

FRANCISCO MURIAS • V8232778 • RESEARCH METHODS PROPOSAL

ABSTRACT

Procedural techniques have been used to generate 3D content for games ¹ as they provide the advantage of parametrisation and randomization to generate asset variations. In the games industry, it is standard practice to use workflows based on creating **modular kits** of a determined aesthetic, to simplify and reuse components in larger structures, as well as optimize memory.

The aim of this research proposal is to explore the applicability of **procedural content creation workflows** combined with **modular content development** for generating 3D assets for videogames.

A prototype of the **generator** was created using **Houdini**. The algorithm receives as input a **collection of modular building parts**, that can be modelled in any 3D Package. It assembles the provided input meshes from a **defined set of parameters** to quickly generate an **infinite amount of building variants**. The generator functions **independently of the style and aesthetic choice** of the modular assets provided, as these are only defined by the artist creating the modular meshes.

The generator was tested for different aesthetic styles: a Medieval and a Mayan styled modular collection.

MOTIVATION AND AIMS

- Explore the creation and application of a procedural algorithm in Houdini to generate variations of 3D building structures based on the artist's desired parameters and input meshes.
- Define an optimal ruleset and workflow to balance between the freedom of the artistic construction of the modules and the limitations needed for the generator to function within its indented parameters.
- Investigate into the methods for deconstruction of different aesthetic or cultural styles in the creation of the modular kits.
- Adapt the generative model of the generator for a wide range of multiple uses.

PROPOSED ARTEFACT & TECHNIQUES

For the research proposal, an **initial prototype** of the generator has been developed using **Houdini**, that can randomly create grid structures and determine placement positions for the modular assets.

To test it, 2 different asset collections have been used as **proof of concept**:

- A Stylized medieval collection
- A Stylized Mayan Temple collection

Houdini

As further work, the generator would be developed further to support more **features and rulesets**, and new asset collections could be created to further test and iterate on its capabilities.

Furthermore, a **scene in Unreal Engine 4** would be developed using in part the resulting meshes from the generator. This would allow testing **usability and optimization** in a **realistic game development scenario**.

RESEARCH QUESTIONS

Within the larger question of **how to structure a multiple use procedural content creation generator for modular sets**, other questions arise:

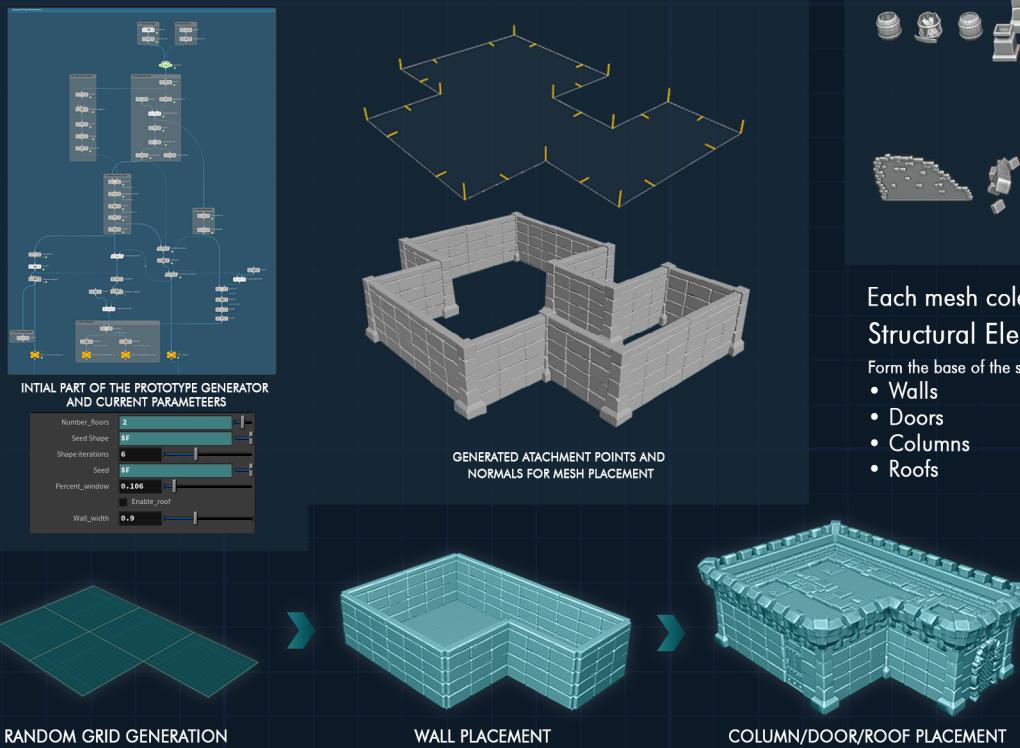
- How should the rules and parameters of a generative system be defined to ensure the greatest degree of flexibility for artists?
- What type of games and projects would most benefit from the application of these workflows?
- What limitations should be set so that we can represent the widest possible range of aesthetic and cultural styles in our generated structures?
- Can these processes be recursively scaled to procedurally generate larger structures such as cities?

