Homework 2

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***Abstract*— 3 Scenarios as listed in the homework were performed in MATLAB and numerical results were recorded and plotted.**

I. SIMULATION 1

1. An elastic rod with a total length l = 20 cm is naturally curved with radius Rn = 2 cm. The location of its N nodes at t = 0 are:

$$X_k = [R_n \cos((k-1)\Delta\theta),\ R_n \sin((k-1)\Delta\theta),\ 0]$$

where $\Delta\theta = (l/Rn)*1/(N-1)$. The twist angles θ^k (k = 1, . . . ,N − 1) at t = 0 are 0. The first two nodes and the first twist angle remain fixed throughout the simulation (i.e.one end is clamped). The physical parameters are: density ρ = 1000 kg/m3, cross-sectional radius r0 = 1 mm, Young's modulus E = 10 MPa, shear modulus G = E/3 (corresponding to an incompressible material), and gravitational acceleration g = [0, 0,−9.81]^T . Choose an appropriate time step size Δt and number of nodes N. (see Section 7)

A. *Write a computer program that simulates the deformation of this rod under gravity from t = 0 to t = 5 s.*
Time: 5 sec

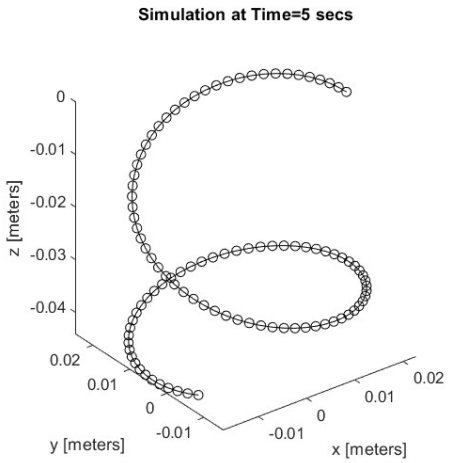

Fig 1: Final deformed shape of the helical elastic rod

B. *Plot the z-coordinate of the last node (xN) with time. The solution can be found at the end of this Chapter*

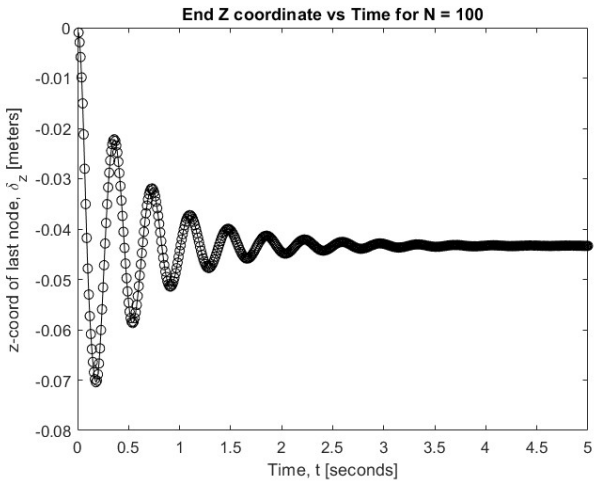

Fig 2: Variation of z-coordinate with respect to time

APPENDIX.

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REFERENCES

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