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Technical Skills

Programming Languages:

C/C++, Pentium Assembly (SIMD: SSE, MMX), PowerPC and AltiVec VMX intrinsic, STL, Boost, PlayStation2 MIPS assembly, VU microcode and MMI, DirectX shader assembler and HLSL, Cg, Xbox pixel shader combiners, Python, HTML/CSS, CGI, JavaScript, Unix C-Shell, Lisp (Scheme), BASIC

Tools/Libraries:

DirectX8/9/10/11 (PC/XBox), libgcm (PS3), Unreal Engine, RenderWare, IrisGL/OpenGL, Glide (3dfx raster library), MS Visual Studio/Visual C++, CodeWarrior, Perforce, SVN, Emacs, MASM, VTune, PIX (PC, Xbox 360), GPAD (PS3)

Operating Systems:

Windows 9x/NT/2000/XP/Vista/7, Mac OS X, DOS, Linux, Unix, SGI Iris, HP-UX

Work Experience

4/10 – present: Principal Graphics Engineer, [Turbine \(Warner Bros\)](#) – Redwood City, CA

[Lord of the Rings Online](#) and [Dungeons & Dragons Online](#) Massively Multiplayer Online (MMO) games for the PC

- Multi-platform rendering support, including PC DX9, DX10, DX11, PS3 and Xbox 360
- Optimizations of various components, including skinning, rendering pipeline, core parallelism
- Vertex compression improvements on all platforms
- Investigation of features to improve the graphics and performance of our engine

10/07 – 12/09: Principal Graphics Engineer, [Shaba Games \(Activision\)](#) – San Francisco, CA

7/09: [DJ Hero](#) for Xbox 360 and PlayStation3

- various rendering optimizations
- eliminated CPU and GPU stalls on the Xbox 360 for improved parallelism
- implemented and improved some post processing filter effects for Xbox 360 and PS3

10/08: [Spiderman: Web of Shadows](#) for Xbox 360 and PlayStation3

- improved and maintained rendering pipeline and shader architecture
- optimized graphics pipeline and shaders
- implemented HDR rendering, with high quality bloom and tone mapping
- implemented new post processing system, with numerous filters, including depth-of-field and radial blur
- implemented image-based lighting for more realistic lighting
- responsible for the majority of the PlayStation3 graphics, nearly full parity with Xbox 360 graphics
- SPU code improvement and increased utilization to relieve the PPU

Graphics R&D:

- efficient deferred lighting, supporting 100s of light sources and still maintaining framerate
- experimented with tiled lighting and pass per light with stenciling
- real-time computation of line light sources, can be later extended to area light sources
- multiple methods of doing real-time ambient occlusion in screen space
- vector and matrix library fully optimized using AltiVec VMX intrinsics

8/05 – 9/07: Senior Graphics Engineer, [Perpetual Entertainment](#) – San Francisco, CA

[Gods & Heroes – Rome Rising](#): Massively Multiplayer Online (MMO) game for the PC

- mainly responsible for the rendering pipeline and shader architecture

- improved shadow rendering algorithm by increasing effective resolution of the shadow map
- post-process filtering architecture for easily adding post-render full screen effects (e.g. bloom, radial blur)
- extensive profiling and optimizations of various systems (shaders, rendering pipeline, vector, matrix and math libraries, etc.)
- geometry batching for reduced D3D draw calls, which leads to higher performance
- geometry compression for saving memory
- re-designed the shader architecture and replaced RenderWare's D3D rendering structures
- memory usage optimizations, memory managing, memory tracking
- numerous profiling and visual debugging tools to help programmers and artists improve the game
- multi-threaded asynchronous asset loading / streaming, highly optimized with minimal thread contention
- fully memory mapped file system, with and without packed files, with optional compression

7/00 – 8/05: **Senior Graphics Technology Engineer, [Rainbow Studios \(THQ\)](#) - Phoenix, AZ** (remote office in Emeryville, CA)

Shipped games:

- 3/05: [MX vs. ATV Unleashed](#) for PlayStation2 and for Xbox
- 2/04: [MX Unleashed](#) for PlayStation2 and for Xbox
- 8/03: [Splashdown: Rides Gone Wild](#) for PlayStation2
- 11/02: [ATV Offroad Fury 2](#) for PlayStation2
- 8/02: [Mat Hoffman's Pro BMX 2](#) for PlayStation2 and for Xbox
- 6/02: [Splashdown](#) for Xbox
- 2/02: [Star Wars - Racer Revenge](#) for PlayStation2
- 11/01: [Splashdown](#) for PlayStation2

multi-platform rendering engine (PS2, Xbox, PC):