PROPOSED METHODOLOGY



DEVELOPMENT WORK

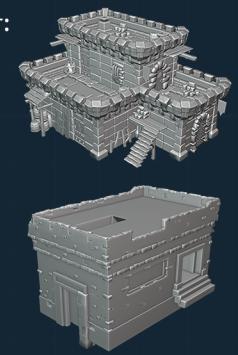
A prototype of the generator was developed using Houdini. It generates a random grid and attachment points with correct facing normals for placing the input meshes facing the right direction.



Two asset collections were developed and tested with the generator:



STYLISED MEDIEVAL COLLECTION



STYLISED MAYAN COLLECTION

Each mesh collection was split into categories for correct placement:
Structural Elements

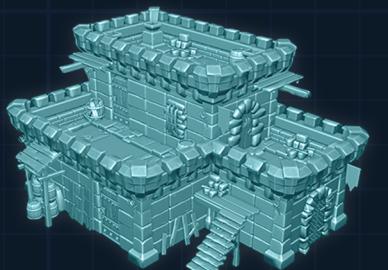
Form the base of the structure with random variations

- Walls
- Doors
- Columns
- Roofs

Decoration Elements

Extra meshes that attach to the structure for extra variation

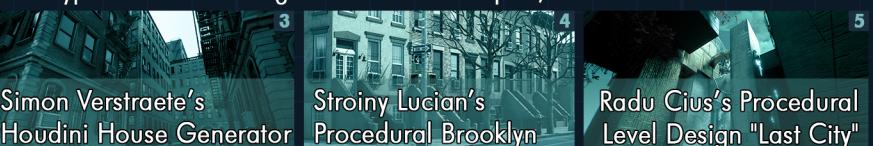
- Wall Decor
- Column Decor
- Roofs Decor



FIRST FLOOR ROOF PLACEMENT / DECOR

CONTEXT AND RELATED WORK

Procedural generation projects are still mostly deployed for specific single use cases. ² However, several resources were invaluable while developing the prototype and researching into current techniques, such as:



REFERENCES

1. Moss, R. (2016) 7 uses of procedural generation that all developers should study. Available at: https://www.gamasutra.com/view/news/262869/7_uses_of_procedural_generation_that_all_developers_should_study.php [Accessed: 17 November 2019].
2. Kazemi, D. (2019) How to effectively use procedural generation in games. Available at: https://www.gamasutra.com/view/news/340190/How_to_effectively_use_procedural_generation_in_games.php [Accessed: 20 November 2019].
3. Verstraete, S. (2019) Tutorial House generator Houdini. Available at: <https://www.artstation.com/artwork/oOWNB> [Accessed: 04 November 2019].
4. Lucian, S. (2019) Creating a Procedural Brooklyn in Houdini. Available at: <https://80.lv/articles/001agt-006sdf-procedural-brooklyn-in-houdini/> [Accessed: 6 November 2019].
5. Cius, R. (2019) Houdini Tutorial Procedural Level Design in UE4. Available at: <https://www.artstation.com/raducius/blog/wjR2/creating-procedural-level-design-last-city> [Accessed: 15 November 2019].