

Project Number	TQP106
Project Title	GPU based Real-Time Terrain Lighting
Project Description	Current rendering technologies enable us to include extensive and detailed out-door scenes in games using large number of triangles. However, an important part of the out-door scenes is its lighting model. If the light is static, it is simple enough to pre-compute but when the light is dynamic, we have to consider many aspects of lighting such as: sunlight, skylight, scattering, and reflection to produce high quality physically based scene. Global illumination takes into account light reflecting off all surfaces in the world (indirect illumination) in addition to light coming directly from light sources (direct illumination). The images created using global illumination are more photorealistic and natural-looking than images lit with direct light only. Global illumination looks great, but traditional techniques for calculating it are far too slow for real-time applications. Render times for global illuminated scenes are often measured in hours per frame. Render times for a frame in real-time applications are measured in milliseconds. This situation has lead many to pursue ways of pre-computing global illumination information and using the results in real-time rendering. Unfortunately, such techniques do not work satisfactorily with deformable geometry in dynamic environments. Just as bad, they often force the user to separate objects being rendered from the environment that provides the light, which is often impossible. Radiosity, ray tracing, beam tracing, cone tracing, path tracing, metropolis light transport, ambient occlusion, photon mapping, and image based lighting are examples of algorithms used in global illumination, some of which may be used together to yield results that are fast.

	The computation power of the programmable graphics processors (GPU) in commodity graphics hardware is increasing at a much faster rate than that of the CPU. It is often not possible and not even meaningful to use CPU algorithms for GPU processing. The key to harnessing the GPU power is to re-engineer the lighting computation algorithms to make better use of the SIMD processing capability of GPU. The aim of the project is to create a dynamic, photorealistic terrain lighting model by investigating the physical aspects of lighting and implementing this model using GPU.
Hardware/Software/ References	• Microsoft Visual Studio 2005 C/C++ environment • http://en.wikipedia.org/wiki/Global_illumination • http://realtimeradiosity.com • http://www.vterrain.org/Performance/lighting.html • http://graphics.cs.ucf.edu/GPUassistedGI/GPUGISubmission.pdf • http://www.fantasylab.com/newPages/rtgi.html • Instant Radiosity. Proceedings of ACM SIGGRAPH 1997 • Low Latency Photon Mapping Using Block Hashing. In Proceeding of Eurographics Workshop on Graphics Hardware • Methods for Dynamic, Photorealistic Terrain Lighting Naty Hoffman and Kenny Mitchell (Westwood Studios)