

FOCUS K3D – Foster the Comprehension and Use of Knowledge intensive 3D media

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www.focusk3d.eu

FOCUS K3D was a coordination action that aimed to exchange and disseminate novel ideas and techniques in the emerging research field of semantic 3D media, contribute to identify current issues in knowledge intensive 3D media, trace future research and technological directions, and establish new partnerships to promote innovative projects, addressing a highly multi-disciplinary community, both from academia and industry:

- Scientists not only in Computer Graphics but in all the disciplines that make strong use of 3D modelling and simulation;
- Professional developers of tools for 3D content creation and management, and
- Creators of digital 3D content.

Summary of Activities

The project focused on four application scenarios, considered in Application Working Groups (AWGs):

- Medicine and Bioinformatics; contact: Frederic.Cazals@sophia.inria.fr
- Gaming and Simulation; contact: Wolfgang.Huerst@cs.uu.nl
- Computer-Aided Design & Engineering (CAD/CAE) and Virtual Product Modelling; contact: Andre.Stork@igd.fhg.de
- Archaeology and Cultural Heritage; contact Marios.Pitikakis@cereteth.gr

Based on specific questionnaires designed for each AWG (still available from the project web portal), and also on in-depth interviews of selected stakeholders, the consortium prepared peer-reviewed state-of-the-art reports on 3D Shapes and Semantics in the four AWG subject areas, which were published in spring 2009 and can be freely downloaded from the web portal.

These reports then led to position papers as a basis for discussions of the existing problems and of the way forward in semantic 3D media at AWG-specific workshops held in the summer of 2009. Position papers, workshop material, and reports of the workshop outcomes are also available for download from the web portal.

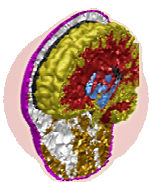
All the collected material was used to elaborate a Research Roadmap in 3D Shape Semantics in the beginning of 2010. This roadmap was then presented to stakeholders for discussions at the FOCUS K3D final conference on Semantic 3D Media in Sophia Antipolis (France) on February 11&12, 2010. The conference provided interesting insights on novel ideas and applications in the emerging research field of semantic 3D media and content. The programme featured six keynote talks and an invited talk given by a representative of the European Commission. Technical sessions and project presentations completed the programme. The conference addressed scientists not only in Computer Graphics but also in all the disciplines that make strong use of 3D modelling and simulation; professional developers of tools for 3D content creation and management; publishers/dealers of online 3D repositories; creators of digital 3D content. Key event of the programme was the presentation of the research road map envisaged by FOCUS K3D that was discussed with the participants during a panel session.

Based on the comments received there, a final version of the roadmap was prepared to conclude the project. The roadmap is being widely disseminated by the project partners and available for download from the project web portal. It will serve as the baseline document for the consortium partners in their future research activities on 3D shape semantics.

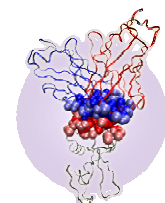
Important work areas

Each state-of-the-art report was intended to draw a picture of the current use of 3D geometry and knowledge in the different application domains and to provide a catalog of existing knowledge technologies, domain ontologies and related initiatives and projects. The reports reflect the diversity of the status of applicable knowledge intensive methodologies in the respective domains.

AWG Medicine and Bioinformatics

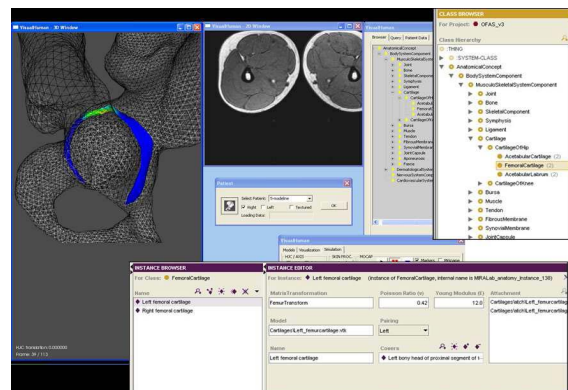
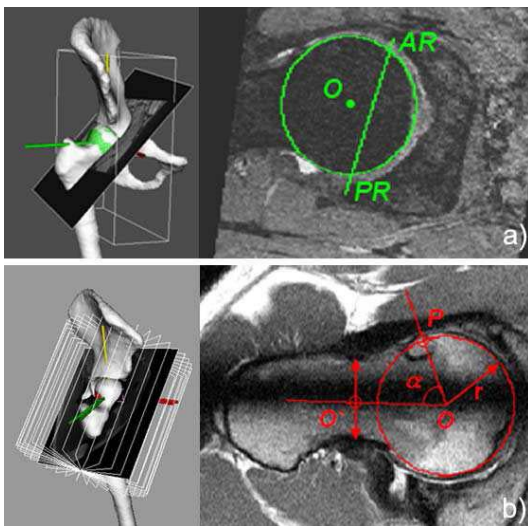


