MAE 263F Homework 4

Feng Xu

I. Part 1

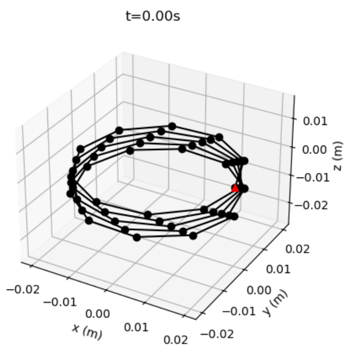

Fig. 1. Snapshot of the helix at t = 0 s

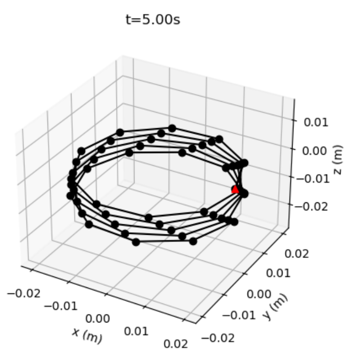

Fig. 2. Snapshot of the helix at t = 5 s

My rule to decide the system has reached steady state is that for all the displacement in each time step of the past 2 seconds, it can not exceed 0.1% of the displacement 2 seconds ago. $\max(abs(\delta_z(t_c-2)-\delta_z(i)) < 0.001$ for all $i \in [t_c-2, tc]$. It reaches steady state at -0.00154m.

II. Part 2

I fit $F = k\delta_z^*$ with $k = 0.0137$ N/m.

III. Part 3

As the helix diameter D increases, the spring becomes more flexible and the axial stiffness k_{text} decreases according to $\frac{Gd^4}{8ND^3}$, the k from the simulation follows the same trends. k and k_{text} seems to follow a linear pattern with a slope less than 1. k from simulation is in general smaller

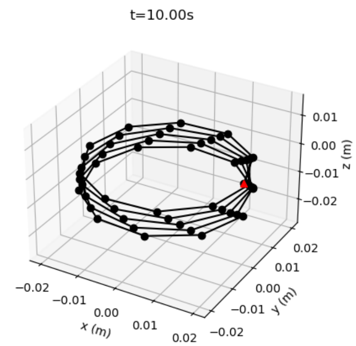

Fig. 3. Snapshot of the helix at t = 10 s

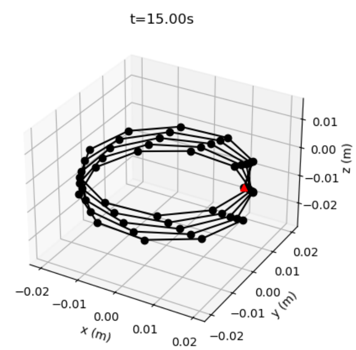

Fig. 4. Snapshot of the helix at t = 15 s

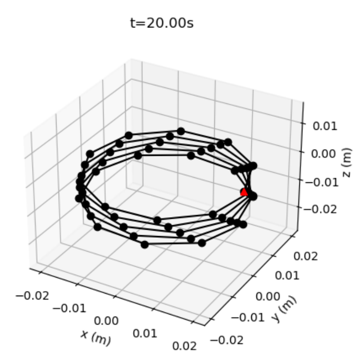

Fig. 5. Snapshot of the helix at t = 20 s

than k_{text}. When D is large, both k_{text} and k are small and they are near to each other, when D is small the difference

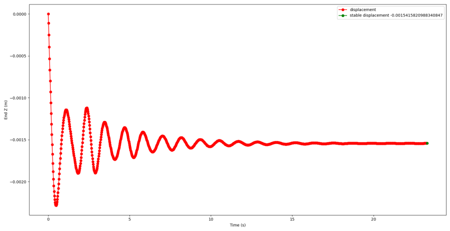

Fig. 6. t vs. $\delta_z(t)$ with steady-state identification

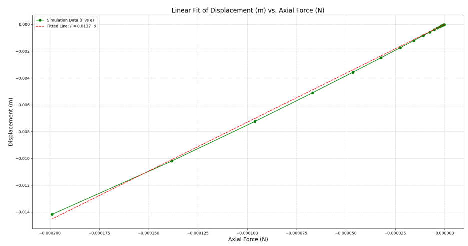

Fig. 7. Force F vs the steady displacement δ_z^*

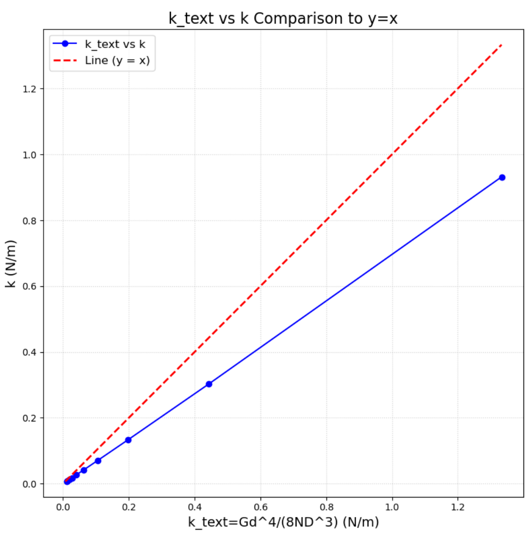

Fig. 8. $\frac{Gd^4}{8ND^3}$ vs k

becomes larger.