualization, the application allows users with different kinds of skills to interact with the system in terms of performance, music-sound exploration, or entertainment. The display presents groups of music-sound objects:

- A simple scale (pentatonic),
- four sets of chromatic scales with three sets of effects and one of musical patterns,
- one set of selectors of audio files of different styles,
- a slider for the use of glissando with sounds,
- a transport control and
- some additional buttons to change the sound patches and general values.

The movement of the sound sources in the real environment is possible by dragging and zooming the musical objects in the virtual environment.

This paper presents a musical instrument in a virtual audio environment based on affordable standard hardware components and using the three musical elements pitch, timbre, and space, while trying to give the user an environment of great freedom and at the same time some entertainment or experimentation.

In the final phase of the project, WAVE will be tested as an instrument for musical performance, as an entertainment instrument during cultural and artistic events, and as a tool for the development of educational components in the artistic domain and in corporal expression.

## Points of contact

Dipl.-Ing. Leonel Valbom  
 Dipl.-Ing. Christophe Forni  
 Prof. Dr.-Ing. Adérito Marcos  
 Centro Computação Gráfica  
 Guimarães, Portugal  
 Email: leonel.valbom@ccg.pt  
 christophe.forni@ccg.pt  
 aderito.marcos@ccg.pt



# HIZKING21 – Human Language Technologies to help the scientific-technological, business and social areas

Nora Mendoza, Igor G. Olaizola, Amalia Ortiz, Iker Aizpurua, David Oyarzun, Maider Lehr, Jose Ignacio Sánchez

## Introduction

In recent years, the Information and Communication Technologies (ICT) of the Information Society have been marked by a vertiginous speed of change. Their importance affects not only the technological, business, and economic worlds (marking the so-called »New Economy«), but society in its entirety being part of the common language and of the worries of a high percentage of the people. There are also important implications for the public administrations, because nowadays they allow, based on the technological advances and expectations, to improve their relations with the citizens, to invigorate the information exchange of especially interesting contents, as well as to improve the public services in social environments, public health, or diverse infrastructures.

The research aims focus on several aspects:

- The natural language as ideal mass medium: Given that language is the natural communication medium among people, it is also the most effective way for people to communicate with others. Therefore, it is basic for all the aspects of human life. But its use is quite limited, because it is used only in the direct communication among human beings, not in the interaction with systems, services, and applications. Even among people, the understanding is limited to groups that share a common language, so the language can become an obstacle for the communication. Furthermore, the globalization that accompanies the Information Society can constitute a threat for non-majority languages like the Basque that are important cultural identity signs.

- Fomenting the daily use of ICT and speech-based technologies: This is basically the use of the ICT in the personal and domestic environments, so they could mean a real improvement in the quality of the citizens' lives.
- Advanced management of multimedia linguistic contents: The language technologies and linguistic engineering are prone to answer the necessity of management for contents of increasing complexity, to allow a more natural relation with the systems, and to eliminate the barrier of the languages, so everyone could use his mother tongue at any time, so it will turn into an indispensable tool in the Information Society.
- Adaptation and integration of the speech technologies with other ICT: Linguistic engineering is the use of the knowledge about language in the development of computer science systems so that they could recognize, understand, interpret, and generate any kind of human language.

The development of language technology for minority languages differs in several aspects from its development for widely used languages. The high capacity and computational power of present computers, combined with the scarcity of human and linguistic resources, motivates the design of new and different strategies. Human Language Technologies HLT will make an essential contribution to the success of the Information Society, but most of the working applications are only available in English. For those working with minority languages, a great effort is needed to face this challenge.

## German Abstract

Sprachbasierte Technologien (Human Language Technologies HLT) werden kontinuierlich weiterentwickelt. Im Projekt HIZKING21 verfolgt VICOMTech die aktuellsten Entwicklungen des linguistischen Leistungsvermögens integrierter Geräte, besonders in Bezug auf die baskische Sprache. Das Hauptziel dieses strategischen Projektes ist die Gründung einer HLT-Expertengruppe, die sich technisch auf dem neuesten Stand befindet, um ein »Basque Network of Excellence« im Bereich linguistischer Info-Engineering-Technologien aufzubauen. Damit wird im Baskenland eine solide Infrastruktur geschaffen, die sowohl spezialisierte Techniker als auch andere Ressourcen zur Entwicklung und Integration linguistischer Tools und Mensch-Maschine-Schnittstellen umfasst sowie deren Bereitstellung für die wissenschaftlich-technischen, wirtschaftlichen und sozialen Vertreter des Landes.

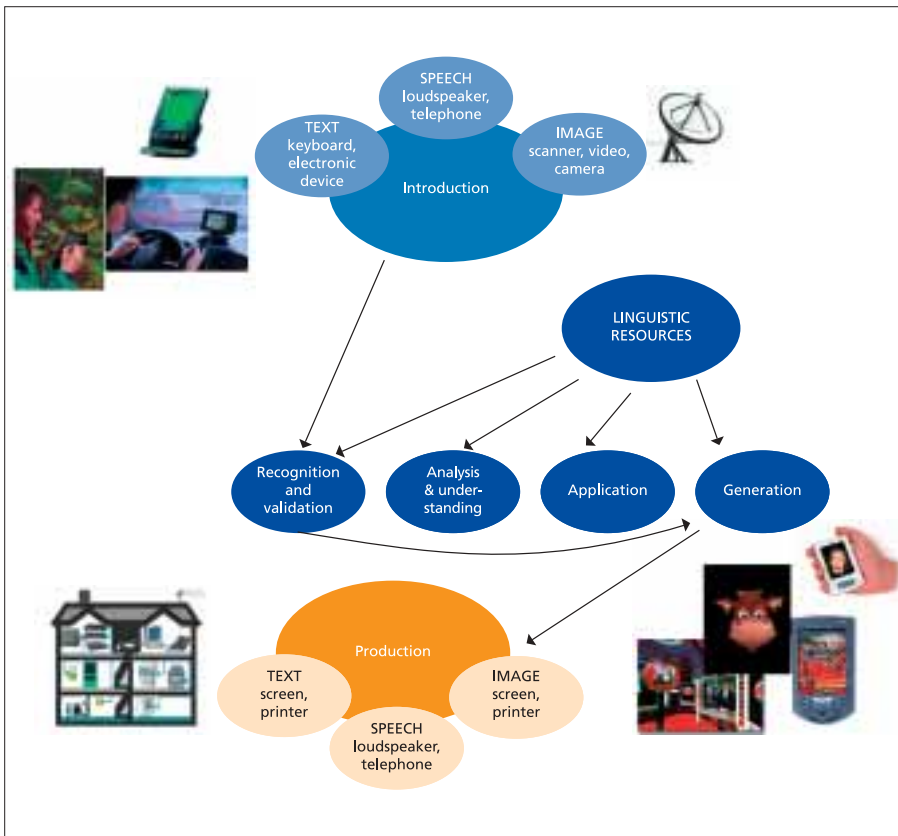


Figure 1: Systems with linguistic capability integrated in several platforms

The main goal of the HIZKING21 project is to go more deeply into the development of systems with linguistic ability that can be integrated into different devices, stressing the development of the linguistic ability also in Basque language. Thus, this project will provide knowledge, linguistic tools, and human-machine interfaces to the scientific-technological, business, and social agents of the Basque Country that allow them to easily integrate the said technologies into their needs.

### Objectives

The aim of this three-years project is to develop resources, tools, and pre-applications in linguistic engineering and their integration in systems with linguistic capacity. Most of the advances in this area are done for English, German, French, Spanish, etc. The challenge in HIZKING21 is to place a minority language like Basque on the same level as other languages

are nowadays. The acquired technical knowledge will allow the development of similar tools for languages with little relation to the most extended ones, contributing to the conservation of minority languages.

The project aims at achieving the following general objectives:

- Creating an Excellence Network in linguistic engineering of a research, development, and marketing framework in speech and linguistic technologies, unique in Spain and one of the most powerful in Europe, that will allow successfully competing with other European networks,
- stocktaking of existing linguistic resources in the Basque Country, identifying needs, and analyzing the possibility to adapt the existing resources to other languages and the possibility to export our resources,

- positioning the Basque language as a communication language in the Information Society in the year 2005 at the same level as English was in 2002, regarding resources, tools, and linguistic applications,
- improving the citizens' quality of life, enabling the interaction with various systems, communication, provision and reception of services, as well as contributing the access to information to Basque speakers so that they do not have to renounce their language.

The main social objectives of the project are:

- Positioning the Basque language at the same level as the most used languages worldwide in the field of speech technologies and linguistics, guaranteeing the creation of solutions that will enable a Basque Information Society,
- bringing Information Technologies and Communication from different fields closer to citizens to improve the quality of life by:
  - Providing direct access to services (telephone, banking, technical assistance, administration, health service, etc.) of any person through several devices,
  - providing tools that guarantee a more efficient communication that may eliminate any language barrier so that work, spare time, or personal relationships on a European and international scale become more efficient and include more people,
  - contributing to accessibility and participation of everybody, essential aspect in a democratic, open, and equal society in the information era,
  - increasing possibilities to access information by using the simplest computers and information services, as well as the best quality and filtering of the necessary information.

From the scientific-technical point of view, it is aimed at developing research lines involved in the generation of systems with linguistic capacity, such as:

- Acquisition/Introduction. Multi-mode (text, speech, image) information entry to the system, including physical expressions (voice, face, and body gestures) by means of different devices (microphone, telephone, keyboard, video, etc.).
- Management. Management of the information received:
  - Language and/or format recognition, its symbolic encoding and validation,
  - analysis and understanding of the meaning of the introduced information,
  - use of comprehension in conversion applications (for example, speech into text), applications for translating into another language, applications for creating programs of operations and tasks for other devices, etc.,
  - creation of an environment to present the results of the application.
- Production. Presentation of the results obtained from several devices (monitor, speaker, printer, etc.), using a multi-modal point of view, such as in the case of the introduction of information.

The most relevant business objectives proposed by the strategic research program are:

- Bringing the solutions offered by the linguistic engineering closer to the SME by simplifying platforms and reducing costs,
- creating linguistic tools regardless of the language so that those tools and their applications to specific industrial products can be exported and internationally commercialized,
- providing companies with continuous training of their staff and qualified professionals by using telematic services and computer-aided learning systems to improve the efficiency of distance learning,
- developing multimedia interfaces to integrate them into products created by sectors of great economical importance, such as automobile components and electrical appliances, taking into account the potential that emerging wireless technologies offer,
- enabling the creation of new companies with technological basis oriented to the development of advanced applications in the area of linguistic engineering, based on the research results.

#### **Consortium**

Due to the nature of the project, a core workgroup has been established consisting of the University of the Basque Country (EHU-UPV), Elhuyar, Eleka, Robotiker, and VICOMTech.

Two departments of the University of the Basque Country are working in the project: IXA Group from Computer Science Faculty and Aholab Group from the Signal Treatment and Radio communication Team of Electronics and Telecommunication Department.

Elhuyar is a non-profit entity that develops its activities through integration of science and technology in society and collaborates and promotes the social normalization of the Basque language.

Eleka is a company that carries out innovative developments in linguistic engineering: It offers R&D&I solutions to companies and organizations that apply information technologies and knowledge management.

Robotiker Technology Centre is specialized in information and telecommunication technologies.

From the INI-GraphicsNet, VICOMTech (Visual Communication and Interaction Technologies Centre) is the main technological partner in the consortium and also the leader, working in applied research and development of multimedia technologies for visual interaction and communication.

#### **Acknowledgement**

This work is sponsored and partially financed by the industry department »Technology Management and Information Society« of the Basque government through the ETORTEK Strategic Research Program.

#### **Point of contact**

Nora Mendoza  
 VICOMTech Donostia-San Sebastián,  
 Spain  
 Email: nmendoza@vicomtech.es  
 URL: <http://www.hizking21.org>



Figure 2:  
 Multimedia content management by means of human-machine natural interfaces



# Lip-synch and motion capture technologies in the animation of 3D characters

Amalia Ortiz, David Oyarzun, José Manuel Jiménez, Ricardo Ramón

In order to understand a person's movements, it is mandatory to have information regarding the different positions adopted by the different parts of the face and head, as well as body relationships. This information can be obtained using some markers and computer vision techniques. At present, several systems exist that are capable of doing motion capture. However, of the state of the art, a system has not been found that captures facial expressions and corporal movements just in one session with the actor/actress, and that also performs spoken language synchronization.

Generally, current systems capture both kinds of data in separate processes and the animation artist must merge the sources in order to obtain the desired result.

This project aims at fulfilling two key points:

- Synchronization of motion capture data in one session,
- standardization of the system.

We account some reported problems to achieve these goals. They refer to the unsynchronized and interrupted animation that traditional systems normally obtain, given by the difficulty embedded in the identification of objects like the head and the expressions. In order to solve the problem, we will develop a lip-synch system that processes some lip-synch information coming from text and voice, and that mixes this information with the motion capture data to generate whole body animation.

As shown in Figure 1, the facial motion capturer will be integrated in a body motion capturer, and the whole generated animation will then become complete. All motion data will be generated just in one session with the actor/actress.

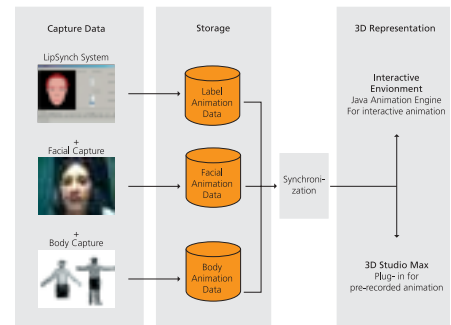


Figure 1: System Architecture

The system will generate a precise, reliable animation obtained from real data and independent of the proficiency of the animator. This animation will be executed in two main environments, in 3ds max, through a plug-in, and in Interactive Environment, through a java animation engine.

One of the intended goals is the usage of standard methodology as the interchange format in order to solve the standardization problems that commonly arise, given that a clear consensual status in the format of present animation systems is not stated. To that end, we are studying MPEG-4 and H-Anim possibilities. We have already achieved some successful results with H-Anim compliant characters.

## Acknowledgements

This work has been partially funded by the INTEK 2003 program from the Basque Government, code I-CN03SP05.

## Point of contact

Amalia Ortiz  
VICOMTech Donostia-San Sebastián,  
Spain  
Email: aortiz@vicomtech.es

## German Abstract

Das Hauptziel des Projektes LIPSYNCH ist die Entwicklung eines Systems zur optischen Bewegungserfassung für eine Ganzkörperanimation. Im Besonderen steckt sich VICOMTech zwei Ziele: Zunächst sollen Bewegungsdaten von Gesicht und Körper des Darstellers in nur einer Sitzung erfasst und Körper- und Gesichtsbewegungen mit Sprech- und Umgebungshandlungen synchronisiert werden. Außerdem werden Bewegungsdaten nach MPEG-4 und H-Anim standardisiert. Das in diesem Projekt entwickelte System wird synchronisierte Animationen ermöglichen, die den kompletten Körper einer virtuellen Figur animieren können.

# TARVITEK – Virtual Reality technologies and applications

Dra. María Teresa Linaza, Eduardo Carrasco, Amalia Ortiz, Iván Macía, Álvaro Segura

## Introduction

TARVITEK ([www.tarvitek.net](http://www.tarvitek.net)) is a Basque Strategic Project about Mixed Reality technologies with the aim to foster and promote applied research on these technologies and to train new qualified researchers. We work in constant relation with the Basque SMEs to fulfill their requirements and to search for new investment opportunities that may lead to the creation of new technology-based enterprises. This project is being developed within a consortium including four centers of the Basque Science, Technology, and Innovation Network: LABEIN, CEIT, EUVE and VICOMTech. These centers work in close collaboration with the University in the training of new professionals in order to achieve a critical mass in these areas of research.

## Objectives

The main objectives of TARVITEK include:

- Creation of a Basque Network of Excellence concerning Mixed Reality technologies and Human-Computer Interfaces. As the participants of the project have wide experience in this research area, the integration of efforts should lead to greater benefits for the Basque Research community.
- Implementation of different demonstrators and prototypes to evaluate and refine the technologies developed within the project. A group of eight technology-based enterprises will act as consultants and early adopters in the implementation and evaluation of prototypes and demonstrators.

- Training activities in order to achieve a critical mass concerning Mixed Reality technologies in the Basque Country. This objective includes collaboration agreements with well-known world-wide research centers and universities for the exchange of know-how and researchers.
- Establishment of a group of early-adopters among Basque SMEs for the development of innovative and technologically advanced applications of the Information and Communication Technologies.

## Technological research areas

### Virtual Prototypes

Virtual Prototypes refer in this project to the virtual prediction and representation of the know-how associated with products and processes. This research area tries to implement new simulation tools, integrate them into traditional manufacturing cycles, and

## German Abstract

TARVITEK ([www.tarvitek.net](http://www.tarvitek.net)) ist ein strategisches Projekt aus dem Baskenland zur Förderung und Unterstützung angewandter Forschung von Mixed-Reality-Technologien. Ein weiteres Ziel ist die Ausbildung qualifizierter Forscher, die in enger Verbindung mit baskischen Mittelstandsunternehmen realisiert wird. Damit werden deren Anforderungen erfüllt und gleichzeitig neue Investitionsmöglichkeiten aufgezeigt, die zu der Gründung neuer technologie-basierter Unternehmen führen könnten. Dieses Projekt wird innerhalb eines Konsortiums entwickelt, das vier Zentren des baskischen Netzwerkes für Wissenschaft, Technologie und Innovation umfasst: LABEIN, CEIT, EUVE und VICOMTech. Diese Zentren arbeiten bei der Ausbildung neuer Experten eng mit der Universität zusammen, um in diesen Forschungsbereichen eine kritische Masse zu erreichen.



Figure 1: TARVITEK partners

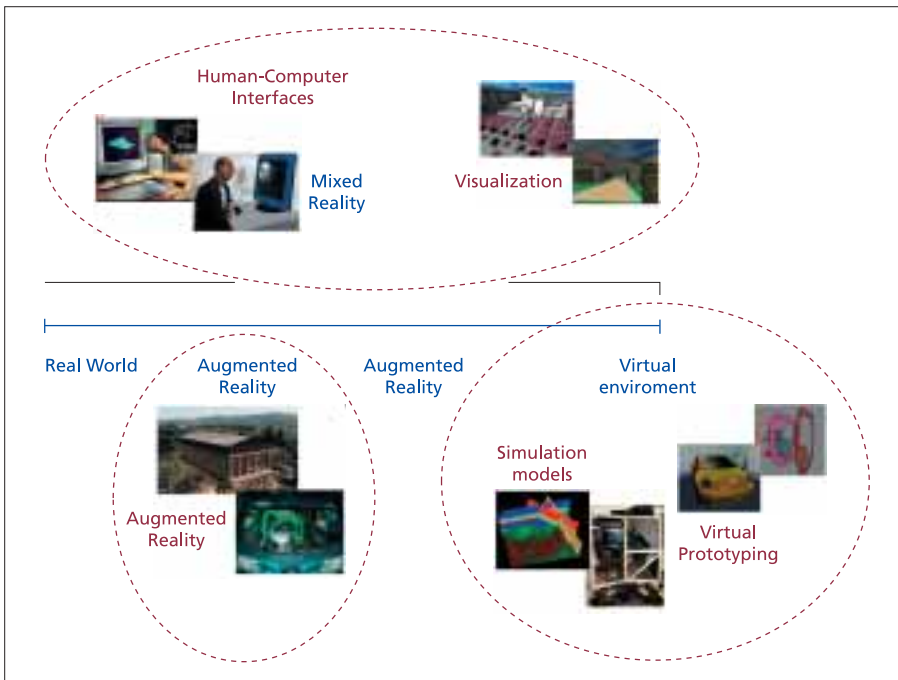


Figure 2: Technological areas of TARVITEK

to develop innovative applications to reduce physical prototyping costs in the design phase of a new product. Some of the activities within this area include multi-physic simulation to achieve the interconnection of different simulation systems, the development of tools for an integrated simulation of assembling and maintenance processes, or the implementation of new technologies for collaborative design environments.

### Augmented Reality

Augmented Reality allows users to see the real world enhanced by additional information generated by a computer. Ideally, users perceive that real and virtual objects coexist within the same space. The expected results of this area should allow building new applications in a simple way, giving a proper solution to technological challenges such as correct alignment and tracking in open environments for mobile applications, realistic rendering independent of the light conditions, or user-friendly interaction. Another objective is the design and implementation of an open-source distributed software platform to author Mixed Reality applications.

