A two scales approach in cancer motility and invasion

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Recent biological information points to the existance of a secondary group of cancer cells that exhibit lower proliferation rates, higher motility, stem cell-like properties, and are able to metastasize to different locations within the organism and engender new tumour. These cancer cells are termed Cancer Stem Cells, they constitute the smaller part of the tumour with the bulk being comprised by the more usual (and not metastatic) Differentiated Cancer Cells (DCCs). The CSCs emanate from the DCCs by a cellular transition program that resembles the Epithelial-Mesenchymal-Transition (EMT) found also in normal tissue. In this talk we present our efforts in this direction from a two dfferent scales.:

From a macroscopic deterministic point we describe the participating quantities by their densities. The derived models are Advection-Raction-Diffusion (ARD) systems with the cancer cells as their primary components. They address the invasion of the Extracellular Matrix (ECM) by both DCCs and CSCs and they include the EMT between them. The numerical simulations are conducted with a problem specific high order FV method we have developed, endowed with Adaptive Mesh Reconstruction (h-refinement in particular) techniques.

From an atomistic point of view, we describe the motility mechanism of cancer cells. This is done by considering the main componenent of the cells motility mechanism: the lamellipodium and its constituents the actin-filaments. The resulting Filament Based Lamellipodium Model (FBLM) is a system of Advection-Reaction-(fourth order)Diffusion delay equations that address the dynamics the actin-filaments and resutls to the motility of the cells.