Crafter Engine

Real-Time Volumetric Terrain Rendering and Data Processing

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Introduction

- Problem
- Terrain Rendering Approaches
  - Height Map only approaches
  - Object Substitution
  - Multiple Height Maps
  - Procedural Generated Terrain.
  - Volumetric/Voxel Rendering
- Crafter Engine
- Results

Problem definition

Create Terrain that can be easily modified in real-time with:

- Cliffs
- Caves
- Tunnels
- Overhangs

Height Map only

Pros:

- Very simple to implement
- Fast to render
- Very Good on memory
- Very Good on CPU
- Easy terrain modification
- Fast Collision detection

Cons:

- No Caves
- No Overhangs
- No Cliffs
- Needs to be supplemented

Object Substitution

Pros:

- Simple to implement
- Height-Map Based
- Fast To Render
- No shape limitations
- Good on CPU
- Good on Memory

Cons:

- Needs models for all objects
- Terrain modification creates extra problems

Multiple Height Maps

Pros:

- Good on Memory
- Height-Map based
- Removes some shape limitations

Cons:

- Hard to implement
- Still some shape restrictions exist
- Slower then Height Maps
- Real-time terrain alteration very hard to implement.

Procedural Generation

Pros:

- Very fast with GPU
- Very efficient with memory
- No shape restrictions

Cons:

- Usually data is stored as a “seed”
- Easy alteration
- Requires newer GPU with Geometry Shaders

Volumetric/Voxel Terrain

Pros:

- No shape restrictions
- Very easy LOD
- Very easy real-time terrain changes
- Combination of Height-Maps and Procedural Generation

Cons:

- Very Large Memory requirements
- Hard to implement

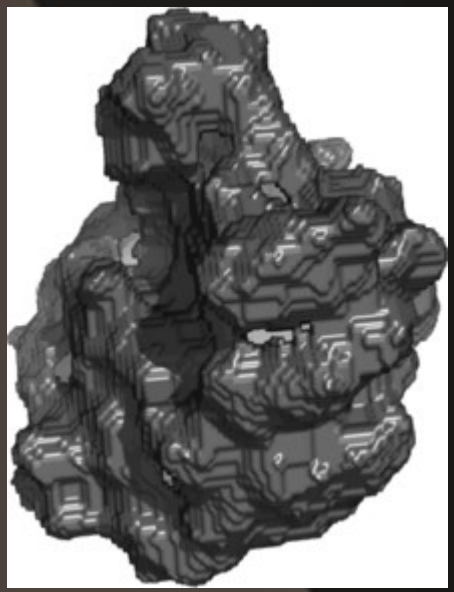
Crafter Engine (on CPU)

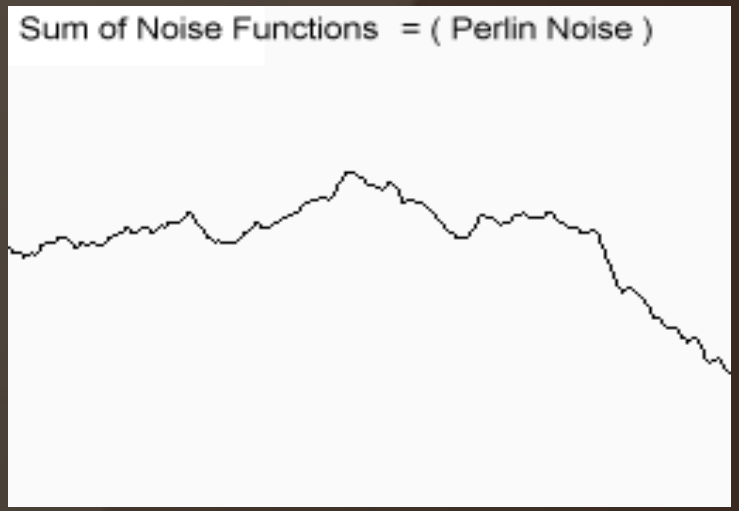
- Collision Detection
- Basic Gravity
- Infinite Terrain
- Block Picker tool
- Simple Light system

Crafter Engine: Structure

Data Generation

- Generate Voxel type information (Rock,Sand etc.)
  - Height-Map
  - Perlin Noise
- Compute Occlusion of Voxels
- Compute Light partial information





