

NVIDIA®

Performance Tools

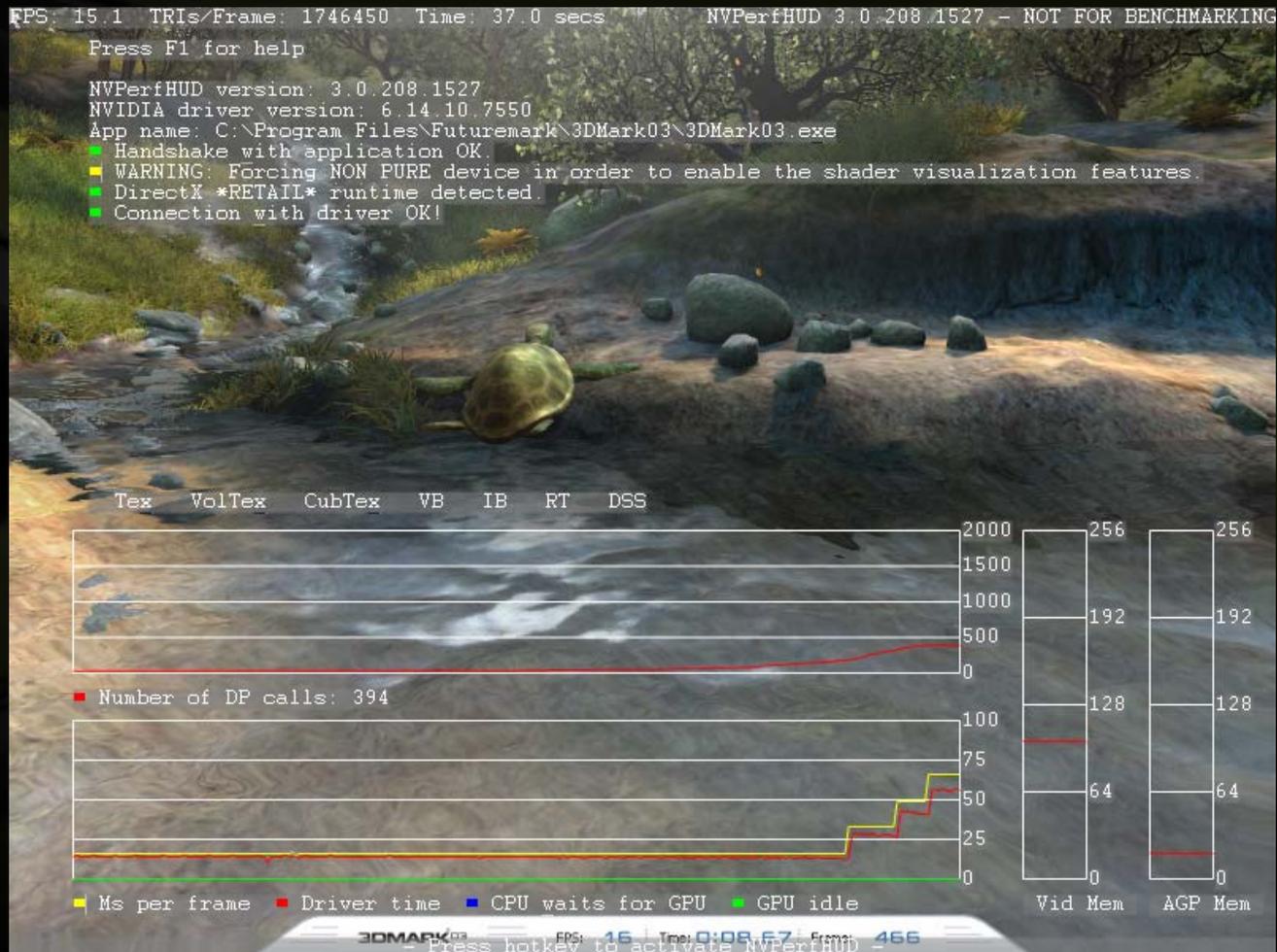
Raul Aguaviva, Sim Dietrich, and Sébastien Dominé

Agenda



- **NVPerfHUD 3.0**
 - The tool
 - In real life
- **NVPerfKIT 1.0**
- **NVShaderPerf 71.84**
- **FX Composer 1.6**
- **Conclusion**
- **Q&A**

NVPerfHUD 3.0



Debug Console



The screenshot shows a game window titled "DeferredShading" with a blue title bar. The window contains a 3D rendered scene of a desert landscape with a red building and a road. A debug console is overlaid at the bottom, displaying the following text:

```
D3D9 Helper: Enhanced D3DDebugging disabled; Application was not compiled with D3D_DEBUG_INFO  
Direct3D9: (INFO) :===== Hal HWVP device selected
```

On the right side of the console, there are two checkboxes:

- Clear Log each frame.
- Stop Logging.

