Nanoparticle transport and cell migration simulation using a Multi-Scale Approach

Goal:

The main objective of the study is focused to understand the phenomena transport, the mobility and isolate by size of tumor cells through porous media at different scales.

Brief Description:

The cell migration is the movement of the cells from one location to another in response to a stimuli. For example, chemotaxis is the movement of cells in response to a soluble gradient of chemoattracts. Also, some diseases caused by erroneous cell migrations are tumor invasion and metastasis, cardiovascular diseases, among others. On the other hand, there are several techniques that are used to isolate tumor cells based on size. One of them are the microfilters with pores to act as a porous media with miniature sieves for cells of certain size.

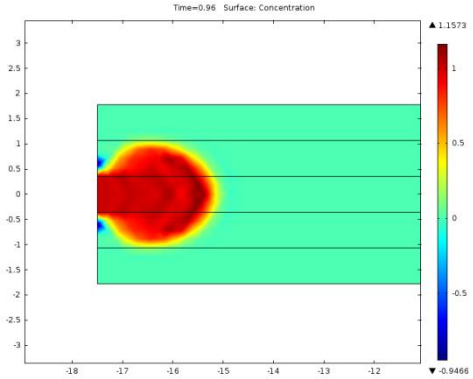
This work presents a research in progress about cell migration of tumor cells (under physiological conditions) thorough porous media such as vascular grafts and artery wall in response to changes of the concentration of nutrients, shear stress inside the porous media and properties such as size and distribution of pores, material, thickness, permeability, tortuosity and diffusivity, among others. Additionally, physical phenomena that do not influence macroscopic flow could be interest at micro and nano-scale for their nteraction with the cells.

Heights of Achievements this semester:

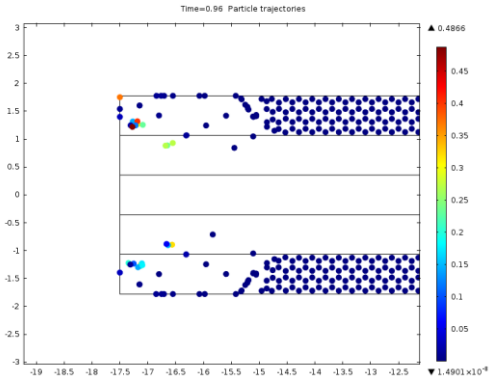
- Develop a computational model to determine the extent of interaction between the movement of cells and porous media. For this purpose, it will be used the tool of Comsol®.
- Begin to write an article.

