NVIDIA Parallel Nsight™

Jeff Kiel



Agenda: NVIDIA Parallel Nsight[™]



- Programmable GPU Development
- Presenting Parallel Nsight
- Demo
- Questions/Feedback



More programmability = more power, more control and cooler effects!

BUT more power = longer programs...how do I debug this code?

How do I harness this amazing hardware in an environment I am familiar with?



Image property of Unigine Corp., used by permission

Programmable GPU Development



My scene should look like this...



Image property of Emergent Game Technologies Inc., used by permission

Programmable GPU Development



...but instead looks like this ⁽²⁾ How do I...debug my skinning shader?



Image property of Emergent Game Technologies Inc., used by permission

Programmable GPU Development How do I...



...figure out *what* model led to *which* draw call that produced *some* fragment that was or wasn't blended properly to produce *this broken pixel*!?!?

...understand why my performance tanks in this room or when a certain character enters the scene?

...and on...and on...and on.



Image property of Emergent Game Technologies Inc., used by permission

Programmable GPU Development







- 2-4 cores
- 6-12 concurrent threads

256-512 or more cores 1000s...10000s concurrent threads

Fundamental problem: Scaling from CPU to GPU is immense and we need tools to make this possible!

Presenting Parallel Nsight[™]



GTX480 + Parallel Nsight + Visual Studio One Killer DirectX Development Environment

Integrated into Visual Studio

Powerful and familiar user interface

Hardware-based shader debugger

All shader types, including tesselation and compute No game modifications required

Full DirectX10/11 frame debugging & profiling

Including Pixel History, with debugger integration

Combined CPU/GPU performance tools

CPU and GPU activities on the same correlated timeline



Parallel Nsight Environment





Run remotely for Shader Debugging (GPU halts at breakpoint) Run locally or remotely for Frame Debugger and Profiling/Tracing

Demo: Launching

1. Launch Nsight Monitor



2. Configure Nsight Project Settings

x NVIDIA Parallel Nsight - User Settings: MangledMetal Launch Synchronization Launch Action Caunch project Launch external program: c:\Emergent\Gamebryo-DX11\Samples\GameDer ... Launch Options Connection name: DTPNCWin732-01 Command line arguments: c:\Emergent\Gamebryo-DX11\Samples\GameDer ... Working directory: OK Cancel

3. Launch Your Application in Visual Studio





Demo: HUD with Application Running



Demo: HUD in Frame Debugger





Demo: HUD Render Target Zoom





Demo: Frame Debugger Capture



Nsight performs a real time capture on your running application

Frame information synced between target application and Visual Studio on the host