- shader architecture enabling hundreds of combinations of shaders
 - VU1 microcode for PS2, DirectX shaders for Xbox and PC
 - shader generators used to maximize code sharing, and minimize rewrites
 - one can easily and quickly create a new shader for a new effect
 - various lighting techniques (diffuse, specular, iridescent, etc.)
 - various texture mappings (environment mapping, projected texturing, etc.)
- terrain renderer microprograms
- vector and matrix library (highly optimized for Pentium3/Xbox using SSE and for the PS2 using VU and MMI)
- quaternion library
- math library
- code optimization (algorithmic optimizations and instructional optimizations using Pentium and MIPS assembly, SSE, VU, MMI)
- portals for visibility culling
- hierarchy of matrices and bounding boxes for models
- wake water physics simulation optimization in SSE
- VU0 micromode vector and matrix library (runs in parallel with CPU)
- octree spatial subdivision for fast scene search and traversal
- efficient triangle stripping and vertex caching algorithm
- shader convertor that takes PS2 multi-pass blended shaders into single pass Xbox pixel shader combiners (highly optimized)

3D graphics research and development: [\[demos\]](#)

- **Procedurally generated and animated clouds and smoke volumes**
 - Dynamically renders and animates layers of clouds using dynamically generated noise
 - Smoke volume represented as slices of a procedurally generated noise volume texture
- **Post-processing filter architecture**
 - Highly optimal and extensible system for rendering multiple filter passes
 - Includes filters such as bloom, Gaussian blur, radial blur, spherize, and noise
- **Multiple detail layered terrain rendering**
 - Spline for low frequency hill details
 - Displacement map for next level of details
 - Bumpmap for finer details
 - Procedural noise textures for minute details, with numerous levels of detail

- **Water simulation and rendering on the GPU**
 - Computes motion of water with forces applied to it as a spring based force simulation
 - Renders water as a dynamically displaced height field
- **[Sort independent alpha blending](#)**
 - Dissecting the alpha blend formula and using higher precision render targets (16-bits per channel) we can achieve a close approximation to the final color of multiple passes of alpha blending without having to do any sorting
- ***Bicubic spline surface rendering***
 - renders bicubic Catmul-Rom spline surface
 - could render different uniform splines just by changing basis function matrix
 - dynamic lod tessellation
 - each surface patch has 4 edge lods and a separate center lod, to avoid cracks between adjacent patches with different lods
- ***Deferred lighting***
 - uses floating-point render targets and cube texture maps, in addition to multiple render targets
 - per-pixel lighting and shadowing for multiple point light sources done as a fullscreen post process
 - depth buffer shadow mapping supports self shadowing, and works in a single pass for 4 lights, computed at the same time as the lighting
- ***Procedural texture mapping***
 - procedurally generated noise texture maps
 - completely generated in a pixel shader
 - pixel shader generates random colors and computes noise function
 - virtually unlimited texture resolution at essentially zero memory cost
- ***Procedural volumetric lightmap with bumpmapping and offset displacement mapping***
 - per-pixel lighting for 8 point lights
 - volumetric lightmap generated procedurally in pixel shader
 - texture coordinates are moved away from view direction to give a visual effect of per-pixel depth using a displacement map (matching the normal map used for the bumpmap lighting)
- ***Shadow mapping***
 - depth buffer shadow mapping with self shadowing
 - improved perceptual resolution with a trapezoidal projection warping
 - multiple levels of percentage closest filtering (PCF) for smoother shadow edges
- ***Displaced subdivision surface***
 - subdivision surface with displacement mapping
 - triangles are treated as barycentric Bézier patches
- ***Slick surface***
 - surface defined by a displaced cylindrical shape following a cubic Cardinal spline as the center axis
 - each section of the base spline is tessellated by a section of a displaced, scaled and twisted cylinder
- ***Displacement mapping***
 - mapping a displacement to an arbitrary triangle
 - normals are quickly and efficiently interpolated across the triangle, using spherical linear interpolation (quaternions)
 - interpolated normals don't require re-normalization
 - almost all work is done on the GPU, including transformation to tangent space, displacement, and surface normal computation from the displaced surface
 - CPU is only used for tessellation (dynamic), displacement map lookup, and normal interpolation
 - next generation shader model 3.0 will allow texture lookup in vertex shaders, which will further speed up performance
- ***DX9 shader effects***
 - uses HLSL shader language
 - per-pixel effects, including bumpmapped lighting, bumpy environment mapping, parallax displacement mapping

