

ENGINEERING THESIS

# Game Level Building Techniques Using a Game Engine

Procedural Generation and Photogrammetry in Unreal Engine

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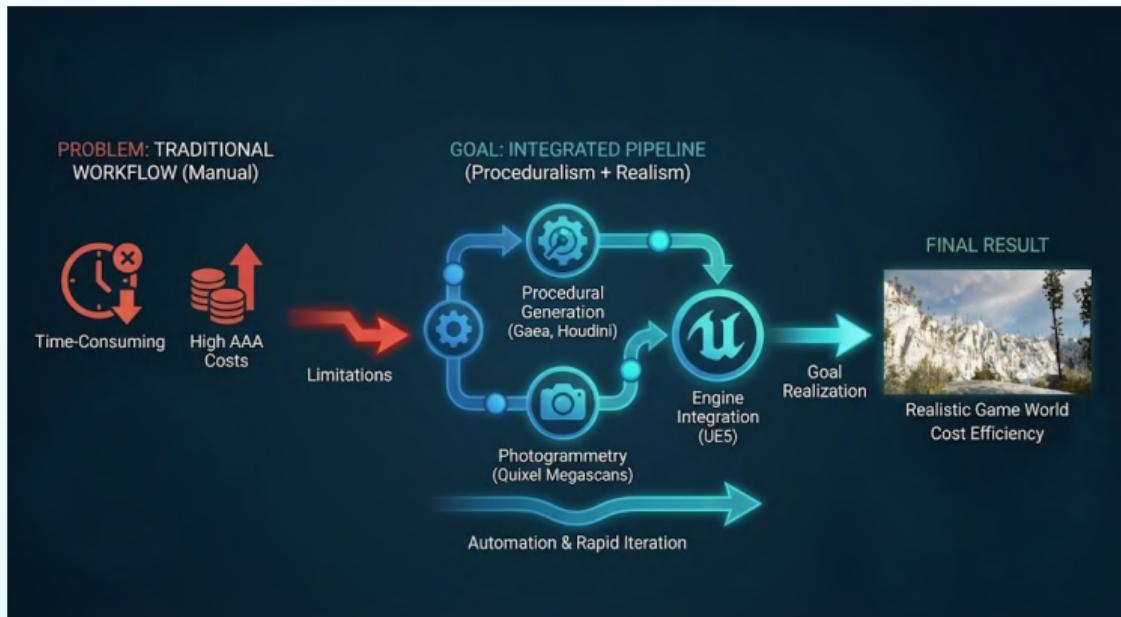
# Research Objective and Problem

## Problem:

- ▶ Time-consuming manual work.
- ▶ High AAA costs.

