Comparing Semi-Implicit and Full-Implicit Method for Solveing Stiff Density Dependent Diffusion-Reaction Equations Arising in Biofilm Growth Models

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Abstract

This is the abstract. The discussion of the difference between fully-implicit and semi-implicit method will be discussed in this paper.

1 Intro

This is the intro, it'll go something like:

Paragraph introducing and defining what a biofilm is, include some applications and such.

Describe the history of modelling these systems. Talk about how to solve these systems.

Mention that some methods are semi-implicit. Define semi-implicit (with a reference). Mention that others are fully-implicit. Define fully-implicit. Have a little bit on the difference between semi-implicit methods and fully-implicit (which should be relativly clear from the definitions).

Talk about the difference in what I'm doing here (i.e. that using a fully-implicit method won't add too much time but still be accurate, or that it doesn't matter which you use since there isn't a difference in accuracy).

2 Model

Talk about the biology of the system (alex paper).

Describe the system mathematically (what I've been doing all along) Talk about what each function represents, and what each equation is. Also mention the significance of each parameter if possible. Mention the initial conditions and the region that is solved on (square?) With the region, mention the boundary conditions (Neumann)

3 Method

Talk about the numerical methods used (trapezidral rule, finite difference method, and Conjugate Gradiant method). Probably mention that it's stored in a diagonal format. Talk about the grid division and ordering.

Actually list the discretized system, with the grid ordering (report 02)

Find some way to prove that the discretized system is positive definite, symmetric, and diagonally dominent (have a Propsition with proof?) Proposition [1] [2] Now with theses characteristics we can sove it using the Conjugate Gradiant method (according the the Y Saad Iterative methods for sparse linear systems).

4 Results

4.1 Simulation Setup

Mention region, grid size, number of grids (i.e 1024 x 1024 or something). Mentions what language the code is written in " any libraries used.... (none, openMP? " the platform used (Reckoning2!, altixuv?, Dell-T-1600?)

4.2 Results

Mention the parameter values used (or reference the appendix that holds them) Show a few snap shots of the map view? Describe, biologically, what the soltion shows?

4.3 Comparisons

Here, report the computation time, max/average num. of iterations for the linear solver AND the fully implicit iteration. Also mention the Accuracy of the solutions by using the norm of each solution compared to the most accurate one.... (Maybe take a solution at a higher grid resolution?, not sure what to do here) Take differen solutions with different level of accuracry for the fully-implicit iterations (i.e. change eSoln)

5 Conclusions

Make conclusions....

References

[1] H.J. Eberl and L. Demaret. A finite difference scheme for a doubly degenerate diffusionreaction equation arising in microbial ecology. *Electron. J. Differential Equations*, page 7795, 2007.

[2] H.J. Eberl, D.F. Parker, and van Loosdrecht M.C.M. A new deterministic spatio-temporal continuum model for biofilm development. *Journal of Theoretical Medicine*, pages 161–175, 2001.