A Rational Interaction - A Fractal Description of Spacetime

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Abstract

This report presents a fractal method for understanding the structure of spacetime through a combination of spherical and cubic geometries. By using rational approximations of π and its square root, a model is developed to explain scaling symmetries and universal proportions. The purpose of this work is to establish a strict mathematical foundation for the structure of spacetime, demonstrate a self-stabilizing fractal geometry, and present practical applications in physics, cosmology, and quantum theory.

1 Introduction

This report presents a fractal method for understanding the structure of spacetime through a combination of spherical and cubic geometries. By using rational approximations of π and its square root, a model is developed to explain scaling symmetries and universal proportions.

1.1 Purpose

- To establish a strict mathematical foundation for the structure of spacetime.
- To demonstrate a self-stabilizing fractal geometry.
- To present practical applications in physics, cosmology, and quantum theory.

2 Fractal Structure and Spacetime

Spacetime is modeled as a self-organizing fractal with natural symmetries. Key principles include:

- The scaling properties of the Fibonacci sequence.

- The harmonizing role of the golden ratio (ϕ) in geometry.
- A balance between cubic and spherical volume integrations.

2.1 Mathematical Definition

Let K be a scaling factor and F_n the Fibonacci sequence:

$$V_n = \left(\frac{1}{2} \cdot \phi F_n \cdot \pi - k\right)^3 \cdot \pi$$

This equation describes volume changes in fractal expansion where the Fibonacci sequence and the golden ratio govern the structure.

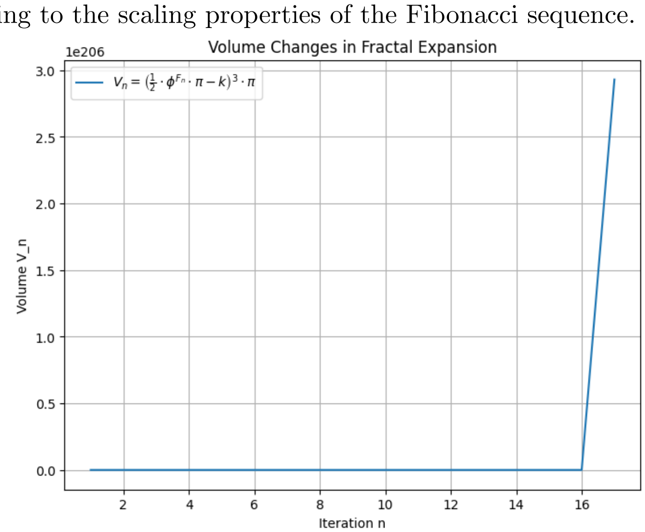
3 Volume Changes in Fractal Expansion

In this section, we illustrate how the volume of a fractal structure changes over iterations, according to the mathematical model derived from the Fibonacci sequence and the golden ratio, as shown in equation 1. The equation describes the volume changes in fractal expansion, governed by the Fibonacci sequence and the golden ratio ϕ:

$$V_n = \left(\frac{1}{2} \cdot \phi^{F_n} \cdot \pi - k\right)^3 \cdot \pi \tag{1}$$

Where: - ϕ is the golden ratio, - F_n is the Fibonacci sequence, and - k is a constant scaling factor.

The following figure demonstrates the volume changes over iterations of the fractal expansion. As n increases, the volume of the fractal structure grows according to the scaling properties of the Fibonacci sequence.



[h!] Volume Changes in Fractal Expansion over Iterations

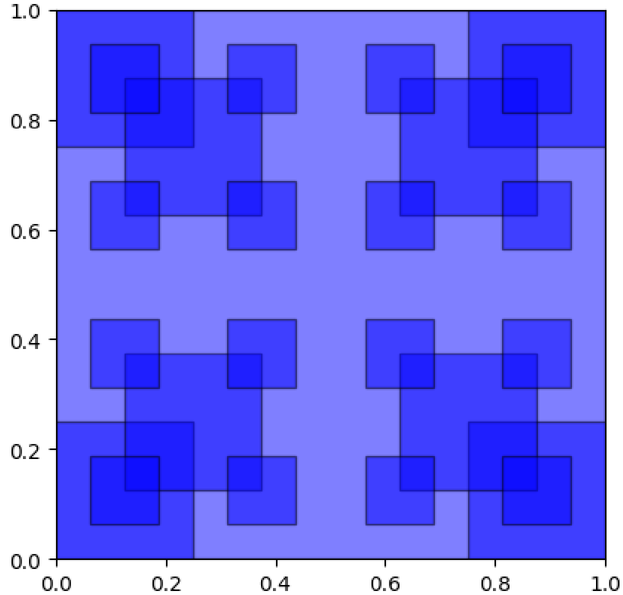
4 Explanation of the Fractal Models and Their Optical Illusion Effects

This section provides a detailed explanation of the fractal models introduced in the report, specifically focusing on the Cube Fractal and Sphere Fractal. These models illustrate how different geometrical shapes—cubic and spherical—interact and create a dynamic and balanced spacetime structure. The models are visualized in 2D projections, which gives rise to an **optical 3D illusion** due to the recursive and self-similar nature of the fractal construction.

