MAE 259B   HW1

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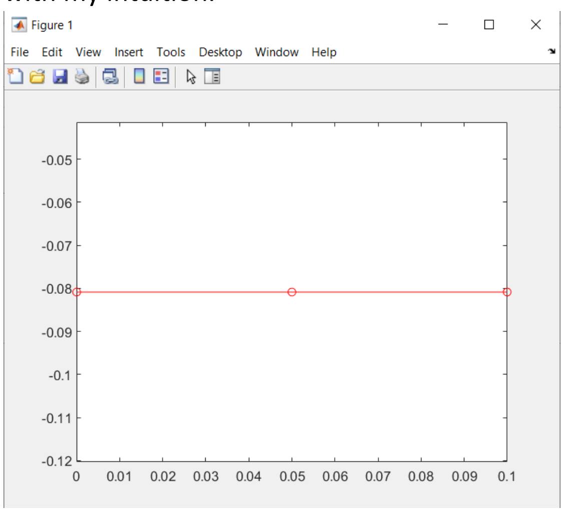
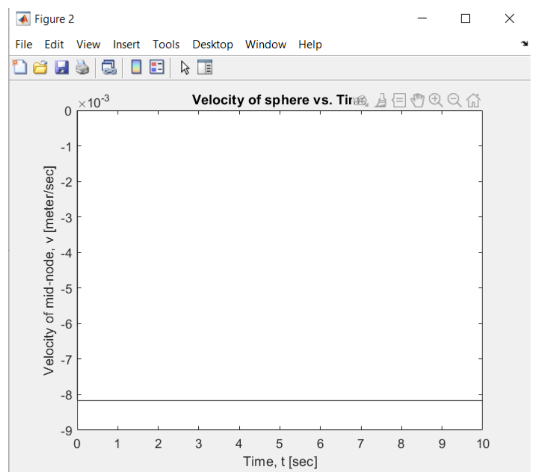
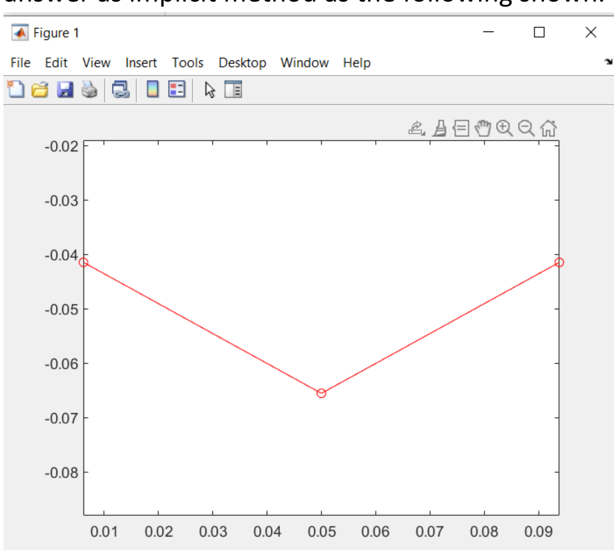
Problem 1: Section 4.2

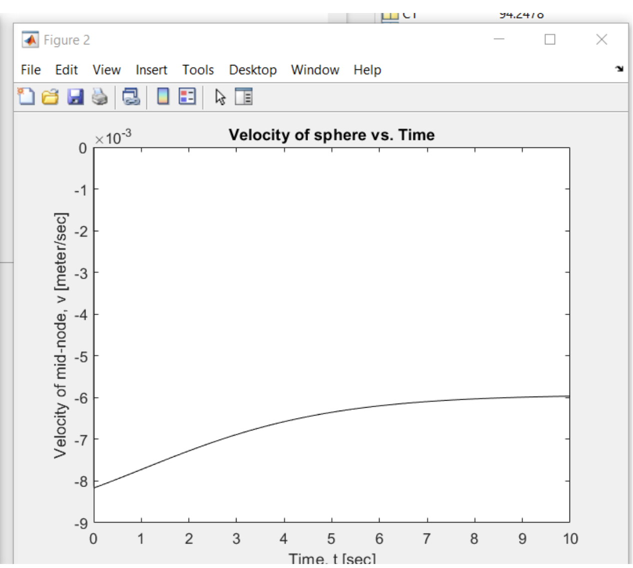
1. When R1 = R2 = R3, the three ball will drop uniformly in the viscous fluid. The turning angle will be equal to zero. The velocity line will be horizontal. (As shown below); the simulation agrees with my intuition.