At the bottom of the window, there are three keyboard shortcuts: F5 - Performance, F6 - Debug Console (highlighted with a green dot), and F7 - Frame Analysis.

Frame Analysis



DeferredShading FPS: 53.9 TRIs/Frame: 68883 Time: 732.2 secs [ON] NVPerfHUD 3.0.208.1527 - NOT FOR BENCHMARKING

Top 10 Warning List

	D3DRTYPE_TEXTURE 256x256 D3DFMT_DXT3 MIPs:9 Mag:LINEAR Min:LINEAR MIP:LINEAR		
	Not used		
	Not used		RD3DRTYPE_TEXTURE 791x565 D3DFMT_A8R8G8B8 MIPs:1
	Not used		RD3DRTYPE_TEXTURE 791x565 D3DFMT_R32F MIPs:1
	Not used		
	Not used		RD3DRTYPE_TEXTURE 791x565 D3DFMT_A8R8G8B8 MIPs:1

Prims Drawn: 68219
DrawIndexedPrimitive(D3DPT_TRIANGLELIST,
0, 0, 211, 0, 380)
RT:0x00aed730 BB:0x001565a0
DP Pointer 220 / 247

Step Back Step Forward Advanced

- Jump to Warnings
- Force Clear
- Wireframe
- Depth Complexity

F5 - Performance F6 - Debug Console F7 - Frame Analysis

Advanced - Index Unit

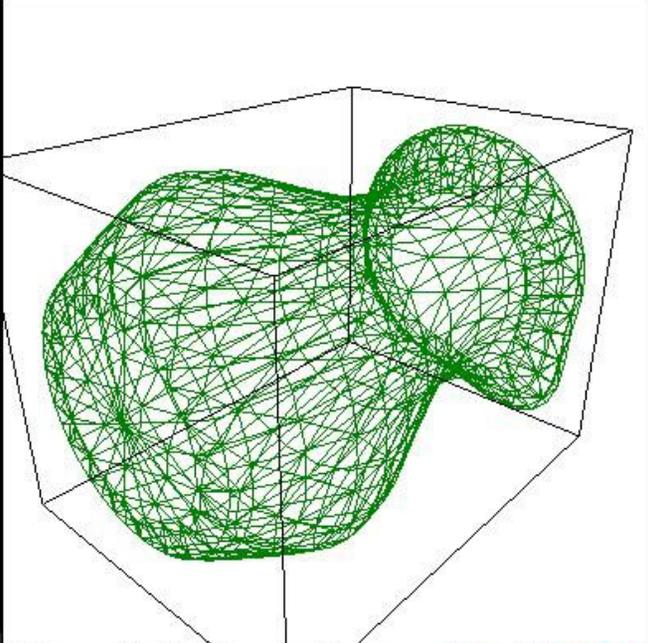


DeferredShading

FPS: 57.2 TRIs/Frame: 68883 Time: 938.3 secs [ON] NVPerfHUD 3.0.208.1527 - NOT FOR BENCHMARKING

Index Unit Vertex Shader Pixel Shader Raster Operation

Wireframe



Index / Vertex Buffer

```
** DP Info **  
DrawIndexedPrimitive:  
Type: D3DPT_TRIANGLELIST  
BaseVertexIndex: 0  
MinVertexIndex: 0  
NumVertices: 783  
startIndex: 0  
primCount: 1484  
HRESULT: 0x00000000  
Msg: S_OK  
Desc: The function completed successful  
  
** Index Buffer Description **  
Format : D3DFMT_INDEX16  
Pool : D3DPOOL_MANAGED  
Usage : D3DUSAGE_WRITEONLY  
Length: 8904 bytes  
  
** VB Declaration **  
Total vertex size: 72  
0 - POSITION FLOAT3 DEFAULT  
0 - NORMAL FLOAT3 DEFAULT  
0 - COLOR D3DCOLOR DEFAULT  
0 - TEXCOORD FLOAT2 DEFAULT  
0 - TEXCOORD FLOAT3 DEFAULT  
0 - TEXCOORD FLOAT3 DEFAULT
```

Step Back Step Forward Simple DP Pointer 176 / 247

F5 - Performance F6 - Debug Console F7 - Frame Analysis

Advanced – Vertex Shader



DeferredShading

FPS: 57.7 TRIs/Frame: 68883 Time: 1054.4 secs [ON]NVPerfHUD 3.0.208.1527 - NOT FOR BENCHMARKING

