Homework III

In class, we have discussed the tensegrity model as a possible model to simulate cells with a nucleus, an internal skeleton and a cell membrane. Below you see a typical example of a heart muscle cell dervied from human embryonic stem cell differentiation. It is important to understand forces in the cell generated by

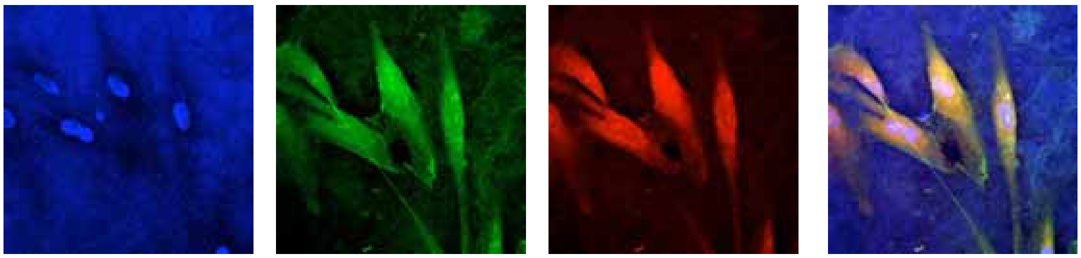

Figure 4.1: Human embryonic stem cell derived cardiomyocytes grown on collagen sheets. Cell nuclei (blue), actin filaments (green), integrins (red), and merged image. By courtesy of Oscar Abilez & Jayakumar Rajadas, Stanford School of Medicine

attachment and contraction. Tensegrity structures provide fundamental guidelines of how forces are transmitted within the cell. The picture shows four simple tensegrity models of cells with microtubuli as compressive units and actin and intermediate filaments as tensile units, both with and without nulcei.

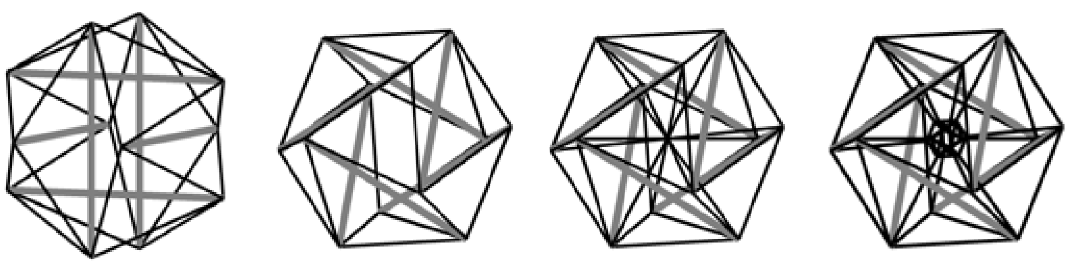

Figure 4.2: Different tensegrity models for the cell. Model discussed analytically in class (left), models with and without internal filaments (middle) and model with nucleus (right).

Design your own cell model(s) with or without nucleus and internal filaments! You can include microtubules, actin and intermediate filaments and a nucleus.

- Since we will later use this model for a finite element simulation, generate both, nodal coordinates and element connectivity of the cell components. Examples are given on the open class webpage `http://biomechanics.stanford.edu` under teaching on the ME339 website, but feel free to use any other software you know!

- For addtional information about nodal coordinates, you might want to search online for `Buckminster Fuller`, `tensegrity structures` or `geodesic domes` (these are cool because they could also be used to verify the six fold network model of red blood cells without nucleus that we have derived in class)!
- Plot the design of your cell model(s) and provide the nodal coorinates and the element connectivity!
- Discuss the cell structure you have designed!

We will later compare all the different designs and calculate their effective Young's modulus numerically with the help of the finite element method.