### Human-Computer Interfaces

The main objective in this area is to achieve natural multimodal interfaces including touch, gestures, and voice as most important modes in the Human-Human communication channels. The main technological challenges are related to new haptic interfaces for force restitution, non-intrusive tracking systems based on cognitive vision techniques, and the implementation of avatars as a feedback channel from the computer.

### Simulation Modules

In order to gain a greater level of realism in computer simulations, models are required that are able to accurately reproduce real behavior. A simulation module should be able to reproduce the real behavior of mechanical elements, processes, or different phenomena with the best possible accuracy. A general software platform is being implemented that may allow the reuse of the software. Some of the applications proposed for this platform include the development of traffic models and emergency scenarios.

### Visualization Technologies

Visualization technologies are crucial in the social acceptance of Mixed Reality applications. Within the project, different renderers and graphical approaches have been tested in order to evaluate the definition of a generic visualization platform for TARVITEK. Therefore, new software components will be implemented in order to achieve more realistic simulation of vegetation, particles, fluids, and weather phenomena. Moreover, new visualization technologies such as autostereoscopic devices will be analyzed.

### Implementation of prototypes and demonstrators

All the previously defined technological areas include the implementation of different innovative prototypes by the end of 2004 as well as the design and implementation of four demonstrators that will be presented to SMEs by January 2005. These demonstrators will be built as a combination of different components developed within the five technological areas of research, and should act as potential products for the early adopters. For the time being, different demonstrators have been proposed, including simulators for assembling and maintenance in the tooling machinery or mobile prototypes for the civil engineering sector.

### Acknowledgement

This project has been financially supported by the Industry Department of the Basque Government within the strategic ETORTEK Program (2002-2003).

### Point of contact

Dra. María Teresa Linaza,  
VICOMTech Donostia-San Sebastián,  
Spain  
Email: mtlinaza@vicomtech.es

# MIROWALK-SEM – Development of advanced techniques for interactive 3D navigation in large CAD models using semantic tools

Carlos A. Toro, Dr.-Ing. Jorge Posada, Stefan Wundrak, Dr.-Ing. André Stork

## German Abstract

Die Untersuchung großer Industrieanlagen mittels einer virtuellen Umgebung – vergleichbar einer Ortsbesichtigung – verbessert Design-Überarbeitungen erheblich und senkt Kosten, die durch Konstruktionsmängel entstehen können. Komplexe Industrieanlagen umfassen jedoch Millionen von Elementen und übersteigen somit oftmals die verfügbaren Leistungen normaler Arbeitsplatz-PCs. Im Projekt MiroWalk werden semantische Daten in der CAD-Modellkonvertierung mit Hilfe einer Ontologie und deren Inferenzmaschine vorgestellt. Semantik verbessert die Performanz und passt die Visualisierung an die Bedürfnisse der Anwender an. Eine Taxonomie, zusammen mit semantischen Gesichtspunkten der Beziehung zwischen Anwender, Modell und Ressourcen, bildet die Basis für die Entscheidung, welche Regel für die spezifische Visualisierungstechnik angewendet werden soll. Wir arbeiten an der Erweiterung der ursprünglichen MiroWalk-Software, um verschiedene Visualisierungstechniken automatisch anzuwenden, basierend auf semantischen Kriterien: Ein Modell wird für einen spezifischen Visualisierungskontext produziert. Zudem kann das System sich wiederholende Elemente des CAD-Modells identifizieren und deren semantische Informationen nutzen, um die Komplexität des Modells zu reduzieren, indem es komplexe Teile mit alternativen 3-D-Symbolen ersetzt, sogenannte semantische Synonyme.

## The problem of Large Model Visualization (LMV)

In recent years, LMV has become an important research field in scientific computing. In very basic terms, the problem consists in interactively visualizing models that surpass the capabilities of the computing resources. The fast increasing complexity of recent datasets in architecture, mechanical engineering, or scientific computing is easily exceeding the abilities of modern graphics systems.

Various techniques including geometrical simplification of primitives and level of detail control (LOD) have been implemented with good results by high-end commercial walkthrough packages. The common strategy followed in order to obtain a Design Review viewable scene still depends on converting the model to a Virtual Reality format such as VRML.

## Exploiting semantic information in an LMV environment

We hypothesize that semantic considerations added to simplification techniques of the geometrical data present in walkthroughs increase the



Figure 1: A typical LMV problem in a Plant Design environment

efficiency and complement the traditional methods. Semantic considerations taken into account when the model is converted to VR are also very useful, because the conversion can be performed specifically for given user needs or user types.

It is, for instance, relevant, if the user who is walking through the model is an engineer or a manager, as they are interested in different aspects of the model. It is also relevant, if the intention is to inspect the model or just to walk through it.

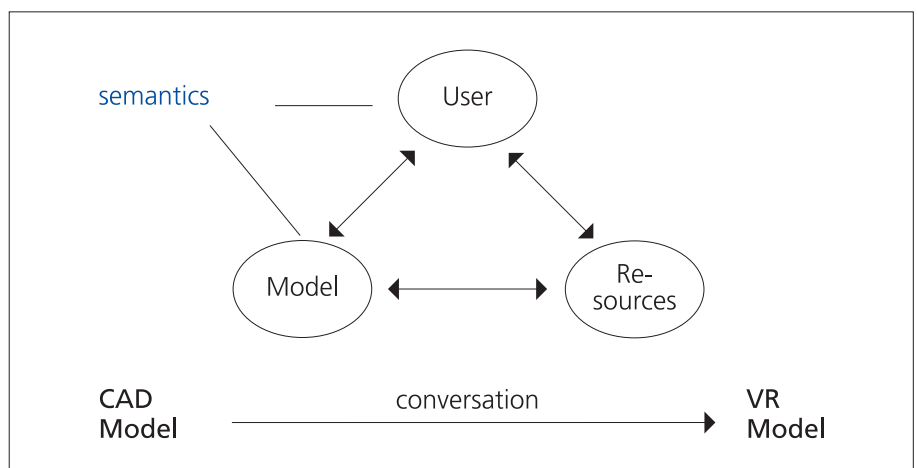


Figure 2: The semantic triangle, used as base of our approach



Figure 3: Valves at different complexities and a valve symbol

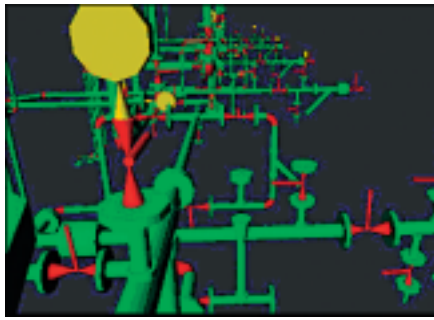


Figure 4: An outside view of a chemical plant. Valves are replaced with 3D symbols that are more simple to render. In this case, the viewer has an engineering background and the semantic information associated by the user is maintained



Figure 5: The MiroWalk viewer showing the semantically optimized parts in red

An important aspect must be mentioned as we also take into account the computational resources available for the Design review process. Clearly, if the user has a better computer with more resources (more RAM and graphic capabilities, for example), the conversion to the VR model can be optimized in order to fully take advantage of the situation.

All of the above capabilities are extracted directly from the semantic information embedded in the CAD model. The internal semantic data is stored in an ontology, which is currently in the development stage.

The ontology commonly defined as »a specification of a conceptualization« is closely related to a database in the sense that it is capable of carrying data, but it also has intrinsic knowledge of the relationships among the elements described by the data.

#### Approach verification

Although this project is still in the development stage, some interesting mid results have been found, which show that this approach is very promising.

We are following a 2-2-2 strategy in order to test our work: With two models, for two users, on two resources. This is consistent with the semantic triangle in figure 2.

As test models, we are using two complex CAD models from two different engineering domains: A large process plant already known from the previous MiroWalk project, and a large plant from the chemical industry.

As test users, we are using two typical user profiles with different intentions and abilities – an engineer and a manager (chosen as an example for our role-based representation). The engineering profile affects the semantic techniques by forcing a detailed structural representation (all important structures and components should appear), but allowing a more schematic (conceptual) visual appearance of some elements. On the other hand, the manager has a more esthetic perception and the VR model can have a more loose structural representation (e.g. some structures such as small clamps can just be dropped) while the overall visual quality should be very realistic.

As test resources, we use two computer systems with different hardware configurations: An up-to-date workplace computer system with an advanced graphics card, and a less powerful computer system with less main memory and an older graphics card.

#### Acknowledgement

This is a joint project between Fraunhofer Institute for Computer Graphics IGD-A2 and VICOMTech. The project is partially financed by the Spanish-German cooperation projects fund.

#### Point of contact

Carlos A. Toro  
VICOMTech Donostia-San Sebastián,  
Spain  
Email: [ctoro@vicomtech.es](mailto:ctoro@vicomtech.es)

# Augmented Reality-based welding simulation system for technical training

Álvaro Segura, Íñigo Barandiarán

## Introduction

A number of activities in the industry imply certain risks, and thus require good previous training. In the first training stages, simulators can provide the trainee with valuable knowledge and practical skills within a safe environment. Welding is one of those activities presenting some risks and wasting costly materials and energy. The goal of this ongoing project is to develop a welding simulation system, which can be used as a learning tool avoiding potential risks and especially reducing energy and material costs. The consortium is led by Redox Multimedia, a company specialized in multimedia and online eLearning courses for professionals, and includes VICOMTech as well as educational centers specialized in technical training with experience in welding courses.

## System overview

The simulator is a virtual substitute of the real welding equipment, emulating parts such as the regulation panel and the welding hand-tool. The system will provide its users with a set of practical exercises of increasing difficulty and it will guide them while performing the virtual welds, storing statistics about their progress.

The system has a physics simulation core, where the welding process is modeled mathematically, a visualization module, and a physical setup including the tracked hand tool. Results of a first functional prototype are expected for the first quarter 2005.

## Visualization module

The project will select the visualization technique that is best suited for this particular application among several advanced graphics technologies. The project has specified a few possible designs based on techniques such as Augmented Reality, Virtual Reality, or 3D graphics on an orientation-adjust-

table flat panel. In the case of an AR-based system, the user would use physical replicas of the hand-tool and working pieces, and the visualization subsystem would superimpose the evolution of the welded seam, sparks, and other information (guides and error indications) on his view. An HMD (head-mounted display) VR system would work similarly although everything would be computer-generated, including the tool, electrode, and pieces to weld.

A survey of the devices required for the different proposed designs has been made in order to have a clear idea of their complexity, cost, and overall suitability for this project. For instance, a video-see-through AR-supporting HMD with small mounted cameras has been identified, as well as several stereo VR HMDs and pose tracking devices.

## Tracking module

Some form of tracking is necessary to continuously monitor position and orientation of the hand-tool, as these are the main input variables to the mathematical simulation of the welding process. Small tracking devices have been identified that can be mounted on the tool. Alternative methods such as optical tracking techniques using small video cameras will be studied and evaluated, not forgetting that an AR or VR system will also need some head and objects tracking.

## Acknowledgement

This project is partly funded by the Spanish Ministry of Science and Technology.

## Point of contact

Álvaro Segura  
VICOMTech Donostia-San Sebastián,  
Spain  
Email: asegura@vicomtech.es

## German Abstract

Schweißarbeiten sind ein Beispiel für einen industriellen Vorgang, der von qualifizierten Arbeitern ausgeführt werden muss. Die Ausbildung dieser Arbeiter erfolgt traditionell durch Übungen mit echten Geräten, wodurch bestimmte Risiken und Kosten entstehen. Das Hauptziel des Projektes SIMUSOL ist die Entwicklung eines Systems für Schweißsimulationen, das am Beginn der technischen Ausbildung zukünftiger Schweißer eingesetzt werden soll. Das System wird aktuelle Visualisierungs- und Interaktionstechnologien einsetzen und verschiedene Technologien wie Erweiterte und Virtuelle Realität auf ihre Eignung hin auswerten. Das Design wird von der ausgewählten Technologie abhängen und in jedem Fall verschiedene Schwierigkeiten beheben müssen.

# Development of an advanced 3D graphic simulation system for milling and lathe CNC machining operations

Aitor Moreno, Carlos Toro, Álvaro Segura, Iosu Arizkuren, Dr.-Ing. Jorge Posada

## Introduction

The aim of this project is the generation of a simulation system for the machining processes managed by a CNC numeric control. The final result will be a simulation software system for the programming and verification of machining processes by material removal, commonly associated with milling and lathe.

## Target environments

The simulation system is used in two different environments, the simulation kernel is the same in both: The client applications use the simulation kernel in an easy way through a common API.

The first environment is educational software. A simulation system is very useful (even needed) to support the learning process in a quicker and safer way. The material costs can be reduced because only the programs that are simulated correctly are machined by the CNC machine.

The second environment is the real machine simulation environment, where the kernel represents an added value to the CNC control. Our kernel supports real-time simulation for conventional machined parts without any pre-processing, providing the possibility to simulate the feedback of the CNC machine in real-time. This is useful because it allows simulating the real result of the simulation in a CNC machine, not the theoretical result.

## Internal Representation

Our internal model representation is based on geometric primitives. This fact allows the obtained models to have all the geometrical and topological advantages of the exact representation techniques like BREP. Some advantages of this representation are, for instance, that the user of the kernel has complete freedom of parts

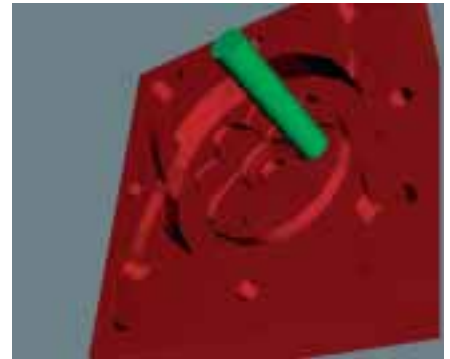


Figure 1: A milling simulation

of the evaluation, or that the obtained geometrical model can be saved for further post-processing in other file formats, like STL or OBJ. Additionally, graphics cards are nowadays optimized to work with this kind of representation in order to achieve an interactive frame rate.

The main advantage of the implemented internal representation is that the simulation kernel offers a unified geometric model for both milling and lathe operations, being not limited to these machining processes. Scalability and extensibility are two of the main features supported.

## Acknowledgements

This work is sponsored by the Basque Government under the INTEK program. The project consortium is composed by three companies: FAGOR Automation, which is the main machine-tool automation company in Spain; Alecop, which is the main Spanish educational training material company; and SOME, a software developer.

## Point of contact

Aitor Moreno  
VICOMTech Donostia-San Sebastián,  
Spain  
Email:  
amoreno@vicomtech.es

## German Abstract

Das Ziel von SIMUMEK ist die Entwicklung eines Simulationssystems für CNC-Bearbeitungsprozesse. Das Endergebnis wird aus einer Simulationssoftware für die Programmierung und Verifizierung von Bearbeitungsprozessen bestehen, die sich auf die Entfernung von Material beziehen, allgemein bekannt als Fräsen und Drehen. Das wichtigste technische Ziel ist die Entwicklung eines Simulationskerns unter Einbeziehung von technischem Know-how, um die Simulation des Materialentfernens in Echtzeit auszuführen. Wichtige Innovationsaspekte stellen der Echtzeitsupport für konventionelle Maschinenteile ohne vorherige Bearbeitung, ein einheitliches geometrisches Modell sowohl für Fräsauch für Dreh-Vorgänge, die komplette Bewertungsfreiheit für das Teil (ohne feste Kamera) und die Persistenz des bearbeiteten Modells für weitere Verarbeitung im STL-Format dar. Der Simulationskern wird in zwei verschiedenen Umgebungen verwendet: erstens in der Ausbildung, in der das Simulationssystem nützlich für die schnellere und sichere Unterstützung des Lernprozesses ist, und zweitens in der echten Umgebung der Maschinensimulation, wo der Kern einen zusätzlichen Nutzen für die CNC-Kontrolle bietet.

# SPORT-LIVE – Improving the performance of soccer players through the use of new visual technologies

Dr. Ana C. Andrés, Dra. María Teresa Linaza, Ana Susperregui, Íñigo Barandiarán

## Introduction

The major Basque 1st Division soccer clubs Real Sociedad (number two in 2003 Spanish League) and Athletic de Bilbao are investing in the development of new high-tech training facilities. To obtain the best results, they have looked for experts in communications and visual technologies to create the most suitable hardware and software to improve every training session.

Both soccer clubs have joined efforts under the SPORT-LIVE initiative. The main goal of this project is the research and development of a system that allows coaches to track, outdoors and indoors, the position and the fundamental vital signs of the players by using portable devices. Furthermore, the data obtained from this tracking and the camera recordings from the training sessions will be used to develop a graphic tool that will help coaches to evaluate their players' performance.



Figure 1: Traditional heart rate analyzer (PL-6000: CatEye)

## German Abstract

Fußballspieler haben lange und stressige Trainingseinheiten. Trainer müssen sowohl die physischen wie technischen Anstrengungen kontrollieren, die jeder Spieler währenddessen aufwendet. Aktuelle Technologien ermöglichen Messungen der Leistung etwa mittels unbequemer Herzfrequenzmonitore oder analysieren Aktionen erst nach Spielende. Die Anwendung innovativer drahtloser Kommunikation wird Trainern die Überprüfung der Spielerleistung in Echtzeit ermöglichen, indem sowohl die Herzfrequenz als auch die Position zu jedem Zeitpunkt des Trainings überprüft werden können. Schnelles visuelles Feedback aus Kameraaufzeichnungen wird durch neuartige grafische Tools die Bewertung des Trainings innerhalb eines Tages oder schneller ermöglichen.

## Wireless heart rate control

During the first stage of the project, a new wireless heart rate analyzer was designed. Traditional heart rate devices are not very practical and do not include communication capabilities. At present, physical performance evaluation is generally done after the training session, studying the data that has been stored in the device memory. Miniaturizing the device makes it easier to wear; adding a communications module enables coaches to check their players' health status in real time.

## Real-time player localization

Speed, strategy, and technique are further issues to take into account when studying a player's performance. Trainers do it live or on site, or they take notes to remind themselves of the necessary corrective actions. SPORT-LIVE researchers are studying the most suitable solution to be able to keep track of these characteristics in an efficient and fast manner: Mixing localization techniques and video analysis.

There are several localization technologies that could be used such as DGPS (differential GPS), Bluetooth, UWB (ultra wide band), customized radio frequency, etc. DGPS, for instance, is very suitable for large covered areas outdoors, where a high degree of precision is not required. UWB, however, works in smaller spaces at very high precision. UWB's precision makes it the best solution for training sessions on soccer fields,



but it utilizes a wide range of frequencies and the use of these frequencies has not yet been officially approved in Europe. The developers of the SPORT-LIVE prototype will choose the most convenient solution according to the soccer clubs' requirements.

**Visual post-processing:  
Useful technical feedback**

All the information obtained from the heart rate analyzers, location sensors, and cameras will be received at the control center placed on the training site. This processing facility will process and adequately store the data in order to prepare it for a profound analysis. A fast post-processing procedure will generate visual feedback in the form of 2D graphs, 3D diagrams, video captures, etc. to help coaches performing the technical analysis of the players.

During this last part of the project, the most advanced vision techniques will be used. Image analysis along with 3D graphics will be integrated in a software program that will enable coaches to watch the players' data shortly after the training session. Graphically enhanced camera recordings from professionals will also be used to train young soccer players.

**International scope**

SPORT-LIVE addresses a key need in today's sports: Improving the athletes' and players' performance with the help of new technologies. This research line is becoming a field of its own. To gather other similar initiatives, the SPORT-LIVE consortium is preparing an international congress about »Sports and Technology« in the Basque Country for December 2004.

**Acknowledgments**

Special thanks go to Real Sociedad and Athletic Bilbao soccer clubs, and other SPORT-LIVE partners: Gaia, Thaummat and Bilbomatica. This work is sponsored by the Basque Government within the scope of the INTEK program.