Captures can be saved for later analysis Return to application at any time

	Debug Noisi	t Sandbox	Tools Test Wins	sow Help								
Edit View Build D	arread read.											
9 - 😂 Я 🗿 🕺	20 20 19	· @ · IJ ·	Debug	· Win32	- 3		• • • •	3 X 🖬 🖬 -				
a 4 % [3	I CI Hex S	- -										
C	- Thread		- 7	Stack Frame:								
raphics Inspect Many	ngledMetal.ex											-
0 . 4 6	Process	3588 + Snaps	hot + Frame1 +									
Fuer	rots		20000	20000	30000 600	an 5000	0 600	00 7	745272			
Frames		-			Frame 1							
Draw/Dispatch	Y				و و و و ا ا ا							
Dependencies												
DertMarkers												
					Renderframe/Ren	der Frame)			and the second se			
				District	1992			National Charles	10	3 14		-
		-		318401	ustep			Jenenieu step	OI I	and the second	an and a state	-
				ShadowRC(R)	ender Click)		Deptrelormals D	ghtAccum Materia	Past		A DECK	
											1.11	
										Pixel History	Color Transform:	
		•								Pixel History	Color Transform:	
Actions: See details for Data	w Call 751 (6u	•			III Capture Statistics 818 draw calls in	fames				Pixel History Event 71776 - Dra (Frame 1)	Color Transform: nw Call 751	
Actions: See details for Draw Profile Frame 1	w Call 751. (Exp	•			11 Capture Statistics: 806 draw calls in 3	. frames				Pixel History Event 71776 - Dra (Frame 1)	Color Transform: w Call 751	
Actions: See details for Draw Profile Frame 1	w Call 751. (Eve	• []			19 Capture Statistics 808 draw calls in 2	. frames				Pixel History Event 71776 - Dra (Frame 1)	Color Transform: w Call 751	
Actions: See details for Draw Profile Frame 1	w Call 751. (Eve	• () nt.71776)			11 Capture Statistics 808 draw calls in 3	frames				Pixel History Event 71776 - Dro (Frame 1)	Color Transform. ww Call 751	
sctions: See details for Draw Profile Frame 1 th 1 me	w Call 751. (Eve	• [] nt 71776)			m Capture Statistics 808 draw calls in 1 0 3 7 spc	fames X Shaders * Handle		Shader Type	Symbolies Statu	Pixel History Event 71776 - Dro (Frame 1)	Color Transform: w Call 751	ue
stions: Sec details for Draw Profile Frame 1 th 1 me	w Call 751. (Eyr	•			n Capture Statistics B08 draw calas in 2 50 1 7 1 7 1 7 1 7 1 7 1 1 7 1 1 1 1 1 1	fames Studens Handle Ox1b41650 Dol	+20000000030	Shader Type Vertex	Symbolics Statu Reedy.	Pixel History Event 71776 - Dra (Frame 1)	Color Transform: w Call 751 age Technic No Tech	ue nique
Actionse See details for Draw Profile Frame 1 ch 1 me	w Call 751. (Eye	• Int 71779)			re Capture Statistice 808 draw calls in 7 808 draw calls in 7 7 ype	frames Shaders Shaders Handle Orthel 1840 0dd Orthel 1740 0	⊌00020000030 e0002000005e ⊌0002000005e	Shader Type Vertex Pixel Vertex	Symbolics Statu Ready. Ready.	Pixel History Event 71776 - Drc (Frame 1)	Color Transform: w Call 751 age Techniq No Tech No Tech	ue nique nique
Actions: See details for Draw Profile Frame 1 tch 1	w Call 751. (Sve	• (nt 71778)			m Capture Statistics 808 draw calls in 1 7 7 9 7 7 9 7	Fames Sheden Handle Ortha1850 0xd Ortha1720 0xd Ortha1720 0xd Ortha1720 0xd	60000000000000000000000000000000000000	Shader Type Vertex Vertex Vertex	Symbolics Statu Ready. Ready. Ready.	Pixel History Event 71776 - Drz (Frame 1)	Color Transform: w Call 751 age Techniq No Tech No Tech No Tech	ue nique nique
Actions: See details for Draw Profile Frame 1 ich 1 anne	w Call 751. (for	• (171776)			n Gapture Statistics 100 draw calls in 1 100 draw 100 draw 100 draw 100 draw 100 draw 100 draw	Frames Shedern Handle Cortise1860 Ord Onten120 Ord Onten1	#/00000001030 #/0000000058 #/0000000058 #/000000008 #/000000008	Shader Type Vertex Vertex Pael Vertex Pael Vertex	Symbolics Statu Resdy, Resdy, Ready, Ready, Ready,	Pixel History Event 71776 - Drz (Frame 1)	Color Transform: ww Call 751 age Techniq No Tech No Tech No Tech No Tech No Tech No Tech No Tech	ue nique nique nique nique
Actions: See details for Draw Profile Frame 1 ch 1 cmme	w Call 751. (Evr	• (nt 71776) Talue			m Capture Statistics 008 draw calls in 2 V 3 Type	frames # Shadan # Handle 0x1541180.004 0x1541781.004 0x1551781.004 0x1551781.004 0x1551781.004 0x1551781.004 0x1551781.004 0x1551781.004 0x1551781.004 0x1551781.004	w/0000000030 w/0000000094b w/0000000006b w/000000006c w/000000006c	Shader Type Vertex Pisel Vertex Vertex Vertex	Symbolics Status Ready Ready Ready Ready Ready Ready Ready	Pixel History Event 71776 - Dri (Frame 1)	Color Transform: w Call 751 no Techniq No Tech No Tech No Tech No Tech No Tech No Tech No Tech No Tech	ve nique nique nique nique
Actions: See Setails for Draw Profile Frame 1 ch 1 mme	w Call 751. (Eve	•			n Capture Statistics 808 draw calls in 1 9 9 1 9 1 9 1 9 1 9 1 9	fames Sector Se	#200000030032 #00000000590 #000000000590 #00000000000	Shader Type Vertex Vertex Paci Vertex Paci Vertex Vertex Vertex Vertex Vertex	Symbolics Statu Ready Re	Pixel History Event 71776 - Dro (Frame 1)	Color Transform: w Call 751 age Technic No Tech No Tech No Tech No Tech No Tech	ue nique nique nique nique