Index Unit Vertex Shader Pixel Shader Raster Operation

Vertex Shader

```
// c2 = { 0, 0, 0, 0 };  
// c3 = { 0, 0, 0, 0 };  
//  
// WorldViewIT  
// c4 = { 0, 0, 0, 0 };  
// c5 = { 0, 0, 0, 0 };  
// c6 = { 0, 0, 0, 0 };  
//  
  
vs_1_1  
dcl_position v0  
dcl_normal v1  
dcl_texcoord v2
```

Textures



Sampler: s0
D3DRTYPE_TEXTURE 256x256
D3DFMT_DXT3
MIPs:8
Mag:LINEAR Min:LINEAR MIP:LINEAR

Vertex Shader Constants

Floating Point Constants:

```
C[ 0]: -1.130298 0.503030 0.0000  
C[ 1]: 0.063986 0.143776 1.7248E  
C[ 2]: 0.404976 0.909972 -0.090E  
C[ 3]: 0.404912 0.909830 -0.090E  
C[ 4]: -0.913609 0.406594 0.0000  
C[ 5]: 0.036943 0.083009 0.9958E  
C[ 6]: 0.404912 0.909830 -0.090E
```

Step Back Step Forward Simple DP Pointer 161 / 247

F5 - Performance F6 - Debug Console F7 - Frame Analysis

Advanced – Pixel Shader



DeferredShading

FPS: 48.7 TRIs/Frame: 68883 Time: 1338.9 secs [ON]NVPerfHUD 3.0.208.1527 – NOT FOR BENCHMARKING

Index Unit Vertex Shader **Pixel Shader** Raster Operation

Pixel Shader

```
// Registers:  
//  
// Name      Reg Size  
// -----  
// DiffuseMapSampler s0  1  
//  
  
ps_2_0  
def c1, 1, 0.5, 0, 0  
dcl t0.xy  
dcl_2d s0  
texd_pp r0, t0, s0  
mov r0.w, c1.x
```

Pixel Shader Constants

```
Floating Point Constants:  
C[0]: 0.000000 0.000000 0.000000  
C[1]: 0.000000 0.000000 0.000000  
  
Integer Constants:  
  
Boolean Constants:
```

Textures

Sampler: s0
D3DRTYPE_TEXTURE 1024x512
D3DFMT_DXT3
MIPs:11
Mag:LINEAR Min:LINEAR MIP:LINEAR

Step Back Step Forward Simple DP Pointer 164 / 247

F5 – Performance F6 – Debug Console F7 – Frame Analysis

Advanced – Raster Operation



DeferredShading

FPS: 33.5 TRIs/Frame: 68883 Time: 1640.2 secs [ON]NVPerfHUD 3.0.208.1527 - NOT FOR BENCHMARKING

Index Unit Vertex Shader Pixel Shader Raster Operation

Render Targets and Render States

```
** Back Buffer Information **
Back Buffer size: 791x565
BackBufferFormat: D3DFMT_X8R8G8B8
Back Buffer count: 2
MultiSampleType: D3DMULTISAMPLE_NOI
MultiSampleQuality: 0
AutoDepthStencilFormat: D3DFMT_D24X8
FullScreen_RefreshRateInHz: 0
Windowed: 1

** RenderStates Dump **
ZENABLE = D3DZB_FALSE
FILLMODE = D3DFILL_SOLID
SHADEMODE = D3DSHADE_GK
ZWRITEENABLE = TRUE
ALPHATESTENABLE = FALSE
LASTPIXEL = TRUE
SRCBLEND = D3DBLEND_SRC
DESTBLEND = D3DBLEND_INV
CULLMODE = D3DCULL_CCW
ZFUNC = D3DCMP_LESSEQL
ALPHAREF = 0
ALPHAFUNC = D3DCMP_ALW
DITHERENABLE = FALSE
ALPHABLENDENABLE = TRUE
FOGENABLE = FALSE
```

Step Back Step Forward Simple DP Pointer 247 / 247

F5 - Performance F6 - Debug Console F7 - Frame Analysis

NVPerfHUD 3.0 – Freezing the game



- Only possible if game uses time-based animation
- Stop the clock
 - Intercept: `QueryPerformanceCounter(...)`
`timeGetTime(...)`
 - No RDTSC
- $Pos += V * DeltaTime$
- When `DeltaTime` is 0
 - Don't divide by `DeltaTime`
 - Don't skip `Presents()`

Coming Soon!



