

CONVERGENCE ANALYSIS OF A NUMERICAL SCHEME FOR A TUMOUR GROWTH MODEL

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ABSTRACT

We consider a one-spatial dimensional tumour growth model that consists of three variables; volume fraction and velocity of tumour cells, and nutrient concentration. The model variables form a coupled system of semi-linear advection equation (hyperbolic), simplified stationary Stokes equation (elliptic), and linear diffusion equation (parabolic) with appropriate conditions on the time-dependent boundary which is governed by an ordinary differential equation. An equivalent formulation in a fixed domain is used to overcome the difficulty associated with the time-dependent boundary in the original model. Though this reduces complexity of the model, the tight coupling between the component equations and their non-linear nature offer challenges in proving suitable *a priori* estimates. A numerical scheme that employs a finite volume method for the hyperbolic equation, a finite element method for the elliptic equation and a mass-lumped finite element method for the parabolic equation is developed. We establish the existence of a time interval $(0, T_*)$ over which the convergence of the scheme using compactness techniques is proved, thus proving the existence of a solution. Numerical tests and justifications that confirm the theoretical findings conclude the paper.

REFERENCES

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