HARNESSING THE POWER OF GAN AND WFC TO GENERATE MAPS

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PROBLEM

Wave Function Collapse (WFC) is procedural content generation algorithm. It needs a set of meshes, and a set of constraints associated with the meshes. These meshes need to be created by artists and must be modular. This is time consuming and tedious.

What if there was a way to bypass the mesh creation step ?

METHOD

Our method is to use a trained GAN 3D ShapeNets: A Deep Representation for Volumetric Shape Modeling. We train the GAN with some meshes and the constraints. The tile choice and placement are still resolved by the WFC, but instead of picking a random predefined mesh that satisfy the constraints, it it generated on the fly.
Each time the WFC needs a new mesh, it calls the GAN, feeding it with constraints to satisfy, the GAN then gives it back the newly generated mesh.

RESULTS

Different meshes are generated instead of being created by an artist

GAN APPLIED TO WAVE FUNCTION COLLAPSE FOR PROCEDURAL MAP GENERATION

The first tile has been chosen randomly. It has the following constraints : At the top it needs to be grass; at its left, right and bottom it needs to have a path

The WFC wants to put a tile at the bottom of the first one. It needs to have a path at its top. The rest of directions are free of constraints. The GAN is given this information and generate a path going from top to bottom.

OUR APPROACH

The generator aims to produce a voxel grid that is plausible.It has three 3D convolutional layers, each of which includes a bank of $4 \times 4 \times 4$ filters with strides of $2 \times 2 \times 2$, followed by a leaky ReLU activation function. It gives a 32 x 32 x 32 shape result.

The discriminator has the objective of distinguishing whether the estimated 3D shapes are plausible or not. It takes in input both real reconstruction pairs and fake reconstruction pairs.

The reconstruction of the mesh is made by using a marching cube function on the voxel grid produced by the generator. For better reconstruction we can use a Poisson reconstruction but we need a better shape result at least 128 x 128 x 128.

RELATED WORK

[1] Nordvig Møller, T., Billeskov, J., & Palamas, G. (2020, September). Expanding wave function collapse with growing grids for procedural map generation. In International Conference on the Foundations of Digital Games (pp. 1-4)
[2] Mintrone, A., & Erioli, A. (2021). Training Spaces-Fostering machine sensibility for spatial assemblages through wave function collapse and reinforcement learning.
[3] Wang, X., Xu, D., & Gu, F. (2020). 3D model inpainting based on 3D deep convolutional generative adversarial network. IEEE Access, 8, 170355-170363.
[4] Wu, Z., Song, S., Khosla, A., Yu, F., Zhang, L., Tang, X., & Xiao, J. (2015). 3d shapenets: A deep representation for volumetric shapes. In Proceedings of the IEEE conference on computer vision and pattern recognition (pp. 1912-1920).