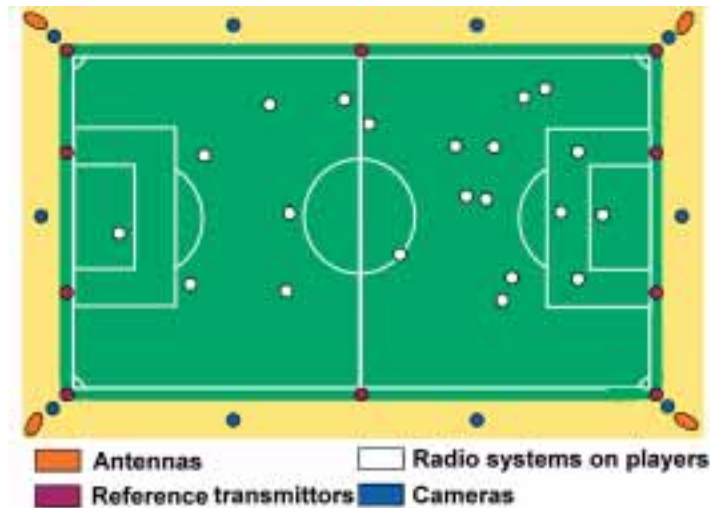


Figure 2: Distribution of analysis devices on the soccer field during training sessions



Figure 3: The proposed system presents statistical information (mean, max, min, etc.) about the players' heart rate performance through an easy-to-use user interface

**Points of contact**

Dr. Ana C. Andrés  
 Dra. Maria Teresa Linaza  
 VICOMTech Donostia-San Sebastián,  
 Spain  
 Email: acandres@vicomtech.es  
 mtlinaza@vicomtech.es

# VIP-TV – 3D synthesis and visual tracking that enhances broadcast TV retransmission of sport events

Dr. Ana C. Andrés, Alejandro Ugarte, Íñigo Barandiarán,  
Dra. María Teresa Linaza, Igor García

## Motivation

Thanks to satellite broadcast TV, »Pelota vasca« matches are watched all over the world. This sport has thousands of supporters that rely on TV retransmissions to get the best of the matches they are interested in. Unfortunately, when watching a »pelota« match on TV, ball motion is difficult to follow due to the speed of the ball (up to 80 km/h). The VIP-TV project intends to improve these TV retransmissions. Some of the objectives of this project are:

- To improve the way the ball is seen,
- to enrich the retransmission with relevant visual data, and
- to technologically innovate a classical sport.

To achieve these goals, an advanced visual tracking system is being developed that will be able to obtain 3D location of the ball in the court. This information will enable producers to synthetically enhance the ball on TV broadcasts by highlighting it. The 3D location will also be used to reproduce conflictive ball moves over a synthetic 3D representation of the court, allowing producers to provide the audience with new and clearer perspectives.

The project is following these steps:

- Design of the Augmented Reality system that will enhance the visual experience of the »pelota« game with the help of motion detection algorithms. In order to achieve this objective, a camera system will be developed by taking into account the possible occlusions related to the ball's position and the players' spatial locations.
- Replay the most interesting scenes of the game from different perspectives on a 3D synthetic court.
- Broadcast of test-enhanced matches obtained in a real a game court in order to do prototype validation.

## 3D Ball tracking

High speed video cameras located on strategic points of the playing court record each match. The images coming from these cameras are analyzed in real-time to track the ball in two dimensions (2D). Thanks to a precise calibration process performed before the match starts, the system can relate the images to the environmental 3D space. This relationship permits obtaining the 3D location of the ball. All these data will enable us to

## German Abstract

Das Pelota Vasca-Spiel hat dank Fernsehausstrahlungen zahlreiche Fans auf der ganzen Welt. Aufgrund der Geschwindigkeit des Balls können die Zuschauer beim Zuschauen im Fernsehen oftmals nicht genau sehen, was passiert ist. Um dieses Problem zu lösen zieht VIP-TV das Design eines Systems in Betracht, das auf dem neuesten Stand der Technik ist und den Ball in Echtzeit verfolgen und seinen Weg über Fernsehbilder zeigen kann. Da die Überwachung des Balls über 2-D-Bilder erfolgt, den Standort des Balls nach exakter Kalibrierung jedoch in 3-D erhält, wird VIP-TV zudem wichtige Bewegungen auf einem synthetischen Feld abbilden und somit die Fernseh wiederholung aufwerten können.



Figure 1:  
TV broadcast  
frame, before and  
after visual  
enhancement

enhance the TV broadcast images by visually highlighting the ball (for instance, artificially drawing a bigger ball). The overall process needs to be done in real-time.

### **Synthetic reproduction of key ball moves**

3D ball motion information is also useful to study games and actions during a match. Data about the ball behavior (speed, instant at which it has hit the floor, etc.) is interesting for viewers. We have designed a synthetic »pelota vasca« court upon which producers will animate the evolution of the ball as it has been obtained from the tracking system.

This kind of animation can be used to provide viewers with new perspectives from which they can better evaluate what has happened during the game. It also appears as a new commercial opportunity, since synthetic reproductions of the court might include publicity or any other kind of information.

### **Live tests on public TV**

ETB, the Basque public television company and cofounder of VICOMTech, is a major partner in VIP-TV. Along with G93, TV producer of sport events, they broadcast around 150 matches of »pelota vasca« per year. This alliance provides the VIP-TV consortium with the perfect test-bed, and a great opportunity to exploit the results of the project as they are obtained.

### **Acknowledgments**

We would like to thank our project partners, STT, G93, ETB for their support. This work is sponsored by the Basque Government under INTEK program.

### **Points of contact**

Igor García  
Dra. María Teresa Linaza  
VICOMTech Donostia-San Sebastián,  
Spain  
Email: igarcia@vicomtech.es  
mtlinaza@vicomtech.es

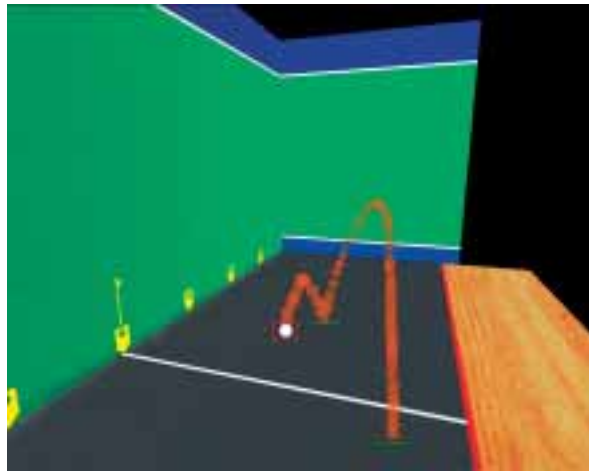


Figure 2:  
Diagonal synthetic  
view of ball  
movements

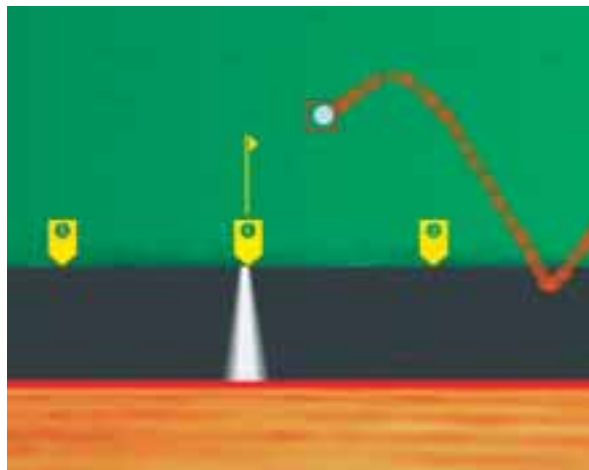


Figure 3:  
Detailed synthetic  
close-up on the  
ball

# ColliMatrix – Simulation of multi-leaf collimated fields for radiotherapy planning

Dr. Céline Paloc, Iñigo Barandiaran, Eduardo Carrasco

## Main Core

X-ray simulators play two roles in the preparation of patients for external beam radiation therapy. The first is localization, in which the high contrast and the high resolution, achievable with kilovoltage X-rays, are used to guide the radiotherapist in the determination of the anatomical volumes to receive therapeutic radiation doses and those to be avoided. The second role is that of true simulation. Beams, which may have been designed during a three-dimensional treatment planning process, are set up on the patient and the radiotherapist confirms that the geometric aspects of the treatment intent are being met. A limitation of current equipment in this regard is the inability to simulate multi-leaf collimated (MLC) fields found in the latest radiation treatment units. An MLC consists of multiple narrow leaves which allow custom-shaped beam apertures required to deliver the desired radiation distribution.

Current solutions to counter this problem are to construct physical leaves for the simulator to set the desired leaf positions. Another approach has been to project the MLC field using an LCD device placed in the light field during treatment simulation. The project ColliMatrix was developed as a software solution which can be easily integrated into the current infrastructure providing the planned MLC configuration directly overlaid on the X-ray images as they are acquired during treatment simulation.

As traditional simulators provide analogue X-ray images on a TV monitor, specific hardware is first integrated to digitize these images as they are acquired and to allow further processing. The treatment planning process then provides the files storing the MLC information to be confirmed by the radiotherapists. An easy-to-use and intuitive user interface has



Figure 1: Snapshot of the ColliMatrix application

been implemented to display the digital X-ray images and superimpose the planned MLC settings in real time. Several simple features have been added, such as the interactive correction of the leaf positions and the control of rendering options (leaf transparency, textual information overlay...). Moreover, we are currently incorporating a lens distortion model, to reproduce the barrel and pincushion distortions inherent to the X-ray image intensifiers.

The application has been installed in the radiotherapy unit of Hospital Donostia and is being evaluated by radiotherapists in real clinical conditions. We expect our application to greatly help overcome the two key limiting factors in radiotherapy efficiency, namely set-up time and inaccuracies, which will lead to higher patient throughput.

## Acknowledgments

We would like to thank Dr. Rafael Larretxea, Dr. Félix Peinado, Dr. Andoni Orube, and Dr. Francisco Lozano from the Radiotherapy unit at Hospital Donostia for their cooperation.

## Point of contact

Dr. Céline Paloc  
VICOMTech Donostia-San Sebastián,  
Spain  
Email: cpaloc@vicomtech.es

## German Abstract

Zurzeit ist die Planung von externen Strahlentherapie-Behandlungen eingeschränkt, denn ein konventioneller Strahlentherapie-Simulator kann die Feldformen des Multi-Leaf-Collimators (MLC) nicht simulieren und verifizieren. Die Strahlentherapeuten umgehen dieses Problem unter anderem damit, dass sie durch eine Kombination von Bleiblöcken per Hand einen konventionellen Strahl errichten, der zu dem geplanten MLC-Profil passt. Dies ist eine sehr umständliche, riskante und zeitaufwendige Aufgabe. ColliMatrix präsentiert als praktischere und effizientere Lösung eine Echtzeit-Validierung der MLC-Konfiguration während der Behandlungsplanung durch Simulation der Lamellenpositionen auf Röntgenbildern, sobald sie aufgenommen werden. Die Lösung basiert vollständig auf Computer-Simulationen, die einfach in jeden traditionellen Simulator integriert werden können.

# Visual End-User Authoring of Complex Workflows

Christoph Jung

## German Abstract

Das Ausführen von umfangreichen und zeitintensiven Berechnungen sowie die Steuerung von komplexen Systemen stellen hohe Anforderungen an die IT-Infrastruktur und die damit betrauten Fachkräfte im wissenschaftlichen und wirtschaftlichen Bereich. Während durch den technologischen Fortschritt die Effizienz der IT-Infrastruktur durch verbesserte Ressourcenauslastung mittels z. B. Grid Computing erhöht werden konnte, erfordert die Beschreibung der systemweit auszuführenden Workflows Detailkenntnisse des zugrundeliegenden Grids und seiner Ressourcen. Vergleichbar verhält es sich mit hochgradig voneinander abhängigen Geschäftsprozessen, deren Beschreibung großen Aufwand erfordert und die vielfach nur von Spezialisten auf die vorhandene IT abgebildet werden können. Einem breiteren Einsatz und Durchbruch in Bereiche außerhalb der Forschung wird dem Grid Computing bislang u. a. durch diesen Umstand verwehrt. Zur Erleichterung der Erstellung von Grid Jobs wurde daher für das Fraunhofer Resource Grid ([www.fhrg.fhg.de](http://www.fhrg.fhg.de)) der Prototyp eines Editors entwickelt, mit welchem sich die Beschreibung des komplexen Arbeitsablaufes mit Hilfe von Methoden der visuellen Programmierung, die ebenfalls in modernen Business Process Management Systemen zunehmend angewendet werden, wesentlich einfacher gestalten läßt.

## Introduction

The execution of complex and time-consuming calculations as well as the control of complex systems make high demands on the underlying IT infrastructure and the experts involved. The efficiency of the IT infrastructure has been improved due to e.g. enhanced load balancing caused by the technological development and the increased usage of grid computing, which is particularly popular in North America. However, the description and definition of complex workflows, e.g. the so-called grid jobs, are still inconvenient and not satisfying. In case of (scientific) distributed computing systems, several toolkits like Globus ([www.globus.org](http://www.globus.org)) provide the basic network functionality and services for heterogeneous operating systems and hardware combinations using open internet standards, whereas commercial vendor-specific integrat-

ed business systems try to handle the fragmented underlying company-specific applications. Nevertheless, it is still hard to launch or even define a so-called grid job or business process without the help of experts and prior intense training. This is why a simplification of the authoring of complex workflows – grid jobs, business processes, etc. – is required to save time and costs.

## Visual Programming

The principles of visual programming (VP) are to visually represent the objects and actions, to replace typing with pointing and dragging, to provide rapid, incremental, and reversible actions, and to offer immediate and continuous feedback to users. VP is using information hiding to reduce the complexity for a user while handling complex dependencies in the background, and to provide suitable

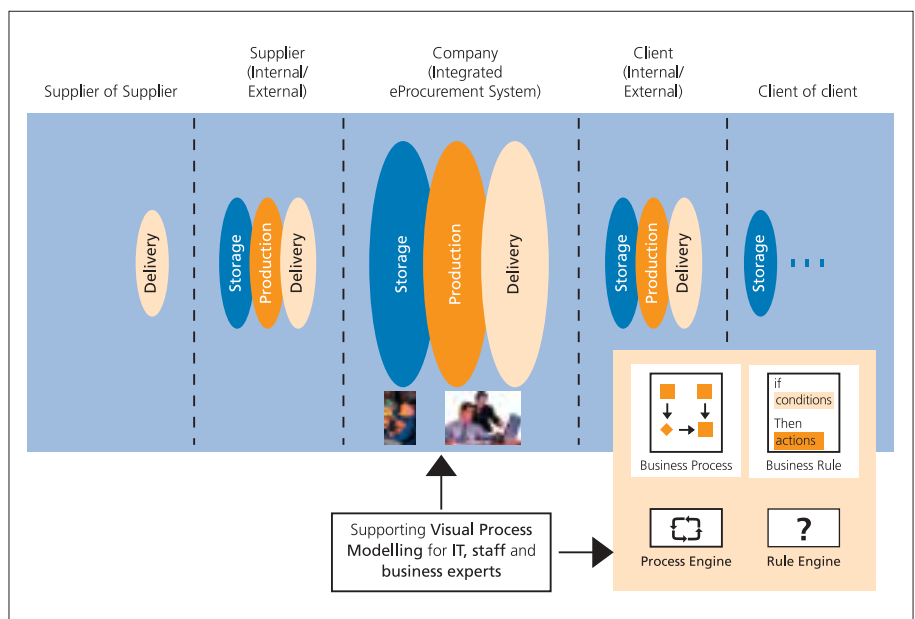


Figure 1: Visual grid job authoring and distributed execution in the FhRG

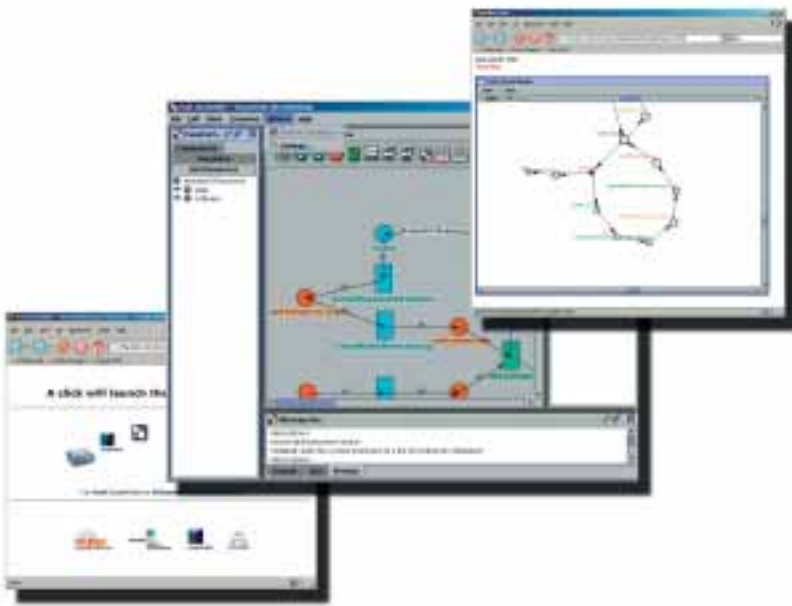


Figure 2: Modeling workflows for business processes

mechanisms for the interaction with complex systems like computing grids on an abstract level.

### Grid Computing Workflows

Grid Computing itself stands for a more sophisticated distributed computing infrastructure for advanced science and engineering. While computing grids are powerful and efficient tools to solve complex problems, there is no convenient way to use them. Grid jobs based upon scripts are still widespread in the computing grid community, but they require detailed knowledge of the underlying grid architecture and resources. Several more or less sufficient attempts have therefore been made in the grid computing community to solve this problem to increase the usage of grid technology outside the fields of expensive scientific or commercial research.

### Grid Service Applications

Several Fraunhofer Institutes – including the Fraunhofer IGD – have founded the Fraunhofer Resource Grid FhRG ([www.fhrg.fhg.de](http://www.fhrg.fhg.de)) making use of a bundle of software components which have been developed by the partners. These software components provide a new way to simplify the process of defining, scheduling, and running complex grid jobs as well as describing and mapping the grid resources involved. While a special repository for content storage and delivery of resources, and a specific handler for analysis and execution of grid jobs have been developed for storing, retrieving, and handling the large amounts of different sources like data, software, or hardware, an additional tool is used to combine system and user selected resources for solving specific problems.

The Grid Job Builder (GJB) is an end-user oriented tool which supports the import of resource descriptions as well as the definition and submission of generated grid jobs.

The jobs are modeled as a workflow of involved resources with their dependencies. Using visual elements, the generated job will later be executed when it has been submitted to the grid infrastructure. The imported physical existing grid resources are shown in a special tree and can be dragged and dropped into the drawing area where they can be connected. The drawing area of the Grid Job Builder visualizes the logical dependencies of the elements which are needed to determine the execution sequence within the grid. All the essential information for the resulting grid job execution will be automatically supplied by the editor in the final grid job description – the job workflow design remains simple in contrast to the complexity of the underlying computing grid processes.

Common grid jobs may consist of calculations in the following areas:

- Parameter optimization (material research),
- flow simulation (aircraft industry),
- molecular simulation, data analysis, and visualization (pharmaceutical industry),
- financial calculations (electronic commerce).

### Business Processes

With increasing size of a company, the management and controlling of business-related activities described as business processes get more and more complex. In order to enable a broad amount of the staff throughout the hierarchical organization to map their specific processes (workflows) to the underlying IT infrastructure, it is important to provide technologies which can be handled by all the people involved in important business processes, so-called Business Process Management (BPM) and Business Rule Management (BRM) tools. They are complementary tools and support powerful and flexible adaptation of a company to changed business constraints.

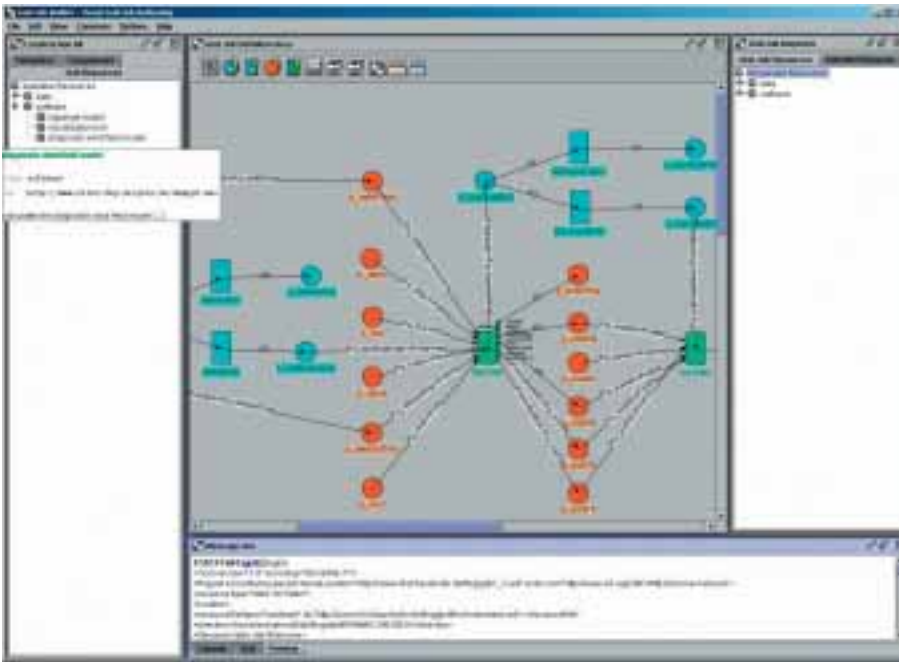


Figure 3: Grid Computing Workflow

Business processes (e.g. an order workflow) are hereby considered as data that can be interpreted and executed by process engines which ensure the proper execution of procedures by delegating the activities involved to software, hardware, or human resources. Business rules are found, e.g. in customer care and billing applications, to apply permanent or occasional discounts, or permanent pricing policies.

