МАТЕМАТИЧЕСКОЕ МОДЕЛИРОВАНИЕ РАЗЛИЧНЫХ ПОВЕРХНОСТЕЙ НА ЯЗЫКЕ ПРОГРАММИРОВАНИЯ PYTHON

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АННОТАЦИЯ

Рассмотрены возможные варианты компьютерного моделирования различных поверхностей, как изолированных, так и групповых, со случайным характером разрушения. Для этой цели используется рабочая оболочка программы на Python, которая позволяет успешно выполнять подобные процедуры. Представленные варианты имеют реальные аналоги поверхностей, полученных после определенных видов механической обработки.

Ключевые слова: *поверхность, шероховатость, моделирование, компьютерная программа.*

MATHEMATICAL MODELING OF VARIOUS SURFACES IN THE PYTHON PROGRAMMING LANGUAGE

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ANNOTATION

Possible variants of computer modeling of different surfaces, both isolated and group, with a random nature of destruction are considered. For this purpose, the working shell of the Python program is used, which allows you to successfully perform such procedures. The presented variants have real analogues of surfaces obtained after certain types of mechanical processing.

Keywords: *surface, roughness, modeling, computer program.*

Introduction

When solving many technical problems, it becomes necessary to model surfaces with specified characteristics. One of such tasks is modeling the surface of the product both before and after the final processing of products – grinding, polishing, etc. The aim of the work is to create schemes for mathematical modeling of surfaces in such a way that the model makes it possible to explore the surface even with a very large zoom in. From a mathematical point of view, the problem is reduced to the description of a continuous surface with specified characteristics.

Python is a popular programming language for machine learning, because of its convenience, high performance and rich library of tools.

- ✓ Functionality: Support for high-level mathematical operations
- ✓ Extended support for vectorized operations using NumPy
- ✓ Rich library of data visualization tools using Matplotlib and Seaborn
- ✓ Support for multiple machine learning algorithms using libraries such as scikit-learn and TensorFlow
- ✓ Multithreading and scaling support
- ✓ Ease of integration with other programming languages, such as C++ and Java.

Mathematical modeling of a one-dimensional random process with specified parameters

To plot a function in Python, you need to specify the library itself. Matplotlib is a comprehensive library for creating static, animated, and interactive visualizations in Python. Matplotlib makes easy things easy and hard things possible.

Most of the Matplotlib utilities lies under the pyplot submodule, and are usually imported under the plt alias:

```
import matplotlib.pyplot as plt
```

The problem of modeling a random process can be solved in various ways. For example, in the Python programming language, plotting verify three functions can be shown with this way:

```
1  import numpy as np
2  import matplotlib.pyplot as plt
3  x = np.arange(-10, 10.01, 0.01)
4  plt.figure(figsize=(10, 5))
5  plt.plot(x, np.sin(x), label=r'$f_1(x)=\sin(x)$')
6  plt.plot(x, np.cos(x), label=r'$f_2(x)=\cos(x)$')
7  plt.plot(x, -x, label=r'$f_3(x)=-x$')
8  plt.xlabel(r'$x$', fontsize=14)
9  plt.ylabel(r'$f(x)$', fontsize=14)
10 plt.grid(True)
11 plt.legend(loc='best', fontsize=12)
12 plt.savefig('figure_with_legend.png')
13 plt.show()
```

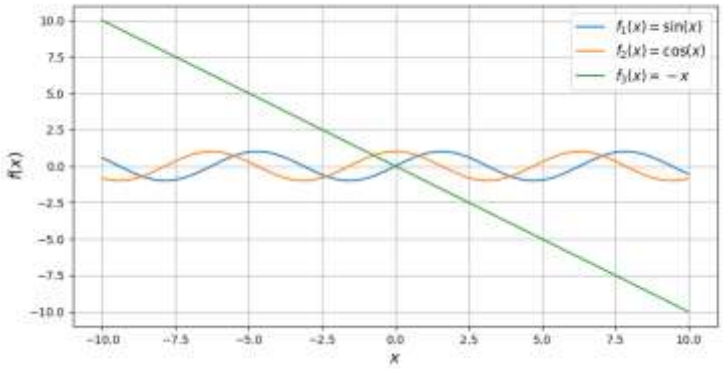

Figure 1. Plotting three different functions

Mathematical modeling of a two-dimensional random process (surfaces)

Similarly to how a random process is defined by localization points , the surface can be defined by the product of sampling functions at localization points on the X, Y coordinate grid.