- **NVPerfHUD 4.0**
 - **Pipeline utilization graph**
 - **Automated Bottleneck Identification**

NVPerfHUD Schedule



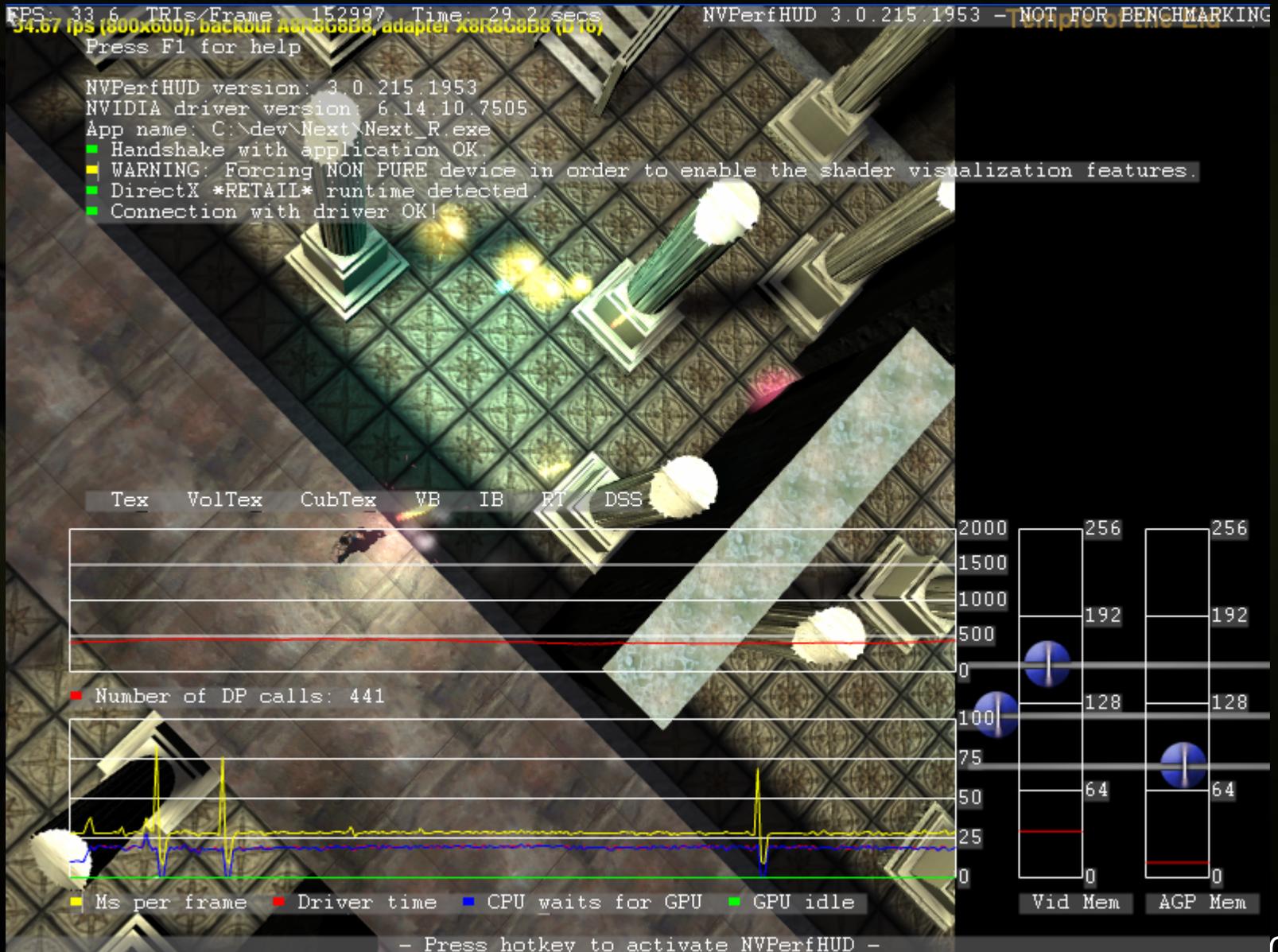
● NVPerfHUD 3.0

- Registered developer Beta 2 : now
- Registered developer Beta 3 : 3/16/2005
- Final Release : 3/23/2005

● NVPerfHUD 4.0

- Registered developer Beta: 5/1/2005
- Final Release : 5/15/2005

NVPerfHUD in real life...