## Thesis objective:

- ▶ Integrated pipeline.
- ▶ **Proceduralism + Realism.**



# Technology Stack



**UNREAL  
ENGINE**

**Houdini**™



**GitLab**



**Quixel  
BRIDGE**



**Quixel  
MEGASCANS**



**Unreal Engine 5**  
Core & Render

**Gaea**  
Terrain → Erosion

**Houdini**  
Vegetation HDA

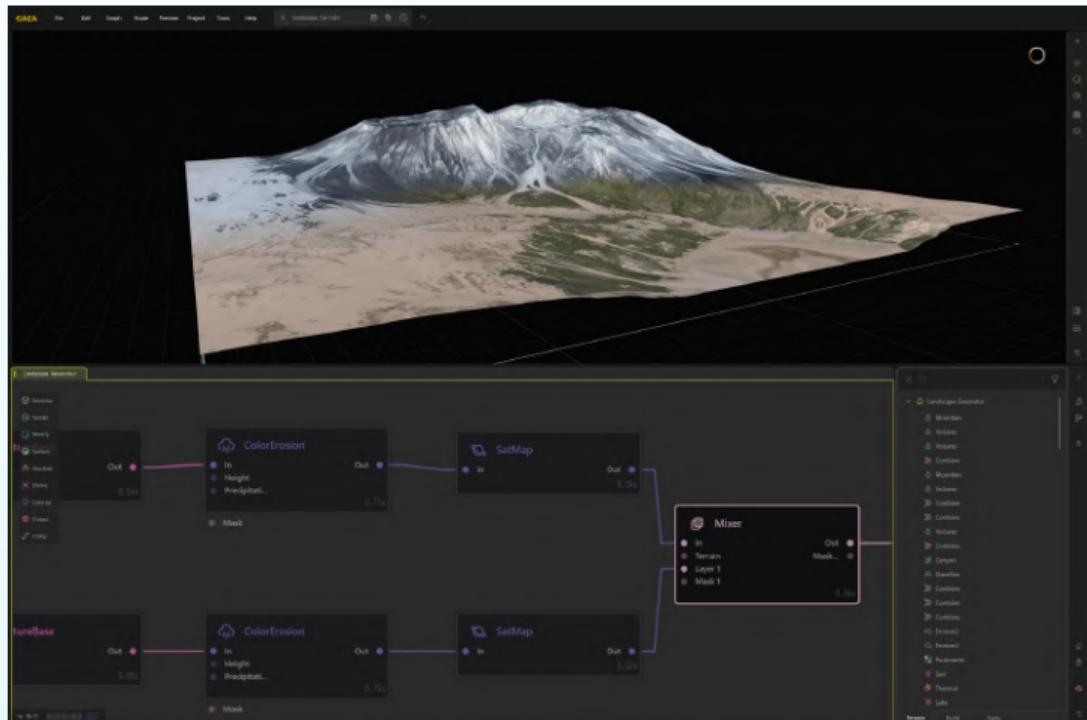
**Quixel Tools**  
3D Scans

**GitLab**  
Backup

# Methodology: Terrain Generation (Gaea)

## Process:

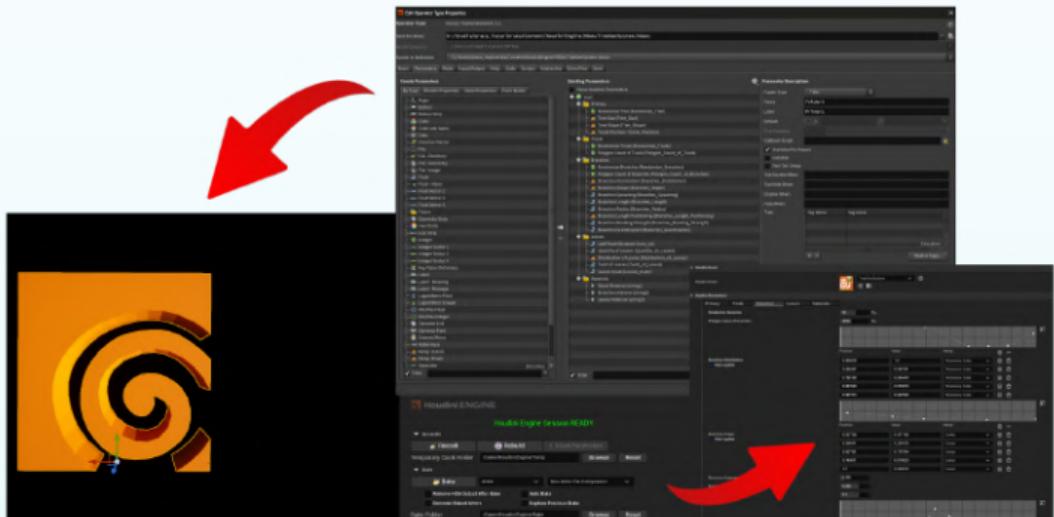
- ▶ Natural erosion simulation.
- ▶ Flow mask generation.



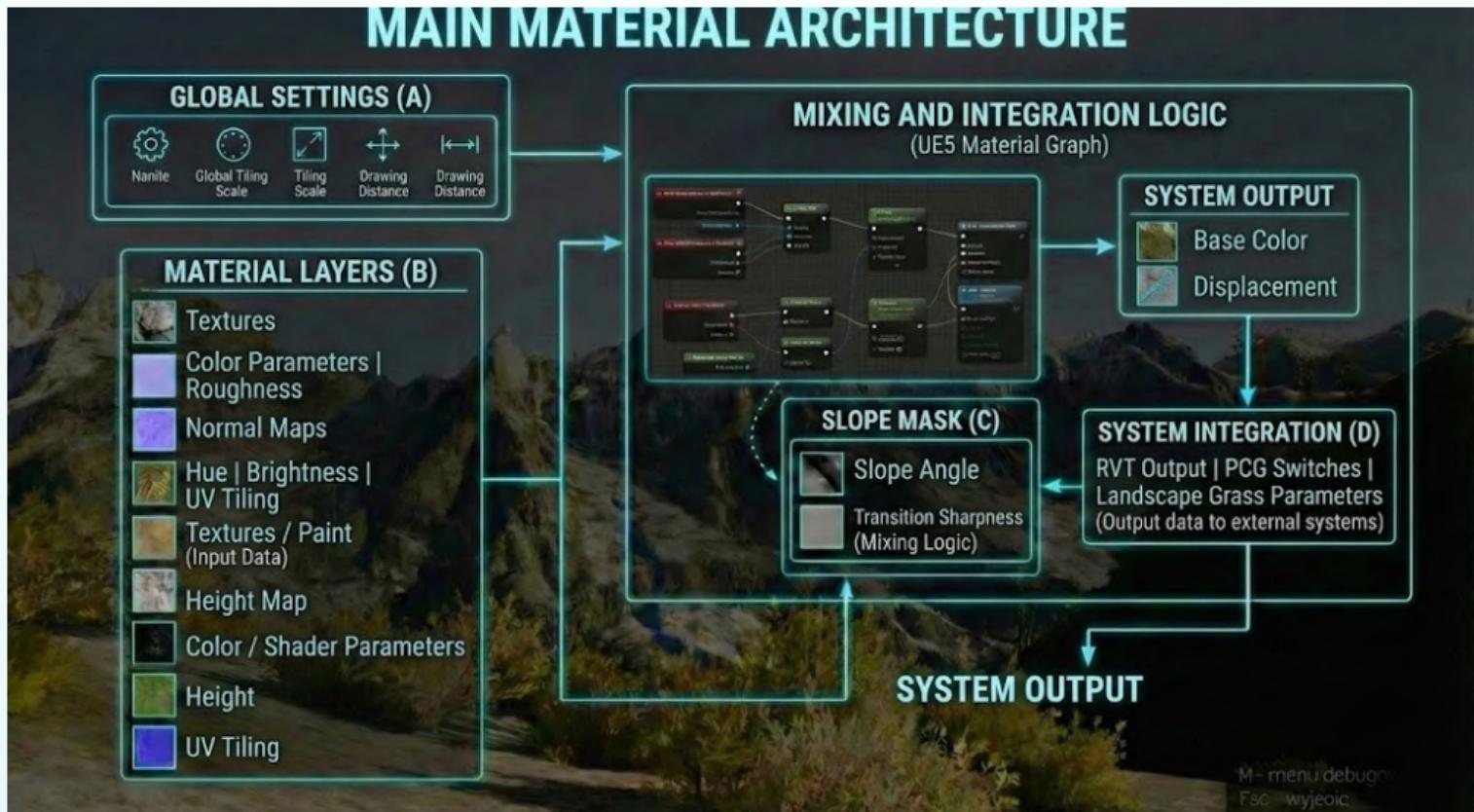
# Methodology: Procedural Vegetation (Houdini)