Crafter Engine: Structure

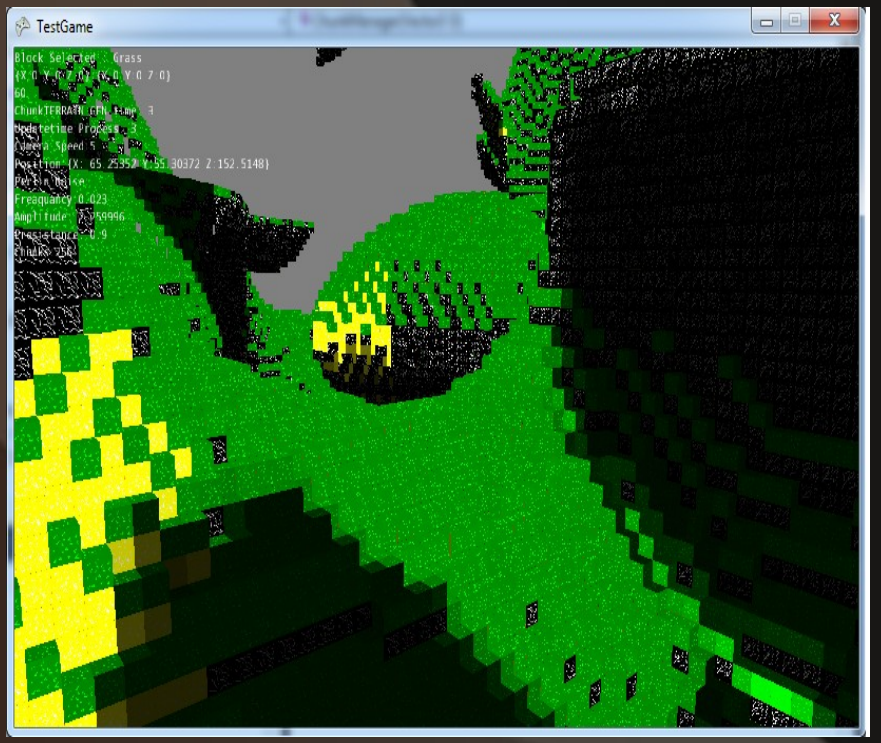
Data Processing

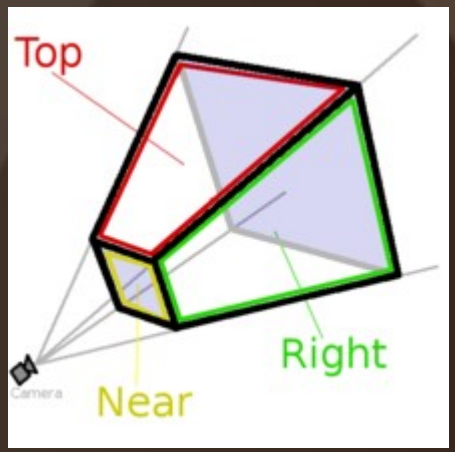
- Encoding Voxel's data
- Decoding Voxel's data
- Data Streaming
- Saving Data to HDD
- Collision Detection
- Ray Casting for Block Picker