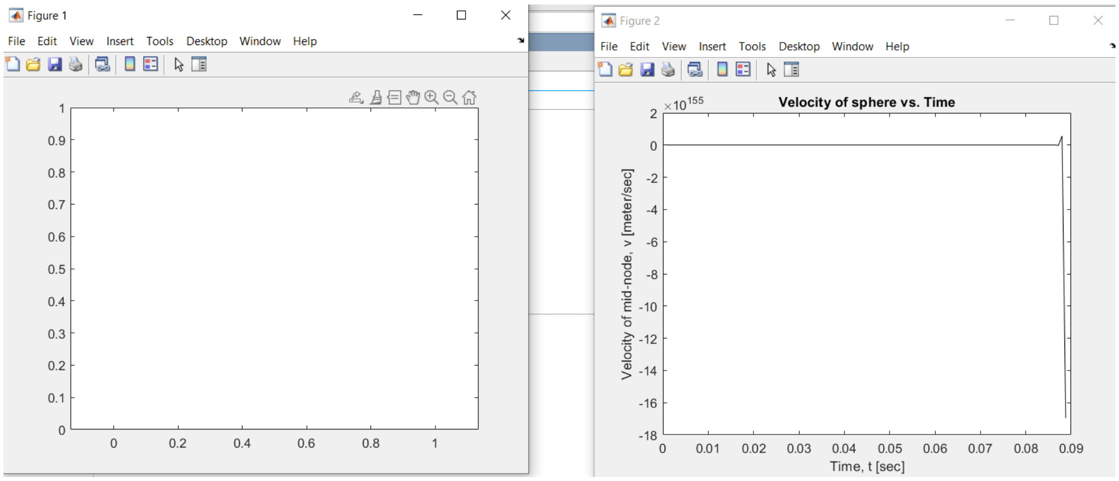


2. Originally, when I used the step size close to 1e-5 for explicit method. It gives almost same answer as implicit method as the following shown.



