

“THE USE OF PROCEDURAL MODELLING IN THE CREATION OF 3D OBJECTS”

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Conventional methods of manually modelling complex 3D objects are time-consuming and resource-intensive. Automated approaches, particularly procedural modelling, enable geometry to be generated using algorithms and formal rules. This method is effective for creating large, detailed scenes with repetitive or hierarchical structures, such as buildings, vegetation or urban environments.

The objective of the study is to analyse procedural modelling methods and determine their effectiveness in creating 3D objects. Procedural modelling is based on a generative description of objects, where geometry is created through the sequential application of rules, functions and algorithms. One of the key approaches is the use of shape grammars, where an object is described as a system of rewriting rules.

This approach allows complex structures to be built from simple initial elements.

Among the first and most important methods are L-systems (Lindenmayer systems), which operate on the basis of recursive string rewriting. Formally, an L-system is defined as:

$$G = (V, w, P),$$

where V – an alphabet of symbols;

w – an initial string;

P – a set of rewriting rules.

Once a string has been generated, its geometric interpretation is performed, allowing complex structures to be created, such as plants or fractal objects.

The other important approach is CGA shape grammar, which is used for modelling architectural objects. In this case, the geometry is created by splitting the object into constituent parts (split operations) and subsequently applying rules to each element.

An additional method involves structural graphs and trees (model graphs), where the modelling process is represented as a hierarchical structure. Geometry is generated by traversing the tree, with each node creating a corresponding geometric element.

This approach combines global constraints with local modifications.

Script-based modelling is widely used in modern systems, particularly with the use of programming languages (such as JavaScript). In this case, the model is described as a programme that generates geometry. The process involves the following stages:

- code parsing,
- validation,
- rendering into the target environment,
- geometry generation.

This approach allows for the creation of compact and portable model descriptions, independent of a specific visualisation environment.

The results show that procedural modelling is a powerful tool for automating the creation of 3D content, providing a concise description and a high degree of variability in the results, particularly when working with complex, large-scale scenes.

In modern 3D systems, it makes sense to adopt these approaches due to a shift in working methodology. Instead of manual, object-by-object model-

ling, it is better to build parametric systems where the key characteristics of objects are defined by rules. In Blender, this means organizing the scene as a set of interdependent node-based networks that can be quickly adapted to different tasks without reworking the model. For maximum productivity, it is advisable to combine this with scripting (particularly Python), using it to automate routine tasks, generate standard elements and manage complex processes. This reduces the number of operations, improves the quality and enables scaling of scenes.

Future development of procedural modelling is linked to the simplification of interfaces, the expansion of node-based systems, and further integration with automated content generation methods.

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