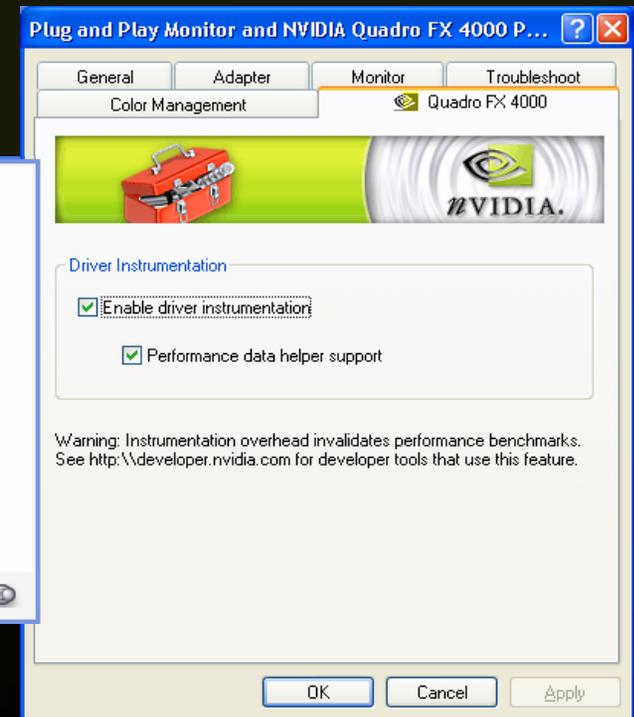
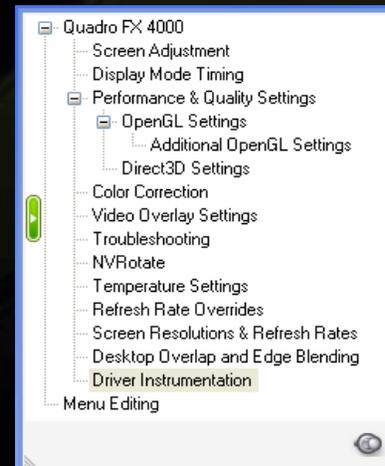


- **Complete Performance Instrumentation Solution**
 - **Instrumented Driver**
 - **NVIDIA Developer Control Panel**
 - **Plug-in for Microsoft PIX for Windows**
 - **Support for PDH (Performance Data Helper)**
 - **Code samples for OpenGL and Direct3D**
 - **Secure mechanism for authorizing applications to be instrumented**

