

GameTools Annual Report

GEOMETRY - VISIBILITY - ILLUMINATION



GAMETOOLS

www.gametools.org

The
GameTools Project
is an EU project from the [6th Framework Programme](#) that brings together
leading European computer graphic experts
from universities in Austria, France, Hungary and Spain with
European industrial partners
from the fields of computer game development and virtual reality to create
next generation realtime 3D libraries
for **Geometry, Visibility and Global Illumination** for the
PC platform,
with an extension to consoles
PS2, XBox, PS3, XBox 360
planned.

In addition to the core GameTools members,
additional industrial partners
can get preliminary access to the technology by becoming members of the
[GTP Special Interest Group \(SIG\)](#)

Summary of Activities

The second year of the GameTools project covers the period between September 2005 and August 2006.

Right at the beginning of this project period a pre-review meeting was held in Luxembourg on September 13th 2005, followed by a review meeting, which took place in Girona on November 18th 2005. During the mentioned meetings the GTP team could present the actual project results to the Scientific Officer and the Reviewers. The reviewers concluded that the project has made good progress during the 1st project year and that its positive development demonstrates promising future results.

The first Project Management Committee Meeting of the second project year took place on March 10th 2006 in Innsbruck, Austria, and the second on July 14th 2006 in Budapest, Hungary. In these meetings project partners had the opportunity to discuss all important issues concerning ongoing research and management activities, delivered and expected outputs as well as their further activities and expectations.

Apart from the work on agreed deliverables for the second year of the project, academia partners have uploaded the first versions of working modules into the Subversion server in order to share it with the other partners in the consortium and the SIG members. This way, industrial partners are able to begin incorporating these modules in their own software. The second project year is the period of intensive exchange between all involved project partners as well as of intensive communication with industry partners and their participation as members of the GameTools Special Interest Group.

The GameTools scientific efforts were directed to the implementation of the working modules on visibility, geometry and illumination. At the same time, companies were focused on the integration of the modules into their own products, solving new and already identified problems, and giving feedback to the universities. As new results come out of the project, the effort on dissemination and exploitation has been intensified and will be in the focus of the next project period.

Work Areas

The development of next generation **Real-time 3D Libraries** is the agenda of the GameTools Project (GTP), an EU project from the [6th Framework Programme](#). The GTP pushes the envelope in the fields of:

- **Geometry**
- **Visibility**
- **Global Illumination**

The GTP libraries are being developed for next generation **PC hardware**, with videogame consoles - PS2, XBox, PS3, XBox 360 - planned as additional hardware platforms.

Current developments on Geometry

GPU Friendly Level of Detail, Geometric LOD, Automatic Image Based Simplification...

Continuous Multi-resolution Models are a **level of detail (LOD) technique** in computer graphics addressing the problem that scenes often **contain too much**

geometric detail when all of the visible objects are rendered at their full resolution. While similar algorithms have long been available, most modern game/3D-engines implement the much simpler technique of discrete LODs instead. Discrete LOD techniques are widely known for the annoying visible artefacts they produce at the moment the switch between the different resolution models occurs, an unacceptable drawback for the visual quality of the next generation of 3D/game applications.

The **GTP Geometry Lib** supplies a **multi-resolution LOD solution** that addresses the shortcomings of previous approaches by giving developers access to a complete package of solid technology which offers:

- A continuous multi-resolution model for **static and animated meshes** that includes **connectivity information** and uses basic primitives like triangle strips. These features **reduce dramatically** the amount of information stored and **overcome the bandwidth bottleneck** between the main processor and the memory of the modern high performance graphic cards.



- A new multi-resolution model specially suited for the real time rendering of trees and plants, allowing an incredible amount of close up detail. The model is able to show each leaf when the user is closer and gives automatically simplified representations when the observer moves away.



Current developments on Visibility

Volumetric Particles, Caustics, Realtime Raytracing Effects, Realistic Materials, Local Density Fog...

In computer graphics, **Visibility** deals with the problem of rendering faster by rendering only the objects of the scene that can be seen.

