# AN EFFICIENT EXPLICIT FINITE-DIFFERENCE SCHEME FOR SIMULATING COUPLED BIOMASS GROWTH ON NUTRITIVE SUBSTRATES

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ABSTRACT

A novel explicit finite-difference method is presented to provide the positive and bounded solutions to a nonlinear parabolic partial differential equation system that describes the development process of a microbial colony on a substrate with nutrients. Our novel finite-difference (FD) scheme is designed to convert the nonlinear terms in the PDE into a discrete set of linear ones that can be solved very efficiently by computers, while ensuring the stability and the bounds of the numerical solution. This is achieved through 1) a proper design of intertwined FD approximations for the diffusion function in both time and spatial variations, and 2) the control of the time-step based on our establishing stability criteria. The present scheme is applicable for solving systems of partial differential equations in the investigation of the dynamics of biological films. Our examples have shown the fact that the numerical solution can be ensured nonnegative and bounded.

**Keywords:** Coupled substrate-biomass system; Finite-difference method; Nonlinear diffusion reaction; Explicit algorithm;