An important part of these tools are graphical process design and rule editors, which provide the right level of abstraction to develop, evaluate, enhance, and maintain the business application. BPM and BRM applications are designed for experts (administrators, executives) as well as for non-process specialists – i.e. the workforce, the real experts in what's being done like the warehouse worker – to capture the processes they perform on a daily basis in a simple graphical format. They are intended to be easy to use and impose a uniform process framework across the

organization. This approach is comparable to the described FhRG with its visual authoring tool and related software acting as mediators to the underlying complex system (computing grid). The modeling of the workflow with visual programming techniques is similar for an end-user although the area of application and the resources involved are very different.

An integrated environment, including specific BPM and BRM tools to develop and maintain processes and policies, allows a separation of duties between the processes and the policies. IT workforce can develop the business process and the business users can develop and maintain the business rules – see figure 2 for an example (concept of an integrated eLogistics solution). This separation of duties provides the organization with an environment in which rapid changes in processes and policies can be effected by the appropriate persons in the organization.

## Conclusion

Visual workflow or rule-based programming environments are examples for common and wide-spread approaches due to their easily understandable modeling concepts for non-programmers. While the amount of time needed to describe a grid job to an expert could be shortened, beginners and intermediates will benefit from the reduced complexity of the information overload evoked by the grid resources and their highly-nested dependencies which are involved in the workflow of a grid job. In addition, an increasing amount of modern commercial BPM/BRM tools are simple enough to use so that a broad variety of business users are able to create and manage their own processes. However, complex business processes with integration requirements and the need to develop new applications still require involvement of IT staff.

## Points of contact

Dr. Raffaele de Amicis  
 Dr.-Ing. Stefan Noll  
 GraphiTech, Italy  
 Email:  
[raffaele.de.amicis@graphitech.it](mailto:raffaele.de.amicis@graphitech.it)  
[stefan.noll@graphitech.it](mailto:stefan.noll@graphitech.it)

Martin Einhoff  
 Fraunhofer IGD Darmstadt, Germany  
 Email:  
[martin.einhoff@igd.fraunhofer.de](mailto:martin.einhoff@igd.fraunhofer.de)

# SIMI-Pro – A Semantic-based Information Management system to support Innovative Product Design

Giuliana Ucelli Ph.D., Loris Delpero

## German Abstract

Die internationale Konkurrenz und die rasch wachsende globale Wirtschaft bescheren dem Verbraucher eine enorme Auswahl an Gütern und Dienstleistungen. Aus diesem Grund müssen die Firmen Qualität und Innovation fördern, und gleichzeitig Preis sowie Produkteinführungszeit verringern. Im Automobilssektor macht sich dies in der Notwendigkeit bemerkbar, den Entwicklungsprozess zu verbessern. Dies kann durch eine erhöhte Einbindung moderner Technologien in die kreative Design-Phase erreicht werden, sowie durch Maximierung der Wiederverwertung von Daten und internem Know-how der Firma. Das Ziel dieses Forschungsprojektes ist die Entwicklung einer Plattform, die das Sammeln und Extrahieren von Informationen sowie die Wiederverwertung von Wissen und Informationen in den frühen Phasen des Designprozesses zum Schwerpunkt hat; dies soll durch semantische Web-Technologien, MPEG-7-kompatible Meta-Daten und die Einbindung von kulturbezogenen Informationen in Agenten-Systeme erreicht werden. SIMI-Pro unterstützt nicht nur die Kreativität während des Design-Prozesses, indem es die natürlichen Fähigkeiten des Stylisten erweitert, sondern führt durch die Zerlegung des kreativen Entwicklungsprozess auch zu dessen besserem Verständnis.

## Objectives

The performance of the Product Development Process (PDP) can be assessed by indexes such as the time-to-market (TTM) – the time elapsing from the definition of the functional features of the product to the first production lot – and the overall development cost. The activities that mostly affect TTM and costs are the translation of market needs into product technical specs, the certification of the performances of the product and the subsequent adjustments of the design in the case that actual performances do not fit with

market needs. These activities are of critical importance for the lack of efficiency and effectiveness in the knowledge management along the PDP: The right data or information is not available at the right time, when needed, resulting in time consuming search and costly design mistakes. Furthermore, information is typically dispersed in a heterogeneous set of information sources that are managed by different actors through different technological tools, formats, and semantic representations (e.g. taxonomies, ontologies, category systems) which are not interoperable.

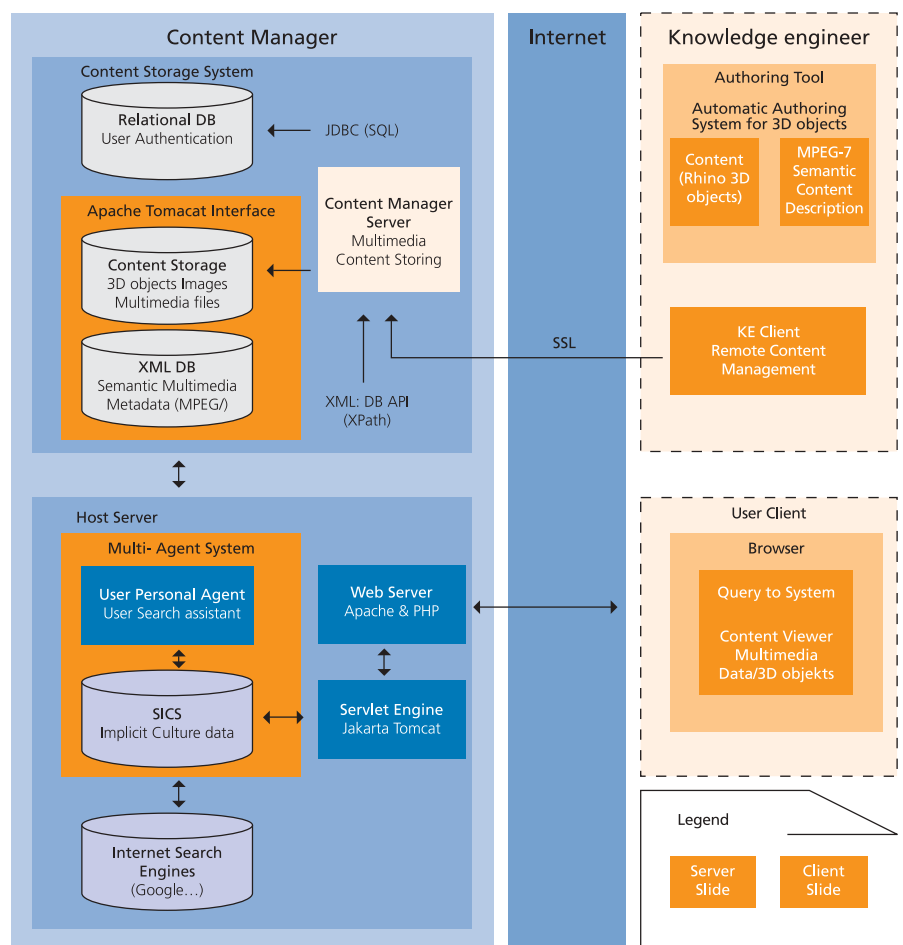


Figure 1: SIMI-Pro system architecture



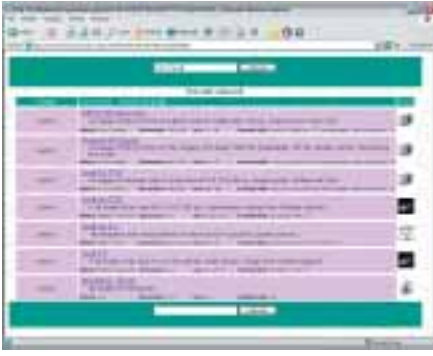


Figure 2: A screenshot from the system

As a consequence, retrieving relevant information results in a time-consuming, often ineffective, and incomplete process. In other words: Knowledge is not capitalized along the PDP and errors are quite systematically repeated. The objective of our research activity is to integrate knowledge management and semantic web technologies to create a platform that supports the early stages of the product development. We believe that the introduction of these technologies in the early design pipeline could significantly ease the reuse of information, design solutions, and knowledge that already exist within the company.

### A Semantic-aware KM system

Today's search engines show evident limitations when dealing with multimedia content and 3D models. Designers and engineers are in need for a tool that eases the retrieval of:

- Generic content about a particular concept: This is the case at the very early stages of the design, when pictures, videos, brochures, and all sorts of other materials are used for the generation of ideas and to inspire the first strokes of the pencil,
- 3D models and their parts: When first design solutions have been achieved and are formalized in virtual prototypes,
- technical information: When engineers are involved in feasibility studies and in the definition procedure of the initial design.

Our solutions to these requirements brought the implementation of standard metadata descriptions for the

SIMI-Pro content. Metadata gives the possibility to search in databases looking for multimedia content and 3D models using semantic queries. Our data types are: Texts, audios, videos, images, and 3D models, where images and 3D objects are more numerous than the other content types. Text-based files are already largely supported in search engines, while other content has until now been difficult to search for efficiently since its description, apart from using file names, has usually not been available. In order to overcome the lack of annotation for these data types, we used the MPEG-7 ISO/IEC [1] standard for metadata. MPEG-7, formally named »Multimedia Content Description Interface«, provides a rich set of standardized description tools, Descriptors, and Description Schemes (DS). SIMI-Pro uses the Multimedia Description Schemes (MDS), which provide the flexibility necessary to describe various data types from audios to videos, from pictures to 3D models. The system uses the Semantic Description Scheme, which describes events, objects, concepts, places, and time in narrative terms. The scheme provides the means for a semantic description of the content, which is readable by humans and computers, that describes properties, definitions, and relations of data content in a standardized format.

The search engine has to be able to retrieve information from various sources, from database to the web. Our approach implies an extensive usage of XML-based technologies such as an XML database, the MPEG-7 (the use of MPEG-4 is now under evaluation for wrapping the various content formats), and the searching mechanism relies on the implicit culture framework for agent technology.

### Implicit Culture to improve filtering

Agents need to have a good knowledge of the surrounding environment where they happened to interact in order to work efficiently. The approach of the Implicit Culture framework [2] brings forward the idea of taking advantage of knowledge and behavior of groups of agents already acting in the environment. The observation of

the behavior of other agents belonging to the same group, which share the same »culture«, improves the efficiency of the new agent. Current and past actions carried out by the group are used as input for the new agent, which is implicitly guided in its actions without needing a profound knowledge of the surrounding environment. The Implicit Culture paradigm has been implemented in a framework, called SICS, which has been embedded and adapted during the development of SIMI-Pro.

### Conclusions and Further Work

The outcome of this on-going research project is a prototype, which has proved to be a promising starting point for further refinements and enhancements. This initial prototype implements all the functionalities discussed in the previous sections, but further work has been planned to provide:

- A basic MPEG-7 authoring tool for the semi-automatic creation of metadata descriptions,
- profiles customization for designers and engineers.

### References

- [1] MPEG homepage:  
<http://www.chiariglione.org/mpeg>
- [2] E. Blanzieri and P. Giorgini. From Collaborating Filtering to Implicit Culture: A general agent-based framework. Proceedings of the Workshop on Agent-Based Recommender Systems (WARS) in Autonomous Agents (Agents2000), ACM, Barcelona, Spain, June 4th, 2000.

### Points of contact

Dr. Raffaele de Amicis  
 Dr.-Ing. Stefan Noll  
 GraphiTech, Italy  
 Email:  
[raffaele.de.amicis@graphitech.it](mailto:raffaele.de.amicis@graphitech.it)  
[stefan.noll@graphitech.it](mailto:stefan.noll@graphitech.it)

Giuliana Ucelli Ph.D., Gino Brunetti

## German Abstract

AIM@SHAPE ist ein europäisches Expertennetzwerk, dessen Ziel es ist, von einer rein geometrischen zu einer semantischen Beschreibung digital dargestellter Formen zu gelangen. Damit soll in der kommenden Generation formgenerierender und -verarbeitender Systeme die Bedeutung von geometrischen Formen explizit dargestellt werden können, um auf dieser Basis das Wissen um die Form effektiv zu nutzen. Anwendungen in Bereichen wie Modellierung, Medizin, Unterhaltung oder geographische Informationssysteme sind beispielsweise die Suche in Datenbanken oder im Internet, die verteilte Nutzung von digitalen Formen, aber auch die Untersuchung von digitalen Objekten, um neues/abgeleitetes Wissen zu digitalen Modellen und Bildern zu generieren. Dieses wissenschaftliche Ziel soll interdisziplinär erreicht werden, indem Computergraphik und Computer-Vision mit Wissenstechnologien zusammengeführt werden. Kern dieser Integration ist die Homogenisierung der Ansätze zum Modellieren mit denen zur semantischen Assoziation, wozu formalisiertes Wissen, d.h. Ontologien und Metadaten, mit Formen regelbasiert in Beziehung gesetzt werden. Das Expertennetzwerk besteht aus 14 renommierten europäischen F&E-Einrichtungen aus den genannten Disziplinen und steht in regem Austausch mit einer industriellen Interessensgruppe, bestehend aus Systemanbietern und Anwendern.

AIM@SHAPE is a European Network of Excellence that is aimed at coordinating research on representing, modeling, and processing knowledge related to digital shapes as they occur in many different environments like design, medicines, entertainment, personal environments, geographical information systems, and many more.

While the technological advances have made available plenty of tools for using and interacting with the geometry of shapes, the interaction with the semantic content of digital shapes is still far from being satisfactory. While we have tools for viewing digital shapes, we miss tools for the interaction with the semantics of digital shapes. It is, for example, not possible to search digital shapes by their semantic meaning.

## Mission

The mission of AIM@SHAPE is to advance research in the direction of semantic-based shape representations and semantic-oriented tools to acquire, build, transmit, and process shapes with their associated knowledge. Objective is to enable the development of shape processing tools in which knowledge is explicitly represented and therefore can be retrieved, processed, shared, and exploited to construct new knowledge. The attainment of this new vision of shape knowledge is achieved by the formalization of shape knowledge and the definition of shape ontologies.

## Innovation

The scientific goal of AIM@SHAPE is ambitious, and it can be achieved only by establishing the infrastructures necessary for growing a new multi-disciplinary research field, where

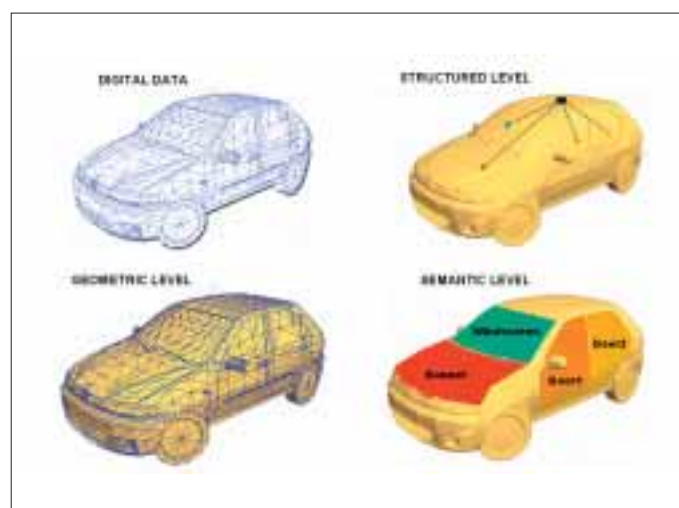


Figure 1:  
From low-level acquisition data to high-level semantic models

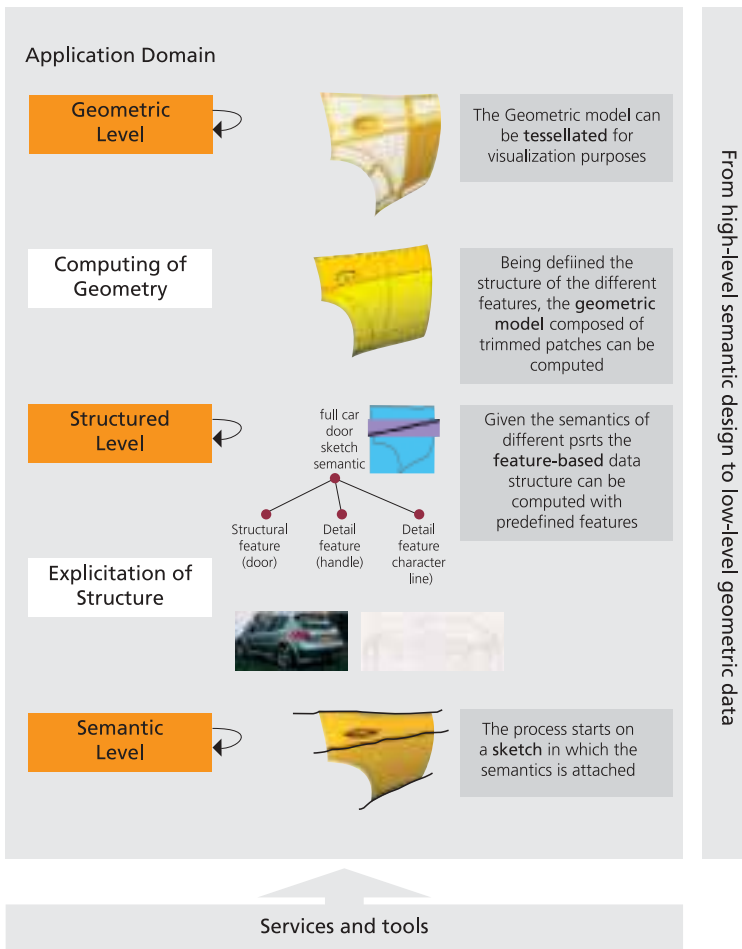


Figure 2: From high-level semantic concepts to low-level geometric realizations

excellence in Computer Graphics and Vision, Computational Mathematics, Geometric Modeling, and Engineering, joins state-of-the-art Knowledge Technologies. The scientific innovation of AIM@SHAPE is advanced in terms of the new methodological approach to model digital shapes and of developing ontologies for the representation of digital shapes and their semantics. Technological innovation is advanced in terms of tools for the automated semantic annotation of digital shapes, as well as tools for accounting for the semantics while digitizing, modeling, and sharing shape data.

### Network of Excellence

The AIM@SHAPE consortium of 14 excellent European R&D institutions in the fields of shape modeling and knowledge technologies will pursue lasting integration both at the foundational level, by initiating a new Theory of Digital Shapes, and at the component level, by developing a Digital Shape Workbench as a common platform for shape models and software tools for modeling, processing, and interpreting digital shapes. Integrating activities include the design of common shape ontologies and a program for human capital mobility and training.

### Network Industrial Group

The industrial relevance of the achievements of AIM@SHAPE is ensured by regular exchange of results and ideas with the network industrial group (NIG) built by developers and users of shape processing tools. So far, the NIG members are Think3, GISIG, ICEM, MegaTech, and DaimlerChrysler, and several other well-known companies which have signed letters of interest.

### International Forum

An International Research forum for Shape Modeling and Reasoning (<http://www.aimatshape.net>) has been organized to constitute a reference point for everybody interested in shape research. Furthermore, a newsletter informs about the progress and activities of the project.

### Points of contact

Dr. Raffaele de Amicis  
 Dr.-Ing. Stefan Noll  
 GraphiTech, Italy  
 Email:  
[raffaele.de.amicis@graphitech.it](mailto:raffaele.de.amicis@graphitech.it)  
[stefan.noll@graphitech.it](mailto:stefan.noll@graphitech.it)

Dr.-Ing. André Stork  
 Fraunhofer IGD Darmstadt, Germany  
 Email: [andre.stork@igd.fraunhofer.de](mailto:andre.stork@igd.fraunhofer.de)

# Using Automatically Inferred Geometric Context for Shape Analysis

Istvan T. Hernadvolgyi Ph.D., Olga Symonova

## Introduction

In many applications, digital 3D models and shapes play a pivotal role in the creative design process, visualization, and analysis. The application domains include Industrial Design, Architecture, and Medical Imaging, just to name a few. Extracting, storing, and retrieving semantics associated with these models is therefore important to be able to reuse designs.