Existing solutions along that line employed in modern day 3D/game-engines are mostly based either on **Portals** or on **Quake style PVS** (potentially visible set). While these

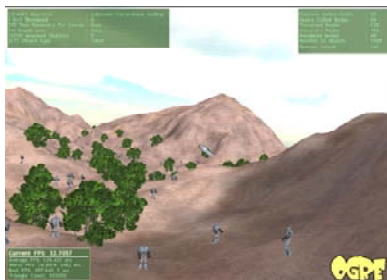
approaches have been successfully employed in commercial products for years, they nonetheless have considerable drawbacks:

1. Both approaches are *not suited for outdoor scenes* (except scenes which are technically indoor-scenes).
2. It is *hard to automatically place portals efficiently*, so it normally has to be done by hand.
3. *Portals* are by nature a very *conservative visibility approximation*.
4. *Portals* are *not suited for dynamic occluders*.
5. For maximum efficiency *Quake style PVS* is usually done on a scene *stored in a BSP tree*, which, amongst other drawbacks, is a scene data structure *not well suited for dynamically changing scenes*.
6. *Quake style PVS* pre-calculation can take prohibitively long.

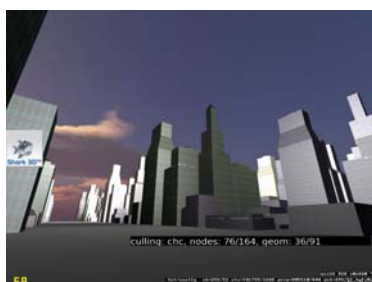
The **GTP VisibilityLib** will overcome these problems with a 2-phase strategy:

1. A solution which supplies **pre-calculated visibility** based on **modern visibility research**, also suited for **outdoor scenes**.
2. A solution which efficiently employs **modern day graphic hardware** to deliver **on-the-fly visibility** with **minimal overhead**.

Both solutions work best when used together, but can also be employed independently from one another, as to best suit the 3D/game engine in use. The focus of Visibility in this project period is on integration and demonstration delivering many remarkable results.



Online Occlusion Culling: Integration



Illumination

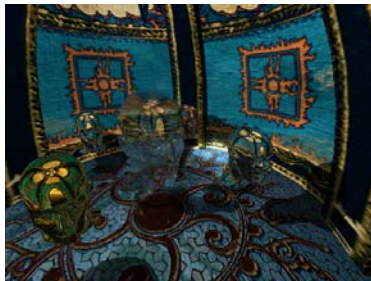
Fast Online Visibility Culling, Incremental & Exact Visibility Precalculation, Visibility Scene Analysis...

Global Illumination is the field of computer graphics that deals with **physically correct illumination**. Usually this is associated with stochastic ray-tracing solutions **taking hours to calculate a single picture**.

Accurate **specular reflections, refractions, and caustics** are usually rendered with ray-tracing in off-line renderers, but are often ignored or drastically simplified in games, since the ray-tracing algorithm does not fit into the rasterization approach of current GPUs. In order to include these visual effects in real-time games, we developed a **GPU friendly algorithm** that combines the generality of ray-tracing with the speed and hardware support of rasterization.

The **GTP Approximate ray tracing module** delivers ray tracing effects, such as reflections, refractions and caustics at few hundred frames per second due to their GPU implementation. The method is based on special environment mapping when the distance information is also stored in environment map texels, from which accurate localized reflections can be obtained. Exchanging the roles of the camera and light sources, the same approach is also good for rendering real-time caustics.

The **GTP IlluminationLib** brings physically correct rendering to the domain of real-time graphics.



Effects that will be possible include:

- 1. Soft Shadow/Lighteffects**
- 2. Dynamic Lightsources**
- 3. Indirect Illumination**
- 4. Reflections**
- 5. Realtime Radiosity**
- 6. High-Quality Materials (Metal,...)**
- 7. Cloud Rendering**

allowing for **previously unseen levels of realism** in 3D/game applications.



User Involvement, Promotion and Awareness

Since the start of the project we are in the process of **creation of the SIG (Special Interest Group)**. The Community Manager consecutively created a SIG membership agreement, which was evaluated by the IPR Helpdesk.

Until September 2006, seven companies have signed the SIG membership agreement and are the members of the SIG. These companies are: Invictus-Games Ltd., a game development company from Hungary; Brainstorm Multimedia, a 3D graphics company from Spain; Animante Baleares, S.L., a 3D animation company from Spain; Sproing Interactive Media GmbH, a game development company from Austria; Bouncing Bytes, a Graphic Design company from Austria; and TAB Austria, a leading company for entertaining terminals located in Austria; VIS – Visual Imagination Software, a services and development company for high quality solutions in the computer graphics from Germany.

New dissemination activities, which are going on during the time of this writing, will help to achieve more interactions with companies and to present the GTP all over Europe. On the September 13th, 2006 the GTP Subversion repository (GTP SVN) was opened to the future GTP SIG members. Accordingly the GTP CM took the opportunity to inform major game development news sites, recognized forums and expert sites about this news and spread out information about the GTP. One month later we already can register four new SIG members: Over the Edge - 3D Engine (non-source code) located in Denmark; Vertex4, a development company in Austria; Game Studio Trinigy, a company for development of advanced 3D graphics technology from Germany and 3D Engine Elekta Project, a European research project.