Demo: Host Frames Page





Demo: Draw Call Page





Ready

Demo: Texture Viewer





Demo: Depth Buffer Viewer





Demo: Output Merger State Inspector



× 141	sociedMetal (Bre	nden - Masser Wind Cherley (Menderheiter) - Eveningen Hinn	
Eile	Edit View	Ruild Rebug Niight Sandbox Iools Test Window Help	
101	- 01 - 😝 🔒	월 [사 집, 전, 전 · 전 · 전] · Debug · Weit2 · @ · 전 구매 2 · 이 · 이 · 이 · 이 · 이 · 이 · 이 · 이 · 이 ·	
1.5		1 (3 1) Hex 🚯 🔂 📲	
1 Proc	.e11.	- Thread: - Y Stack Frame:	
2	Graphics Insper	ct MangledMetaLexe	• x
Solut	000	🖀 🚳 + Process 2512 + Snapshot + Frame 1 + Event 55625 / Draw Call 632 + Output Merger	
on E			
2	IA	Depth Stendi State	
	+	StencilEnable False StenciReadMask 255 StencilWriteMask False	
	VS	Front: StenciFaiOp Keep StenciDepthFaiOp Keep StenciPassOp Keep StenciFunc Always Parts StenciFaiOa Keep StenciFunce Always	
	-	Backe stencinarup keep stencineptmalup keep stencinassup keep stencinunc Always	
	GS	Depth Stencil View	
	P	View Dimension Format Flags Dimension Usage bind CPU Misc Width Height invit/OpectName Texture2D D24 UNORM S8 UINT Undefined Texture2D Default DeothStencil Unspecified Undefined 1280 720 ID3D10Texture2D 2	
	SO	Evolution Taxante Views	
	191	View Dimension Format Dimension Usage Bind CPU Misc Width Height nwtObjectName	Inspect All
	RS	Texture2D R8G88848_UNORM Texture2D Default RenderTarget Unspecified Undefined 1280 720 ID3D10Texture2D 1	
		Blend States	Direct3D State
	PS	BlendFactor (0,0,0,0) BlendSampleMask 4294967295	
		BlendEnable SrcBlend DestBlend BlendOp SrcBlendAlpha DestBlendAlpha BlendOpAlpha RenderTargetWriteMask	
	OM	1 False Undefined Undefined Undefined Undefined Undefined 15	
		2 False Undefined Undefined Undefined Undefined Undefined 15 9 False Undefined Undefined Undefined Undefined Undefined 15	
		False Undefined Undefined Undefined Undefined Undefined 15	
		6 False Undefined Undefined Undefined Undefined Undefined 15	
		7 False Undefined Undefined Undefined Undefined Undefined 15	
		View Apy Stage	
		view Ally Stage	
		in the Direct3D	
		Pipeline	
L			
A	utos	- 4	X Shaden - 3 X
	fiame	Value Type	Shader Type Symbolics Status Language Technique Pass Name Vertex Ready. HLSL No Technique No Pass VSMain
			1 Poxel Ready HLSL No Technique No Pass PSMain
			3 Poxel Ready. HLSL No Technique No Pass Main
			4 Vertex Ready. HLSL No Technique No Pass Main 5 Pixel Ready. HLSL No Technique No Pass Main
			6 Vertex Ready, HLSL No Technique No Past Main
	Autos Cloca	Ir Si Thready 🕞 Modules 😰 Watch 1	Shades Sack Stack Operations Operations
100	Provinces		The answer and the entremeter and the Review and the Review and the Second second

