Homework4_SUN

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***Abstract*— This is HW4 for 263F**

I. QUESTION1

The method I used to determine if the end tip reaches steady state is that the value changes by less than 1 percent in a 1-second interval. The end tip displacement at steady states is $4.7 \times 10^{-5} m$, as seen in figure 6.

The Snape shots of the twisted helix and the plot of end tip displacements are as follows:

Figure1. snapshot of helix at t = 0s

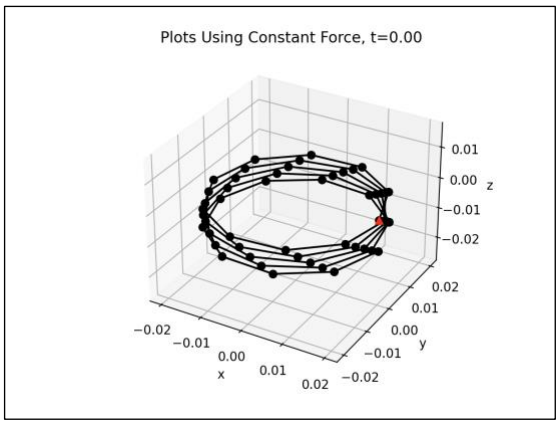


Figure2. snapshot of helix at t = 1s

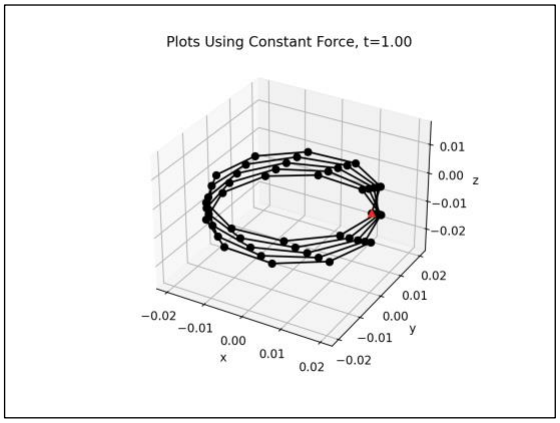


Figure3. snapshot of helix at t = 2s

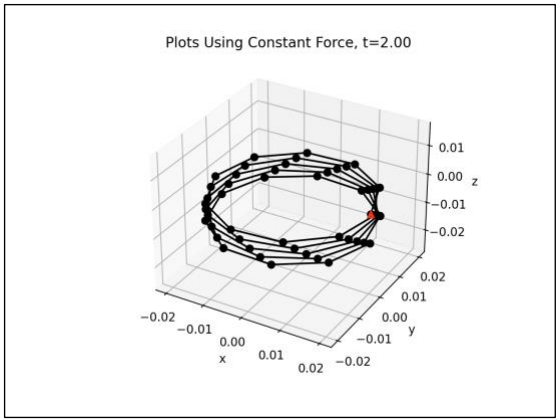


Figure4. snapshot of helix at t = 3s

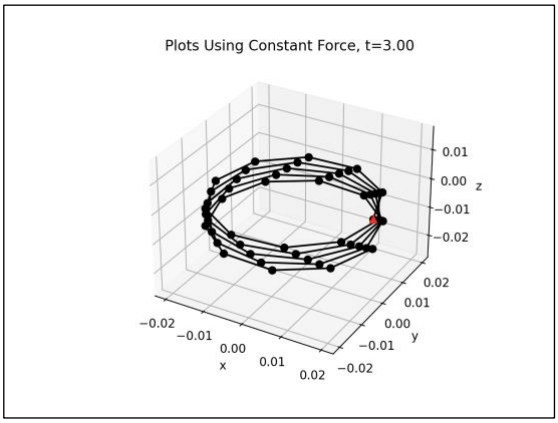


Figure5. snapshot of helix at t = 4s

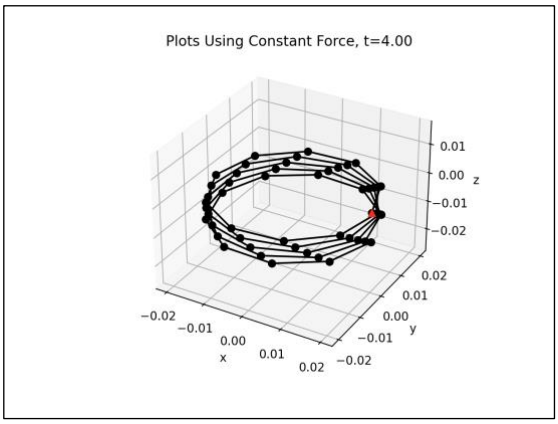


Figure6. snapshot of helix at t = 5s

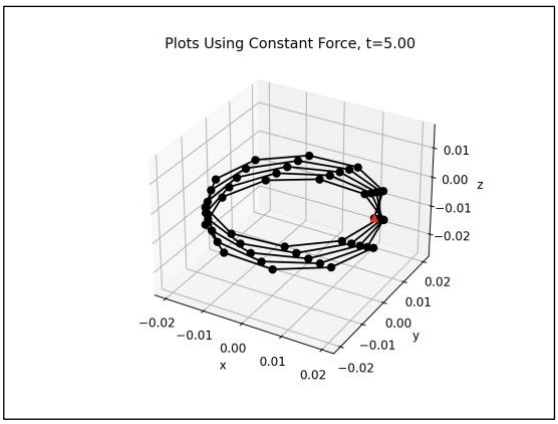
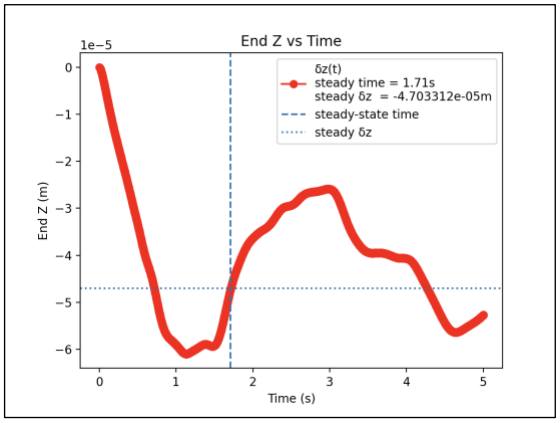


Figure6. end tip displacement



II. QUESTION 2

Plot of the linear fit of $F = k\,\delta_z^*$ is as follows, with fitting, spring constant k is $1.062 \times 10^{-2}\,\frac{N}{m}$

Figure7. fitting of steady displacement and applied force

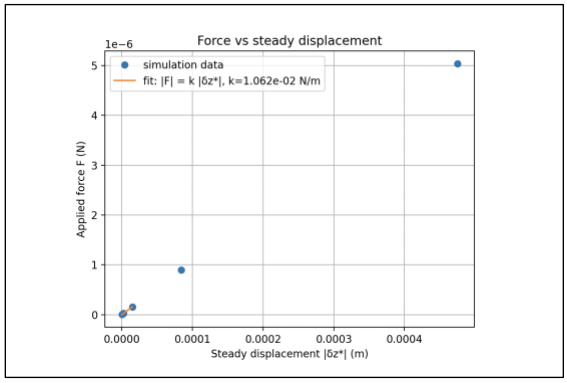
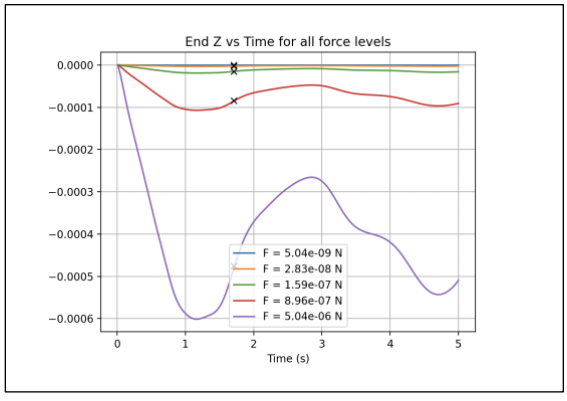