## Houdini Digital Assets (HDA):

- ▶ Creating "live" tools in UE5.
- ▶ Parameterization of vegetation density and type.



# Logic: Auto Blend Material



# Results: Three Biomes, One System



1. Sunny

# Results: Three Biomes, One System



## 2. Desert

# Results: Three Biomes, One System



3. Winter

## Performance

**30-36**

FPS (1440p, Epic)

**94%**

VRAM Usage (8GB)

# Technical Overview

USTAWIENIA UPSCALING/AA	NVIDIA DLSS FRAME GENERATION	RTX DYNAMIC VIBRANCE
Rozdzielcość <b>1440p</b>	Wsparcie DLSS-FG <b>Supported</b>	Tryb Wsparcia <b>Supported</b>
Upscaling <b>NVIDIA DLSS</b>	Tryby DLSS-FG <b>Auto</b>	Tryb Dynamic Vibrance <b>On</b>
USTAWIENIA GRAFICZNE	STATYSTYKI DLSS-FG	DYNAMIC VIBRANCE - STAT.
<input type="button" value="Włącz RTX"/> <b>RTX ON</b>	Min. Wersja Sterownika <b>512.15</b> Wykryta Wersja Sterownika <b>591.74</b> Min. Wersja Systemu Operacyjnego <b>10.0.19_041</b> Wykryta Wersja Systemu Operacyjnego <b>10.0.26_200</b> Wsparcie API <b>D3D12</b> Wymagane Planowanie GPU <b>true</b> Aktywacja V-Sync <b>true</b>	Min. Wersja Sterownika <b>512.15</b> Wykryta Wersja Sterownika <b>591.74</b> Min. Wersja Syst. Oper. <b>10.0.0</b> Wykryta Wersja Syst. Oper. <b>10.0.26_200</b> Wsparcie API <b>D3D11 D3D12</b>
STATYSTYKI DLSS	STATYSTYKI KŁATEK NA SEKUNDĘ	
Min. Wersja Sterownika <b>470.0</b> Przestarzały Sterownik <b>No</b> Min./Max. Skalowanie Obrazu <b>50%/100%</b>	Licznik FPS <b>32</b> Aktualny Licznik FPS <b>33</b>	.
NVIDIA REFLEX	STATYSTYKI TRYBÓW DLSS	NVIDIA REFLEX - STAT.
Stale Skalowanie Obrazu <b>No</b> Min./Max. Skalowanie Obrazu <b>50%/100%</b>	Wsparcie Reflex <b>Supported</b> Tryb Reflex <b>Enabled</b>	Min. Wersja Sterownika <b>512.15</b> Wykryta Wersja Sterownika <b>591.74</b> Min. Wersja Syst. Oper. <b>10.0.0</b> Wykryta Wersja Syst. Oper. <b>10.0.26_200</b> Wsparcie API <b>D3D11 D3D12</b> Wym. Planowanie GPU <b>false</b> Aktywacja V-Sync <b>false</b>
LATENCY STATS		
		Opóźnienie Gry → Render <b>896.712</b> Opóźnienie Gry <b>450.679</b>

# Summary: Personal Contribution

## Implementation and Logic:

- ▶ Development of a procedural pipeline (Gaea, Houdini → UE5).
- ▶ Creation of HDA tools in Houdini (vegetation).
- ▶ Implementation of a Master Material with an Auto Blend function.

**Custom solution**  
for tool integration

## Art & Design:

- ▶ Composition of three diverse biomes.

## Summary: Conclusions and Future Work

### Encountered problems and limitations

- ▶ High VRAM usage with 4K textures.

### Perspectives for future work

- ▶ Optimization to improve performance.
- ▶ Adaptation of the pipeline for generating simulation environments (automotive/aviation).

**Thank you for your attention**