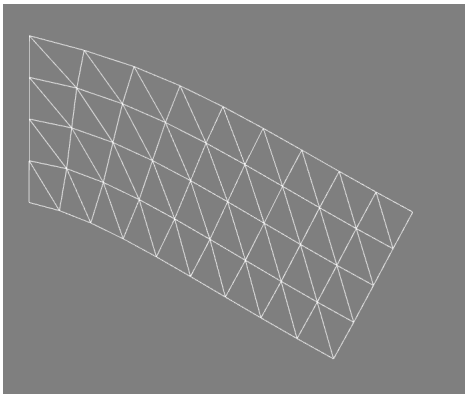
Assignment 3: Finite Element Simulation

Due March 22 at 11:59pm



Introduction

In class, we presented an introduction to finite element methods for simulation. In this assignment, you will be implementing the material models we covered in class, and observing how they behave differently under certain circumstances.

Getting Started

The project to run for this assignment is `Assignment3`. However, unlike in previous assignments, this time, you will be writing code in one of the libraries, `FEMSimLib`, which was added for this assignment. In particular, all of the code you will be writing will be in the file `FEMSimLib/CSTElement2D.cpp`. To change the material model, uncomment the relevant line of code in the CSTElement2D constructor.

If you would like to change the dimension of the simulation grid, edit the constructor of the TestAppFEMSim class in Assignment3. Note that the leftmost nodes will always be constrained.

As before, the places where you will need to fill in code are marked with a `TODO`.

Your Tasks

- In `CSTElement2D::computeDeformationGradient`, implement the computation of the deformation gradient as described in the notes.
- In `CSTElement2D::getEnergy`, implement the energy density functions for the three material models we covered in class: St. Venant-Kirchhoff, linear isotropic, and neo-Hookean.
- In `CSTElement2D::computeGradientComponents`, implement the Piola-Kirchhoff stress tensor for these same three material models as described in the class notes.

Submission instructions

This assignment is much smaller than previous assignments. Since the only code you have to write is in `CSTElement2D.cpp`, in order to submit your code, please e-mail *only this file* to the instructor (scoros@cmu.edu) and TA (christoy@cs.cmu.edu).

Include also a brief writeup of your observations of how the three materials behave differently in the bar example, and your explanation for why this might be the case.

Please also include the string "CS15467" in your subject line so we know to look for it.

Notes on Academic Integrity

You are allowed to collaborate on the assignment in terms of formulating ideas, developing physical models and mathematical equations. However, you must implement the code and do the write up completely on your own, and understand what you are writing. Please also list the names of everyone that you discussed the assignment with.