Semantics stored in a digital encoding of a 3D model is inherently implicit. Hence, it must be extracted from the model's geometry by a dedicated algorithm. Unfortunately, today's state-of-the-art shape matching systems which can retrieve objects similar to a query shape are not accurate enough to distinguish between shapes which have a similar overall shape or which have mostly subtle differences. There are dedicated systems, however, which were designed for the geometrical analysis of a very specific task. The algorithms can therefore rely on »hard-coded« domain knowledge to achieve better performance. In contrast, to our knowledge there is no automatic system which uses an automatically inferred context to aid the process of shape analysis.

Our system can be decomposed into two parts: first, automatically infer the context of an individual shape, and second, use the geometry of the context elements to analyze the shape. This is a viable approach, especially for 3D layered CAD models where the geometry of individual components is evident and the parts are explicitly named.

## Automatically Inferring Context

One of the inherent problems of identifying an individual component in an exported 3D digital model is the fact that designers prefer to assign abbreviated names to the elements. For example, it is more likely



Figure 1: A randomly generated NURBS surface



Figure 2: Reconstruction from the low order harmonics of a 2D discrete cosine transform

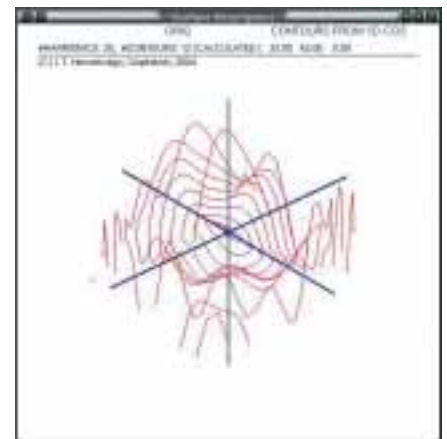


Figure 3: Reconstruction from the low order harmonics of a 1D discrete cosine transform on projected contours

## German Abstract

Dieser Artikel beschreibt die Verwendung des geometrischen Kontexts, um einzelne Elemente in einem 3-D-Modell zu analysieren. Die Herangehensweise ist besonders für mehrschichtige (layered) CAD-Modelle geeignet, in denen die Geometrie der einzelnen Komponenten offenkundig ist und deren Teile eindeutig benannt sind, so wie die mechanischen Teile, die sie beschreiben. Zuerst wird WordNet mit einem eindeutigen sequentiellen Anordnungs-Algorithmus verwendet, der nach einer bestimmten Komponente sucht, um dann deren geometrischen Kontext zu extrahieren. Daraufhin erstellt der Form-Deskriptor ein eindeutiges, affines transformations-invariantes Bezugssystem (reference frame), in dem die gesuchte Komponente genauer analysiert werden kann.

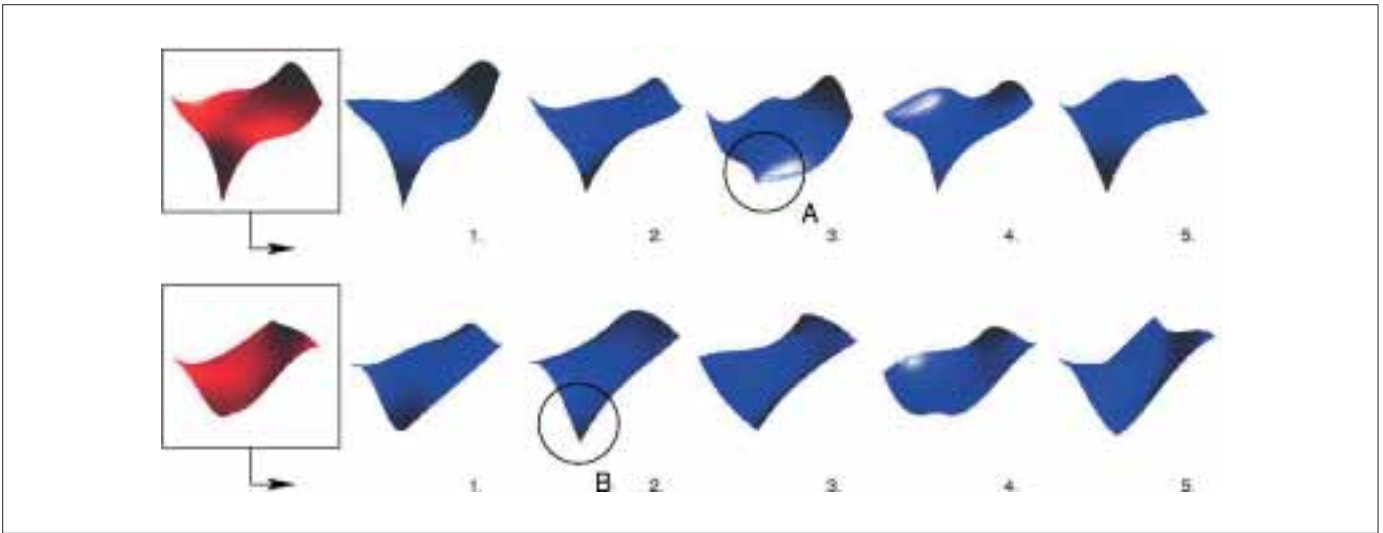


Figure 4: The 5 most similar shapes retrieved from a random database of 5000 NURBS according to our shape descriptors

The surfaces marked A and B are arguably more similar to the other query shapes because of peculiar details which draw the

attention of the human eye. This fact provides further opportunities to use context in shape analysis and matching

that the bonnet of a car would actually be named something like `_bnt1`. Another problem is due to the fact that the component names are not unique. For example, in American English, the term hood is preferred to describe the cover panel of the engine. This presents the problem that the user is looking for a hood but the element is named `_bnt`.

Determining string similarity is a well-known problem and in recent years it has significantly evolved due to advancements in Bioinformatics. In fact, aligning strings of speech or proteins and DNA are very similar problems. We have designed a novel metric for the purpose of matching a concept (like bonnet) to an acronym of the concept (like `_bnt1`). This metric is the ratio of the well-known Longest Common Subsequence (LCSS) maximization and the Levenshtein minimization scores. Moreover, we have designed a specific cost structure used in Levenshtein which takes into account the following observations:

- A component name may contain special characters,
- the case of letters carries no information,
- the non-special characters in the acronym directly correspond to characters in the concept in exactly the same order,

- when abbreviated, it is usually the consonants that are retained from the original term.

We calculate our measure for the full synset (set of synonyms) of each concept to find the most likely match. The synset is obtained by WordNet and the user can provide context clues (hints) which will be taken into account when the term is in more than one and possibly unrelated synsets.

### Using Context to Aid Shape Analysis

Once the neighboring (context) elements of an individual part have been identified, we can use the geometry of these components to position the object in a unique way. For example, the hood of any car lies on top of the front fenders and they share common edges. Using these edges, we can place the hood into a reference frame which is unique, and therefore it can provide a unique orientation and scale, so the usual affine invariance (scaling, rotation, translation) requirements of shape descriptors need not apply. We also have designed two shape descriptors for surfaces which use this common reference frame. Both descriptors are based on discrete cosine transforms. The first is a 2D discrete cosine transform of the

surface and the second one is a series of 1D cosine transforms of concentric contours on the surface. The shape descriptor, in both cases, is comprised of the low order harmonics. Certainly, one can design other shape descriptors which incorporate a fixed reference frame. Since cosine transforms are invertible, we can also examine the reconstructed surface to gain insight into what the shape descriptor »thinks« of the surface. Our preliminary experiments indicate that both shape descriptors are effective to compare NURBS surfaces (our testbed).

### Points of contact

Dr. Raffaele de Amicis  
 Dr.-Ing. Stefan Noll  
 GraphiTech, Italy  
 Email:  
[raffaele.de.amicis@graphitech.it](mailto:raffaele.de.amicis@graphitech.it)  
[stefan.noll@graphitech.it](mailto:stefan.noll@graphitech.it)

# Mobile AR Sketching (MARS)

Dr. Christian Faisstnauer, Dr. Raffaele de Amicis

## Introduction

In recent years, the notion of »Computer Aided Styling« (CAS) has become an important factor in the product development cycle. The use of Augmented Reality (AR)/Mixed Reality (MR) technology has shown considerable potential in this field by allowing the development of intuitive user interfaces that can be operated not only by engineers, but also by stylists and designers.

However, many of these applications are static installations and/or they require powerful hardware in order to be operated which implies high costs.

The MARS toolkit tries to fill this gap by supporting the development of mobile AR sketching applications, based on inexpensive and low-profile hardware, so that such applications can easily be implemented by researchers in the field.

The MARS system consists of:

- A video see-through Head Mounted Display (HMD) constructed with cheap off-the-shelf hardware,
- a 3D pen that can not only be used as a 3D pointing device, but also as a 2D mouse, and
- an image processing library containing functions for the detection of simple hand gestures.

As the image processing functions are optimized for low-profile (portable) hardware (such as PDAs or handheld computers), and both the HMD and Pen are portable devices, this system provides a framework for the development of mobile AR sketching applications.

## Hardware setup

The two devices used by the MARS toolkit are a low-cost video see-through Head Mounted Display (HMD) and a 3D pen based on a standard optical mouse.

## Head Mounted Display (HMD)

The HMD, depicted in Figure 1, consists of the following components:

- I-Visor DH-4400VP Head Mounted Display. This HMD has a reasonable performance (resolution 800x600, 31° diagonal viewing angle) at a relatively low cost (approx. 2000 Euro),
- two FireFly2 cameras (from Point-Grey research). These extremely small and lightweight FireWire cameras (40x40mm, 12 g) are able to capture 30 fps at 640x480. As the cameras are shipped without a casing, we constructed a Plexiglas box for them,
- a FireWire-Hub that can be powered by an external battery; this allows to connect both cameras to a laptop (for a mobile application),
- a standard construction helmet as can be found in any hardware store.

Unfortunately, the only low-cost optical see-through HMDs that were available until few years ago (the Sony Glasstron and the i-Glasses from IO-Systems) have been discontinued; therefore we had to build a video see-through solution based on one of the VR helmets still available (in our case, the i-Visor). The two cameras mounted on the HMD are used not only for the video see-through capability of the HMD, but they can also be used for the optical tracking of the 3D pen and the user's hand.

## German Abstract

In den letzten Jahren ist »Computer Aided Styling« (CAS) zu einem wichtigen Faktor in der Entwicklung von neuen Produkten geworden. Die Verwendung von Erweiterten Realitäten (AR) erlaubt die Entwicklung von intuitiven Benutzerschnittstellen, die nicht nur von Ingenieuren, sondern auch von Stilisten und Designern verwendet werden können. Dieses Projekt befasst sich mit der Entwicklung von Software und Hardware (Eingabe- und Ausgabegeräte), die in mobilen AR-Systemen zur Anfertigung von Skizzen verwendet werden können; das Hauptaugenmerk liegt auf niedrigen Kosten und Hardware-Anforderungen, sodass die Hardware auch von kleinen Forschungsgruppen nachgebaut werden kann, und die Software auf leistungsschwachen mobilen Geräten wie PDAs und Handhelds läuft. Das MARS Toolkit, das aus einem durchsichtigen Head Mounted Display (HMD), einem 3-D-Pen und einer optimierten Bildverarbeitungs-Bibliothek besteht, stellt ein Basis-Kit zur Entwicklung von mobilen AR-Sketching-Anwendungen zur Verfügung.



Figure 1: AR helmet (front view)



Figure 2: Use pen as 3D pointing device

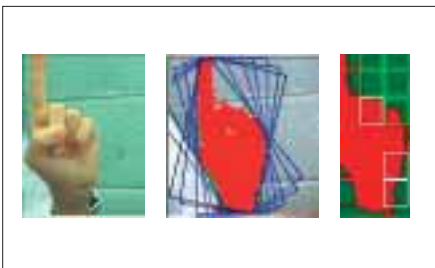


Figure 3: Captured image, Segmented band with MBRs, Gesture recognition

The cameras and the i-Visor HMD, which make up for the better part of the helmet's cost, can easily be removed from the construction helmet so that they can also be used in other setups if required; the FireWire-HUB is fixed with Velcro, and it can also be detached. Therefore, this has proved to be a very versatile and cost-efficient solution.

### Pen

We constructed a 3D pen (cf. Figure 2), based on the components of a standard 2D mouse: the casing of the pen, which is made of Plexiglas, contains the components of an optical mouse. On the one hand, this allowed us to use the electronics of the mouse to drive the buttons of the pen (so that the 3D pen can be connected to any computer, using the standard mouse drivers to read the button events); on the other hand, the pen can not only be used as a 3D pointing device, but also as a normal 2D mouse.

In 2D mode (i.e., when laying on the surface of an object), the LED/diode of the mouse's electronics suffices to detect the pen's motion; in 3D mode (moving the pen freely in 3D space), however, it is necessary to employ a 3D tracker for the tracking. We use the cameras mounted on our helmet to implement optical tracking of the pen. First we experimented with exploiting the presence of an LED in the mouse' electronics to implement a simple color tracking algorithm (this was one of the reasons why we built the pen out of transparent Plexiglas); unfortunately, it turned out that the LED (inside the pen's casing) was not clearly visible from all directions, and that the Plexiglas itself changed the color of the LED depending on the orientation of the pen.

Therefore, our current approach is to mount three different LEDs (blue, red, and green color) in a right angle on the surface of the pen (under construction).

### Image Processing Library

This library contains most of the basic functionality required to implement optical tracking capabilities; it supports functions for image processing, object segmentation, skin detection, or simple gesture recognition. The functions have been optimized for low-profile hardware (such as PDA or handheld computers) so that they are especially suited for use in mobile AR applications, (cf. Figure 3)

We are currently implementing a very simple AR sketching application to demonstrate the use of the MARS toolkit. This application will allow to sketch lines and curves directly in 3D space by using either the bare hand (based on the skin detection and gesture recognition of the image processing library), or the 3D pen (using the LEDs mounted on the pen for optical tracking).

MARS was developed in the context of the »SpaceDesign Pro« project.

### Points of contact

Dr. Raffaele de Amicis  
 Dr.-Ing. Stefan Noll  
 GraphiTech, Italy  
 Email:  
 raffaele.de.amicis@graphitech.it  
 stefan.noll@graphitech.it

# Play Acting Enhanced by Augmented Reality

Giuliana Ucelli Ph.D., Valentina Giovannini, Giuseppe Conti Ph.D.

## From Virtual to Interactive Art

Art has always been about creating representations that are able to communicate the impression of reality through different perceptive stimuli. In various epochs, parallel to the technical development, there have been numerous experimental artifacts aiming at the imitation of reality. The illusion of movements through the study of patterns and textures typical of artists of the Programmed Art, the surrealism of Magritte and the last achievements of technology in the field of computer graphics have been only few examples that confirm the humans' desire to break the limit of what is defined as real and what as illusory.

Before the 1980s, artifacts made with unconventional digital methods were labeled as »synthetic« and generically considered as pieces of Virtual Art. Lately, few movements have departed from the Virtual Art

one and formed sub-branches called Internet Art, Electronic Art, and Interactive Art. Prof. Stephen Bentos from the Media Lab initiated the Interactive Art movement and is an expert for three-dimensional art. The MIT museum [1] shows many of his artifacts, which use hologram techniques.

The desire to involve visitors in the interaction with the artifact has grown with the spread of Virtual, Mixed, and Augmented Reality technologies. Interactive and VR artists refuse tout-court traditional approaches for making and showing art, and propose artifacts that allow new means of interaction with the visitor using sensors, tracking systems, and state-of-the-art displays (LCDs, HMDs, and CAVEs) [2]. Artifacts blend virtual and real worlds and induce to multi-sensorial experiences, while they immerse the visitors in the artistic scene.

## German Abstract

Erweiterte Realitäten (AR) zeigen, dass die menschliche Wahrnehmung nicht unmittelbar von den umgebenden (physischen) Objekten abhängt, sondern von den Impulsen, die von unseren Sinnen erfasst werden. Aufgrund ihres kreativen Potentials und der Möglichkeit, die Welt, die Menschen wahrnehmen, zu manipulieren, werden Erweiterte Realitäten in diesem Projekt als artistisches Ausdrucksmittel für eine schauspielerische Performance verwendet. AR ermöglicht es dem Schauspieler, mit Objekten und Tieren aus einer »anderen Welt« zu interagieren, und lässt die Zuschauer an einer Vielzahl von Gefühlen teilhaben, wie zum Beispiel Freude, Überraschung, Schmerz, Trauer, Verwirrung oder Neugier. Die kreative Verwendung von Erweiterten Realitäten erlaubt es, eine gänzlich neue Umgebung zu erschaffen, in der Wirklichkeit und Illusion zu einer einzigen Phantasiewelt verschmelzen.



Figure 1:  
Pictures and sketches of the scene:  
(1) (2) the stage area, (3) the audience area





Figure 2: A sequence of the performance



Figure 3: Blend of virtual and real objects



Figure 4: The »augmented« table

### Play Acting Using Augmented Reality

Augmented Reality technology is used in this work as an innovative expressive vehicle for artistic purposes. Rather than putting effort in the creation of a single object like in painting or sculpturing, performance art was decided to be the most interesting artistic expression for our work. Such highly expressive art provides a degree of interaction and communi-

cation that was considered essential for our experiment. Play acting generates situations that involve time, space, the performer's body, and the relationship between performer and audience. It delivers a message to a broad public at once and in real time. It can happen anywhere, at any time, or for any length of time. Illusory effects are also traditionally part of this artistic expression, but real-time digital effects are not common, which makes their introduction a new and original experience for the audience.

Our play acting was in line with the ideology of interactive art: The audience was immersed in the scene that was populated by ordinary objects and virtual enhancements. We designed a scene that suggested an ordinary situation, a lunch in a restaurant, where the audience, being also part of the scene, was sat on chairs around dinner tables while waiting to be served. The choice of both, scene and plot was made with the intent of maximizing the contrast between the real and ordinary environment and the virtual objects and events. Two actors were involved in the play, one as a customer, who was sitting at the »augmented« table and was interacting with objects and markers, and a waitress who took orders and delivered virtual plates and animated food. A lamp was the only source of light in the scene, and it had the double function of illuminating the area where the actors were playing, and of holding and hiding the camera necessary for the recognition of the markers. The audience could follow the enhanced play on a screen sitting in the scene, as one could find TVs in many Italian restaurants. As the screen was close to the stage area, it was immediately clear that the scenes captured by the camera where projected on it with the real-time superimposition of virtual objects. The plot was deliberately simple in order to experiment with the potential of the virtual objects triggering the emotions of the audience.

### Technical Aspects

Our enhanced performance was implemented using a customization of the ARToolkit [3] developed at HIT lab at the University of Washington. The

constraints brought by this technology, for instance the need to use particular squared images to allow the pattern recognition of the markers and the consequent overlay of the VRML models, was used as an occasion to design various markers that could be easily recognized by the camera and the actors. 3D models and animations were created using standard modeling packages, 3ds max, and Character Studio.

### Conclusions

Our augmented comedy was very well received by the audience, and on many occasions we succeeded in changing the emotional status of the spectators invoking hilarity and surprise. Many people showed genuine interest for its technological aspects and expressed curiosity about the background that led to its conception. Such a positive feedback was considered by the research team as a remarkable result for two main reasons:

- For the background of the audience, mostly artists, teachers and students of art, which are generally very skeptical about the introduction of innovative technologies in their traditional domain,
- for the simplicity of the plot, which proved to be of secondary importance if compared to the interest aroused by the experimental use of real-time technology.