Crafter Engine Structure

Render

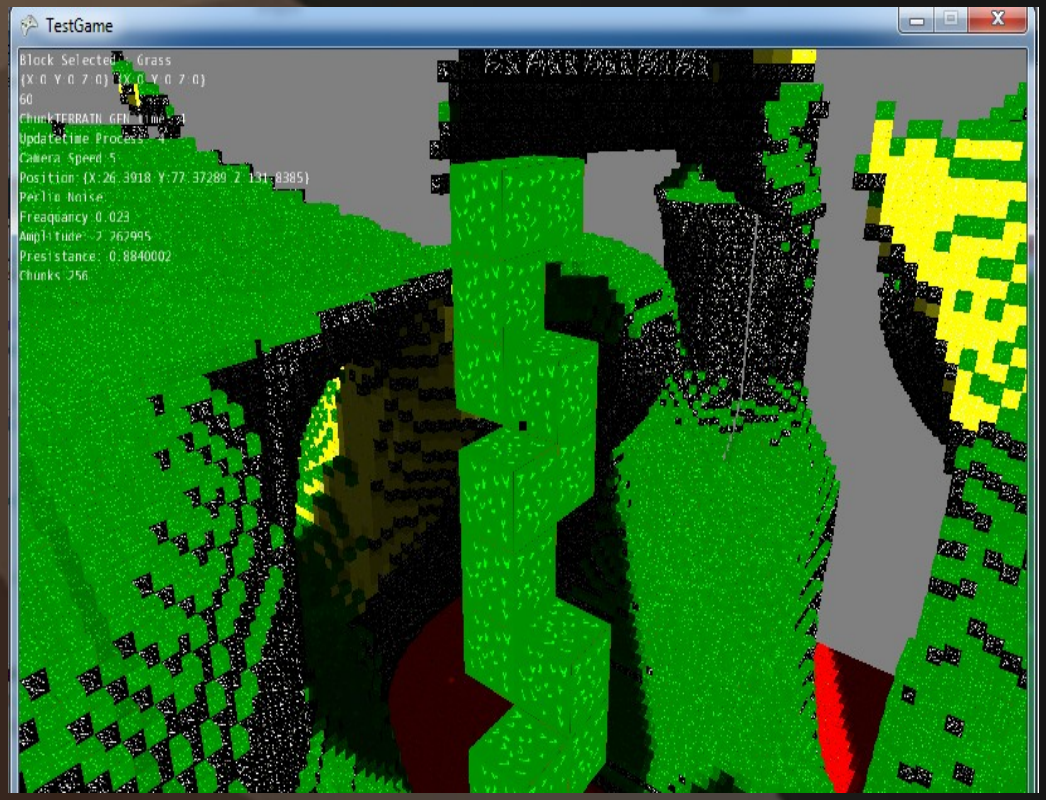
- Very simple Tessellation
- Light information computations
- Double Buffering
- Viewing frustum culling