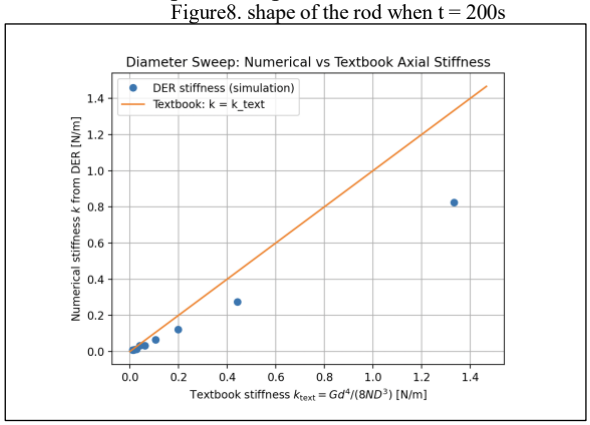
Figure8. plot of displacement of end tip at different forces



III. QUESTION 3

Figure 9 depicts the. Simulation result and the textbook predictions. Looking at the plot, the blue dots represent various diameters of the helix, the x-axis is the text book stiffness, and the y-axis is the numerical simulation stiffness. The orange curve represents the equation. However, this prediction only works for a small deformation area, as seen in Figure 8, the blue dots near the origin seem to follow what the textbook equation predicts. On the right side of the plot, the blue dots deviate further away from the orange curve, indicating they are no longer in the small area. deformation zone, which no longer follows the textbook equation. On the other hand, the blue dots also have a linear relationship, but with a smaller slope compared to the textbook equation, with a larger helix diameter, the spring constant decreases, and the helix itself stretches more easily. Is like packing more mass in a fixed space compared to a smaller helix diameter.

Figure8. shape of the rod when t = 200s



ACKNOWLEDGMENT

The source code is taken from Dr.khalid's Google Colab notebook shared on Slack, then modified by Shixuan Sun to accomplish HW3