The first **GTP demogame, “Jungle Rumble”** TPF FPT was completed by VUT students under the supervision of the GTP CM; “Jungle Rumble”, besides being fun to play, showcases the GTP technologies Depth Imposters and Raytrace Effects, showing that they can be successfully employed in an actual game environment. “Jungle Rumble” is currently presented on the GTP webpage. It was also made available to SIG members in the GTP SVN.

During the **Eurographics Conference 2006** in Vienna, the GTP had its own stand showing the latest demo versions and outputs. Gametools also sponsored the Graphics meets Games competition, which was announced worldwide via many different channels, always associated with the Gametools logo. Furthermore it was possible to present the GTP at **GCDC in Leipzig 2006**, the biggest event for game developers in Europe, in a panel discussion that had collaboration between academia and industry as a topic. The GameTools project was presented also on international level in Novosibirsk, Russia during the **GraphiCon’2006** conference and at the **Siggraph 2006** conference in Boston. In addition our partner Infowerk from Austria presented the GTP to several relevant institutions in Austria like the Chamber of Commerce and the Office for European Programs Austria as well as at the following fairs: Boot Düsseldorf, Bootsmesse Tulln.

Furthermore on the GTP website can be downloaded numerous, significant **scientific publications** connected to the GTP topics as well as many interesting **videos**, which represent some GTP scientific work.

Future Work

The GameTools consortium will finish the modules of the visibility, geometry and illumination in its third and last project phase. The emphasis will be therefore especially on project integration, evaluation and testing on the demonstrators and platforms of the industrial partners. The GTP team will work hard in order to apply as much as possible the exploitation and use plan, since the results will be strong enough to cause a good impression to further interested companies.

Regarding Community Management & the GTP Special Interest Group, efforts will be directed to get more adaptors to join the SIG; this will give us feedback on the technology created and the support given by the GTP WP groups. Furthermore this way we will approve the cooperation between academia and industry according to our objectives.

In parallel and taking the lessons learned from the early adaptors into account, advertising methods for the GTP SIG will be evaluated and implemented. It is planned to send out a quarterly newsletter in order to inform periodically more than 150 companies about GTP. In addition following PR materials are available: GTP poster, GTP leaflet and general GTP presentation. All these materials are available for a download on the GTP website for all interested parties. Furthermore we plan to organise a GTP exhibition by the end of the project presenting the applied scientific work by industrial partners.

By the end of the project we will deliver the final version of the exploitation and use plan, market and technology watch report and exact demonstrator descriptions apart of the final scientific and general project outputs.

Annex I

GameTools Flyer and Poster

PARTNERS

University

Industrial Partners

GAMETOOLS

Advanced Tools for Developing Highly Realistic Computer Games

GOALS: Developing 3D Engines in the areas of **Visibility, Geometry & Lighting** to increase Realism & Visual Quality in:

1. Computer Games
2. Graphical Simulators
3. Industrial Robots
4. VR environments

The benefits are five:

- Join the OTP Special Interest Group, to get access to GameTools technology right now.
- The GameTools Project is funded by the European Union to support the European 3D software industry.

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Illumination

GameTools brings physically correct rendering to the domain of realtime graphics.

Topics that will be priority include:

- Soft Shadow / Lightmaps
- Dynamic Lightsource
- Indirect Illumination
- Reflections
- Realtime Raytracing
- High-Quality Materials
- Cloud Rendering

Geometry

A fast image based simplification algorithm to efficiently create high quality M.O.D.s without human intervention.

- Multiresolution triangle strip generation taking into account topology and texture of the base model.
- A new multiresolution model based on that contains triangle strip information, avoiding the need for costly on-the-fly strip generation.

A new multiresolution model **oriented** toward for games allowing for an **arbitrary amount of detail** (e.g. leaves).

Visibility

The GameTools Visibility & renders faster by only displaying the visible objects in your scenes through:

1. Fast precalculated visibility based on modern visibility research.
2. Efficient visibility for dynamically changing scenes employing modern culling graphics hardware.

Both approaches work for indoor & outdoor scenes, and are much faster and smaller than existing techniques.

Industrial Partner

GameTools Presentation

GameTools

Advanced Tools for Developing Highly Realistic Computer Games

Information Society Technologies

EUROPEAN UNION