### References

- [1] MIT museum website: <http://web.mit.edu/museum/>
- [2] Studio Azzurro website: <http://www.studioazzurro.com/>  
VR artist Margaret Dolinsky website: <http://www.evl.uic.edu/dolinsky/>
- [3] ARToolkit website: <http://www.hitl.washington.edu/artoolkit/>

### Points of contact

Dr. Raffaele de Amicis  
 Dr.-Ing. Stefan Noll  
 GraphiTech, Italy  
 Email:  
[raffaele.de.amicis@graphitech.it](mailto:raffaele.de.amicis@graphitech.it)  
[stefan.noll@graphitech.it](mailto:stefan.noll@graphitech.it)

# Opal – Online Partnership Lens

Urs Krafzig, Gregor Heinrich, Dr.-Ing. Stefan Noll

## German Abstract

Opal (Online Partnership Lens), ein neu hinzugekommenes Konzept und Software-Werkzeug, geht ein wichtiges Problem im Bereich Wissensmanagement an: Die Nutzung des vorhandenen Wissenskapitals von Mitarbeitern in kleinen und mittelständischen Unternehmen (KMU) in unternehmensübergreifenden Projektpartnerschaften. Um gegen größere Konkurrenten am Markt zu bestehen, sind kleine Firmen oft gezwungen, Kooperationspartnerschaften einzugehen. Durch die damit verbundene Bündelung von Ressourcen und die bessere Ausnutzung der eigenen Expertise können KMU den Bereich ihrer kommerziellen Aktivitäten erweitern und effizienter arbeiten. Das Ziel ist die Ermöglichung von Kooperationen in verteilten Arbeitsgruppen durch die Verwendung von Opal. Diese Teams werden sowohl mit Hilfe einer Online-Datenbank mit Expertisedaten zusammengestellt als auch durch die Nutzung »weicher« Kriterien wie Vertrauens- und Kompatibilitäts-Beziehungen zwischen Menschen, da dieses als einer der Hauptfaktoren für den Erfolg von Projektpartnerschaften ermittelt wurde. Hierfür entwickelte das Konsortium eine Methodologie und implementierte eine entsprechende Softwarelösung. Das Fraunhofer IGD entwickelte hierbei insbesondere Komponenten für die Online-Kooperation, die Zusammenstellung von Projektpartnerschaften sowie ein erweitertes Suchkonzept, mit dem Bewertungsdaten über Vertrauen in die Suchdatenbank zurückgeführt werden.

The system supports partners desiring to build learning cooperation from the attraction over the identification to the selection stage of the partner matching process. In order to extend state-of-the-art approaches of knowledge management platforms, the system is based on two different layers:

- The competence layer provides different means to search for partners possessing a certain skill set. Though being itself innovative in a variety of points, this layer will not be part of the following considerations.
- The compatibility and confidence layer extends the first layer by different mechanisms in order to provide a deeper insight into the candidates identified in the first layer. It is this layer that is going to be presented in detail in the following.

In order to provide the user with a deeper insight into candidates going beyond the standard representation of skills, the system makes use of two different mechanisms within the second layer:

- An online interaction component combining video-conferencing functionality with the possibility to conduct structured interviews,

- a social network analyzer permitting to browse one's own as well as the candidate's social environment.

The social network mechanism provides the user with information on past or present relationships between different partners within the system and therefore models historic trust. The mechanism can be seen as modeling standard CVs as relational constructs between an individual and the persons and organizations surrounding this individual (cf. Figure 1). For example, the user can specify relations between him and other individuals or institutions by means of relation types such as colleagueship, mentorship, and others. In addition to these relation types, the user can detail the duration and the intensity of each relation in terms of numerical values. The multi-relational network structure gained from this information is then visualized as an aggregation of the different values and assists the user in systematically browsing his own network or the network of the candidate taken into account.

The structure shown is the search result for a number of relevant people in the surroundings of the node »Max Mustermann« (white-on-black named node).



Figure 1:  
Screenshot of the  
social network  
browser

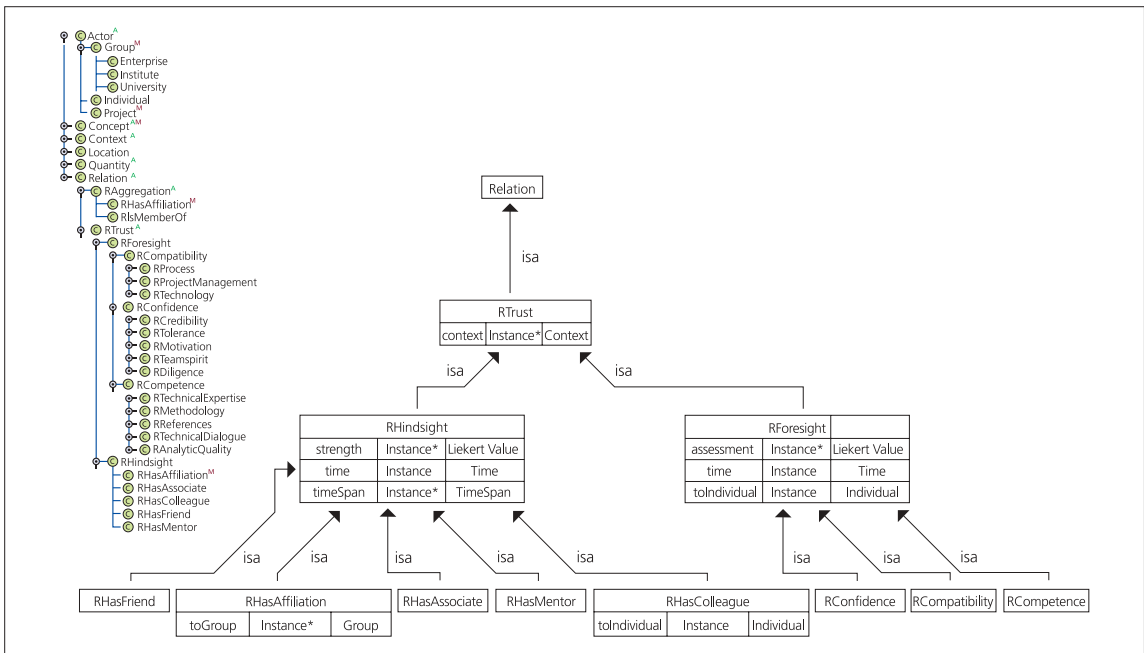


Figure 2: Left: Top-level structure of the trust ontology. Right: Excerpt for the Relation class subtree

The darker relations represent assessments, the lighter ones historic relations. The size of the unnamed nodes represent their reputation values, in named nodes (which are disclosed according to a privacy or other rule) a halo around the node represents reputation value.

In order to overcome the limitation of this network-based trust approach as presented above, we integrated an online interaction mechanism into the system. This module provides the user with the functionality to assess candidates that are not yet members of his direct or indirect personal network, thus considerably extending the set of potential candidates. The online assessment is based on real-time interaction with the candidate supported by a video-conferencing system. In parallel to the conference, the user is provided with a list of questions that address multiple elements of trust. The user can then score each of the candidates he is interacting with for each of the elements along these attributes. Among these, attributes can be found referring to the partners' compatibility addressed through questions on the management of the project considered, the choice of technologies to be used, and the design of the overall workflow. Other questions aim at measuring confidence through questions on the candidate's motivation, credibility, tolerance, and diligence. This trust ontology underlying the struc-

tured interview questionnaire was designed based on a scenario-based design approach in order to assure the attributes measured meet the necessities of real-life partnering projects.

Historic trust is understood as »hindsight« information on the social links of community members.

In conjunction with the »hindsight« on personal relations, we define the »foresight« component of our trust model as follows. Information on collaboration is complemented by other types of trust in order to obtain a richer set of cues to assess a candidate for collaboration and provide a view on the structure of the community. The resulting community model then forms a multi-relational social network that can be browsed (cf. Figure 1), searched, and used for prediction of new relations on the basis of existing constellations.

Both historic and swift trust of »hindsight« and »foresight« can be understood as multidimensional, weighted relations in the social network of the user community.

The social network can be modeled within the framework of ontology, in order to permit wide tool compatibility with existing and emergent Semantic Web and other knowledge management infrastructure.

More specifically, this network has been developed as an RDF Schema – Fig. 2 (left) gives an overview. In this schema, an Actor is a node in the

social network and represents any person (Individual) or group of persons. Groups as »aggregate actors« are modeled to represent educational, scientific, and commercial entities that are persistent over time and are distinguished from projects as temporal groupings of individuals and groups. Beside individuals proper, the concept of Role is defined as a template for an individual or group.

A Relation represents a weighted, directed edge in the social network. The topography of relations naturally forms the main source of information to detect trust and reputation within a community. Fig. 2 (right) shows an excerpt of the class tree of relations, which are modeled as RDF classes, as they provide richer modeling capabilities than RDF properties (the relations in the RDF data model).

**Points of contact**

Dr. Raffaele de Amicis  
 Dr.-Ing. Stefan Noll  
 GraphiTech, Italy  
 Email:  
 raffaele.de.amicis@graphitech.it  
 stefan.noll@graphitech.it

Martin Einhoff  
 Fraunhofer IGD Darmstadt, Germany  
 Email:  
 martin.einhoff@igd.fraunhofer.de

# VERBOSE – Voice Enabled Recognition Based On Semantic Expansion

Giuseppe Conti Ph.D., Dr. Raffaele De Amicis

## Introduction

Traditionally, interaction with Virtual Environments (VE) takes place by means of widgets or menus which force users to have rigid sequential interactions. Research has shown that the adoption of Speech Recognition (SR) allows the use of metaphors which are closer to human-to-human communications. However, SR implementation requires the developer to compile a knowledge repository where spoken utterances are related to relevant commands. This paper illustrates a semi-automatic process which generates the required body of knowledge from the information embedded within the VR/AR application source code.

## Speech Interactions within Virtual Environments

Interaction with Virtual Environment has traditionally relied on the use of a variety of 2D/3D GUI-based elements. These represent a legacy of traditional WIMP applications and do not exploit the full potential that VR applications can unleash. As shown by recent years' research, the process of interaction within VEs can greatly benefit from support of multimodal interactions [1]. In particular, the combination of intelligent speech recognition features and VR technology can let users directly access functionalities without being forced to use serial interaction metaphors as it is the case in menu-based interaction. This approach can benefit from the fact that speech and gestures share the same internal knowledge representation [2] which encodes both semantic and visual information. Further, speech-enabled interfaces resemble the way human beings communicate. It therefore better suits the users' natural capabilities of

using complementary conceptual channels [3] and thus increases the system's overall usability and efficiency.

However, to deliver an effective SR-based interface, developers have to supply the system with some form of human-compiled knowledge. This is necessary to transform each decoded spoken utterance into a defined command. This knowledge is usually compiled into grammars [4] where the developer defines the syntax and the nature of the spoken declarations which will be detected by the SR subsystem.

## The Tools Developed

The tools developed at GraphiTech deliver a semi-automatic process which generates the knowledge required by the SR subsystem directly from the information encoded within the application source code. Specifically the system developed, called VERBOSE (Voice-Enabled Recognition Based On Semantic Expansion), uses the semantic information embedded within the application source code to generate flexible grammars which are then used by the SR engine to comprehend the users' commands. The approach proposed is based upon the acknowledged practice according to which programmers tend to deliver self-explanatory clear code written in human readable form expressed in near-spoken language. This eases readability and becomes a key factor for future developments. However, this practice also embeds a wide range of semantic information as shown in the following, where two examples of pseudo-code are reported:

- 1) funcN123(int a, point3d b)
- 2) create\_circle (int radius, point3d center)

## German Abstract

Üblicherweise werden zur Interaktion mit Virtuellen Welten (Virtual Environments, VE) Widgets und Menüs verwendet, die jedoch den Benutzer zu fixen, sequentiellen Interaktionen zwingen. Die Forschung hat gezeigt, dass der Einsatz von Spracherkennung (Speech Recognition, SR) die Verwendung von Metaphern erlaubt, die eine nähere Verwandtschaft zur natürlichen Mensch-zu-Mensch-Kommunikation haben. Die Verwendung von SR zwingt den Entwickler, eine Wissensdatenbank anzulegen, in der gesprochene Schlüsselwörter mit relevanten Befehlen verknüpft werden. Dieser Artikel beschreibt einen semi-automatischen Prozess, der den notwendigen Wissenskörper aus den im Quellcode (der VR/AR Anwendung) enthaltenen Informationen erstellt.

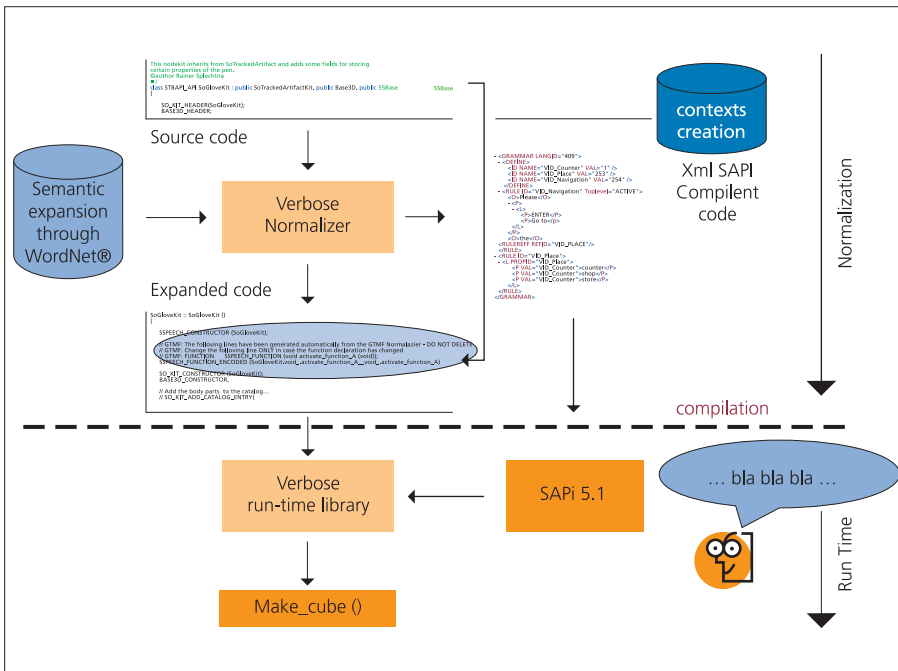


Figure 1: The two stages according to which VERBOSE operates

In fact, both commands deliver the same result (i.e. a circle is supposedly drawn on the screen), the second expression contains semantic information on the nature of the command which is not used by the system at a later time. VERBOSE uses this information to generate a body of knowledge which describes the functions performed by the code. The information is extracted from the source code through a tagging system based on C++ preprocessor macros which are used by the developer to identify functions to be speech-enabled. This repository is then semantically expanded and used to generate a number of grammars used by the SR subsystem to detect the corresponding spoken commands.

### System Architecture

As illustrated in Figure 1, the system comprises of two parts, the so-called Normalizer application and a C++ library. The Normalizer scans the source code looking for the information tagged by the developer with specific preprocessor macros. The extracted data is afterwards arranged

in contexts, which represent different information domains, and the structure of which reflects the classes' structure. Through a process of semantic expansion, the concepts defined within each context are extended to include a wider set of semantically analogous commands. This information is then used to create the relevant grammars responsible for the configuration of the SR engine. These grammars provide a flexible structure capable of responding to different scenarios yet retaining the precision and accuracy typical of grammar-based speech recognition systems [5].

Finally, the application replaces the tagged commands within the source code with more suitable data structures which provide the SR functionality at runtime, and it is finally compiled. As illustrated in Figure 1, this data structure is used by the runtime library to automatically provide flexible speech recognition and Text-To-Speech (TTS) functionalities necessary to interface the user with the application.

### Conclusions and Further Developments

This paper represents a first attempt to use the vast amount of information included within the source code to create a body of knowledge which can be used by the system to improve its comprehension of the user's interaction process. This paper shows a self-configurable system which adapts its understanding of the user's spoken commands according to the content and to the semantic information defined within the application's source code. The system presented eliminates the problem of compiling flexible interfaces for VR systems capable of responding to a range of the user's commands. This is done by exploiting the information contained within specific sections of VR/AR systems which are devoted to the user interaction.

### References

- [1] Oviatt S, Cohen P (2000) Multi-modal Interfaces that process what comes naturally. *Communications of the ACM*, 43(3):45-54.
- [2] McNeill D (1992) *Hand and Mind: What Gestures Reveal about Thought*. Chicago: University of Chicago Press.
- [3] Forbus K D, Ferguson R W, Usher J M (2001) *Towards a Computational Model of Sketching*. In *Proceedings of the 6th international conference on Intelligent user interfaces*. New York: ACM Press.
- [4] Microsoft Speech Technology: <http://www.microsoft.com/speech/>
- [5] Latoschik M E (2001) *A gesture processing framework for multi-modal interaction in virtual reality*. In: *Proc. of the 1st international conference on Computer graphics, virtual reality and visualization*. New York: ACM Press.

### Points of contact

Dr. Raffaele de Amicis  
 Dr.-Ing. Stefan Noll  
 GraphiTech, Italy  
 Email:  
 raffaele.de.amicis@graphitech.it  
 stefan.noll@graphitech.it

Christian Rühl, Frank Morbitzer

Communication is the most important key to successful cooperation within and between organizations. While »classic« communication media such as mail, telephone, fax, and electronic mail are still dominating today's communication behavior, audio-visual communication systems are gaining increasing attraction. These systems promise a more natural communication style even between geographically dislocated people that would otherwise only be possible with much more effort and significantly higher costs.

The technological improvements on the level of computer networks, in particular the Internet as interconnecting communication network, result in higher bandwidth and increased reliability while costs of investment and costs of ownership are decreasing. This development promotes the trend towards an audio-visual communication society.

Although a variety of different audio-visual communication systems already exists, it is striking that the abilities of today's computers and network infrastructures are not nearly utilized. Furthermore, available audio-visual communication solutions do not meet the requirements imposed by larger organizations. In particular, the integration of those systems into existing corporate networks, and the protection of the communication under aspects of security are usually insufficient and leave companies with much to beg for. The very few solutions, which stand out in a positive manner here, are heavily based on specialized hardware components and very expensive – too expensive to be installed by small and medium organizations with only a moderate communication effort.

## **Inexpensive Desktop Solution**

communitrust is an inexpensive, software-based communication system that can easily be installed on any Microsoft Windows®-based computer system. It delivers features that have been reserved to costly hardware-based communication solutions at a price that is just a fraction of the price of those solutions. It even outperforms those solutions under aspects of security, audio quality, video quality, and firewall compliance.

## **High-Quality Audio and Video**

communitrust allows MS Windows® users all over the world to communicate in excellent audio and video quality via Internet. One of communitrust's strengths is the ability to deliver unmatched audio/video quality via conventional ISDN and DSL connections: Good image quality in resolutions of 352x288 at 15 frames are already achieved at just 128 kBit/s, while superior high definition quality is achieved at about 700 kBit/s. Thus, communitrust starts where other currently available videoconferencing tools reach their limit. If quality is not of primary concern, smooth communication via 56k modems is possible, too. If used as pure VoIP tool, communitrust is able to also deliver 44 kHz-sampled audio on 28.8k modems. Resolution and frame rates are only limited by the available hardware and network bandwidth.

## **Secure Communication**

communitrust is probably the most secure IP-based communication solution available today, providing true end-to-end-security without the need for dedicated encryption servers, extending the security even to WLAN networks. All control and data streams exchanged between communication

---

## German Abstract

Effektive und effiziente Kommunikation stellt den wichtigsten Baustein zur Realisierung erfolgreicher Zusammenarbeit innerhalb und zwischen Unternehmen dar. Die stetigen Fortentwicklungen auf Ebene der Netzwerke, insbesondere die erhöhten Verbindungsgeschwindigkeiten, die hohe Zuverlässigkeit und die mittlerweile niedrigen Einführungspreise, begünstigen die Entwicklung zur audio-visuellen Kommunikationsgesellschaft. Mit seinen geringen Anschaffungs- und Betriebskosten ist communitrust eine kostengünstige Alternative zu teuren hardware-basierten Kommunikationssystemen. Diese software-basierte Kommunikationslösung überträgt Audio und Video in einer Qualität, die bislang nur wesentlich teureren Kommunikationssystemen vorbehalten war. communitrust kann mühelos in private, durch Firewall und Router geschützte Netzwerke integriert werden. Außerdem ermöglicht communitrust die sichere Übertragung der Kommunikationsdaten durch ein mehrschichtiges Sicherheitskonzept.



Figure 1:  
Video conference  
with communitrust

endpoints are always encrypted using a strong but low footprint cipher. Another cryptosystem makes it possible to assert authenticity of transmitted streams, hence preventing impersonation attacks and unauthorized recording of encrypted data for later offline (brute-force) decryption.

#### **Firewall Compliance**

communitrust is firewall-compliant and provides several distinct mechanisms to traverse local firewalls and enable clients surrounded by a firewall to receive calls, including Port Forwarding, HTTPS Tunneling, and proxy-based traversal. These mechanisms are suitable for personal firewalls, router-based firewalls, and full enterprise firewalls, which includes cascaded firewalls as well. With the proxy server that has been specifically developed for communitrust, a scalable solution for secure, policy-based traversal of enterprise firewalls is already available and has been successfully employed in a variety of very different firewall environments.

#### **Adaptability**

communitrust consequently relies on plug-ins, which can be used in order to add new functionality to or update existing functionality of a communitrust installation. A client is automatically informed of new and updated

plug-ins, which are then downloaded on demand from a vendor's Internet repositories. Plug-ins available for communitrust enable application sharing, shared whiteboards, digital document signing, and exchange.