Medicine and structural bioinformatics are multi-disciplinary research fields featuring a subtle mix of geometric and knowledge based pieces of information.

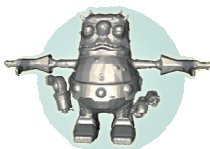


In medicine, geometric modeling as such is required, among others, for diagnostics, therapy planning, surgery, radiotherapy and legal medicine, though a growing number of problems actually require a combination of geometry and knowledge, one example scenario being the simulation of human articulations for replacement with a prosthesis. The answers collected to our questionnaires show that users seem to be aware of knowledge technology in general but do not use it and just resort to in-house software to manage their still relatively small collections of 3D models.

Structural bioinformatics is concerned with the investigation of the relationship between the structure and the function of bio-molecules with major applications in fundamental biology but also drug design. Geometry plays an important role to model molecular surfaces, volumes or interfaces. A central knowledge resource is the Protein Data Bank (PDB), which contains most of the structures of bio-molecules experimentally resolved. As the users resort to the PDB, they are aware of knowledge technologies but most of them exclusively restrict their use to the PDB, and some difficulties connected to it were reported.



AWG Gaming and Simulation



Game research involves the creation of virtual worlds, in which physical and human behaviours are properly simulated. Obviously, modelling and processing 3D content plays an important role in this application area, which requires multidisciplinary research. Involved disciplines include computer graphics, modelling and animation, (physical) simulation, artificial intelligence and agent technology, human-computer interaction, and semantics.



The community involved in the gaming and simulation area is very diverse and multifaceted. One mutual concern is the need to provide the fastest but yet most realistic computer graphics. Game and simulation designers do not only have to create realistic models of objects and characters in 3D virtual worlds but also mutual relations between them and their virtual environment. Coding semantics into models promises solutions for the related problems. In addition, it is not only important to provide the best, most

realistic models but there is also the need for an effective and efficient production process. Again, semantic shapes promise to help with this by offering better ways to manage and document 3D models. The survey showed that knowledge technologies have not really arrived yet but there is a growing awareness and some high hopes concerning the improvements knowledge technologies could provide in the future.

AWG CAD/CAE and Virtual Product Modelling



Product Modelling is the application sector that contributed most to the development of techniques for modelling and processing digital 3D models. It can be informally defined as the whole workflow that stretches from an idea about a new product (e.g. an appliance or a car), to the concept development and shape design, and then to a series of engineering-related steps such as testing, manufacturing or machining the physical object. Obviously CAD/CAM

technologies do not address the requirements of the integrated design engineering process completely. All too often, the CAD model is merely a geometric interpretation of the design intent. Design iteration is achieved by iterative procedures that are cumbersome and inevitably stretch design timescales.



All the respondents of the questionnaires were aware of knowledge technologies in general and their benefits but almost half of them do not feel very familiar with them. For the management and organization of data people have different systems in usage, ranging from a simple database up to PDM or PLM systems. The AWG's state-of-the-art report provides an overview about methodologies in knowledge-based engineering, which extends the product design process beyond geometric modeling to capture the knowledge of a company's most important asset – the experience of its engineers. The survey is also addressing engineering ontologies, reflecting the open issue that users of 3D modeling systems need more support for the "intelligent" handling and usage of 3D digital content to achieve significant, quantifiable benefits in time and expenses.

AWG Archaeology and Cultural Heritage



A large part of the European archaeological and cultural heritage exists in digital collections (e.g. virtual museums, digital libraries, scientific repositories), which are becoming more and more demanding in terms of management, preservation, and delivery mechanisms.