Let's look at the example of the graph of the function

$$z(x, y) = \frac{\sin x \cdot \sin y}{x \cdot y}, \quad (1)$$

```
import pylab
from mpl_toolkits.mplot3d import Axes3D
from matplotlib import cm
import numpy

def makeData():
    x = numpy.arange(-10, 10, 0.1)
    y = numpy.arange(-10, 10, 0.1)
    xgrid, ygrid = numpy.meshgrid(x, y)
    zgrid = numpy.sin(xgrid)*numpy.sin(ygrid)/(xgrid*ygrid)
    return xgrid, ygrid, zgrid

x, y, z = makeData()

fig = pylab.figure()
axes = Axes3D(fig)
axes.plot_surface(x, y, z, rstride=4, cstride=4, cmap=cm.jet)
pylab.show()
```

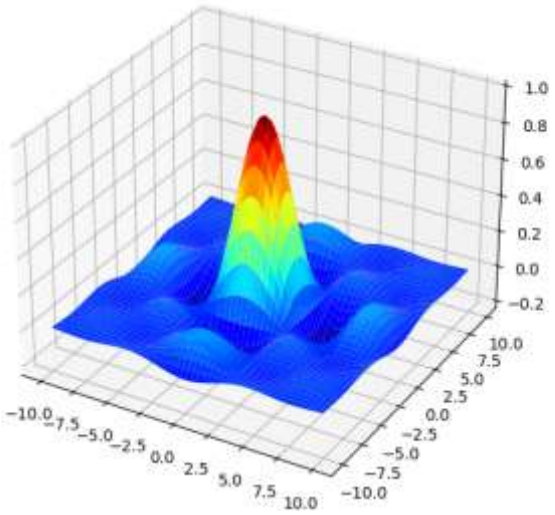

Figure 2. Single spray surface

The graph of a hyperbolic paraboloid is formed in this way:

$$z(x,y) = \frac{x^2}{a^2} - \frac{y^2}{b^2}, \quad a > 0, b > 0, (2)$$

```
1 from mpl_toolkits.mplot3d import axes3d
2 import matplotlib.pyplot as plt
3 import numpy as np
4 ax = axes3d.Axes3D(plt.figure())
5 i = np.arange(-1, 1, 0.01)
6 X, Y = np.meshgrid(i, i)
7 Z = X**2 - Y**2
8 ax.plot_wireframe(X, Y, Z, rstride=10, cstride=10)
9 plt.show()
```

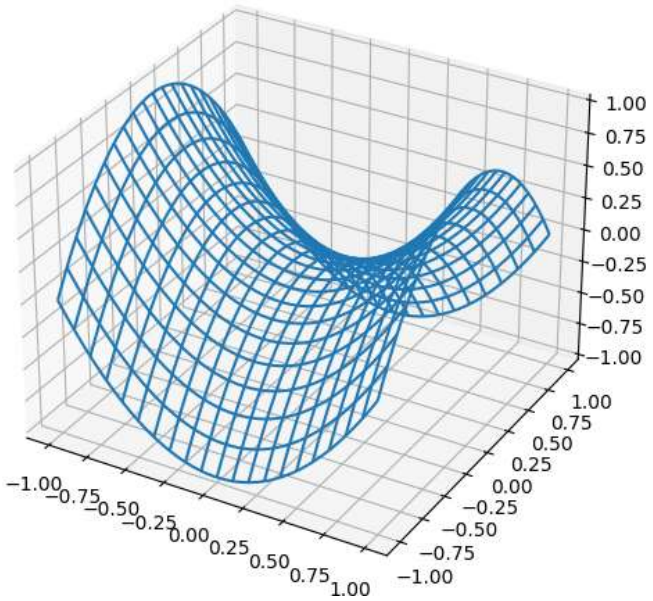

Figure 3. Hyperbolic paraboloid

Conclusion

The article presents various options for modeling two-dimensional and three-dimensional surfaces. To do this, the most popular and convenient programming language Python and its libraries are used. All formulas and program codes are shown as well as a graph of these functions.

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