SIVIRT

UTSA



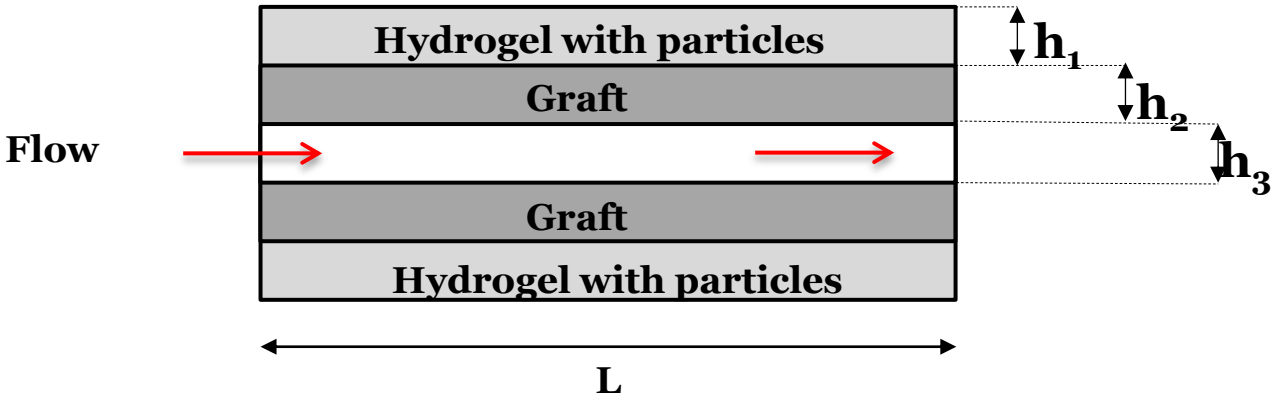
Concentration t=0.96

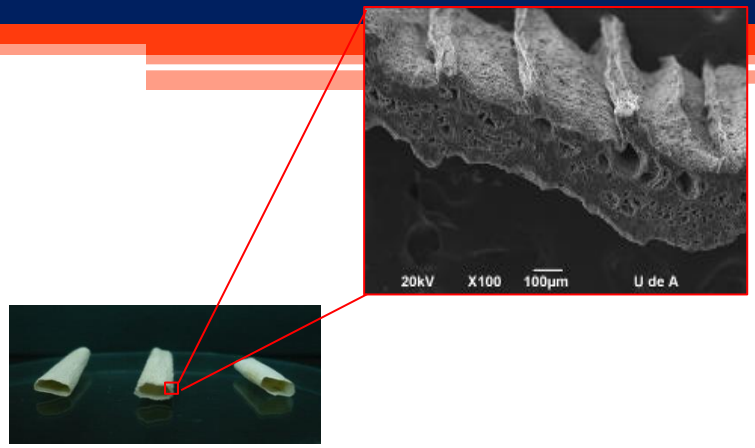


Particles distribution t=0.96

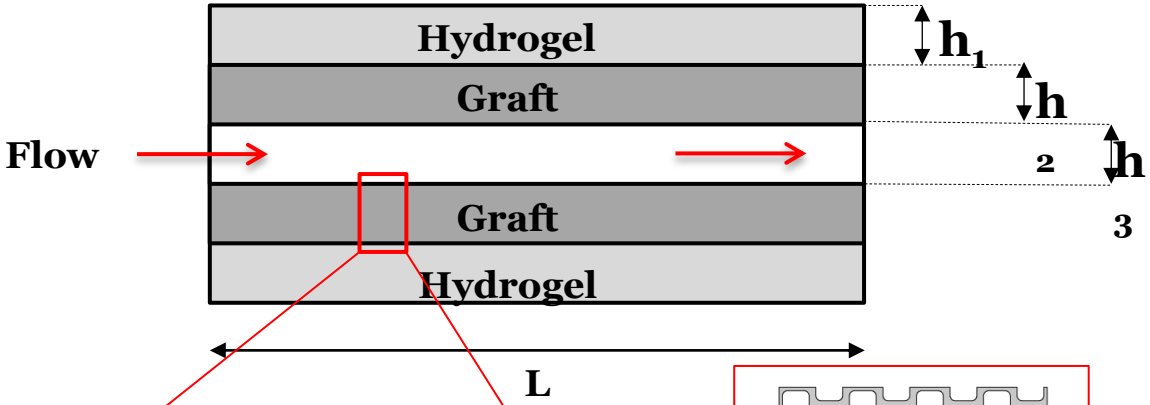
Graft
Porosity:0.65
Permeability: 1 m²
Thickness: 0.711 [mm]

Velocity inlet
5.45 [mm/s]

