VR and Game Engine Workflows with CityEngine

Eric Wittner, Taisha Waeny
Agenda

• Introduction into Game Engines - Taisha
• User Examples - Taisha
• GIS2VR workflow: CityEngine to Unity - Eric
• GIS2VR workflow: CityEngine to Unreal - Eric
• Unreal Basics & Principles - Eric
• CityEngine VR Template - Eric
Introduction into Game Engines

• Unity vs Unreal
GIS to Game Engines

GIS data → CityEngine

- CityEngine VR Experience
  - out-of-the-box premium VR via Unreal project template

- Game engine (Unity & Unreal)
  - professional XR dev environment

- ArcGIS 360 VR
  - out-of-the-box mobile VR for Oculus Go & Samsung Gear

- Datasmith
- FBX
Architectural Visualization

“Unreal Engine is 4th most used production renderer (including offline renderers)” CGarchitect 2018 Survey

→ Industry is using game engines for high-end 3D real-time visualization
What is a Game Engine?

A SW dev environment designed for people to build video games:

- Rendering engine for 2D or 3D graphics
- Physics engine, collision detection
- Spatial audio rendering
- Animation, artificial intelligence
- Scripting, scene graph
- Video support for cinematics
- Networking, memory mgmt, threading, localization support …
Why Game Engines?

A SW dev environment designed for people to build video games
An environment designed for people to build experiences

Experience != line of sight tool with which you can do multiple things
Experience = use-case specific intuitive real-time UX e.g. *find sniper*

...*BUT: game engines don’t support geo-referencing!!!*
Unity vs Unreal

Both are for free as long as you basically don’t publish “exe”
Unity vs Unreal: Tech

• Unreal more built-in features (Blueprints, Material Editor, etc.)
  - Unity catching up on features (Material Editor)
  - Some available via plugins (not all of them for free though)
  - Replicating high-end features of Unreal can be complicated in Unity

• Unreal default materials and assets are of higher quality

• Unreal tends to better suited for HQ/performance applications
  - E.g. global illumination system of Unity not dynamic and slower
Unity vs Unreal: Development

- Unreal has built-in visual scripting called Blueprint
- Development in Unity in C# & JavaScript and in Unreal in C++
- Source code for Unreal is public for everybody!!!
- Unreal exceptionally good for devops & source code mgmt.
- Unity supports more platforms (Nintendo Switch etc.)
- Both support browser - but stability & performance lacking...
Unity vs Unreal: Adoption

• Unity tends to be more beginner friendly
• Unity has more indie developers i.e. asset store of Unity is bigger
• Epic Games supporting non-game applications more
• Unreal used about 3 times more than Unity in architectural viz
CityEngine User Examples

Vrbn, City of Zurich, HOK
GIS2VR: CityEngine to Unity

- FBX-based Workflow
CityEngine: Select, «Export Models...»
Choose FBX, Tweak Settings, & Click Finish
Unity: Drag&Drop FBX to Assets & into scene
Move «Main Camera» to center
Enable VR

• Edit, Project Settings, Player
• Check «Virtual Reality Supported»
• Add OpenVR Support
  - Click «+», «OpenVR»
  - Drag above «Oculus»
Start in VR: Press «Play» and experience it in HTC Vive
VR: Add Locomotion

- Window, «Asset Store»
- Search «SteamVR Plugin»
- «Import»
- «SteamVR_Settings» Dialog
  - «Accept All»
Add «Player»

- Delete «Main Camera»
- Drag in «SteamVr\InteractionSystem\Core\Prefabs\Player»
Add «teleport» prefab

• Drag in «SteamVr\InteractionSystem\Teleport\Predabs\Teleporting»
Add Teleport Points

• Drag in multiple «SteamVR\InteractionSystem\Teleport\Prefabs\TeleportPoint»

• Optional: Increase their scale
In VR, Teleport Using Click on Wheel
Teleport anywhere

- Click Mesh in Assets
- «Generate Colliders»
- «Apply»
Teleport anywhere

- Double-click street
- Copy/Paste
- Drag «SteamVR\InteractionSystem\Teleport\Scripts\TeleportArea» on street copy
In VR, Teleport Anywhere on Street
GIS2VR: CityEngine to Unreal

• *Datasmith*-based Workflow
Unreal Material Handling in CGA Rules

In CityEngine

• (Optional) Modify CGA rules to assign appropriate Unreal materials
• Export scene with Datasmith exporter

In Unreal

• Create CityEngine Template project
• Import Datasmith file into Unreal
CityEngine to Unreal Workflow Overview

- set(material.shader, «path/to/material/in/unreal/») in CGA

```
set(material.shader, "/Game/Materials/CityEngineMaterials/M_CE_MaskedOpacity")
```

- Template has 3 uber-shaders (opaque, semi-transparent, masked)
- Or create custom materials in Unreal and reference them from CGA
Exporting from CityEngine

- Options to modify mesh granularity
- Choose between standard instancing & foliage system
- Datasmith takes care of game engine optimizations
Importing into Unreal

- Create CityEngine Template Project
- Open project and import Datasmith file
- Default options fine for normal sized meshes
- For lightmap baking the lightmap resolution might need tweaking
Unreal Basics & Principles

• Quickstart Guide
Material Handling

- De-facto standard for material definition
- Graph-based editor UX
- Custom nodes can be created with HLSL code
Visual Effects: Height Fog
Visual Effects: Atmospheric Fog
Postprocessing

- Depth of Field
- Lens effects
  - Vignette
  - Chromatic Aberration
  - Bloom
- Color Grading
- Ambient occlusion
- …
Development Example: UI Popup

- Popup with metadata (CSV) exported from CityEngine
Widget Designer (UMG)

- Can either be HUD based or in-game UI elements
- Functionality can be added using Blueprints
Blueprint Example
Blueprints or C++?

Typically computational expensive methods should be written in C++, everything else via Blueprints

- Create C++ Actor class with special annotations
- Create Blueprint Actor based on this C++ class
- Call function from Blueprint
C++ Example

```cpp
UCLASS()
class BLUEPRINTCPPTEST_API AMyActor : public AActor
{
    GENERATED_BODY()

    UFUNCTION(BlueprintCallable)
    void ExpensiveFunction();
}
```
CityEngine VR Experience
Based on the Tabletop UX

- Common UX pattern in MR, VR & AR
- Collaborative
- Intuitive, people relate to table
- Specific for selected urban planning workflows
Using the CityEngine VR Experience

- Create CityEngine VR Experience Project
- Open project and import Datasmith file (optional: import own room)
- Set-up points of interest
Get in touch with us…

Taisha
LinkedIn: www.linkedin.com/in/taishawaeny
Email: twaeny@esri.com

Eric
https://www.linkedin.com/in/eric-wittner-26002b21
Email: ewittner@esri.com