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3D modeling of glioblastoma multiforme growth in microfluidic devices

A. Costa-Solé[*], M. Discacciati[⋆], M. Pérez-Aliacar[†‡], J. Ayensa-Jiménez[†‡], M. Doblaré[†◇] and J. Sarrate[*]

[*] ETS d'Enginyeria de Camins, Canals i Ports de Barcelona, UPC, Barcelona, Spain
[⋆] Mathematical Sciences Department, Loughborough University, United Kingdom
[†] TME Lab, Instituto de Investigación en Ingeniería de Aragón (I3A), UZ , Spain
[‡] Dpto. Ing. Mecánica, Escuela de Ingeniería y Arquitectura , UZ, Spain
[◇] Centro de Investigación Biomédica en Red, Bioingeniería, Biomateriales y Nanomedicina (ciber-bbn), Spain

ABSTRACT

Glioblastoma multiforme (GBM) is the most common and aggressive brain tumor of the primary gliomas. Its evolution involves the interaction of GBM cells with the tumor microenvironment (TME) that is complex, dynamic and multiply interactive. Understanding and modeling this interaction is a crucial step to predict the growth of the GBM or to develop new drugs and therapies that may impact on a better prognosis.

In vivo tests are very difficult and expensive since it is extremely complex to reproduce specific conditions or isolate the effects produced by a single variable or a certain phenomenon. *In vitro* experiments, and in particular microfluidic devices [1], allow better control of test variables and drastically reduce the cost of new tests.

To further improve the design of these devices, in this work we present a nonlinear diffusion-convection-reaction computational model for the 3D simulation of the growth of GBM cells in microfluidic devices. The numerical resolution of this model is carried out using high-order finite elements and high-order Runge-Kutta Diagonal and Implicit (DIRK) temporal integration schemes [2]. This leads to a non-linear problem in each state of the DIRK scheme that is solved by Newton's method. Several examples will be presented to illustrates the capabilities of the model to predict the evolution of GBM cells in various microfluidic devices and under different operating conditions.

REFERENCES

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