

3-D Plotting of a Convection-Diffusion Equation

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Abstract—This document discusses the Numerical Solutions of the Convection-Diffusion Equation, which models various physical phenomena. Using Python for simulations, we demonstrate a 3-D plot of the solution.

I. INTRODUCTION

Convection-diffusion equations (*CDE*) describe transport phenomena in various fields such as fluid dynamics, heat transfer, and more. The historical context of these equations dates back to the works on diffusion by *Fick* in 1855 and convection analyzed by *Darcy* in the 19th century. The general form of a convection-diffusion equation is:

$$\frac{\partial u}{\partial t} + \mathbf{v} \cdot \nabla u = D \nabla^2 u + S \quad (1)$$

where u is the scalar field (e.g., concentration or temperature), \mathbf{v} is the velocity vector, D is the diffusion coefficient, and S represents sources or sinks.

II. METHODOLOGY

In this paper, we use numerical methods to solve the convection-diffusion equation in three dimensions. We demonstrate the result using Python for plotting.

III. PYTHONTEX IMPLEMENTATION

Below is the Python code using PythonTeX to plot the result of the convection-diffusion equation:

Please refer to the generated plot in Fig. 1.

IV. RESULTS AND DISCUSSION

The solution obtained provides insights into the behavior of the scalar field under given conditions. By observing the plotted surface, we note the interaction of convective and diffusive transport within the domain.

V. CONCLUSION

Incorporating numerical methods and Python enhances the understanding and visualization of the convection-diffusion phenomena. This framework allows further exploration into complex systems governed by such equations.

REFERENCES

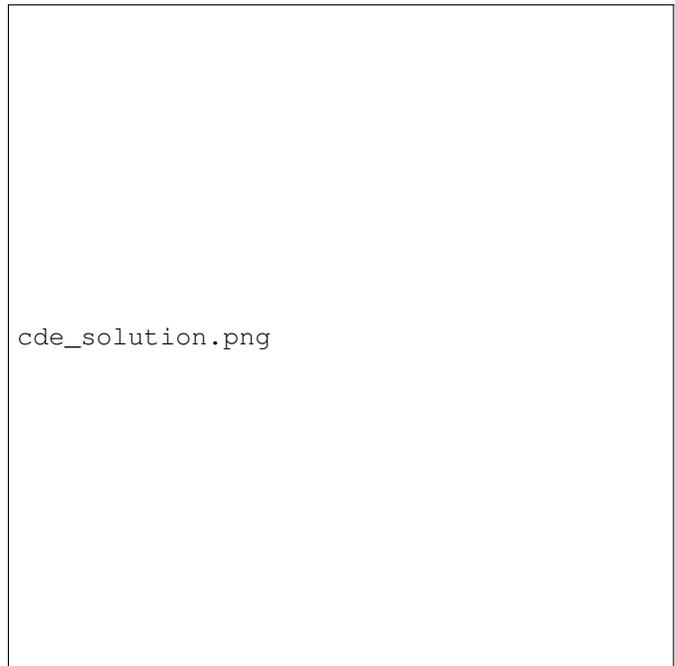


Fig. 1. 3D plot of the convection-diffusion equation solution.