Real-time Visualization through the Internet

by Xavier Cavin and François Cuny

VSP Technology (Visualization Service Provider™)is a new start-up company born from a technology transfer from INRIA and providing services for a realistic and interactive visualization of complex 3D models. The core technology relies on an advanced rendering software developed at INRIA Lorraine within the ISA research team. The innovative objective of VSP is to offer a new approach of real-time visualization through the Internet as an Application Service Provider (ASP).

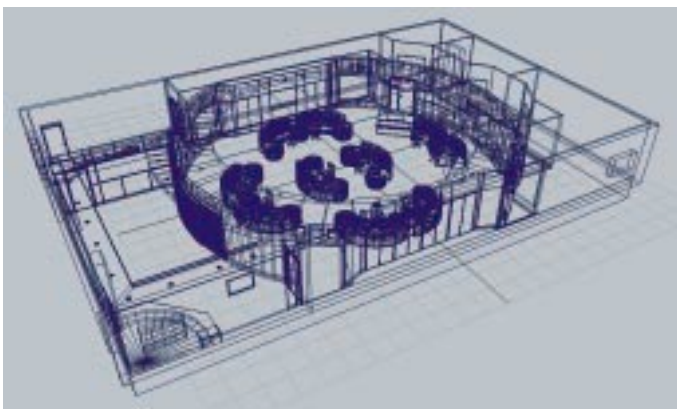
Virtual prototyping is expected by the industrial world to offer an important competitive advantage in comparison with traditional prototyping techniques. On one hand, it allows to greatly reduce the design times and costs of new products; on the other hand it may advantageously assist the marketing and the high-end management in their making decisions. However, existing visualization solutions continue to suffer from too many limitations that have restricted their spread and use: physical inaccuracy, very rough visual perception, poor interactivity and over all an incapacity of coping with the scale required by industrial applications.

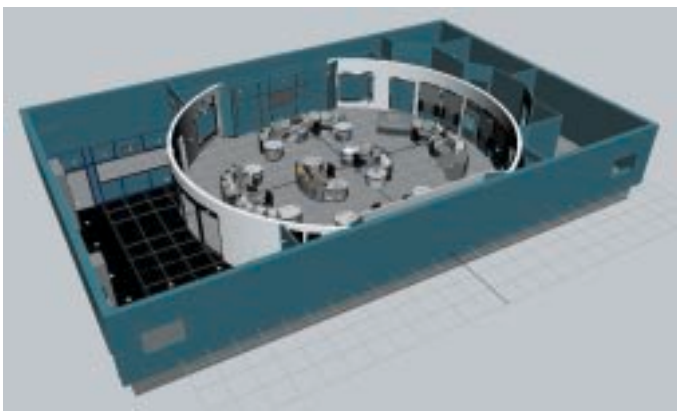
VSP Technology provides solutions for high quality virtual prototyping of very large sized numerical models for industries such as automobile, aeronautics, energy, architecture, etc through an advanced system of geometric optimization, numerical physically based simulation and real-time images generation, directly following from the most recent research in the field of computer graphics.

The process of Visualization Service Providing can be decomposed into three phases: geometric and physical modelling, light transfer simulation and interactive visualization.

For immediate integration purpose, the geometric 3D model can directly come from the traditional CAD/CAM/CAE modelling tools used in the industry, such as CATIA™ or Maya™. Unlike standard CAD polygon-based interchange vocabulary, our loading module generates a compact mathematical representation of the initial geometry that preserves the topological properties of the objects. In addition, physical and spectral properties of surfaces and light sources are taken into account into the model using standard industrial data formats, in order to ensure the physical accuracy of its numerical representation.

