**Lab 3 – Finite Element Method**

**The Fishing Rod Problem**

**Introduction**

In this lab we were asked to use the Finite Element Method in order to solve the problem of a fishing rod being bent at the tip. The bending force is supposed to simulate the force generated by a fish being hooked on the line. The purpose of the whole problem was to calculate the displacements and illustrate the change. IN this way we could build an understanding of how the finite element method was applied practically through Matlab code.

We’re going to refer to the lab instructions for more details about initial values and constants. Thus, the focus is more on how we solved the problem methodically. However, we can add that Neumann boundary conditions were given as opposed to Dirichlet.

**Solving the problem utilizing the Finite Element Method**

In a sense, this problem was an extension of a 1D finite element problem we had been quizzed on earlier during the week. Thus, we knew that all the elements had a certain stiffness matrix and these matrices could be added in order to create a tridiagonal matrix. This matrix in turn could be used to calculate all the displacements in the system.

What made this problem tricky was the degrees of freedom as in the earlier quiz problem we had a system with 2 degrees of freedom whereas this system had 3 degrees of freedom. However, as per instruction, we disregarded 1 degree of freedom. Namely, torque. The reason behind this is that it is very hard to illustrate torque in Matlab.

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Automatiskt genererad beskrivning**Each of the elements in the system had certain transformation matrices connected to them. These transposed, matrix multiplicated by the stiffness matrix and then matrix multiplicated with themselves gave us the parts of the big stiffness matrix. By adding all these together, whilst keeping a close eye on the indexing, we could create a global stiffness matrix for the entire system. The relation of the force vector and the displacements for the entire system was known, thus simply by using a Matlab inverse operation we could solve for the displacement. After that it was only a matter of plotting these displacements with formulas given for their orientation.

Figure 1 - The result of bending the fishing rod with a force of 20 N at the Northeastern tip. Orange is the color of the neutral fishing rod and blue is the color of the displaced fishing rod