Although great progress has been achieved and 3D content is expected to become predominant, the involvement of "traditional" cultural institutions in 3D digitization is still limited. The technology for capturing, storing and managing 3D content is not yet easily available for cultural institutions, and cultural heritage professionals are afraid of the significant additional cost for the equipment used for 3D data acquisition and the high cost of skilled staff.

The recently launched Europeana – the European Digital Library, Museum and



Archive – contains a broad range of content from across Europe (such as photos, sounds, maps, books, film material, etc.) but there is a lack of 3D objects and 3D-related management and interoperability efforts. There is actually significant debate whether the approaches adopted for digital libraries are suitable also for 3D content. It is, however, expected that the use of 3D knowledge technologies can provide effective semantic-based organization of 3D repositories and efficient searching capabilities.

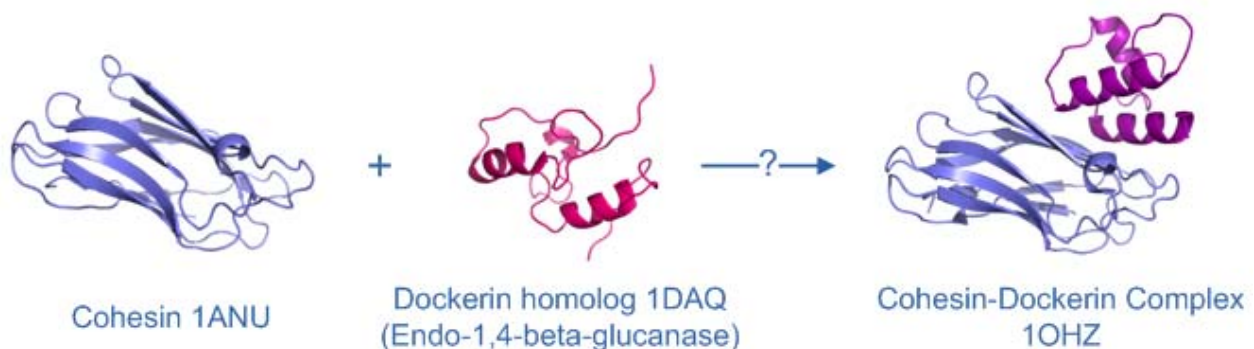
User Involvement, Promotion and Awareness

The 6-monthly project newsletters, public reports and material for all thematic workshops organized by the project can all be downloaded from the web portal.

Stakeholders were solicited to participate in the 5 thematic workshops the project consortium has organized.

AWG Medicine and Bioinformatics:

The thematic workshop in bioinformatics called *Flexibility and Biological Recognition: from Biophysics to Data Models* was held in Sophia-Antipolis, France, on March 18-20, 2009.



Scientists from the biophysics and computer science communities attended the event. The multidisciplinary discussions at the workshop allow it to pitch two facts: first, while there is a steady interest for Knowledge Technologies in the structural bioinformatics community, they are perceived as complex and not easy-to-use. A proper training must be developed to allow easier access. Second, the geometric annotation of macro-molecular shapes is key to foster our understanding of the relationship between the 3D shape of bio-molecules and their function. Yet, advanced geometric tools to study properties to be used for annotations are not readily available, which is clearly a hindrance.

The thematic workshop in medicine called *Anatomical Models* was held in Sophia-Antipolis, France, on June 16-17, 2009.

The workshop featured 15 talks and an open discussion on knowledge technologies for computer-aided medicine. The audience was mostly composed of researchers but also industry representatives and a neuro-surgeon. The discussion on the interplay of 3D geometric modeling and knowledge technologies in the scientific workflow centered on the issues of image segmentation, registration of data, annotation of anatomical models, the quality of software tools, and the sharing of medical data.