Then, the propagation of light in the model is computed from a global physical simulation based on a high performing radiosity algorithm. This algorithm efficiently performs the calculations using high order wavelet functions on parametric surfaces, and can take advantage of existing multi-processor: it can thus be applied with extreme precision and speed to models of very





Interactive design and real-time visualization of an oil and gas control room for ALSTOM: Original model in Maya (top left), Maya visualization (bottom left), VSP visualization (right).

large size. By contrast to classical Monte Carlo ray tracing approaches giving static images, the radiosity method results in a view-independent solution, meaning that views can be displayed without requiring any supplementary lighting computation.

The final step consists in interactively visualizing the illuminated model. Thanks to advanced techniques - including lighting textures, level of details and optimal mesh simplifications - intensively using graphics hardware acceleration, realistic images can be displayed with a high resolution at a high frequency. Supplementary complex optical effects (that were indirectly taken into account in the original simulation) can be added in real-time, and some modifications can be applied to the model, updating the solution accordingly.

Furthermore, a strong concept of VSP Technology is to put forward the complete visualization solution in an Application Service Provider type of process. This concept must allow users to make the most of all the technological power of VSP Technology via the Internet, and to focus all their efforts on their know-how by leaving apart all hardware and software aspects. No matter where they are located in the world and regardless of which resources (high-end or low-end) they are in dispose of, they will be able to interactively visualize and modify their numerical models, even the most complex and largest ones, with a never achieved realism.

The objective of VSP Technology is to bring the academic results of the research made at INRIA to a competitive technology. This work will be done in collaboration with the ISA (Nancy) and iMAGIS (Grenoble) INRIA research teams on one hand, and our strategic partner SGI on the other hand. In particular, INRIA is involved with France Telecom in the RNRT/VTHD project, whose objective is to settle a very high bandwidth network (2.5 Gbits/s) between the five INRIA institutes (Paris, Grenoble, Nancy, Nice and Rennes): this network will help us to conduct experimentations of the ASP aspects and to validate this approach.

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The Pond: Trawling the Information Sea

by Lennart E. Fahlén, Jan Humble, Olov Ståhl, Jonas Söderberg and Anders Wallberg

The Pond is a desk-projection based system for search, visualization and transactions of data elements stored in local databases or on the Internet. Based on a 3D ecosystem metaphor, the Pond approach for querying, presenting and manipulating data elements differs considerably from more conventional information systems.

Conventional data search engines (eg Internet search tools such as AltaVista , Yahoo and products such as Oracle DBMS) mostly provide textual representations of results, and are thereby somewhat limited to 2-dimensional layout. 3D data visualization systems such as VR-VIBE from Nottingham University and Q-PIT developed at Lancaster University show some promise in building a general overview, but require prior knowledge of the system in order to interact and especially navigate.

The ICE laboratory at SICS experiments with new approaches to information presentation and manipulation. As part of this effort the Pond has been developed. The Pond is an information system based on an ecosystem metaphor allowing users to search for data elements stored in local databases or the Internet, and present the results as flocks of aquatic entities inside a 3D virtual pond. The key element in the interface is the information carrying entities' ability to make their presence known and adapt their behaviour based on how they are handled, such as acquiring or relinquishing interest towards user presence.

The design is that of a desk-based projection system, a table around which users gather to perform queries and interact with the resulting pond flocks. The back-projected tabletop surface is touch-sensitive, allowing for direct interaction with the pond environment (see Figure).

Queries

Users perform queries by using credit card sized tags associated with specific keywords that are matched against data stored in a database or on an Internet site. A number of tag readers have been incorporated into the Pond tabletop, and users need only place keyword tags (eg The Beatles or 'techno') on one of these to initiate a search. Once the search results have been retrieved, a flock of pond creatures representing the query result is created and inserted into the virtual pond environment, where the flock starts to move around and respond to user manipulations.

Entity Flocks

Each member of the flock has an autonomous behaviour, controlled by a number of simple navigational rules which, when combined, gives the flock a lifelike behaviour. For instance, entities within a specific flock try to stay together and avoid members of other flocks. This allows for easily identifiable result