

## **TA'LIM JARAYONIDA FRAKTAL GRAFIKASI DASTURIY TA'MINOTLARIDAN FOYDALANISHNING AFZALLIKLARI**

### **ВАЖНОСТЬ ИСПОЛЬЗОВАНИЯ ПРОГРАММНОГО ОБЕСПЕЧЕНИЯ ФРАКТАЛЬНОЙ ГРАФИКИ В ОБРАЗОВАТЕЛЬНОМ ПРОЦЕССЕ**

### **IMPORTANCE OF USING FRACTAL GRAPHICS SOFTWARE IN THE EDUCATIONAL PROCESS**

**Annotatsiya:** *Ushbu maqola fraktal grafik dasturiy ta'minotning ta'limdagi ahamiyatini o'rganib, uning matematika, kompyuter dasturlash, san'at va fan sohalarida qo'llanilishini ta'kidlaydi. Fraktal grafik dasturlardan foydalanish o'quvchilarga matematik tushunchalarni vizual va interaktiv ravishda o'rganish imkonini beradi, geometriya, algebra va hisoblarni chuqurroq tushunishga yordam beradi. Shuningdek, u o'quvchilarga algoritmlarni boshqarish va hatto o'z kodlarini yozish imkonini beruvchi dasturlash ko'nikmalarini rivojlantirish uchun qimmatli vosita bo'lib xizmat qiladi. Matematikadan tashqari, fraktal grafikani o'quv dasturiga kiritish o'quvchilarni matematika va san'atning kesishuvini o'rganishga ilhomlantirib, badiiy ijodkorlikni oshiradi. Maqolada, shuningdek, fraktal geometriya murakkab tabiat hodisalarini modellashtirishda muhim rol o'ynaydigan astrofizika va biologiya kabi turli xil ilmiy sohalarida fraktallarning dolzarbligini ta'kidlaydi. Bundan tashqari, kompyuter grafikasida fraktallardan foydalanish, tasvirni siqish va ko'ngilochar industriyada maxsus effektlar muhokama qilinadi. Xulosa qilib aytganda, maqola fanlar bo'yicha yaxlit va interaktiv ta'limni rivojlantirish uchun fraktal grafik dasturiy ta'minotning ko'p qirrali ta'lim afzalliklarini ta'kidlaydi.*

**Kalit so'zlar:** *Fraktal grafik dasturiy ta'minot, Matematik tushunchalar, Kompyuter dasturlash, San'at va dizayn, Tabiiy dunyo, O'quv quroli, Vizual, interaktiv o'rganish, Fanlararo ilovalar, Astrofizika, Biologiya fanlari, Kompyuter grafikasi, Tasvirni siqish, Xaos nazariyasi, Aniqlik va tasnif, Amaliy fan, Ijodkorlik, Tanqidiy fikrlash, Interfaol ta'lim tajribasi.*

**Аннотация:** *В этой статье исследуется значение программного обеспечения фрактальной графики в образовании, подчеркивая его применение в математике, компьютерном программировании, искусстве и естественных науках. Использование программного обеспечения для фрактальной графики позволяет учащимся визуально и интерактивно изучать математические концепции, способствуя более глубокому пониманию геометрии, алгебры и исчисления. Кроме того, он служит ценным инструментом для развития навыков программирования, позволяя учащимся манипулировать алгоритмами и даже писать собственный код. Помимо математики, включение фрактальной графики в учебную программу расширяет художественное творчество, вдохновляя учащихся исследовать пересечение математики и искусства. В статье также подчеркивается актуальность фракталов в различных научных областях, таких как астрофизика и биология, где фрактальная геометрия играет важную роль в моделировании сложных природных явлений. Кроме того, обсуждается применение фракталов в компьютерной графике, сжатии изображений и спецэффектах в индустрии развлечений. В заключение в статье подчеркиваются многогранные образовательные преимущества программного обеспечения для фрактальной графики, способствующего целостному и интерактивному обучению по различным дисциплинам.*

**Ключевые слова:** *Программное обеспечение для фрактальной графики, Математические концепции, Компьютерное программирование, Искусство и дизайн, Мир природы, Образовательный инструмент, Визуальное, интерактивное обучение, Междисциплинарные приложения, Астрофизика, Биологические науки, Компьютерная*

*графика, Сжатие изображений, Теория хаоса, Точность и классификация, Прикладная наука, Творчество, Критическое мышление, Опыт интерактивного обучения.*

**Annotation.** *This paper explores the significance of fractal graphics software in education, highlighting its applications in mathematics, computer programming, art, and the natural sciences. The use of fractal graphics software allows students to visually and interactively engage with mathematical concepts, fostering a deeper understanding of geometry, algebra, and calculus. Additionally, it serves as a valuable tool for developing programming skills by enabling students to manipulate algorithms and even write custom code. Beyond mathematics, the incorporation of fractal graphics into the curriculum enhances artistic creativity, inspiring students to explore the intersection of math and art. The paper also underscores the relevance of fractals in various scientific fields, such as astrophysics and biology, where fractal geometry proves instrumental in modeling complex natural phenomena. Furthermore, the application of fractals in computer graphics, image compression, and special effects in the entertainment industry is discussed. In conclusion, the paper emphasizes the multifaceted educational benefits of fractal graphics software, promoting a holistic and interactive learning experience across diverse disciplines.*

**Keywords:** *Fractal graphics software, Mathematical concepts, Computer programming, Art and design, Natural world, Educational tool, Visual, interactive learning, Interdisciplinary applications, Astrophysics, Biological sciences, Computer graphics, Image compression, Chaos theory, Precision and classification, Applied science, Creativity, Critical thinking, Interactive learning experience.*

In recent years, fractal graphics software has become increasingly popular, both in the artistic and scientific communities. Fractal graphics are a type of digital imagery that employs mathematical algorithms to create complex, self-similar patterns. This technology has opened up a world of possibilities in the realm of graphic design, but its importance in education is often overlooked. Here, we explore the importance of using fractal graphics software in the educational process.

