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

Edit Minus Build Da		and the second	Tools Tool Mart	dama Allaha							
ran view some be	ebug Nsigi	it Sandbox	Tools Test Wins	зон пер				-			
1 - 😂 🖬 🕔 🕺	20219	· (1 · 17] ·	Debug	· Win32	- 3		• 🔩 😤	± x ∎ ⊡•,			
a a 4 93 (2)	The S										
	- Thread		- 7	Stack Frame:							
raphics Inspect Mangl	pledMetal.ex										
0	Process	3588 + Snap	ishot + Frame 1 +								
Frank			10000	10000	10000 6		5000 A7				
Frames		ī			Frame	1					
Draw/Dispatch	1										
Dependencies											
Darthilacher											ALC: NOT
- Permanars					Bandoo France Da	and the Departure				States and States	
				17 days	Refuestioneric	sue maine	2			3	The second second
	X	-		Shedor	iistep			Deterred Step	01	Sec. South	C. Der
		2		ShadowRCR	ender Click)		Deptifiormals 1	ightAccum Materia	Past		ALL DOUGHT
										Pixel History Color T	ransform:
		*								Pixel History Color T	ransform:
Actions:		•			III Capture Statistics					Pixel History Color T Event 71776 - Draw Cal	ransform: 1751
Actions: See details for Draw i Profile Frame 1	Call 751. (6vr	• []			m Capture Statistics: 808 draw calls in	1 frames				Pixel History Color T Event 71776 - Draw Cal (Frame 1)	ransform: 1751
Actions: See details for Draw I Profile Frame 1	Call 751. (Eve	•			n Capture Statistics: 808 draw calis in	1 frames				Pixel History Color T Event 71776 - Draw Cal (Frame 1)	ransform: 1751
Actions: See details for Draw I Profile Frame 1	Call 751. (Ex	• []			n Capture Statistics: 808 draw calis in	1 frames	uders			Pixel History Color T Event 71776 - Draw Cal (Frame 1)	random: 1751
Actions: See details for Draw P Profile Frame 1 cch 1	Call 751. (Evr	• []			m Capture Statistics 808 draw calls 0 draw calls 7 ype	1 frames	sim. nđe	Shader Type	Symbolice Status	Pixel History Color T Event 71776 - Draw Cal (frame 1)	random: 1751 Technique
Actions: See details for Draw P Profile Frame 1 ch 1 mme	Call 751. (Eve	• () nt 71776) Yelue			n Capture Statistice 808 draw calls in Type	1 frames	nder Inder Ind 1901 Deut-000000000000000000000000000000000000	Shader Type Vertex Pinal	Symbolics Status Ready	Piet History Color 7 Event 71776 - Draw Cal (Frame 1)	ransform: 1751 Technique No Technique
Actions See details for Draw P Portile Frame 1 ch 1 mme	Call 751. (Eve	•			m Capture Statistics 808 draw calls 808 draw calls 909 1999	1 frames	idro de 19180 0-645000000000 19130 0-6450000000000	Shader Type Vertex Pixel Vertex	Symbolics Status Ready: Ready: Ready.	Pitel Histoy. Color Event 71776 - Draw Cal (Frame 1) Language HISL HISL HISL	ransform: 1751 Technique No Technique No Technique
Actions: See details for Draw i Profile Frame 1 I tch 1	Call 751. (Evr	•			n Capture Statisticu 808 draw cata in 1979 1979	1 frames	elers nde b+180.0460000000000000000000000000000000000	Shader Type Vertex Vertex Vertex Vertex Pirel	Symbolics Status Ready, Ready, Ready, Ready, Ready, Ready,	Puel Hatory Color T Event 71776 - Draw Cal (frame 1) https://doi.org/10.1016/ https://doi.org/10	randorm: 1751 Technique No Technique No Technique No Technique No Technique
Actions See details for Draw Profile Frame 1 Noth 1	Call 731. (For	• (nt 71776) *ekue			m Capture Statistice 808 draw calls in 808 draw calls in 90 Type	1 frames	elins de 15180 belar0000000000 15170 belar0000000000 15170 belar00000000000 15170 belar00000000000 15170 belar000000000000	Shader Type Vetex Vetex Vetex Vetex Vetex Vetex Vetex	Symbolics Status Ready Ready Ready Ready Ready Ready Ready	Pirel History Color T Event 71776 - Draw Cal (frame 1) I Language HLSL HLSL HLSL HLSL HLSL HLSL HLSL	ransform: 1751 Technique No Technique No Technique No Technique No Technique
Actions: Set details for Draw I Profile France J Ich 1 enve	Call 751. (Esr	•			rr Capture Statistice 808 draw calls in 908 draw calls in 7556	1 frames	Hits HITS HITS Detac0000000000 HITS Detac000000000000000000000000000000000000	Shader Type Vertex Pisel Vertex Pael Vertex Vertex Vertex	Symbolics Status Ready: Ready: Ready: Ready: Ready: Ready: Ready: Ready:	Pitel History Color T Event 71276 - Draw Cal (Frame 1) I Language Historia Historia Historia Historia Historia Historia Historia Historia	random: 1751 Technose Na Technose Na Technose Na Technose Na Technose Na Technose Na Technose
Actions: Sec attails for Draw 1 Poolie Frame 1 ink 1 ame	Call 751. (Ex	•			m Capture Statistice 808 draw calls in 908 draw calls in 909 Type	1 frames X Shi A Ha Dx1 Dx1 Dx1 Dx1 Dx1 Dx1 Dx1 Dx1	olin de 151120 de 3000000000 151120 de 40000000000 151120 de 400000000000 151120 de 400000000000 151120 de 400000000000 151120 de 4000000000000 151120 de 4000000000000 151120 de 40000000000000 151120 de 4000000000000000 151120 de 4000000000000 151120 de 4000000000000 151120 de 400000000000000000000000 151120 de 40000000000000000 151120 de 40000000000000000000000000000000000	Shader Type Vertex Vertex Vertex Vertex Direct	Symbolics Status Ready, Ready	Piel Histoy Color T Event 72776 - Draw Cal (frame 1)	random: Technique No Technique No Technique No Technique No Technique No Technique No Technique No Technique

