From Pixels to Reality – Thoughts on Next Game Engine

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Twisted Metal- PSX 1995
Outwars - PC 1998
Links 2001 -PC 2000
AMPED-XBOX 2001
AMPED 2 – XBOX 2003

20 Years?....Why am I still here?......😊

Halo 2– XBOX 2004
Halo 3– XBOX 360 2007
Halo Reach– XBOX 360 2010
Destiny– Xbox One PS4, PS3, 360 2014
Same Growth Story - GPU, API, Console, Fidelity

- It’s Moore’s law, stupid!
Game Engine 2016

- Multi-threaded
- Multi-Platform
- Modern API
- Deferred Rendering
- PBR
- Global Illumination
- Dynamic Environment
- 60 FPS@1080P
Game Engine 2018?
What is NOT good enough?

- Aliasing
- Shadow
- Transparency
- Content Production
- Load Time
- Animation
- Performance
What is new?

- Community Based Gaming
- User Created Content
- Mobile
- VR/AR
- E-Sports
- Broadcast
Aliasing is by Design

“Image Quality. We eschew aliasing and faceting artifacts, such as jagged edges, Moire patterns in textures, temporal strobing, and highlight aliasing.”

[CookCarpenterCatmull87]

1986 Pixar Christmas Card by John Lasseter and Eben Ostby.
Film vs. Game

Reyes/Ray Tracing
Object Space Shading
Lots of Visibility Samples
Image Quality

Direct 3D / OpenGL
Screen Space Shading
Few Visibility Samples
Throughput
REYES/Ray Tracing for Games? -- Not Ready Yet

Make REYES work with GPU [Fatahalian10][BurnsFatahalianMark10][Kunzhou09]

- Small Triangle Problem
- Scene Complexity
- Not fast enough

Real-time Ray-Tracing [Nvidia IRay]

- 4K now, 8K soon.
- Multiple-monitors/Stereo
- Not fast enough
Better Way: Borrow and Combine Ideas

Shade in Object Space = Inherently Stable
[CookCarpenterCatmull87] [Fatahalian10]

Decouple Visibility Sampling from Shading = Multi-Rate
[BurnsFatahalianMark10]

Visibility Buffer = Reduce Memory & Bandwidth
[BurnsHunt2013] [[SchiedDachsbacker15]]
Possible Rendering Pipeline
Go Further with Multi-Rate

- Visibility Samples
- Shading Samples
- Lighting Samples
- Light Transport Update

- AI
- Physics
- Input
What about Other “Aliasing”?  

Specular Aliasing  
  • Lean Mapping [OlanoBaker 2010]

Shadows  
  • Frustum Traced Raster Shadows [WymanHoeltzleinLefohn15]

Transparency  
  • Order Independent Transparency
Load Time

Compression – 2X Better Than Z-LIB

Procedural Synthesis – Substance
https://www.allegorithmic.com

Wang Tiles [Wang61][Stam97][Liyy04]
https://artomatix.com
Cloud

- Huge Worlds
- Thousands of Inhabitants
- Thin Clients
- Studio In A Box
- Content Production
Amazon Lumberyard - GameLift
Problem we are solving?

LOCAL

GAME BUILD

BUILD BINARY

DEBUG

RUN

CLOUD

DEPLOY / CONFIG

MONITOR

BUILD BINARY

BUILD BINARY
Get started in minutes, even with little backend experience

Amazon Gamelift

Game Binary

Availability Zone A

Availability Zone B

VPC Private Subnet

VPC Public Subnet
Reduced ongoing engineering and operational effort

- Deploying Gamelift Fleets

1. Game Version A
2. Amazon GameLift Build Catalog
3. UPLOAD BINARY
   - FLEET A
     - Version A
       - Instance 1
       - Instance 2
   - FLEET B
     - Version B
       - Instance 1
       - Instance 2
Scale based on player demand (coming soon)

Traditional dedicated servers

On-demand auto scaling
Amazon Lumberyard - Cloud Canvas
Problem we are solving?
Cloud Canvas - Details

**AWS Primitives**
- Cognito
- S3
- DynamoDB
- Lambda
- SNS
- SQS

**Callable from Script**
- Gifting system
- Leaderboards
- News Ticker

**C++ SDK**
- Create your own nodes
Cloud Canvas – Visual Scripting
Game Engine 2018

Almost No Aliasing
Right Space
Right Frequency
Right Place

Perception Guided “Importance”
Procedural Content
Cloud Connected
Hot Research Topics

- Procedural Synthesis
- Compression
- 3D Scanning
- Perception Science
- Multi-rate Rendering
- Animation
- Distributed Physics/AI/Rendering
References

[CookCarpenterCatmull87]

[Fatahalian00]

[BurnsFatahalianMark10]

[Kunzhou09]

[BurnsHunt13]