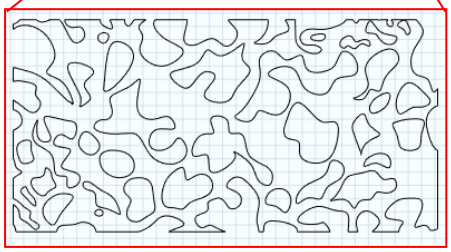




Meso-Scale

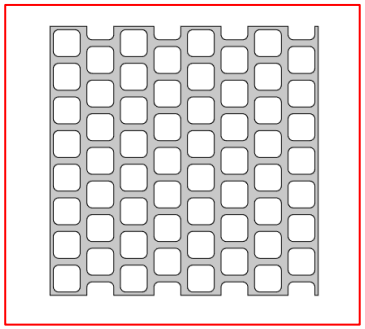


Micro-Scale



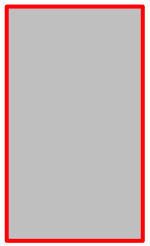
Porous Media From SEM Images

OR

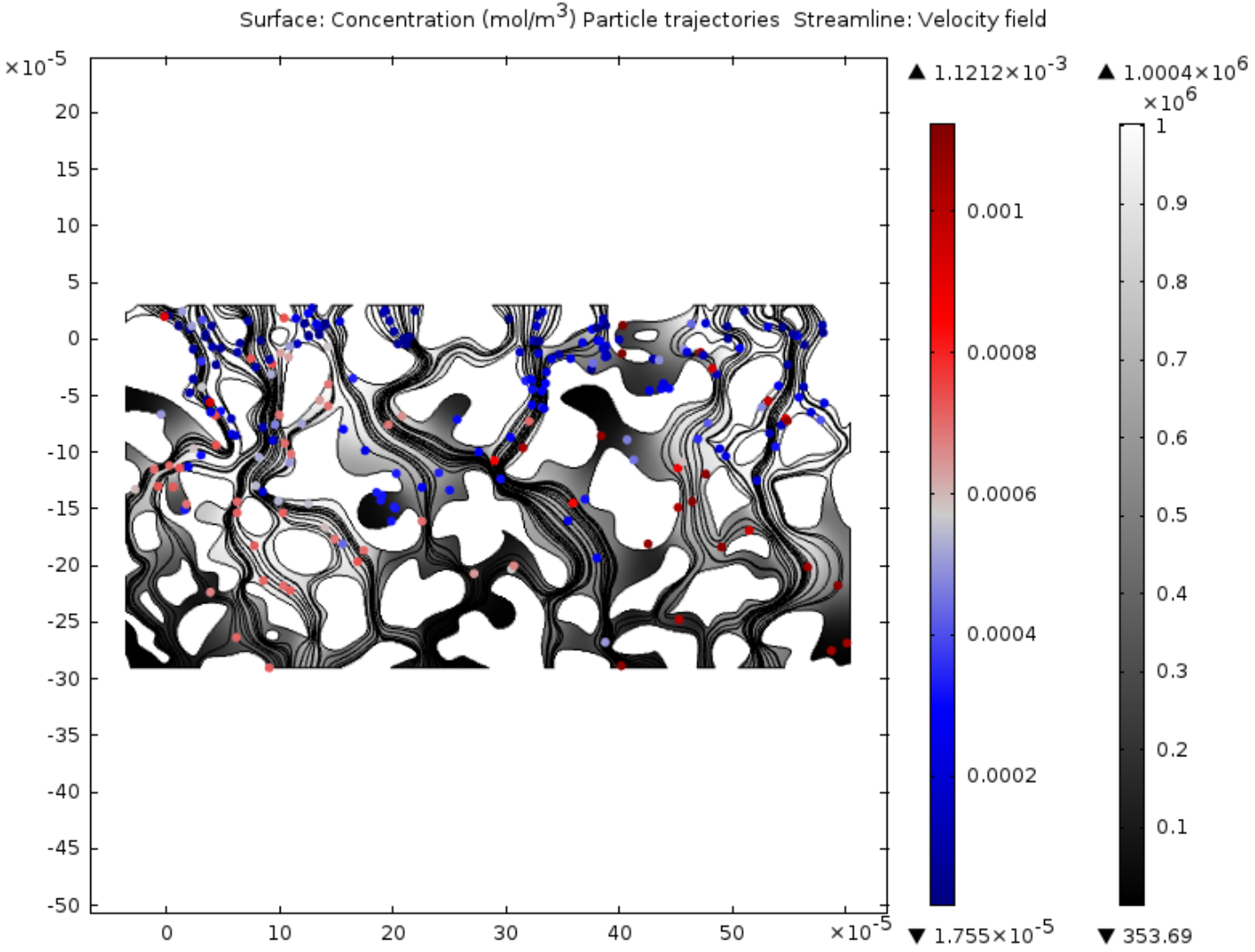


Controlled Porous Media

OR



Homogeneous Porous Media


Surface: Concentration (mol/m3) Particle trajectories Streamline: Velocity field
×10-5
20
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
0
10
20
30
40
50
×10-5
▲ 1.1212×10-3
0.001
0.0008
0.0006
0.0004
0.0002
▼ 1.755×10-5
▲ 1.0004×10^6
×10^6
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
▼ 353.69