Demo: Host Frames Page





Demo: Draw Call Page





Ready

Demo: Texture Viewer





Demo: Depth Buffer Viewer





Demo: Output Merger State Inspector



MacoledMetal (Running) - Microsoft Visual Studio (Administ	utori - Exterimenta Hise						
File Edit View Ruild Debug Nsight Sandbox To-	ols Tegt <u>W</u> indow <u>H</u> elp						
回・回・22日 24 1 24 25 1 1 - 10 - 10 - 10 - 10 - 10 - 10 - 10	Debug + Win32 +	10	・ 22 学 23 父 18 日・				
) 🛛 🖬 🖾 () 🖓 🖓 🖓 🖓 🖓 🖓 🖓 🖓							
Process. Thread:	🖓 🦞 Stack Frame:	· .					
Graphics Inspect MangledMetaLexe							• ×
🖉 💿 💿 🖉 🚔 🚳 🔸 Process 2512 🔹 Snapsho	t Frame 1 Event 55625 / Draw Call 632 Of Control of	utput Merger					
							••
IA Depth Stends State	a DepthWriteMask All	DepthFunc	LessEqual				
StenciEnable Fals	a StenciReadMask 255	StencilWriteMask	False				
Back: StenciFaiOp Ke	ep Stencil/epthrailUp Keep Stencil/ass ep Stencil/DeothFailOp Keep Stencil/Pass	Op Keep StenciFunc	Always				
View Dimension Format	Flags Dimension Usage Bind	CPU Misc Width Height	nvxtObjectName				
Texture2D D24_UNORM_S	& UINT Undefined Texture2D Default DepthStencil (Inspecified Undefined 1280 720	ID3D10Texture2D 2				
Render Target Views					l Ins	bect All	
View Dimension Format	Dimension Usage Bind CPU M	lisc Width Height noxtObject	Vame				
Texture2D R8G88848_UNC	JHM Texture2D Default RenderTarget Unspecified U	ndefined 1280 720 ID3D10Text	ure2D 1		Dire	+2D State	
PS Blend States	Blandfamilekturk #104067205				Direc		
BlendEnable SrcBlend DestBle	nd BlendOp SrcBlendAlpha DestBlendAlpha Bler	dOpAlpha RenderTargetWriteMask					
OM 0 False One Zero	Add One Zero Add	15					
2 False Undefined Undefine	ed Undefined Undefined Undefined Undefined Undefined Undefined Undefined Undefined Undefined	fined 15					
False Undefined Undefine False Undefined Undefine	ed Undefined Und	fined 15 fined 15					
False Undefined Undefine	ed Undefined Undefined Undefined Undefined	dined 15					
7 False Undefined Undefine	ed Undefined Undefined Undefined Undefined	fined 15					
	w Any Stage						
in t	ha Diract2D						
	Pipeline i						
Autos			→ 3 × Shaden				~ 3 X
Value Value	A.		Shader Type O Vertex	Ready.	Language Technique HLSL No Technique	Pass Name No Pass VSMain	12
			1 Pixel	Ready H	HLSL No Technique	No Pasa PSMain	
			3 Pixel	Ready.	HLSL No Technique	No Pass Main	
			4 Vertex 5 Pixel	Ready. Ready.	HLSL No Technique HLSL No Technique	No Pass Main No Pass Main	
			6 Vertex 7 Pixel	Ready.	HLSL No Technique	No Pass Main	
Autos Cocals Threads Modules Watch 1			Shaders Shaders	Il Stack 📑 Breakpoints 🔄 Output	recondue	THE COME OF BEEN	
			In the second second billion				

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 91 Hex % 13 •)	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 the state	
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. 0		
	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	
1	// 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	
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 a second		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