MAE 259B: Mechanics of Slender Structures and Soft Robots

Homework 1

Zhuonan Hao

April 20, 2022

Supervisor Name
Prof. M.Khalid Jawed
Structures-Computer Interaction Lab

UCLA

Department of Mechanical and Aerospace Engineering
University of California Los Angeles (UCLA)
Los Angeles, USA

Assignment 1: Simulation of the motion of a sphere falling inside viscous fluid

1. When the radii are the same, the turning angle become 0 and all the three spheres drop with the same velocity, which agrees with intuition.

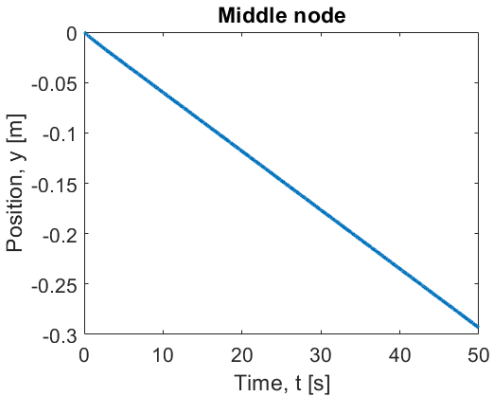
2. For the explicit method, when the time step size raises up, the simulation fails to generate solutions since the position of each sphere goes infinity.

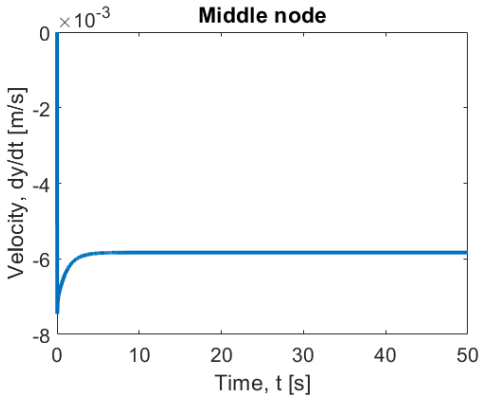
Method	Benefits	Drawbacks
Explicit	Easy to program	Inaccurate, small time step
Implicit	Accurate, larger time step	Complicated to use

Table 1: Benefits and drawbacks of the explicit and implicit approach.

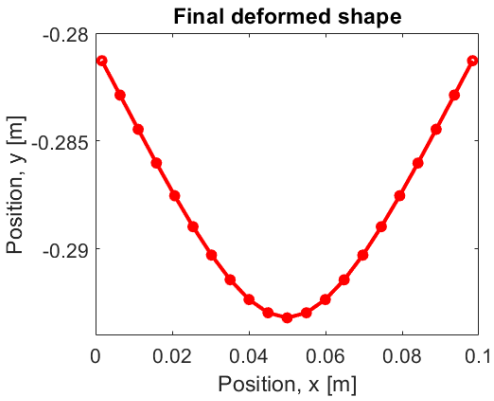
Assignment 2: Simulation of the motion of N-connected spheres falling inside viscous fluid

1. Terminal velocity is -0.0058 m/s

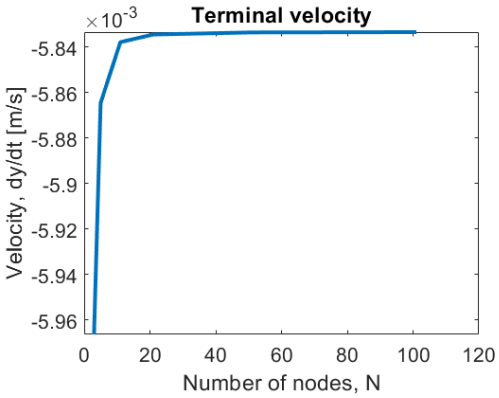


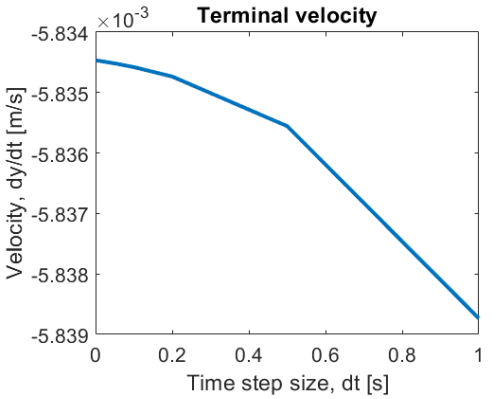


2. The final deformed shape is



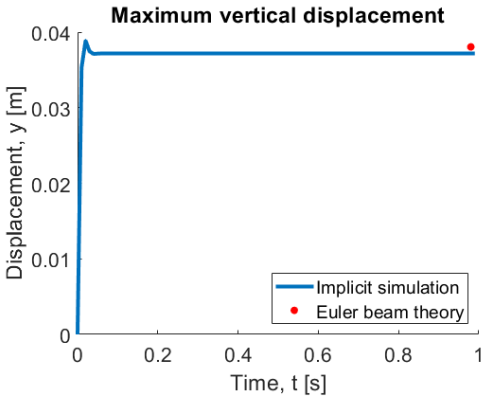
3. The size of spatial discretization and temporal discretization have effect on simulation speed and accuracy. Large number of nodes and small time step size lead to slow but accurate simulation results.


Terminal velocity
×10^-3
-5.84
-5.86
-5.88
-5.9
-5.92
-5.94
-5.96
Velocity, dy/dt [m/s]
0
20
40
60
80
100
120
Number of nodes, N

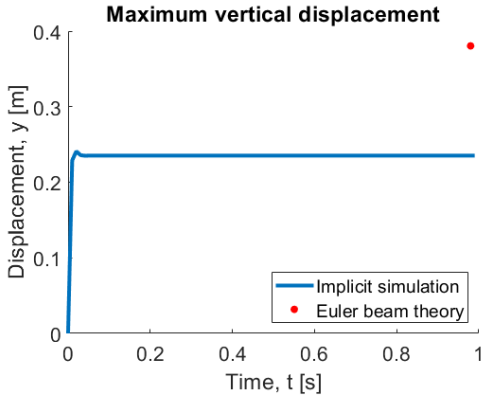
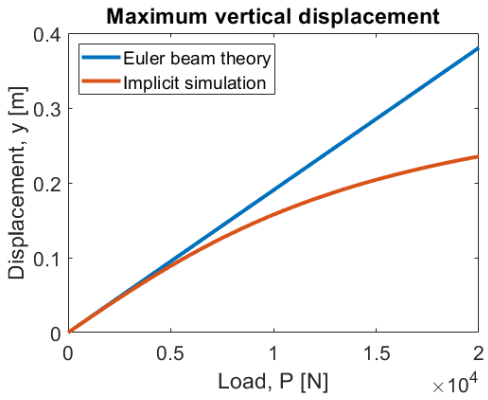

Terminal velocity
×10^-3
-5.834
-5.835
-5.836
-5.837
-5.838
-5.839
Velocity, dy/dt [m/s]
0
0.2
0.4
0.6
0.8
1
Time step size, dt [s]

Assignment 3: Simulation of the deformation of elastic beams and comparison with Euler-Bernoulli beam theory

1. y_{max} eventually reach a steady value, which agrees with the theoretical prediction value.



2. The simulation could handle with high load condition. The difference between two method can not be ignored.



When $P \approx 5000N$, the two solutions begin to diverge.