CODING

Light scattering

by David Jefferies, Climax

The lexicon of next-generation game programming is awash with acronyms and buzzwords. HDR, HDTV, light scattering and normal maps to name just a few.

I'm the lead programmer of the MotoGP series of games for Climax Racing. Each month I'm going to cover some of these techniques and discuss how we went about implementing them.

To kick off this month: light scattering.

Light scattering is an algorithmic technique that models atmospheric phenomena. It simulates the way that light from the sun interacts with particles in the atmosphere to recreate the deep red of sunset or the grey of dawn.

The light scattering algorithm takes as its inputs Mie-scattering and Raleigh-scattering values along with a sun direction. These scattering values determine how the algorithm models the photons passing through the Earth's atmosphere. We never managed to explain in terms the artists understood how these values affect the light scattering colour – but it didn't matter. As long as the artists can alter the values and see the results interactively then they start to get an intuitive feel for what values are needed for different atmospheric effects.

The light scattering algorithm can be coded fairly easily in HLSL and run on the vertex shaders (there are some good demos on the net with example implementations). We run the light scattering shader on every vertex in the scene. The output from the shader is an in-scattering and an extinction colour and these are added to the ambient and diffuse terms of the lighting shader respectively.

If you have a highly tessellated sky dome then the light scattering will produce beautiful colour gradients reflecting the sun position, pollution, fog, blue sky and many other effects which change depending on the time of day.

The difficulty with light scattering is integrating it effectively with the lighting solution for the game. The aim of MotoGP was to have photo-realistic graphics and although the light scattering demos look great it's all too easy for the effect to look like a tech demo rather than a photo-realistic scene.

So, although the tessellated sky dome looked startling, our artists eventually decided to do away with it – preferring instead to use our HDR renderer combined with photographs of the sky (I'll cover this technique in a later column). Instead they only used light scattering on the track, carefully blending and tuning the effect to match the sky domes they had created.

Light scattering is a great tool and can produce some fantastic results; as programmers we were very pleased with it. But we were quickly put in our place when the artists took one look at it and dubbed it 'Fancy Fog'!

■ **www.climaxgroup.com**

CLIMATIC MOMENT

The PC goes Next-gen

Microsoft's most radical games release, DirectX 10, offers advanced graphics but at the cost of backwards compatibility…

Product DirectX 10
Company Microsoft
Price: Free
Contact + 44 870 60 10100

If you wanted a marketing tag for DirectX 10, it would be anything the consoles can do, the PC can do too. After all, the latest release in Microsoft's game development technology marks a big step forward in terms of user experience. That's why Chris Donahue, Microsoft's group manager for Games For Windows, calls the technology revolutionary.

"We've redone the driver model to fit in with the new Windows Vista Display Driver Model, which means you'll have much better performance and a much more stable experience. Shader Model 4.0 introduces new things like streaming and geometry shaders, which promise a revolutionary improvement in graphics quality," he says.

Few revolutions come without discord however, and to that extent at least, DirectX 10 is certainly Microsoft's most radical release. Underpinning many features of the Vista operating system, for that very reason it also marks the first time backwards compatibility with older operating systems has been cut.

■ Chris Donahue, Microsoft's group manager for Games For Windows

Put more starkly, the launch of DirectX 10 will force PC developers to effectively create two SKUs; a DX10 game for Vista users and a DX9 version for the majority Windows XP users.

Of course, in the medium to long-term the pain will be worth it, both for PC developers and Xbox 360 developers as Microsoft's new crossplatform XNA technologies (which now include XNA Studio, Framework and Build) making overall development more efficient.

"The DirectX SDK currently includes cross-platform APIs such as the XInput API, the XACT audio tool, and PIX, the performance improvement toolkit," Donahue points out. "And as XNA develops further, we'll expect to see additional streamlining for cross-platform development across Xbox and Windows."

■ **msdn.microsoft.com/directx/**

WIDENING THE PLATFORM

Originally designated as the breakpoint from the DirectX moniker (it long laboured under the Windows Graphics Foundation label), DirectX 10 has been some time in development. Not only has it been delayed because of its integral position with respect to Microsoft's Vista operating system, but it's also had to contain the demands of PC game developers, in terms of encompassing the future of PC graphics. This has involved everything from behind-the-scenes issues such as reducing batch overhead for drawing triangles to expanding the flexibility of shader architecture.

In this context, DirectX 10 continues to extend the programmability of graphics hardware with geometry shaders, which natively handle primitives and subdivisional surfaces, added to the previous vertex and pixel shaders. The resulting unified shader architecture, which combines all three types, will result in graphics cards which are increasingly CPU-like in their programmability. Havok's FX physics on graphics cards will only be the start of what ATI and Nvidia's hardware will be capable of doing as audio and other CPU-like tasks could be offset – Intel beware.

Torque Game Builder

Price: Between $100 to $1,250
Company: GarageGames
Contact: + 01 541 345 3040

Leveraging its indie technology into a more patalable form for emerging studios, GarageGames has released its 2D-oriented Torque Game Builder and Torque Game Builder Pro products. Features include animated sprites, flexible tiles, special effects system, real world physics and hardware-accelerated 2D rendering, together with level editors. Source code is also provided as part of Torque Game Builder Pro, which accounts for its higher price: $1,250 for commercial studios versus $495 for indies. The source codeless vanilla Builder goes for $250 versus $100 for indies.

■ www.garagegames.com

NVPerfHUD 4

Price: Free
Company: Nvidia
Contact: + 44 118 903 3000

The latest version of Nvidia's Windows performance analysis and visual debugging tool NVPerfHUD 4 comes with more virtual knobs to twiddle. The frame profile mode enables you to automatically check the performance of your application, providing information on the most expensive render states and draw calls. Vertex assembly, vertex shader, pixel shader and raster operations workloads can also be viewed within the performance dashboard with unit utilisation graphs. The user interface has been spruced up too, with the addition of configurable graphs.

■ www.nvidia.com

Hansoft

Price: €25 per month per user
Company: Hansoft
Contact: + 46 18 10 90 90

Project management and collaboration tool Hansoft is becoming even more flexible with its latest release extended to support Agile development techniques such as Scrum and Extreme Programming. Typically involving fast, iterative development cycles, these will be handled using customisable templates so local variations on such methods can be easily managed within Hansoft. This means that teams will be able to pick-and-choose how they approach development; for example having Agile sub-teams working within the unified framework prescribed by Hansoft.

■ www.hansoft.se