2.2 Iterative geometric design for architecture

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1 Introduction

In order to grasp the geometric design method studied here, the mathematical background must be clarified. Before employing, the principles of transformational geometric design must be introduced into the present work. In the first section, the proposed surface method and transformations are tested on a series of applications. The studied geometric formations and generating discrete geometries. Finally, the findings and construction constraints. Furthermore, the handling of specific constraints aim to facilitate the production of architectural forms. A further method based on vector sums is studied, allowing the design of free-form surfaces that are entirely composed of planar quadrilateral elements. The combination of interactive with the design, forming affine transformations and generating discrete geometries. The geometric construction of the Cantor set can be explained as follows: Take a straight line segment, divide it into three parts of equal length and remove the middle third; divide again each of the resulting line segments, and keep removing their middle thirds. If you repeat this for each of the new line segments, you will end up with the Cantor set. This construction is done step by step. The input of a construction step is the result of the previous step. The peculiar properties of the aforementioned objects led mathematicians to name them “monster curves.”

Mathematical background

2.1 Monster curves

The Cantor set is also called Cantor’s devil, in memory of a well-known mathematical invention that describes a set of points that lie on a straight line. All the end of the 19th century, this figure attracted the attention of mathematicians because of its apparently contradictory properties. Cantor basically stipulated it as a pre-figuration of non-measurable sets with geometric properties such as self-similarity, compactness, and discontinuity. These are fractal objects and among the first found. In 1904, the Swedish mathematician Helge von Koch described it for the first time. In 1915, the mathematician Michael Fielding Barnsley defined a formalism based on Hutchinson operators. His IFS-method (see section 2.3) consists of a set of contracting functions that are applied iteratively. In our case, a function is an affine geometric transformation. Iterative means that the construction is done step by step. The geometric construction of the von Koch curve might be constructed on the basis of the original straight line. A meandering curve with strange properties is created: – It does not possess a tangent, which means that it cannot be differentiated. – The length of any of its sections is always infinite. – It does not possess a tangent, which means that it cannot be differentiated.

2.2 Iterative geometric figures

The particular properties of the von Koch curve are based on its invariant sets. The geometric design method studied here, the mathematical background must be clarified. Before employing, the principles of transformational geometric design must be introduced into the present work. In the first section, the proposed surface method and transformations are tested on a series of applications. The studied geometric formations and generating discrete geometries. Finally, the findings and construction constraints. Furthermore, the handling of specific constraints aim to facilitate the production of architectural forms. A further method based on vector sums is studied, allowing the design of free-form surfaces that are entirely composed of planar quadrilateral elements. The combination of interactive with the design, forming affine transformations and generating discrete geometries. The geometric construction of the Cantor set can be explained as follows: Take a straight line segment, divide it into three parts of equal length and remove the middle third; divide again each of the resulting line segments, and keep removing their middle thirds. If you repeat this for each of the new line segments, you will end up with the Cantor set. This construction is done step by step. The input of a construction step is the result of the previous step. The peculiar properties of the aforementioned objects led mathematicians to name them “monster curves.”

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Three-directional timber fabric

The research undertaken between 2007 and 2013 by Prof. Yves Weinand and Dr. Markus Hudert within IBOIS, the Laboratory for Timber Constructions at the Swiss Federal Institute of Technology, Lausanne, Switzerland, analyzes the use of textile techniques at an architectural scale. It was driven by the structural study of the use of timber in a bended form, allowing for the creation of complex and efficient freestanding structures.

The character of the layers and their alignment relative to one another is defined with regard to their constituent modules. Five basic principles of alignment have been established and form the basis for the timber fabric configurations subsequently developed. The alignment principles are conceived in order to provide for varying structural possibilities when applied to the structural logic.

As part of the research, numerous configuration studies of timber fabric demonstrators have been conducted, out of which are drawn lessons.

In this configuration, the layers are mutually rotated around 0° and shifted in the direction of the central axis (that runs in the x-direction) while the exterior layer is perpendicular to the interior layer. The offset between the two layers is only effective if they work as an entity, which in turn depends on the connections between the low- and high-strength zones of the higher structure segment. As such a displacement lowers the character of the layers and their alignment relative to one another is defined with regard to their constituent modules. Five basic principles of alignment have been established and form the basis for the timber fabric configurations subsequently developed. The alignment principles are conceived in order to provide for varying structural possibilities when applied to the structural logic.

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