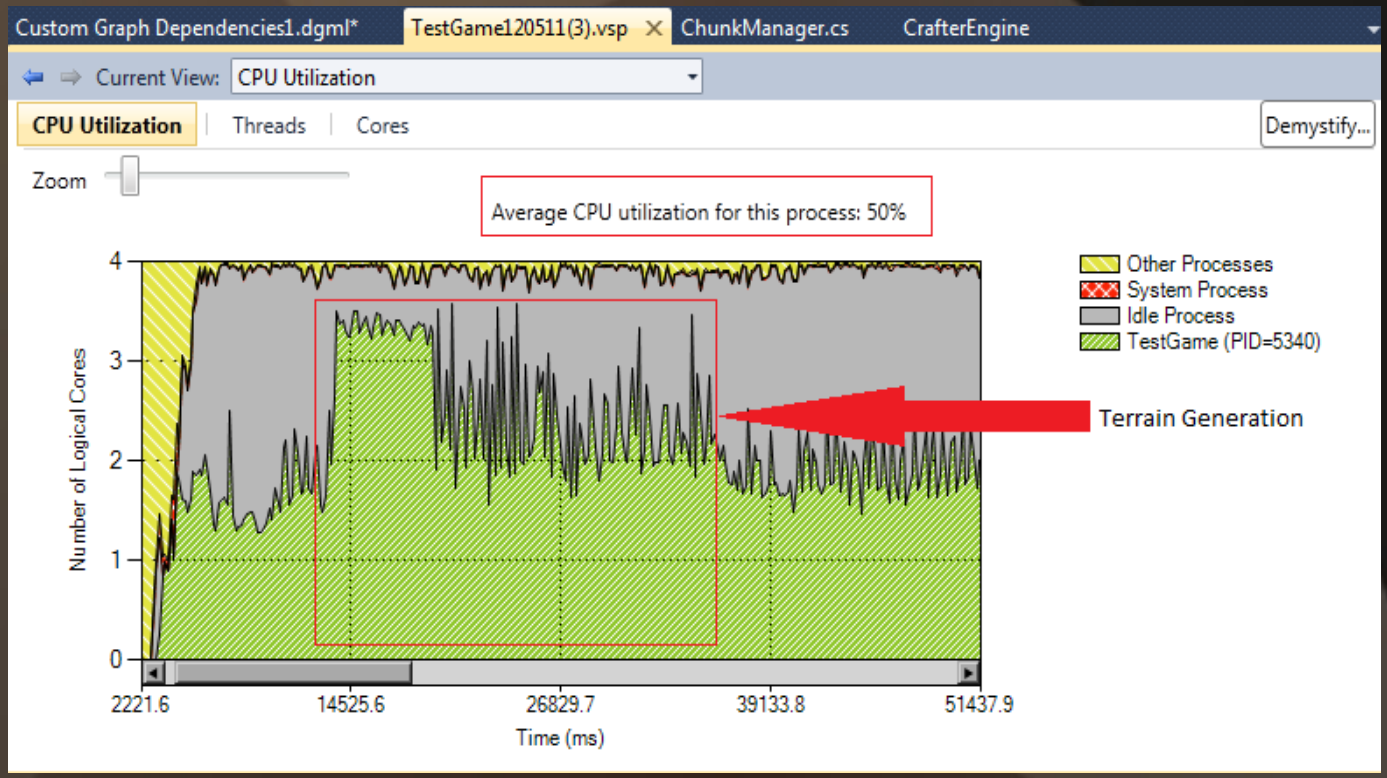
Results

- 16x16 Chunk Area in memory
- 16x16x128 Blocks in Chunk
- 8,388,608 Total blocks with real-time operations.
- Rough estimate for Memory: 1.75GB without optimizations

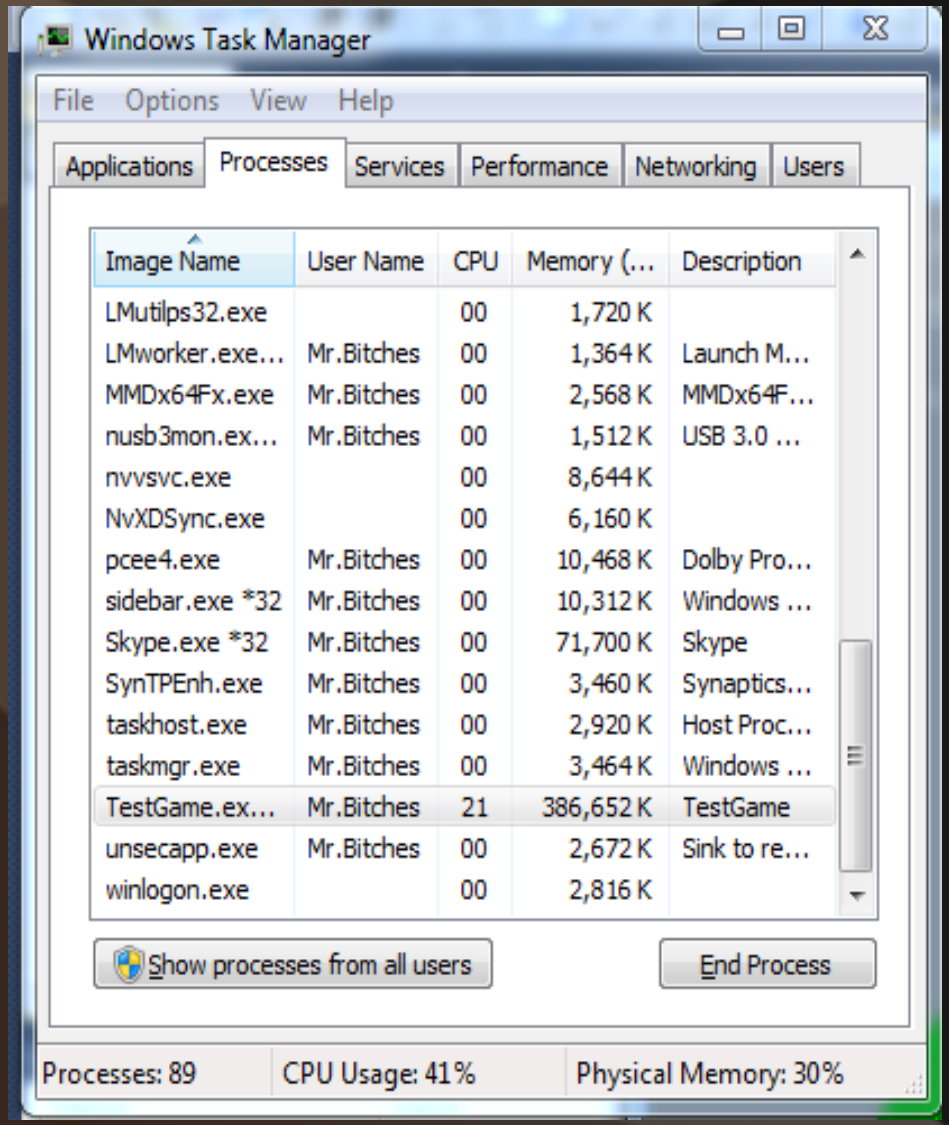


Results

- All core utilization during heavy load(Terrain Generation)



- 400MB RAM usage by TestGame with Crafter Engine



Research References

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Questions?