2/98 - 7/00: Software Engineer, [3dfx Interactive Inc.](#) - San Jose, CA

3D graphics research and development: [[demos](#)]

- ***Donut demo:*** multi-texturing techniques - environment mapping, bump mapping, specular lighting
- ***Surf Demo:*** rendering spline surfaces (B-Spline and Bézier) with dynamic level of detail patch tessellation
- ***Scene Renderer:*** fast high polygon scene rendering (highly optimized for PentiumIII KNI SIMD)
- ***Displacement mapping:*** mapping a height field to an arbitrary quad (using quaternions to interpolate the normals)
- ***Terrain Engine:*** rendering a uniform height field terrain

- **Water Simulation:** simulates the motion of water using a highly tessellated grid
- **Skinned Animation:** vertex animation using hierarchical bones and weighted vertices for organic animation effects
- **Lightmapping:** lightmaps generated from multiple dynamic colored light sources
- **Shadow Volume:** real-time pixel accurate shadow casting algorithm

Game porting/helping:

- **Unreal:** helped make the game run properly on Voodoo Rush
- **Half-Life:** ported the MiniGL version of the game to Glide3; also added detail texturing

Driver work:

- **3dfx Splash Screen:** added clipping, anti-aliasing, lighting, and environment mapping; minor optimizations
- **MiniGL driver:** unifying the MiniGL for all MiniGL based games; helping with AMD's 3DNow optimizations

1/96 - 1/98: Software Engineer, Cyclone Studios ([3DO](#)) - San Mateo, CA

[Uprising](#) (action/strategy PC game, released 10/97):

- **The Level Editor:** 3D pipeline used to render and modify a terrain database
- **The Game:** Special effects, special weapons, rasterizers, hardware support

Third Domain (3D terrain strategy game - cancelled):

- 3D terrain engine; optimizations

2/95 - 12/95: Software Engineer, [Integrated Manufacturing Laboratory](#) - UC Berkeley, CA

Milling Machine Software Utilities:

- Milling machine graphical simulator and path generator
- Tool picking algorithm for the milling machine

Research/Publications

3/07: [Sort-Independent Alpha Blending](#)

GDC 2007 – using modern graphics hardware, we can render alpha blended objects without needing to sort

3/00: [Advanced Lighting Effects - Overbright halos \(high dynamic range lighting, aka HDR\)](#)

Total Immersion 2000 - using numerous texture passes to create overbright halo effects (simulate Gaussian blur)

3/00: [Dynamic Lightmaps](#)

Total Immersion 2000 - multiple colored lightmaps for real-time applications

3/98: [B-Spline Surfaces](#)

Total Immersion 1998 - fast rendering of spline surfaces, using variable patch subdivision (adjacent patch stitching)

4/97: [Interactive Generation of Scherk-Collins Sculptures](#)

Proceedings of the 1997 Symposium on Interactive 3D Graphics (SI3D'97)

8/95 - 8/97: [Professor Carlo H. Séquin](#) - UC Berkeley, CA

Complex single-sided [Scherk Surface](#) generator/renderer written on IrisGL and OpenGL

Education

8/91 - 12/95: [University of California at Berkeley](#)

B.S. in Electrical Engineering and Computer Science

1997 – 2009: [SIGGRAPH](#) Conferences (except for 2006 and 2008)

1996 – 2009: [Game Developer Conferences](#)

Interests

Video games, Computer Graphics, Programming, Code Optimization, Sports Cars, User Interface, Electronics, Astronomy

Organizations

[Eta Kappa Nu \(H.K.N.\)](#) - Electrical Engineering and Computer Science Honor Society

[Computer Science Undergraduate Association \(C.S.U.A.\)](#)

[U.C. Berkeley Karate Club](#) (nidan - second degree black belt)

Demos and references are available upon request.