Fractal graphics software provides students with a unique opportunity to explore mathematical concepts and patterns in a visual, interactive way. By manipulating various parameters in the software, students can create complex patterns and explore the relationships between them. This type of exploration can help students develop a deeper understanding of mathematical concepts such as geometry, algebra, and calculus.

Furthermore, fractal graphics software can help students develop important skills in computer programming and coding. Many fractal graphics software applications provide an interface that allows users to manipulate the parameters of the fractal algorithm, but they also offer the option to write custom code. This feature enables students to create their own unique algorithms and experiment with different programming languages.

In addition to its mathematical and programming applications, fractal graphics software can be used to teach students about art and design. The unique visual patterns created by fractals can be used to inspire students' creativity and encourage them to explore the intersection of math and art. By incorporating fractal graphics into the curriculum, students can learn about the artistic possibilities of mathematical concepts and develop their artistic skills.

Finally, fractal graphics software can be used to teach students about the natural world. Many natural phenomena, such as clouds, coastlines, and snowflakes, exhibit fractal patterns. By using fractal graphics software, students can simulate these natural patterns and gain a deeper understanding of the underlying mathematical principles that govern them.[1]

Fractal geometry has permeated many area of science, such as astrophysics, biological sciences, and has become one of the most important techniques in computer graphics.

### ***Fractals in astrophysics***

Nobody really knows how many stars actually glitter in our skies, but have you ever wondered how they were formed and ultimately found their home in the Universe? Astrophysicists believe that the key to this problem is the fractal nature of interstellar gas. Fractal distributions are hierarchical, like smoke trails or billowy clouds in the sky. Turbulence shapes both the clouds in the sky and the clouds in space, giving them an irregular but repetitive pattern that would be impossible to describe without the help of fractal geometry.

### ***Fractals in the Biological Sciences***

Biologists have traditionally modeled nature using Euclidean representations of natural objects or series. They represented heartbeats as sine waves, conifer trees as cones, animal habitats as simple areas, and cell membranes as curves or simple surfaces. However, scientists have come to recognize that many natural constructs are better characterized using fractal geometry. Biological systems and processes are typically characterized by many levels of substructure, with the same general pattern repeated in an ever-decreasing cascade.

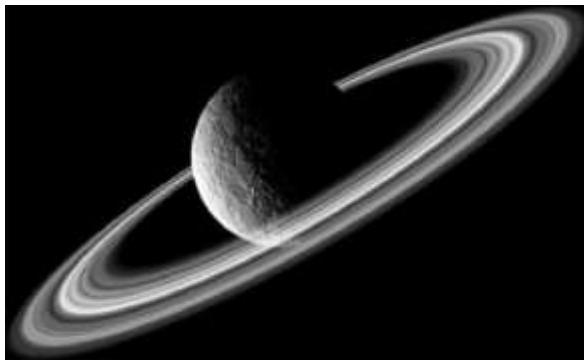
Scientists discovered that the basic architecture of a chromosome is tree-like; every chromosome consists of many 'mini-chromosomes', and therefore can be treated as fractal. For a human chromosome, for example, a fractal dimension  $D$  equals 2,34 (between the plane and the space dimension). Self-similarity has been found also in DNA sequences. In the opinion of some biologists fractal properties of DNA can be used to resolve evolutionary relationships in animals.

Perhaps in the future biologists will use the fractal geometry to create comprehensive models of the patterns and processes observed in nature. .[2]

### ***Fractals in computer graphics***

The biggest use of fractals in everyday life is in computer science. Many image compression schemes use fractal algorithms to compress computer graphics files to less than a quarter of their original size. Computer graphic artists use many fractal forms to create textured landscapes and other intricate models.[3]

It is possible to create all sorts of realistic "fractal forgeries" images of natural scenes, such as lunar landscapes, mountain ranges and coastlines. We can see them in many special effects in Hollywood movies and also in television advertisements. The "Genesis effect" in the film "Star Trek II - The Wrath of Khan" was created using fractal landscape algorithms, and in "Return of the Jedi" fractals were used to create the geography of a moon, and to draw the outline of the dreaded "Death Star". But fractal signals can also be used to model natural objects, allowing us to define mathematically our environment with a higher accuracy than ever before. .[4]



***fractal landscape***



***fractal planet***

**Conclusion.** Many scientists have found that fractal geometry is a powerful tool for uncovering secrets from a wide variety of systems and solving important problems in applied science. The list of known physical fractal systems is long and growing rapidly.

Fractals improved our precision in describing and classifying "random" or organic objects, but maybe they are not perfect. Maybe they are just closer to our natural world, not the same as it. Some scientists still believe that true randomness does exist, and no mathematical equation will ever describe it perfectly. So far, there is no way to say who is right and who is wrong. Perhaps for many people fractals will never represent anything more than beautiful pictures.

In conclusion, fractal graphics software is a powerful educational tool that can help students develop a deeper understanding of mathematical concepts, computer programming, art and design, and the natural world. By incorporating fractal graphics into the curriculum, educators can provide students with a unique and interactive learning experience that promotes creativity and critical thinking.

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