#### **Location Independency**

communitrust is location-independent, i.e. a client can use his or her account from any computer in the world, provided that this computer has communitrust installed on it. The video messages that have been sent to a communitrust user during his/her absence can be viewed by that user by means of a web interface.

#### **Points of contact**

Dr. Raffaele de Amicis  
Dr.-Ing. Stefan Noll  
GraphiTech, Italy  
Email:  
raffaele.de.amicis@graphitech.it  
stefan.noll@graphitech.it

Martin Einhoff  
Fraunhofer IGD Darmstadt, Germany  
Email:  
martin.einhoff@igd.fraunhofer.de  
Url: <http://www.communitrust.com/>

# ELIN – The Electronic Newspaper Initiative

Martin Witzel, Martin Einhoff, Giuliana Ucelli Ph.D.

The ELIN project is a research project sponsored by the European Union. It focuses on the improvement of current electronic newspapers by introducing interactive features, advanced personalization, and ubiquity of use. Smart agents are embedded into the process of creation and consumption. The system eases the integration of news, interactive media content, and advertisements to improve the productivity in the publishing chain. It encourages the use of standards for multimedia data transfer, presentation, and management (MPEG-4/7/21). The ELIN system architecture mainly consists of 3 parts:

## ELIN Server (Provider components)

The server is made up of the following five main parts: Content storage system, publishing manager, smart agent, media server, and community environment. The content storage system hosts an XML database for storage of the MPEG-21 Digital Items. Digital Items are of two kinds: Content Digital Items contain news

events and advertisements, which can be picture or videos of companies that want to present their products. Context Digital Items contain user/network and users' devices capabilities of the current session. All Media Resources are stored in the separate Content Storage File System.

## ELIN client for authoring (Publisher components)

The ELIN client for the authoring of content contains all the tools required by the publisher for the creation and management of the news and advertisements in ELIN. The Authoring Tools are a group of different applications covering different aspects of content creation. Tools in the area of MPEG-4/7/21 have also been developed. For each news event and advertisement, all related news/ads meta-information describing the news message are stored within MPEG-21 Digital Items. The media items contain information about the actual media in MPEG-7 format and reference the media resources.

## German Abstract

Das ELIN Projekt zielt auf die Verbesserung aktueller elektronischer Zeitungen ab. ELIN unterstützt das Erzeugen, Publizieren und Visualisieren von personalisierten und interaktiven Multimedia Inhalten für Media-Unternehmen und deren Kunden. Leser aus aller Welt werden zu 3-D-Personen und erfahren gemeinsam Informationen in einem 3-D-Kontext. Sie tauchen ein in eine Virtual-Reality-Welt mit diversen Nachrichten- und Informationspunkten. Unternehmen stellen ihre Produkte und Dienstleistungen innerhalb einer 3-D-Welt mittels neuester Audio-/Video-Streaming-Technologien vor.

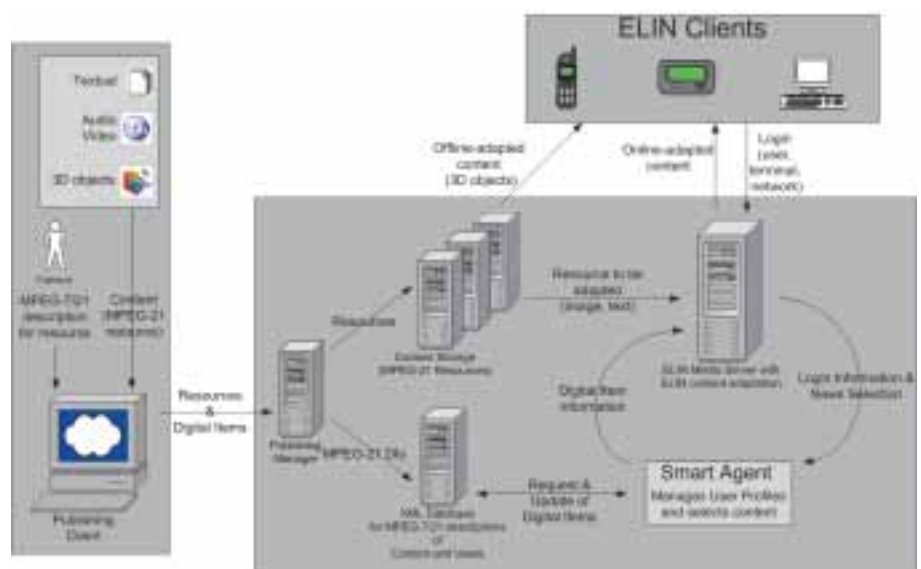


Figure 1: ELIN Scenario



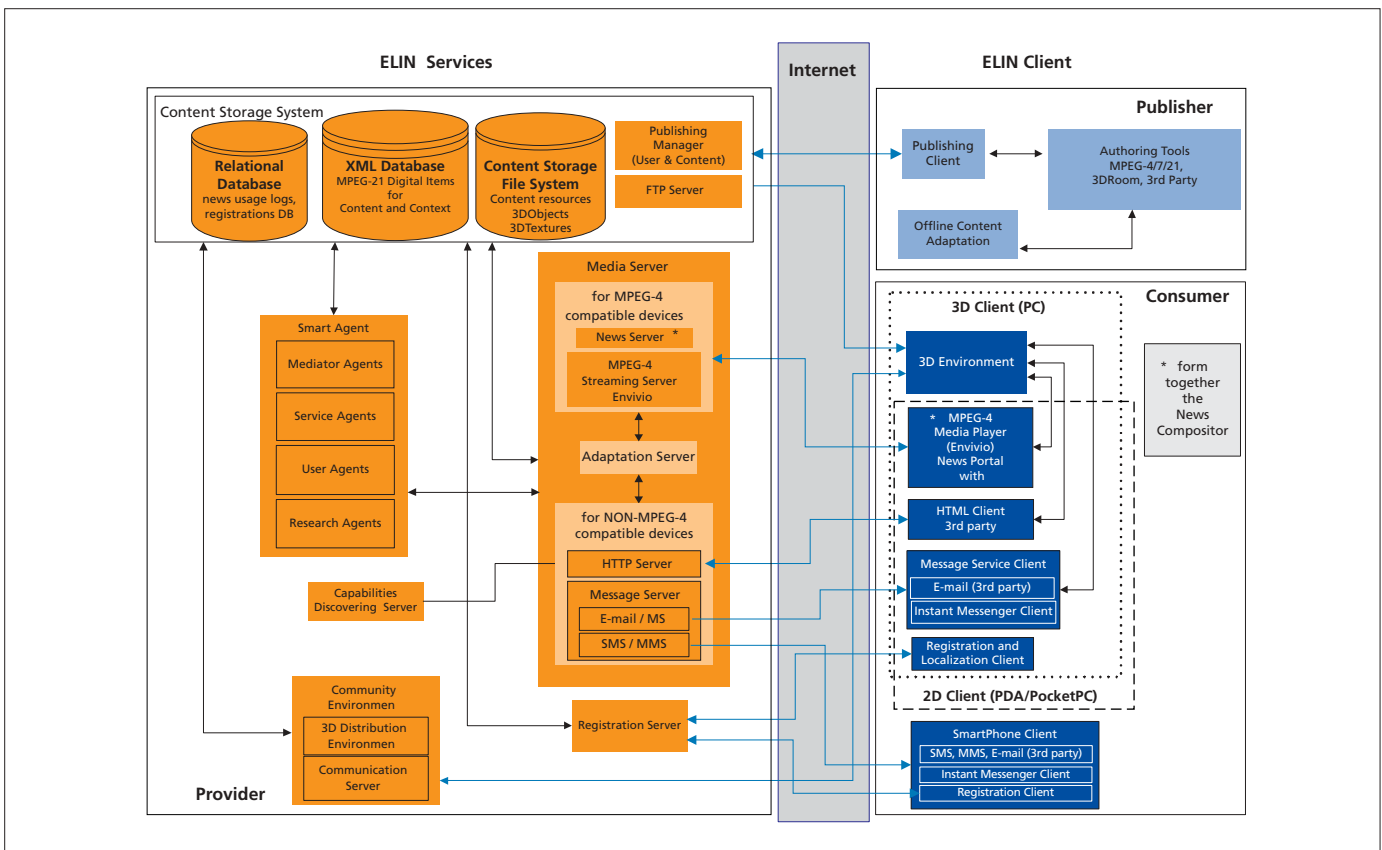


Figure 2: ELIN Architecture

### ELIN client for end users (Consumer components)

The ELIN client for end users consists of components necessary to display the various contents on different platforms like PC, PDA, and Smart Phone. The 3D client developed by Fraunhofer IGD covers the representation of the different users participating in the 3D world. The users have the possibility to interact with the environment and its content via an easy to use user interface. The environment offers integrated audio/video communication technologies in order to extend the 3D environment to a community environment. For the display of standard text, audio, image, and video, various components have been integrated like an HTML client, an MPEG-4 Media Player, and a Message Server-Client. As an alternative, ELIN provides special clients for supporting devices like low power desktop PCs, Pocket PCs, and PDA. The system offers the same functionalities as the 3D client for these devices except for the 3D interface.

### Publishing manager

Graphitech's contribution to the ELIN project was the development of the publishing client and manager, which enable the newspaper publisher to publish news items (audio, visual, textual, 3D objects) and to retrieve news from the ELIN server. The publishing client offers an easy to use interface for uploading, downloading, updating, and deletion of News/Ads Digital Items. Advanced search functionality has been implemented to allow the retrieval of MPEG-21 news, MPEG-7 media items, and to ease access to the linked media resources. Special attention was paid to keep data consistency in the XML database. The validity of the database links and the resource references are also automatically checked and kept updated by the system. In order to make the communication more efficient, each News Item is compressed into an archive with its related media resources before the transmission. On the publishing server side, the files are extracted from the archive; they are sorted and finally stored in the XML database or in the content storage system according to their specific types (News/Ads/Media DI/Resource).

### Other Project Partners

- ALAMO On-Line S.A., Spain
- Diari Segre S.L., Spain
- Universitat Politecnica de Catalunya, Spain
- Linkopings University, Sweden
- Oestgoeta Correspondenten AB, Sweden
- Forschungszentrum Informatik, Germany
- INRIA-LORIA, France

### Points of contact

Dr. Raffaele de Amicis  
 Dr.-Ing. Stefan Noll  
 GraphiTech, Italy  
 Email:  
[raffaele.de.amicis@graphitech.it](mailto:raffaele.de.amicis@graphitech.it)  
[stefan.noll@graphitech.it](mailto:stefan.noll@graphitech.it)

Martin Einhoff  
 Fraunhofer IGD Darmstadt, Germany  
 Email:  
[martin.einhoff@igd.fraunhofer.de](mailto:martin.einhoff@igd.fraunhofer.de)



## Ideas make entrepreneurs

### BusinessplanAward 2004 of the INI-GraphicsNet Foundation – Prizes worth 50,000 euros awarded for clever ideas and entrepreneurial spirit

The talking pen as an appointment calendar, the singing eggcup for a cheerful breakfast, shoes that can resole themselves – seemingly absurd but innovative ideas often have more potential than it would appear at first glance, so they deserve a genuine chance to prove themselves on the market. And there are plenty of ideas out there. Darmstadt and the Starkenburg region in particular are leading centers of innovation in Germany.

Support is often needed in order for innovative ideas to become a reality, however. The more professional the assistance from experienced experts and the more extensive the training and consulting offers for potential entrepreneurs, the easier it is to take the step towards founding a company. Before this can happen, though, the ideas have to reach people who are willing to financially support the courage and drive of potential entrepreneurs. A platform for such an exchange will be offered on October 7 and 10, 2004 with the Businessplan Award 2004 of the INI-GraphicsNet, which will be presented in cooperation with the Arbeitskreis Gründungsberatung Region Starkenburg, a working group for entrepreneurial consulting.

This is first time that the INI-GraphicsNet Foundation has aimed this award at the public. »By doing this, we want the general public to become aware of these innovations, and we also want potential investors to participate without having to commit themselves to a concrete project beforehand,« explained Wolfgang

Kniejski, the commercial managing director of the Foundation. The competition is part of a series of events in Darmstadt for the »Year of Technology« of the German federal ministry of education and research, which is being initiated and carried out by the IHK Darmstadt. At the business plan presentation on October 7, up to ten of the competition applicants will have the opportunity to present their ideas to a wide audience. The jurors are not expecting finished business plans, but rather short, concise and practical presentations. Each of the candidates has only around 20 minutes to present their idea, its market potential, the entrepreneurial team, the financing plan and the plan for founding a company. »It seems like a short amount of time, but it's usually enough to point out the core and the primary components of the business idea,« Kniejski said.

»But the ideas have to convince the public as well as the jury.« The experienced incubator believes this is what makes this event special, because under normal circumstances, the idea people who are looking for money and the venture capitalists come together in closed meetings. After the presentations and a buffet, the Matching Area will open. This is where the people with the ideas and the potential venture capitalists will meet in order to discuss possible joint activities.

### Efficient prizes

On October 10, 2004, the applicants will find out who did the best job of convincing the jury and the public. In the context of a public podium discussion on the future of Germany as a center of technology, minister of research Edelgard Bulmahn and chairman of the INI-GraphicsNet Foundation Prof. Dr. José. L. Encarnação will present certificates to the winners.

In addition to the certificates, the best ideas will also be rewarded with attractive prizes which should provide efficient support for the establishment of a company. There will be monetary awards worth a total of 10,000 euros. The winners will also receive gift certificates for high-quality, non-monetary prizes. »We want to

support the process of establishing a company in a content- and concept-related way in order to prevent early management errors,« Kniejski said, explaining the approach. The prizes are therefore well-balanced, ranging from the provision of free offices, through the arrangement of required insurance policies, to support in creating a business plan and communication consultation.

### Experienced incubator

The INI-GraphicsNet Foundation has many years of experience in identifying and exploiting research results in the area of information and communication technologies. In the past two years, the Foundation has connected a number of companies with venture capitalists through these events with investors and experts. The Foundation has also successfully supported the establishment of numerous spin-offs from the INI-GraphicsNet research network, the world's largest international network for research and development in the area of computer graphics.

Details on the program and additional information on the award can be found on the Internet at: [http://www.inigraphicsnet-stiftung.de/bp\\_award/](http://www.inigraphicsnet-stiftung.de/bp_award/)

Information can also be requested from the:

INI-GraphicsNet Foundation  
Keyword Innovation Competition  
Mr. Thorsten Stürmer or  
Ms. Elke Jäger  
Fraunhoferstrasse 5  
64283 Darmstadt, Germany  
Email: [bpaward@inigraphics.net](mailto:bpaward@inigraphics.net)

## News at NEMETech

The Institute for NEWMEDIA Technology (NEMETech) was jointly established by the INI-GraphicsNET Foundation and the Ewha Womans University in 1999. Since then, this partnership and co-operation have been successfully exercised through technical projects and exchange of researchers and students.

Recently, NEMETech has been assigned by its founding partners and the Fraunhofer Institute for Computer Graphics as the R&D Center responsible for the realization of strategic R&D as established by a major agreement between these institutions and Korean government agencies, namely the Korea Ministry of Information and Communication (MIC), and the Korea Institute of Information Technology Assessment (IITA).

This agreement – in full, »International Joint Research Agreement« – has its basis on the Korean government program to foster international co-operation for the development of cutting-edge ICT in Korea, and thus to achieve leading positions in the global market and innovation front.

On May 17, 2004, a public event was held at Ewha Womans University for the signing of this agreement and inauguration of NEMETech's new premises. For the respective ceremonies, NEMETech was much honored with the presence and encouraging words of the chief officials of the involved institutions and agencies – in particular the Korean Information and Communication Minister, the President of the Ewha Womans University, and the Director of Fraunhofer IGD and Chairman of the INI-GraphicsNet –, and with those from the German Ambassador for Korea. Similar appreciation was also held due to the attendance of several representative authorities from the local industry and research community, and the attendance and support from several colleagues of the INI-GraphicsNet.



Unveiling of the commemorative plaque at the new premises



Signing of the Joint Research Agreement

On assuming such role and new technological orientations, NEMETech is in the legal process of being incorporated as »Institute for Graphic Interfaces« – IGI. This will focus its technological competencies on two major topics from the Information & Communication Technology area: Intelligent Manufacturing and Information Assurance.

### City tour: Always well-informed

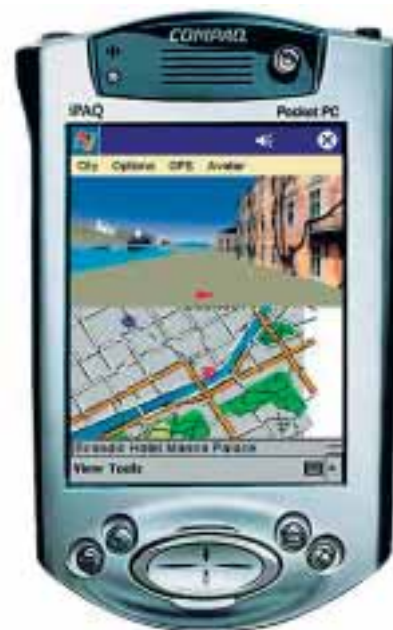
**Fraunhofer IGD demonstrates mobile multimedia systems for leisure and business at INTERGEO – The motto: If you can carry it, it's mobile**

In the future, a mobile phone with multimedia functionality will be all that is needed for people to quickly and intuitively find out about sights of interest in unfamiliar cities, to maintain their orientation and to easily create individualized tours to interesting landmarks, parks or exhibitions. Looking for a suitable hotel, a restaurant with local specialties, or the nearest pharmacy will only be child's play. Tourists will no longer be frustrated by bulky guidebooks, out-of-date maps or stacks of brochures for various events, thanks to the new mobile, location-based services developed by the Fraunhofer Institute for Computer Graphics IGD. These services include interactive city maps with navigational functions, panorama images, audiovisual presentations, guided tours, and other information in the form of videos, graphics or text which can be displayed on mobile telephones or so-called smart phones. »We enable visitors to access a combined tourist and commercial information service which is oriented on their location at the time, their individual interests and the functionality of their mobile phone. The information is presented in a multimedia form, and anyone can access it easily and intuitively,« explained Daniel Holweg, head of the Department of Graphic Information Systems at the Fraunhofer IGD in Darmstadt. At the world's largest congress and trade fair for geodesy, geo-information and land management INTERGEO 2004 in Stuttgart, the research group will be demonstrating in hall 5, booth 434, as a co-

exhibitor at the GISTec GmbH stand, these and other intelligent mobile services for tourism, businesses and public institutions.

Take Darmstadt as an example: A visitor uses his mobile phone to log on to the online audiovisual information system, and soon he receives a section of a map of the city oriented on his current position. If he's interested in art, architecture or history, then the digital guide will point out the nearby palace and the state museum of Hesse as destinations which might interest him. Afterwards, he could make a short excursion to the Mathildenhöhe artists' colony in order to view the Fünffingerturm (»five-finger tower«), other noteworthy art nouveau buildings, or the current exhibitions in the museums there. The intelligent, network-based service, which can be optionally equipped with a digital compass and GPS (Global Positioning System) guides the guest effortlessly to his first destination, the palace. After the information system has told him about noteworthy parts of the building, opening hours and guided tours, he can orient himself with the help of a floor plan and active panorama images. 3D visualizations show what the imposing building looked like in past centuries. If the tourist wants to take a break after viewing the palace, the service will tell him about various restaurants and cafes, parks and small squares in the vicinity. Later on, he can continue his individualized tour or take another pre-defined tour and can retrieve additional cultural, tourist or commercial information by mobile phone.

The modularly designed system is based on a multimedia LBS, or location-based service, which is linked to a multimedia management system. All the information is stored on a server, and a specific filter component makes it possible for tourists to access it individually. The data is transferred via UMTS or GPRS. Researchers at the Fraunhofer IGD put their wide-ranging project experience into practice in order to realize these sophisticated technologies for mobile end devices, which address the interests and needs of many users. Selected visitors to the Olympic



Mobile TellMarisGuide on an HP iPAQ

games in Athens will be able to use a multimedia information system which was developed in the context of the LoVEUS (Location-aware Visually Enhanced Ubiquitous Services) project of the EU in cooperation with the IGD.