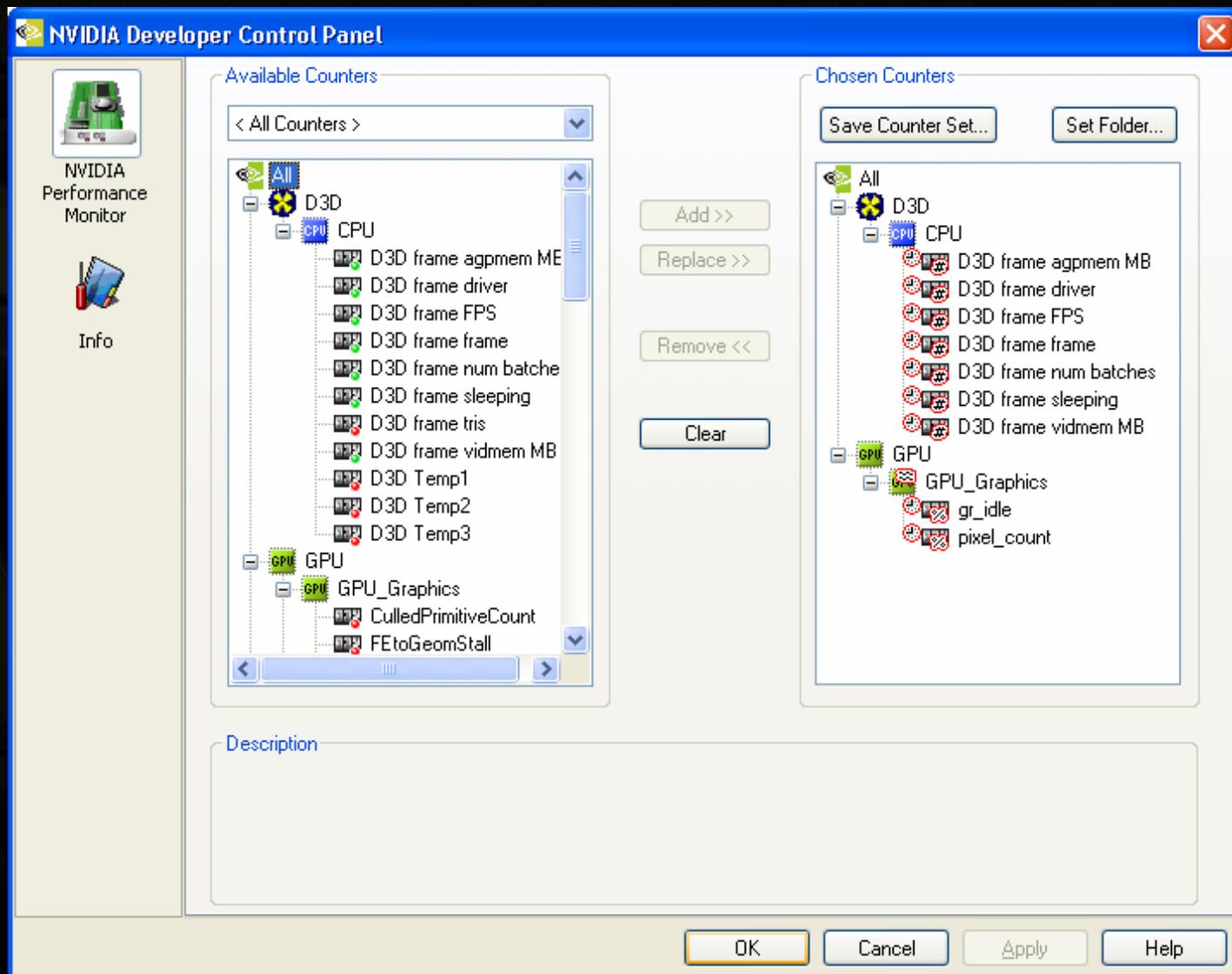


● Instrumented Driver

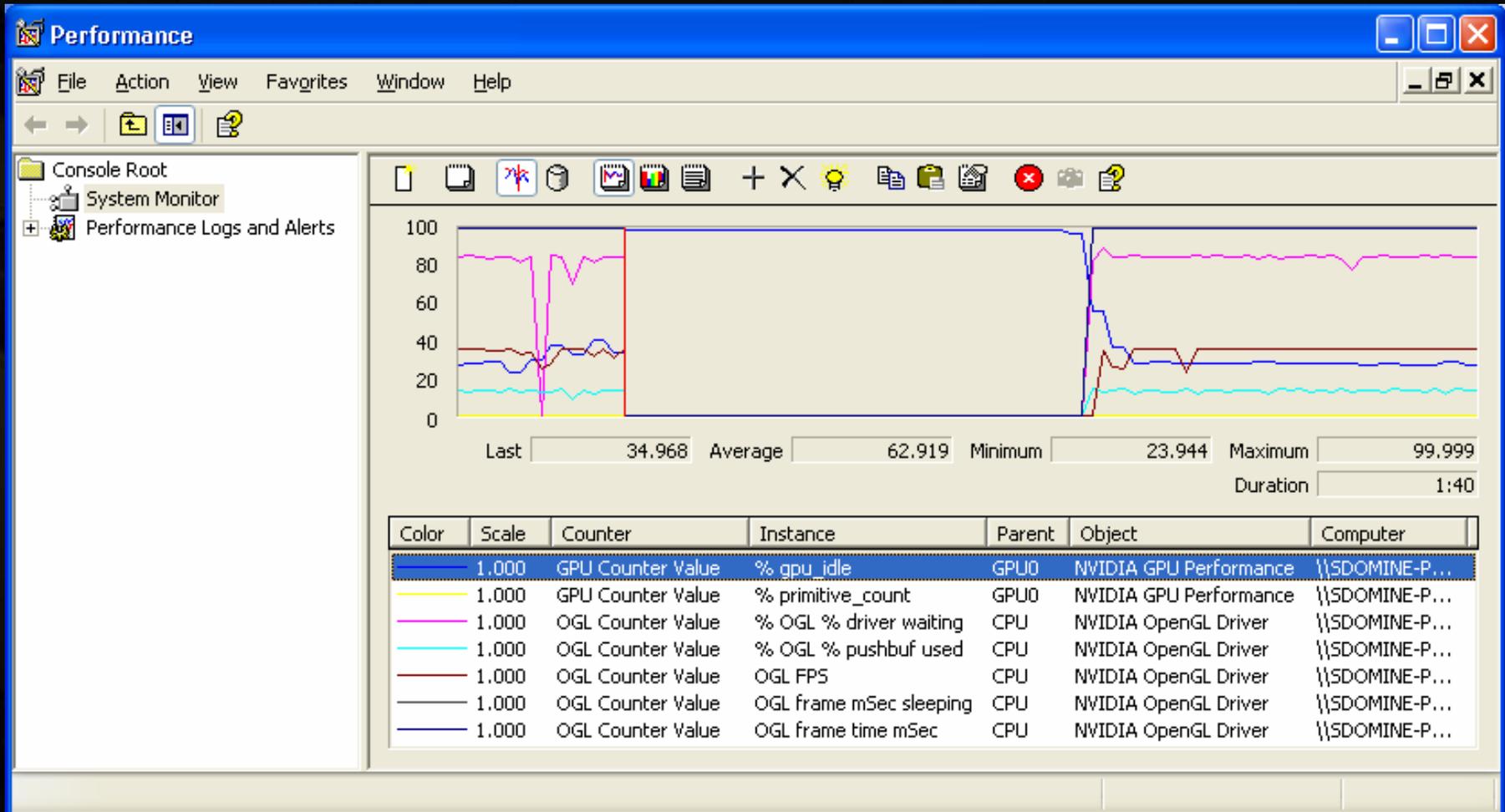
- Exposes GPU and Driver Performance Counters
- Supports OpenGL and Direct3D
- Supports SLI Counters
- Requires GeForce FX or 6 Series



