The use of reaction equations for the simulation of physical phenomena

Simon Abrelat

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Math HL IA

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Words:

Abstract

Tis but a placeholder

Contents

1 Introduction

Hello [Knuth, 2001a]. [Einstein, 1905] [Goossens et al., 1993] asjkldf [Knuth, 2001b]

2 Calculus

3 Diffusion

4 Reaction

5 Reaction Diffusion

6 References

7 Appedix

Listing 1: Diffusion

```
import numpy as np
from mpl_toolkits.mplot3d import Axes3D
import matplotlib.pyplot as plt

# Simulation constants
alpha = 0.00001  # Laplician multiplier
dx = 0.01  # Simulation speed/accuracy
n = 2000  # number of iterations

# Matrix initialization
M = np.empty((100, 100))
M.fill(0)
x, y = M.shape
# Hotspot Seeding
M[20:30, 45:50] = 90
M[70:80, 45:50] = 90
np.set_printoptions(precision=1)


# Implementation of the decretized laplacian operator
def laplacian(Z):
    Ztop = Z[0:-2, 1:-1]
    Zleft = Z[1:-1, 0:-2]
    Zbottom = Z[2:, 1:-1]
    Zright = Z[1:-1, 2:]
    Zcenter = Z[1:-1, 1:-1]
    return (Ztop + Zleft + Zbottom + Zright - (4 * Zcenter)) / dx**2


# Iterations through PDE
for _ in range(n):
    Mn = M[1:-1, 1:-1]
    M[1:-1, 1:-1] = Mn + np.multiply(laplacian(M), alpha)

# Graph Data
plt.imshow(M, cmap=plt.cm.coolwarm,
           interpolation='bilinear', extent=[-1, 1, -1, 1])
```

```
plt.show()
```

Bibliography

[Einstein, 1905] Einstein, A. (1905). Zur Elektrodynamik bewegter Körper. (German) [On the electrodynamics of moving bodies]. *Annalen der Physik*, 322(10):891–921.

[Goossens et al., 1993] Goossens, M., Mittelbach, F., and Samarin, A. (1993). *The LaTeX Companion*. Addison-Wesley, Reading, Massachusetts.

[Knuth, 2001a] Knuth, D. (2001a). Knuth: Computers and typesetting.

[Knuth, 2001b] Knuth, D. (2001b). Knuth: Computers and typesetting.