Hermite-Collocation and Fokas method for Tumor invasion problem with discontinuous diffusion coefficient

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Gliomas are especially aggressive malignant forms of brain tumors. The most common problem in diagnosis and treatment of patients with glioma is the rapid infiltration of tumor cells in adjacent normal tissue. Mathematical models based on experimental data from MRI and CT scans were developed to simulate the growth of a glioma. The basic characteristic of these models is the discontinuity of the diffusion coefficient in areas of heterogeneous interfaces (white and grey matter).

Collocation with continuous Hermite elements is a well known numerical method for the solution of certain PDE's. In this work we applie Collocation method with discontinuous Hermite elements at internal interface points, in order to treat the first derivative discontinuities. Discontinuous Collocation complemented by Backward Euler or Crank Nicolson schemes can be used for the solution of tumor invasion problems.

On the other hand, for the same problem, we implement a novel analytical-numerical integration method based on Fokas transform method. The advantage of this method, in comparison with the classical numerical techniques, is that the analytical solution can be evaluated at any point of space-time domain without requiring any knowledge of the solution at any other point of the domain.

Numerical results show that these two methods are competative.