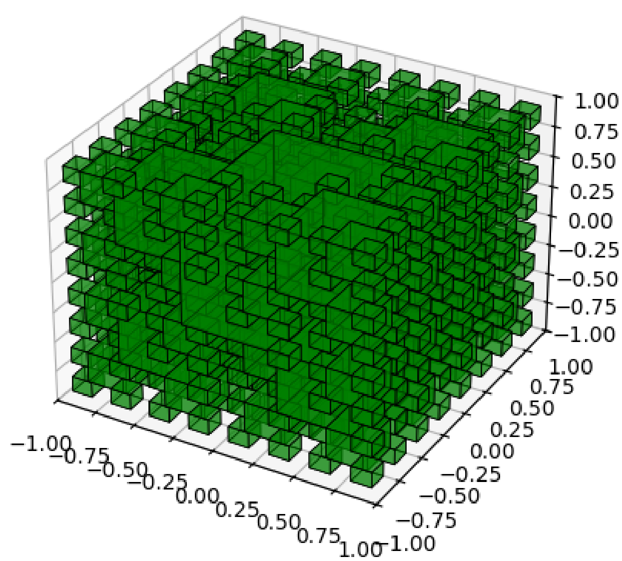
The Cube Fractal and Sphere Fractal, although modeled in 2D for practical purposes, evoke a perception of 3D space when projected, leading to an optical illusion of depth. This occurs because the fractal structures use recursive subdivisions that mimic the **scaling symmetries** observed in the structure of spacetime. The illusion arises from the hierarchical and self-similar properties of the fractals, which are akin to the spatial transformations observed in higher-dimensional spaces. This effect becomes especially pronounced when the models are presented in **recursive iterations**, with smaller cubes or spheres embedded within larger ones. These visual patterns suggest a multi-dimensional structure, despite being represented in a 2D plane.

Furthermore, this **optical illusion** of three-dimensionality plays a crucial role in understanding the fractal geometry of spacetime. The recursive nature of the fractals—particularly when hybrid geometries like the Cube-Sphere Fractal are used—mimics the scaling behavior of spacetime at different levels. Just as smaller cubes or spheres appear nested within larger ones, spacetime is thought to exhibit self-similar properties at various scales. This visual model aids in understanding how scaling symmetries and universal proportions govern the structure of spacetime.

The following figure demonstrates these fractal models and their recursive subdivisions, illustrating how the cube and sphere geometries create the illusion of depth when projected into two dimensions:



Fractal Models: Cube Fractal 2-D,



Fractal Models: Cube Fractal 3-D,

5 External Scaling Formula

The expansion of spacetime follows an iterative process where the relationship between linear and circular forms is fundamental.

5.1 Mathematical Representation

$$V_n = \left(\frac{\phi F_n}{2}\right)^3 \cdot \pi^{n^{0.5}}$$

This equation describes the exponential relationship between scaling and the structure of spacetime.

6 Visualization and Scaling Properties

To clarify the concept, three models are created:

- **Cube Fractal Only** – purely cubic structure.
- **Sphere Fractal Only** – purely spherical structure.
- **Cube-Sphere Fractal** – a combination of both in a unified model.

These models illustrate how linear and circular geometries interact to create a dynamic and balanced spacetime structure.

7 Connection to Spacetime Geometry and Theories

The theory connects to:

- Tensor-based metric models.
- Ricci flow equations and differential geometry.
- Penrose's twistor theory and the AdS/CFT correspondence.

7.1 Experimental Validations

- Correlation patterns in cosmic microwave background radiation (CMB).
- Fractal structures in quantum interference.

8 Rationalization of π and $\sqrt{\pi}$

This theory proposes a new interpretation where π and its relation to the square root can be seen as an integrated part of spacetime geometry:

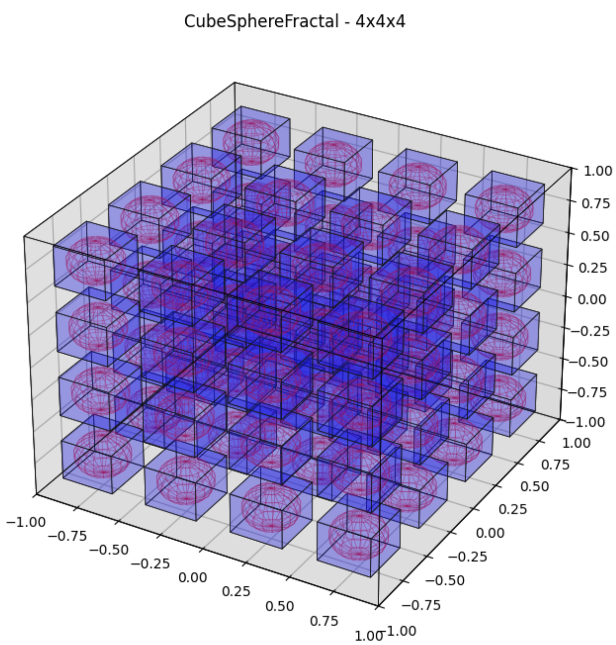
$$\pi \approx \frac{F_n}{\phi^n}$$

8.1 Consequences

- Possibility to unify spherical and cubic symmetry into a single model.
- Creates a harmonic connection between linear and exponential growth.

Simulations show:

- The self-similarity of the fractal structure during iterative scaling.
- Agreement with theoretical predictions on spacetime dynamics.



Fractal Models: 3-D, hyperref

9 Körning av kod

För att köra koden och experimentera med skripten kan du använda Google Colab. Klicka på länken nedan för att öppna Colab-versionen av skriptet:
hyperref

10 Running the Code on Google Colab

To run the code in Google Colab, click the link below:
https://colab.research.google.com/github/AntonWallin999/fractal-project/blob/main/Code-Examples/A1$_{R}ational_{I}nteraction_{AF}ractal_{D}escription_{o}f_{S}pacetime.ipynbRunthecodeonGoogleColab$