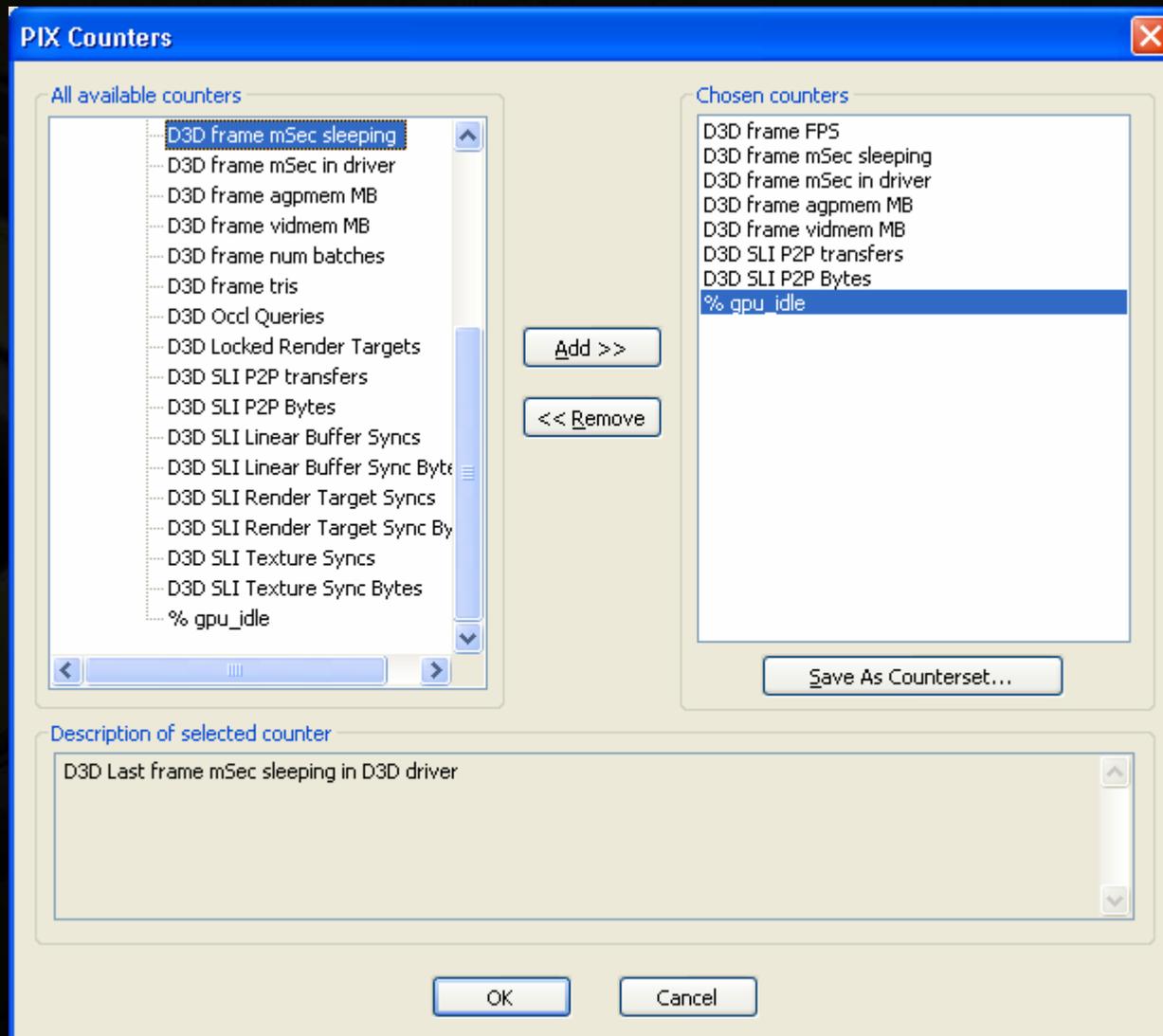
NVPerfKIT NVIDIA Developer Control Panel