Demo: Pixel History





Ready

Demo: Shader Debugger Breakpoint





Demo: Shader Debugger Focus



ManaledMate	Decupano - Microsoft Vitur Continue	devicutator - Sceneroseta Hue								- 0 - X
File Edit Vir	ew Project Build Debug Nsight	Sandbox Tools Test Window Help								State of the local division of the local div
10-00-00	HALL BURNER	- Debug + Win32 +		● 市会 第 回・Ⅱ						
	1 9 91 (3 9 Hex % 3	四年14月1日日日日日日日日日日日日日日日日日日日日日日日日日日日日日日日日日日日	ALA 13 8							
Process: [3296]	GPU - MangledMe - Thread: [0] Graphic	s Default Cont • 🎔 📝 Stack Frame: Shader: shader0000	p.hisi@i +							
5 shader000	00-p.hkl	Title and supported			- ×	Graphics Focus Picker				* 9 ×
0 // Ir	aput :					Summary	Pivels			
Mon //					*	Show the summary of the current status	I IACIS			
m struc	ct Input					Vertices (3D View) show the paused vertices to a 3D view	5542 Pbubet 1285/520	d Picelo		Д
10101	Floated Booksteinered - BORTEL					Vertices (Table View)				T
1	float2 UVSet0 : TEXCOORDO:					Show the paused vertices in a table view				
1.						Pixels Show the paused pixels on the current	1		COLUMN SCORE	1916 M 1
						render target				-
//			Divolc in	n Elight		Show the pauled compute threads			1	1000
//		*******		i i iigiit					all the	1. Au
atruc	ct Output			_					1.250053	
(Select Fo	cus Pive					and there are	
t i	float4 Color0 : COLORO;							A A	2010	100 C
32										ALC: NO.
11								JA N		
// He	sin():									
11								Mar No. 1		
Outpu	ut Main(Input In)							1 1 1 0 m		
	Output Out;							NY CILL		COLUMN THE OWNER
1	// Function call #0								51,105	
Ŧ	fextureROBASample(In.UVSet0,	Base, bool(false), ColorOut_CallOut0);							R: 0.373 G: 0.361	
7	// Function call #1							17	B. 0.290 A. 1.000	
T	float3 Color_CallOut1:							the second	Breakpoints	
1	<pre>/loat Opacity_CallOut1; SplitColorAndOpacity(ColorOu)</pre>	t CallOut0, Color CallOut1, Opacity Call	Dutl):					The second	● shader0000-p.hisl@@CRC(P@8D303555:190
								10 mm 1	A STATE	
4	<pre>// Function call #2 float3 OutputColor CallOut2;</pre>								1 7 7 MA	
¢	CompositeFinalRGBColor(Color	_CallOut1, float3(0.0, 0.0, 0.0),							- 20 M	
	Outputcolor_Callout2):							11 - 1		
	// Function call #3								2 - C - D -	1
× .	composition in a composition for the	second_carroute, opacity_carroute, out.								
, ²	return Out;						51.11	5		STORE IN
1.0							1-1-1-1		10 10	and the second second
31					•				Bet P	iel Rodangle
Locals				- 3 × Shaders				10.111		~ 3 ×
Name		Value		Type * Shader Ty	pe Symbolics S	Status Language	Technique	Pass Name		
E Out	Out_CelOut0	(x = 0.66374512, y = 0.22352941, z = 0.14901961, w = 1)		foat4 1 Pixel	Ready.	HLSL	No Technique	No Pasa PSMain		i i
E Color,	_CalOut1	(x = 0.66274512, y = 0.22352941, z = 0.14901961)		foat3 2 Vertex foat = 3 Pixel	Ready.	HLSL HLSL	No Technique	No Pass Main		
E Outpu	utColor_CallOut2	$\{x = 0.66274512, y = 0.22352941, z = 0.14901961\}$		foot3 4 Vertex	Ready.					
E Q Opixe	d uccordinate	(x=51.5, y=105.5) 0.20.5.3		Pixel Cool 5 Pixel 6 Vertex	Ready.					
In Autor	Locals of Thomas Theorem			* 7 Pixel	Read Ch		No Technique			
Paula Cal	Corres Manuales Change	R.4.]		And the second s		lange го	cus,	, LUCAIS		
neawy										
							ate			
						<u> </u>	rate			

