Description of the GTP Technology

Computer graphics libraries play a key role in providing computer games and other high-end 3D applications with the visual quality crucial for commercial success. The GTP advances three key areas in modern computer graphics:

1. High quality, automated visibility for dynamic scenes, exploiting modern computer graphics hardware, will enable the rendering of larger, more impressive scenery without costly human pre-processing.
2. Intelligent geometry complexity reduction will allow for unprecedented detail in the rendering of highly complex objects such as plants.
3. Real-time global illumination will give previously unseen visual quality in dynamic lighting.

For computer & videogames, this allows for larger, more realistic and impressive worlds to be presented to the player, which leads to a stronger emotional immersion in the game and therefore a better gaming experience. For non-gaming high-end 3D applications, such as interactive architectural walkthroughs, the GTP library allows for a highly realistic visual representation, previously not possible in real time.

The GTP libraries are being developed in OGRE and Shark3D for next generation PC hardware, with videogame consoles - PS2, XBox, PS3, XBox 360 - planned as additional hardware platforms.

GTP Innovation

The **game industry** has a **huge impact on computer graphics research**. Many new research papers mention computer games as one of the main application areas. However, there is still a **lack of knowledge transfer** from academia towards the actual game industry. The gap between the presentation of new ideas to the academic community and their actual applicability in games remains significant, and is often too large for small and medium-sized SMEs to bridge. Creating a channel with a steady flow of information from academia to industry represents a new challenge, both for research groups and game companies. Consequently, this project aims for innovation on two different levels:

First, by creating a channel by which small to medium-sized SMEs in the computer game industry will be able to profit from the latest research in computer graphics. The channel is managed and kept alive by actively contacting the open community based on a website containing the latest state of the available developments (plugins) and all information required to test and use them.
Second, by being the first “customers” of this common interface and providing a number of important innovations to computer games, all of which are mainly concerned with realistic effects in real time.
You can join us at www.gametools.org.

The actual research and development areas targeted in this project are lighting, geometry and visibility processing.

Visibility

Snapshots from the online visibility culling demos. (top row) OGRE demos, (bottom row) Shark3D demos

We have two innovative solutions for visibility calculations in outdoor environments for game engines, suited for different situations:

Firstly, we have analysed the scene as a whole and find a good partitioning of the scene with respect to the visibility structure. This analysis is carried out in line space, where lines are represented as points. Since lines are the entities that carry visibility information in a scene, line

space opens the door towards analysing visibility with a completely new set of tools, for example by clustering or hierarchical partitioning applied directly to lines. The partitioning of the scene into view cells is carried out in order to reduce pre-calculation times for bigger scenes to tolerable values, and to decrease the total amount of storage required for visibility information.

Secondly, we have a new method to calculate visibility online for both outdoor and indoor scenes. The advantage of online calculation is that environments can be highly interactive and dynamic, whereas in pre-calculated approaches, at least the parts of the scene responsible for occlusion need to remain stable. We expect gaming environments to become successively more dynamic in the near future, and therefore pre-calculated visibility alone will not be sufficient to reduce the rendering load to a tolerable amount. The method we propose relies on the recently introduced capability of graphics cards to asynchronously report occlusion information for rendered geometry. This capability has not yet been used frequently due to the large latency of occlusion queries.

Geometry

A forest represented by LodTree objects.

We proposed two innovative solutions for multiresolution modeling:
First, we improve on existing multiresolution models by exploiting connectivity.
Second, we propose a continuous multiresolution model for vegetation. These two innovations require:

- New stripification algorithms that use topology and texture data to best fit the multiresolution strips to the different levels of detail.
- A new image based simplification algorithm that reduces the number of images used by selecting only good view points.
- A new multiresolution strip representation that reduces the size of the model and the LOD extraction time. We do not need to calculate strips on the fly like previous approaches.
- A new multiresolution model for vegetation that improves on previous solutions that uses discrete models where the leaves do not have enough quality when we are close. We have developed a continuous model that does not show artifacts between LOD transitions and shows highly detailed leaves.

LODStips model into Shark3D engine.

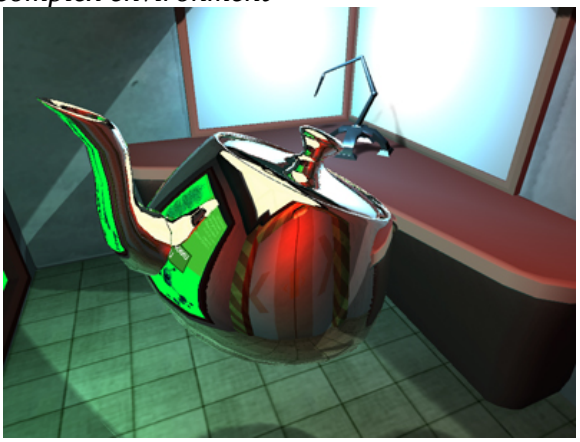
Lighting

Real-time, physically plausible soft shadows integrated into Ogre3D

Our method focuses on the problem from a different point of view. We reduce the redundancy in the initial data, consequently minimising memory requirements. The algorithm is adaptive in order not to lose important details.

The first step is to develop an evaluation algorithm that automatically computes the important regions of a scene in order to improve the image-based modelling step. As it is sometimes necessary to compromise the amount of information in order to obtain fast rendering algorithms, we will try to minimise the effects of this lack of information. In order to do so, regions containing important information will be accurately captured first. The less important the images are, the less accuracy is necessary when capturing them. As opposed to previous methods, we use the image-based model to incorporate illumination information based on the global illumination computations.

Robust triple self reflections in a more complex environment



GTP Actual Situation

The GameTools Project is officially finished by the end of May 2007. After this date the involved universities as the owner of the developed knowledge will set up a Spin off company with its headquarters in Girona. The staff of the GTP Spin off will be manned by experts from Austria, Hungary, France and Spain. Once the project is finished, the GTP Spin off will be ready to provide Consulting services to possible customers.

The possible services include:

- Bug Fixing
- Extension of the libraries with new functionalities
- Customisation
- Formation – Education

The libraries are and will be Open Source. Therefore we will not sell licences to allow the use of the libraries to third parties. An additional commercial, optimised version will be released at the end of the project. Possible GTP customers will be able to use the Open Source non-optimized libraries for free, or to buy the commercial optimised version.

Furthermore the GTP Special Interest Group (SIG) will be open for admission until the end of the project. In this way interested companies have access to the libraries source code during the project lifetime. This is useful for them as they are able to adapt their products to use the results of the project earlier than other companies outside the GTP. It is also useful for the consortium because these companies provide valuable feedback about the results of the project, and hopefully will become our customers at the end of the project.