### Mobile assistants for city, country and sea

At INTERGEO, the Darmstadt-based scientists will present another innovative information system for mobile end devices which they realized in partnership with an international research consortium for yachting tourists on the Baltic Sea. This development will also benefit the professionals among the city explorers who use high-tech devices. Unlike the service mentioned above, users can access the multimedia data on the 3D geo-data server using a PDA (Personal Digital Assistant). In the planning phase before a boat trip, and even during the trip itself, it is necessary to have current data on weather, water depths and shipping lanes. But the digital compass, GPS and interactive 3D maps on the PDA can also support visitors in unfamiliar cities. Visitors can easily orient themselves, find out about noteworthy sights and events in detail, and have

the shortest route to their next destination displayed as a virtual walk through the 3D scenery of the city. Another special feature of the system is that tourists can plan sailing routes and virtually explore terrain and cities from home.

### SketchQuery – A sketch is enough

Darmstadt again: How can a visitor with no knowledge of the city get from the train station to the Mathildenhöhe? That's easy, he simply sketches the outline of the Fünffingerturm on the display of his PDA or mobile phone, and the new SketchQuery system will show him the section of the map with the location of the famous art nouveau building – including a description of the way to get there, the address, opening hours and much more. Users can thus initiate a search intuitively with a little sketch or a symbol. From landmarks to parks to the city library, all spatially related information in a city can be retrieved with the greatest of ease.

With SketchQuery, amateurs and experts can access the spatially oriented information that they need at any given time. The system combines context models, ontologies and mapping procedures in a new and innovative way.

Detailed information on the mobile multimedia systems can be found at the following URL:

<http://www.igd.fraunhofer.de/igd-a5/index.html/>

INTERGEO 2004  
October 13-15, 2004  
Trade Fair Stuttgart  
Congress Center Killesberg  
Hall E5, Booth 434  
<http://www.intergeo.de/>

### Contact

Dipl.-Ing. Daniel Holweg  
Fraunhofer IGD Darmstadt, Germany  
Email:  
[daniel.holweg@igd.fraunhofer.de](mailto:daniel.holweg@igd.fraunhofer.de)

## Events *Workshops*

### VICOMTech celebrates its 3rd anniversary receiving the ISO 9001:2000 certification

On April 2, 2001, VICOMTech initiated its activities as a research center in Computer Graphics and Multimedia. The commitment to excellence in all aspects of research has led VICOMTech to apply quality procedures in the daily work. As a result, VICOMTech has been given the ISO 9001:2000 certification. On June 24, a special act to celebrate VICOMTech's 3rd anniversary and the receipt of the ISO 9001:2000 certificate was held at the Miramon Technology Park, where VICOMTech's facilities are located. The delegate of AENOR (Spanish Association of Normalization and Certification), Luz Emparanza, officially handed the ISO 9001:2000 diploma over to Dr. Julián Flórez, General Director of VICOMTech.

Many distinguished guests attended this important act, for instance, the Basque Minister of Industry, Ana Aguirre; the Director of Innovation of the Gipuzkoa Government, Angel Irastorza; the former Deputy of Economy and current Congressman Jose R. Beloki, and the Director of the Technology Park, Joaquin Tellería, who have been supporting VICOMTech since the first stages. The directors of the institutions who founded VICOMTech, Andoni Ortuzar from EITB and Wolfgang Kniejski from the INI-GraphicsNet, were also present.



Celebration of the 3 years of VICOMTech and the ISO 9001:2000 certification. From left to right: Julián Flórez, VICOMTech's General Director; Luz Emparanza, AENOR Certification agency; Wolfgang Kniejski, Financial Maganer INI-GraphicsNet; Andoni Ortúzar, General Director EITB; Ana Agirre, Basque Minister of Industry; José R. Beloki, Congressman by EHU/PNV at Spanish Congress; and Angel Irastorza, Deputation of Gipuzkoa



## Researchers and Students at INI-GraphicsNet

Due to its international nature, the INI-GraphicsNet is obliged to a long tradition of exchanging researchers and students. Visitors in research and academia from all over the world have been hosted in INI-GraphicsNet institutes, which are adjoined to local universities and participate in university research, teaching and life. The Portuguese Centro de Computação Gráfica (CCG) is related to the University of Minho, CAMTech in Singapore to the Nanyang Technological University (NTU) and imedia, The ICPNM Academy in the US to RISD, the Rhode Island School of Design. The German institutes are adjoined to the Universität Rostock and the Technische Universität Darmstadt. Recently several new institutes joined the INI-GraphicsNet. VICOMTech in San Sebastian/Spain, NEMETech in Seoul/Korea and GraphiTech in Trento/Italy. And of course not to forget the new partnerships with the affiliated universities. These are the Universidad del País Vasco Euskal Herriko Unibertsitatea (University of the Basque Country), the Ewha Womans University in Korea and Università degli Studi di Trento in Italy. Student exchange programs between IGD and imedia in Providence or CAMTech in Singapore directly support the exchange of students between these institutes. This way it's very easy and much less bureaucratic for students to get financial support. But of course there are other possibilities to get funding for exchanges where non of these internal exchange programs apply. Several hints on how to find these scholarships can be found on the studINI Web Site (<http://www.inigraphics.net/students/studini/index.html>).

Of course the student exchange appointee will assist you too, if you have further questions. Another good starting point for a search for scholarships is <http://www.daad.de/>.

Marie Curie Fellowships for example provide European placements for pre and post-doctoral researchers, usually up to the age of 35, and for experienced researchers. Last December the first calls for proposals under the 6th framework have been published. Individuals may have a look at [http://europa.eu.int/comm/research/fp6/mariecurie-actions/action/fellow\\_en.html](http://europa.eu.int/comm/research/fp6/mariecurie-actions/action/fellow_en.html) to find the actual proposals and the deadlines for applications. A good place to start searching for Marie Curie Actions is the new website <http://mc-opportunities.cordis.lu>.

While Marie Curie Fellowships are targeting experienced researchers, there are other funding opportunities for internships. The Leonardo Da Vinci program for example supports exchanges for internships within Europe. Due to the increased number of INI-GraphicsNet institutions within the European community, this program seems to be very promising.

Don't hesitate to contact [studini@igd.fraunhofer.de](mailto:studini@igd.fraunhofer.de) for information and for assistance with the application.

Additionally there are some new calls for application for PPP projects, programs for the exchange of persons in predefined projects. These programs are offered by the DAAD and are available for a special exchange country and typically a German project partner. More information on that subject you can find at (<http://www-zv.upb.de/~eb/neu%20eu%20web/ppp.htm>) (in German).

## Contact

Student Exchange Appointee  
c/o Dr. Jürgen Schönhut  
Fraunhofer Institute for  
Computer Graphics  
Fraunhoferstrasse 5  
64285 Darmstadt  
Phone: +49 (0) 6151/155-228  
Email: [studini@igd.fraunhofer.de](mailto:studini@igd.fraunhofer.de)  
[www.inigraphics.net/students/studini](http://www.inigraphics.net/students/studini)



## ALUMNI

Addressing former staff members of INI-GraphicsNet:

## The INI-Graphics-Alumni Forum

is a meeting-place and pool for former staff members of the INI-GraphicsNet. If you wish to become a fellow member please contact:

Computer Graphics Center  
Herbert Kuhlmann  
Fraunhoferstrasse 5  
64283 Darmstadt  
Germany  
Phone: +49 (6151) 155-120  
Fax: +49 (6151) 155-450  
Email: [herbert.kuhlmann@zgdv.de](mailto:herbert.kuhlmann@zgdv.de)  
URL: [www.alumni.zgdv.de](http://www.alumni.zgdv.de)



**Dr.-Ing. Uli Bockholt**  
**»Computer-assisted Therapy  
Planning in consideration of  
patient specific Biomechanics«**

February 16, 2004

Supervisors: Prof. Dr. José. L. Encarnação,  
Prof. Dr. G. Sakas

Computer-assisted methods have emerged in medical diagnosis and therapy planning. Thereby the planning often relies on a 3D model of the anatomical structures reconstructed from medical image data (CT, MRT, US). Within this dissertation the diagnostic possibilities are enhanced by combining the model generation of with a simulation of the patient specific biomechanics. Not only image data also biomechanical parameters are considered in the simulation. The pathologic function can be analyzed within the simulation, this analysis is combined with a description of the planned intervention and it results in a prediction of the therapy outcome and the change of functionality caused by the planned intervention. Using this approach different biomechanical phenomena have been examined in different medical application fields: Static analyses have been performed to specify an optimal prosthesis for the implantation of an artificial knee joint, a simulation of the patient specific jaw movement helps to detect occlusions and to verify the design of onlays and crowns in dental diagnostics. Stress-strain simulation is applied in spine surgery and flow simulation has been used in ENT medicine to analyze the patient-specific air flow in the nose. For the presented approaches not only the diagnostic method is presented also an evaluation strategy is outlined that can be applied to proof the significance of the simulation. The presented work results in an approach registering biomedical



Dr.-Ing. Uli Bockholt celebrates his graduation

parameters in real-time and considering these parameters in a Virtual Reality based method for whiplash therapy.

**Dr.-Ing. Jörg Sahn**  
**»Collaborative visualization of  
large, interactive, and dynamic  
3D scenes on distributed  
heterogeneous devices«**

June 25, 2004

Supervisors: Prof. Dr. José. L. Encarnação,  
Prof. Dr. R. Klein

Due to advancements in 3D visualization as a consequence of more powerful hardware and the increasing availability of networks with high transmission rates, distributed 3D graphics has become more and more interesting for a wide field of industrial activities. Consequently, applications such as virtual environments, product presentations, CAVE visualizations, 3D simulations, or 3D online-games are important factors of industrial economy. Unfortunately, most of these techniques have their drawbacks: Virtual environments typically lack the graphics quality and detail, product presentations concentrate on very simple 3D scenes with only a few elements, CAVE visualizations require very expensive hardware, and 3D simulations and 3D online-games do not make use of the transmission of graphical information. Although most of these applications provide level of detail (LOD) concepts, they do not support an efficient and exact adap-



Dr.-Ing. Jörg Sahn celebrates his graduation

tation of the data effort and the data itself to the capabilities of the devices and networks. For that reason, mobile devices such as laptops or palmtops are still not considered by many software systems. In almost the same manner, it is unsatisfying, if the capabilities of the user's personal computer or workstation are not exploited.

In order to adapt the data to capabilities such as memory size, computing power, graphics support, and bandwidth, two basic approaches can be identified: The first approach is to select only small parts of the scenes for transmission and visualization, which are currently in the user's interest. The second approach is to reduce the data effort by modifying the elements of a scene, for example with the help of multi-resolution techniques.

In this thesis, a new dynamic 3D scene presentation is introduced in order to transmit the visual information from a server to a client. The scene representation provides memory-efficient data management and includes a progressive data format, which is generated by a progressive simplification algorithm. This algorithm separates the information of a scene element into several streams according to the element's data types. It is therefore possible to precisely adapt the data effort to the clients' capabilities. Because the presented system does not make use of server-based image rendering and video streaming, the server does not have to be graphics-enabled and can be represented by a standard personal computer.

**»Integration of multivariate data visualization of speed values into a visualization system«**

*Bachelor thesis by: Markus Kneissl  
Supervisor: Sascha Schneider*

This bachelor thesis deals with the integration of a transparency regulator into the visualization system HereVR®. On this basis, it is described how all visualization methods present in the system are customized to this new regulator. In addition, the development and realization of a new visualization method is defined, which is called »3D-ISO-Vector-Surface«, for the presentation of vector data as a scalar array. The transparency regulator allows the viewer to present data visualization transparently and therefore allows a better analysis of the data. The visualization method »3D-ISO-Vector-Surface« shows vectors of the same length. The viewer can thus identify, where within a space forces act with a specific force. The technologies used in this thesis are based on OpenGL, Coin3D, and QT. The approach and the realization of a solution are illustrated methodically in further chapters. All explanations are completed by examples, diagrams, and screenshots. Finally, the results are presented, which are achieved with the extensions addressed in this bachelor thesis.

**»Integrating the 3D application Blender as authoring and run-time integration in the Digital Storytelling platform of the ZGDV«**

*Diploma thesis by: Florian Schaar  
Supervisors: Volkmar Richter (Hochschule Anhalt), Oliver Schneider*

The Computer Graphics Center in Darmstadt (ZGDV) is currently working on a system that will allow authors to develop interactive, nonlinear stories. This Authoring Environment will help the authors, who are not aware of the complex technical relationship, to write such stories.

The Authoring Environment consists of different modules: The Story-Engine, the Scene-Engine and a representation module, the Renderer. The story itself consists of several scenes, which are selected by

the Story-Engine, a special search algorithm. The basis of the Story-Engine are defined contexts which change throughout the story. If a scene is selected and the final condition of the story is examined, the selected scene is passed on to the Scene-Engine and executed there. The Scene-Engine uses a scene script and conveys instructions to the Renderer as to what will be displayed. The Authoring Environment will make it possible for authors to create such scene scripts in a simple manner and to provide contexts for the Story-Engine.

This thesis discusses ways for communication between the Story-Engine and the Scene-Engine, considering as example the GHOST project, developed at the ZGDV. In addition, the 3D application Blender will be used as renderer. Blender contains a real-time environment and is therefore suitable to display interactive 3D contents. The development of a VRML Importer for the wide-spread 3D format VRML is also described in this context, as well as the communication between Story-Engine and Blender considering as example the EDUTECH demonstrator. The concept part discusses still existing weaknesses within the system, mainly within the Story-Engine. Solutions are discussed to eliminate the known problems.

**»Augmenting Reality – conception, design, and prototypical realization of an exhibit«**

*Diploma thesis by: Jörg Schindler  
Supervisors: Bernd Lutz, Prof. Dr. Ulrich Schmidt (HAW Hamburg)*

In this work, we describe an application which uses Augmented Reality (AR) technology to present information interactively and within the real-world context, particularly with regard to cultural and natural heritage content. As interface, we propose the Augmented Reality Telescope, an extension of the conventional stationary coin-operated telescope.

After an introductory overview of Augmented Reality technology and application areas in general, we specify by presenting the AR-Telescope and discussing fundamental postulations and calculations for the technical conception of the device. Based hereon, we develop a concept for content presentation with a focus on interaction techniques. Finally, we describe the implementation of a prototype in the form of a simulation.

**»Segmentation and analysis of coronary vessels in CT data«**

*Master thesis by: Toni Tadge  
Supervisor: Stefan Wesarg*

Every year millions of people suffer from heart attacks. The main reason for this is a narrowing (stenosis) of the coronary vessels. Measuring the coronary vessels is therefore an important task for the diagnosis of cardiac diseases. The acquisition of volume data (3D) by means of conventional computer tomography (CT) has already been possible for a long time. But only the increase of the spatial resolution to 0.5 mm per Voxel and the use of contrast agents have made CT interesting for cardiology.

In this master thesis, several techniques for the segmentation and analysis of coronary vessels have been tested. These techniques have therefore been implemented in the Medical Imaging Platform (MIP) of the Fraunhofer Institute for Computer Graphics Darmstadt (department A7). Three different methods have been selected and implemented after a literature research. Together with another method developed during this thesis, they have been compared with respect to robustness, speed, accuracy, and usability. The methods Confidence Connected (region growing) and Freezing Fast Marching (model-based technique) had a low precision. The techniques Resample Verdonck (tracking-based) and the newly developed Vessel Cutter (also tracking-based), however, delivered precise and good segmentation results.

A method that deals with the characteristic curvatures of stenosis and aneurysms (bulge of a vessel) has been chosen for the analysis of coronary vessels. The results of this analysis were questionable, therefore two other characteristics were introduced. They were the cross section of the vessel (low -> stenosis, high -> aneurysm) and a gradient-based criterion for the methods Resample Verdonck and Vessel Cutter.

To conclude, it turned out that the results of the techniques tested using the new high-precision three-dimensional CT data were very promising. The small coronary vessels that are difficult to detect could be segmented and analyzed with the new accurate and robust techniques.



### »End device-specific visualization of three-dimensional geodata in a catastrophe management system«

*Diploma thesis by: Markus Etz*

*Supervisors: Daniel Holweg, Prof. M. Lutz (FH Gießen-Friedberg)*

In this work, a system is presented for the visualization of three-dimensional geodata on a map. This system enables an optimized representation of the map's objects. Objects relevant to a user are optically emphasized, irrelevant information is filtered out. It is thus possible for the user to get relevant information out of the map in a minimal amount of time.

Optimization of data depends both on the user's interest in the thematic content of the map, and on the device used for the visualization of the data. Cartographic abstraction methods are used to highlight wanted objects and to minimize irrelevant objects. The developed platform is the basis for the use of different cartographic abstraction algorithms.

The independence of all systems involved is achieved by using open protocols and languages to compose and visualize the map. The user is thus not bound to a specific device or software. Both, access to the server and visualization of the map have been realized for different categories of end devices. It is possible to present the three-dimensional map both on high-performance PCs and on low-performance mobile devices.

Additionally, the sources of data and the visualization platform have been strictly separated. With the exception of a defined interface, the visualization platform works independently of the subjacent data source. This separation between all layers involved allows interchangeability, extensibility and thus structural independence between the layers.

### »Interactive clothes rendering«

*Diploma thesis by: Martin Knuth*

*Supervisors: Arnulph Fuhrmann, Volker Luckas*

A scenario for a virtual try-on requires fast and stable simulators for clothes, which exist nowadays. Fast and realistic visualization of simulated data is necessary, too, but a lack of compliance with this second requirement can be observed. Critical aspects of the visualization subsystem in this scenario are speed and realism. A customer wants to interactively change the simulation data with visual feedback,

which has to be as realistic as possible. To solve this problem, several existing algorithms were analyzed. The result was that none of the analyzed algorithms were able to meet all requirements of the scenario. If it was not the requirement of a static scene, other restrictions (like complex approximations) were demanded.

In order to fulfill the requirements, new algorithms were developed to solve the problem of interpreting the illumination situation at interactive frame rates without pre-computations. With the assumption of narrow-woven cloth, the reflectance models were developed and optimized. To gain flexibility and speed, shadow buffering was chosen as shadowing algorithm. For the reflectance simulation of cloth and diffuse materials, a Lambertion-diffuse reflection model and Lommel-Selinger-inspired reflection model with surface scattering was developed. For structured materials, a reflectance model for the simulation of leather and cord was developed. To test the capabilities of the GPU, the rendering system is based on vertex and fragment shader, gaining a high flexibility. For the illumination of the 3D scene, a light setup with self shadowing is used, which is created from a HDR environment. A new filter function was developed to smooth shadows.

The developed algorithms allow realistic shadows and clothes-like reflection behavior with interactive frame rates, which was observed using a prototypical implementation. Moreover, the light setup is reconstructed from a HDR environment, allowing a realistic illumination of the scene.

### »Effective spatial partitioning of large dynamic 3D Scenes«

*Diploma thesis by: Sven Schäfer*

*Supervisors: Dr.-Ing. Jörg Sahm, Prof. Dr. José. L. Encarnação*

The demand for dynamic scenes with large amounts of moving and changing objects is growing steadily in the fields of Computer Graphics and Data Management. This thesis develops and implements a solution for the effective maintenance of three-dimensional dynamic objects in a 3D scene.

With this solution, it is possible to use collision detection algorithms, view frustum culling, or use raytracing for rendering to effectively gain the required information. The approach followed here uses existing solutions for spatial representation and develops a hybrid tree structure upon them, which handles the 3D

objects and enables the effective space partitioning necessary for the algorithms described above. It is especially useful when dealing with large amounts of dynamic objects. A comparison of the implemented tree structure with other trees shows its effectiveness and its applicability.

### »Sophisticated appearance modeling of Macroscopic surface structures using BTFs and BRDFs for Photo-Realistic Visualization«

*Diploma thesis by: Ralf Brauchle*

*Supervisor: M.Sc. Poojan Prabhu*

The aim of the thesis was to develop a novel, hardware accelerated algorithm for spatially varying materials using bi-directional texture functions (BTFs) to account for the effects observed when viewing materials with appreciable meso-structure content, something that cannot be achieved using the reflectance function alone (bidirectional reflection distribution functions – BRDFs) together with bump mapping.

The thesis realized a BTF representation as introduced by Dana et al., who captured visual data for a variety of real world surfaces. Therefore, an own realistic BTF model was developed for real-time rendering with graphics programmable unit (GPU) based code for programmable graphic hardware (nVidia Fx, Cg).

Another aim of the thesis was to generalize global illumination from high-dynamic range maps to encompass specular, glossy, diffuse, and retro-reflection effects. For this purpose a sophisticated paint model for exteriors of cars was developed that is based on a physically plausible model taking into account the BRDF of the paint, the roughness of the metal as well as the glossy reflections due to the varnish layer on top of the paint.

The results show that the addressed issues, hardware accelerated algorithm for spatially varying materials and generalized global illumination from high-dynamic range maps, can be efficiently implemented on programmable graphics hardware.