Demo: Frame Profiler





Demo: Launching a Trace



Activity Parameters and Parameters a	angledMetal - Microsoft Visual Studio (Administrator) - Experimental Hive Edit View Build Debug Nsight Sandbox Iools Test Window Help • • • • • • • • • • • • • • • • • • •	Configure Application Setup
Activity Type Sect this ciplic to collect taxe data from a number of domains. System, Naight Tools Extension, CUDA, OpenCL, DirectX and OpenCL taxe options are available. Prode CUDA Mont Sect this ciplic to collect performance counters per CUDA hanch. Trace Control (11) (PdV Treed Trace Control (22) Opiner API Trace, Storage Counters, Kernels and Memory Tranefis COURD (22) Opiner API Trace. Storage Counters, Kernels and Memory Tranefis Counter (23) Opiner API Trace. Storage Counters, Kernels and Memory Tranefis Counter (23) Opiner API Trace. Storage Counter, Kernels and Memory Tranefis Counter (23) Opiner API Trace. Storage Counter, Kernels and Memory Tranefis Counter (23) Opiner API Trace. Storage Counter, Kernels and Memory Tranefis Counter (24) Opiner API Trace. Storage Counter, Kernels and Memory Tranefis Counter (25) Opiner API Trace. Storage Counter, Kernels and Memory Tranefis Counter (20) Opiner API Trace. Storage Counter, Kernels and Memory Tranefis Counter (20) Opiner API Trace. Storage Counter, Kernels and Memory Tranefis Counter (25) Opiner API Trace. Resource Trace. Program Build Callback Trace. Program Counter (Counter (Count	Activity2.nvact* Connection Name: j/kiel-win7 Application: c:\Emergent(Gamebnyo-Lightspeed-Source\Samples)GraphicsTechDemos)MangledMetal\\vin32\VC90\Release\MangledMetal exe Arguments:	Connect Disconnect
 Interview (6/6) Present, Render, Lock, Bit, Clear, Performance Markers API Categories: Present Clock Bit Clear Clear All Connection Status Application Control Cancel Connection Status Open Report on Stop Summary Page 	Activity Type Trace Select this option to collect trace data from a number of domains. System, Nsight Tools Extension, CUDA. OpenCL, DirectX and OpenGL trace options are available. Profile CUDA Kernels Select this option to collect performance counters per CUDA launch. Trace Settings	Select What to Trace
	 It is the initial state of the sector of the	allback Trace, Program Binary Code, Reference Counter, Command Trace

Demo: Trace





Demo: Trace



unarconi-Slad100307.001 Capture 000 oureport, Microsoft Visual Sural	CUDA API, Memory Transfers, and Kernel
 Edit View Project Debug Nsight Sandbox Tools Test 	Vidaministratori - Experimenta Hive
• 🔤 • 💕 💂 🥔 ½ 🖻 🛍 ୬ • 🕅 • 📮 • 🖳 ♦ 🦲	- Internation
SupersonicSled10ture_000.nvreport	
Row Filters	
Seconds 0 1 2 3 4	
Processes supersonicsled.e	
Thread 58.0% [Thread 35.7% [
Context 2 [0]	
Driver API	
Memory Y	
■ E Compute	
E Sys	
Core 0	
Core 1	
E DX	
Device Conte 🍸	
🗉 System	
□ CPU %	
Core 0	DirectX API Calls
Core 1	
Dutpu	
Show (utput from: Nsight Analysis - 이제 (이제	
Show throut from: Neight Analysis Good Definition Window (20 Cill Browsel Durput (3) Pending Chi CPUI Core Littili	zation
Show france from Niele Analyse Core Database with the 20 Cel Barrer Dig Database Celevation of the CPU Core Utili	zation
CPU Core Utili	zation

The Nsight 1.0 Release



A full Visual Studio-integrated development environment

Supports

DirectX11 + DirectCompute, DirectX10, OpenGL, CUDA C, OpenCL

Requires Windows Vista or Windows 7, Visual Studio 2008 SP1





http://developer.nvidia.com/nsight