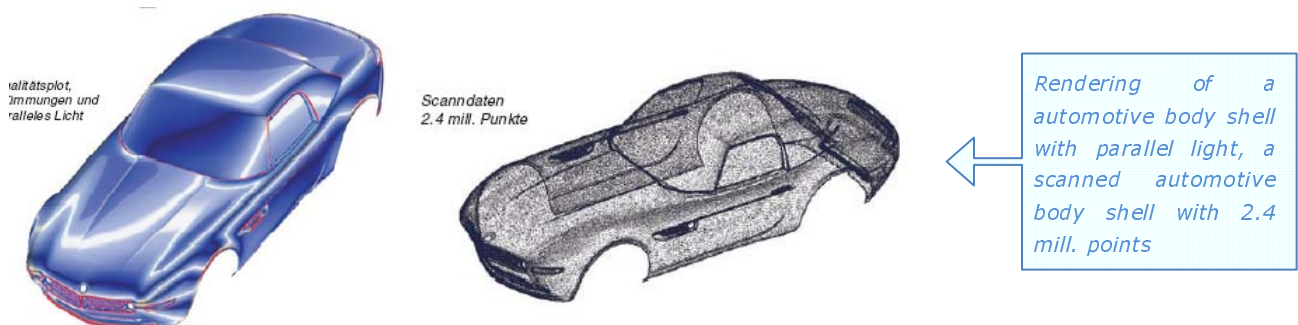
AWG Gaming and Simulation:

The thematic workshop called *CASA workshop on 3D Advanced Media in Gaming and Simulation* was held in Amsterdam, The Netherlands, on June 16, 2009, in conjunction with *CASA 2009*, the 22nd Annual Conference on Computer Animation and Social Agents, June 17-19, 2009.

The workshop featured a technical program of 8 lectures and some demos addressing different aspects involved in the creation and use of advanced 3D media in gaming & simulation. Contributions covered topics including 3D semantic shapes in virtual worlds, rule-based layout solving, procedural methods for terrain modeling, coordinated movements of autonomous agents, and detection, tracking, and recognition of human poses. Two keynote speeches presented issues related to the collaborative visual analytics through serious gaming, and the content creation workflow of a ship simulator game, respectively. The discussion at the end addressed issues like facilitating the creation process, organization of data, 3D search engines, unwillingness to share data, the necessity to document clearly the benefits of new approaches, and the annotation of objects by volunteer groups.

AWG CAD/CAE and Product Modelling:

The thematic workshop called *Challenges in 3D Content for Virtual Product Modelling* was held in Rostock, Germany, on September 1, 2009, in conjunction with the conference "Go for Innovation" of the German Competence Network of 3D-Computer Graphics on August 31.



The workshop featured 4 keynote presentations, 4 position statements from industry and an open discussion at the end about current practices and needs for advanced 3D modeling and processing, and tomorrow's requirements in this area. The list of major issues in the discussion included: semantically enhanced geometric modeling; search and retrieval, especially for 3D; semantic digitization; interoperability of design and simulation; file formats and standards.

AWG Archaeology and Cultural Heritage:

The thematic workshop called *3D Knowledge Technologies for Cultural Heritage Applications* was held in Vienna, Austria, on September 12, 2009, in conjunction with the 15th International Conference on Virtual Systems and Multimedia (VSMM 2009), September 9-12.

The workshop aimed to bring together researchers, 3D content creators/users, and cultural heritage professionals and featured 8 invited presentations, concluded by a discussion. The discussion topics included the lack of consensus on metadata standards, the problem of proprietary formats, documentation of data provenance, annotation, visualization of information, integration of text, 2D and 3D, and the problem of multilingualism.



Future Work

Even though the project is now concluded, the *Research Roadmap in 3D Shape Semantics* – as presented to stakeholders at the FOCUS K3D final conference in Sophia Antipolis (France) on February 11&12, 2010 – will serve as the

baseline document for the consortium partners in their future research activities on 3D shape semantics.

Furthermore, FOCUS K3D has promoted a Special Issue for the Computers&Graphics Journal (Elsevier) (Vol 35(2), April 2011) to provide an up-to-date view of the open issues in knowledge intensive 3D media, and trace future research and technological directions.

The special issue collects a number of papers on perspective applications of 3D content, a rapidly emerging new form of media in the semantic multimedia panorama and an extremely challenging context of application of semantic multimedia.

All interested parties are still most welcome to contact the project coordinator, the AWG leaders or individual project partners to take part in future research activities, projects and conferences in the field.

Further Information

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- EPFL
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