NVPerfKIT Performance Data Helper



NVPerfKIT Plugin for Microsoft PIX



NVPerfKIT



● Schedule

- Registered Developer - Early Beta Access : 3/16/2005
- Registered Developer - Beta : 3/23/2005
- Registered Developer - Release : 4/7/2005

NVShaderPerf – Coming up...



- **Vertex throughput**
- **GLSL vertex program**
- **Multiple driver versions**
- **What else do you need?**

FX Composer 1.6 – Shader Perf



- Disassembly
- Target GPU
- Driver version match
- Number of Cycles
- Number of Registers
- Pixel Throughput
- Forces all fp16 and all fp32 (gives performance bounds)

The screenshot displays two instances of the Shader Perf tool. The top window is for a GeForceFX 5200 GPU, showing a Pixel Shader with 51 cycles and 4 registers, achieving a pixel throughput of 15.69 MP/s. The bottom window is for a GeForce 6800 Ultra GPU, showing a Pixel Shader with 21.00 cycles and 3 registers used, achieving a pixel throughput of 304.76 MP/s. The bottom window also displays the disassembly code for the shader.

```
*****
Target: GeForceFX 5200 Ultra (NV34) :: Unified Compiler: v61.77
Cycles: 51 :: # R Registers: 4
Pixel throughput (assuming 1 cycle texture lookup) 15.69 MP/s
=====
Shader performance using all FP16
Cycles: 51 :: # R Registers: 2
Pixel throughput (assuming 1 cycle texture lookup) 15.69 MP/s
=====

Shader per
Cycles: 51
Pixel throu
*****
PS Instruct
ps_2_0
def c9, 0, -
def c10, 0,
.....
<
Property

Shader Perf
*****
Target: GeForce 6800 Ultra (NV40) :: Unified Compiler: v61.77
Cycles: 21.00 :: R Regs Used: 3 :: R Regs Max Index (0 based): 2
Pixel throughput (assuming 1 cycle texture lookup) 304.76 MP/s
=====
Shader performance using all FP16
Cycles: 14.00 :: R Regs Used: 2 :: R Regs Max Index (0 based): 1
Pixel throughput (assuming 1 cycle texture lookup) 457.14 MP/s
=====
Shader performance using all FP32
Cycles: 21.00 :: R Regs Used: 3 :: R Regs Max Index (0 based): 2
Pixel throughput (assuming 1 cycle texture lookup) 304.76 MP/s
*****
PS Instructions: 38
ps_2_0
def c9, 0, -2, 3, 1
def c10, 0.5, 0, 0, 0
.....
<
Properties Shader Perf
```

Questions?



- NVPerfHUD@nvidia.com
- FXComposer@nvidia.com
- NVshaderPerf@nvidia.com
- NVPerfKIT@nvidia.com

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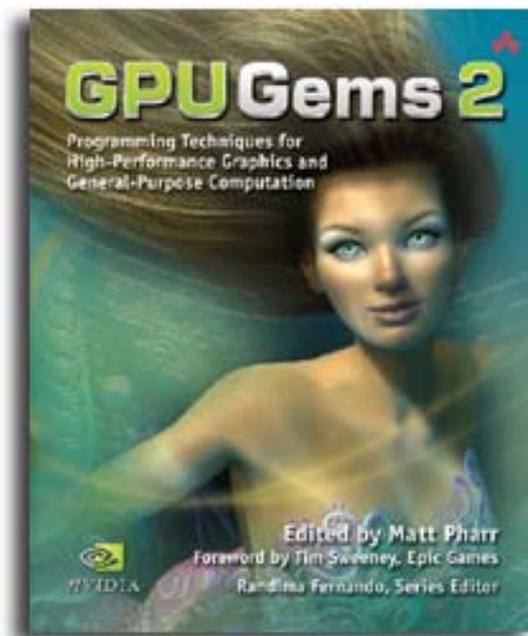
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