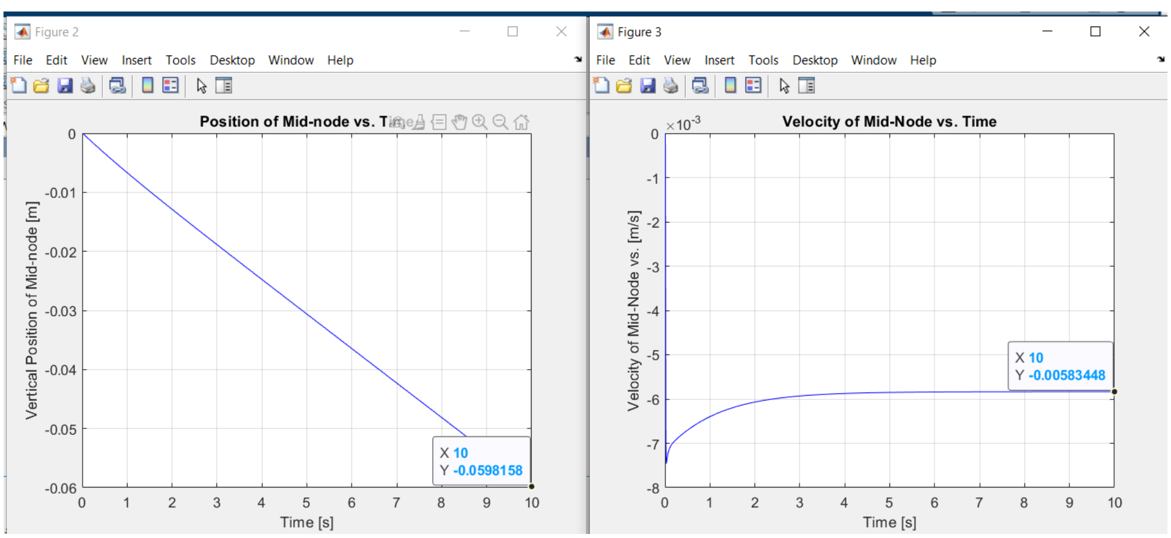


When I decrease the step size to 1e-3, the implicit method is just slower to simulate the sphere drop case. However, when I increase the step size for explicit method to 8e-4, it cannot the simulate the case because explicit method for solving large step size will deviate from its true value

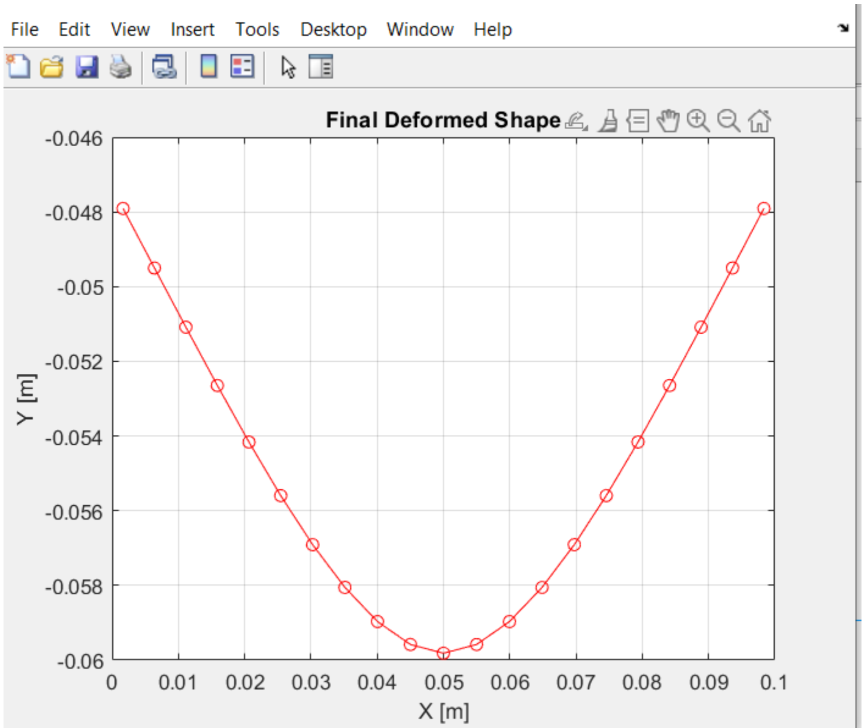


Problem 2: Section 4.3

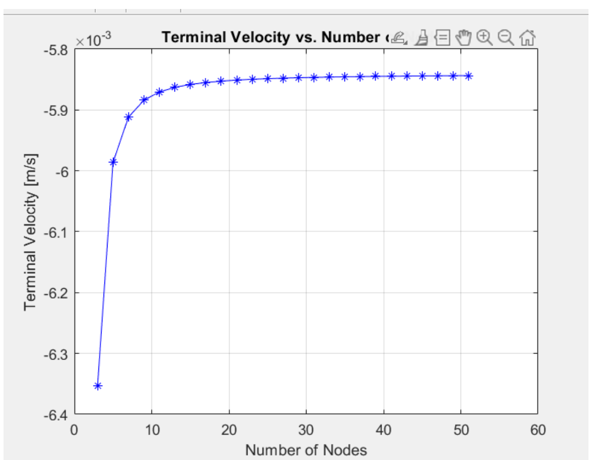
1. The vertical position and velocity of the middle node with time
   Terminal Position = -0.0598 [m]
   Terminal Velocity = -0.05834×10^{-3} [m/s]

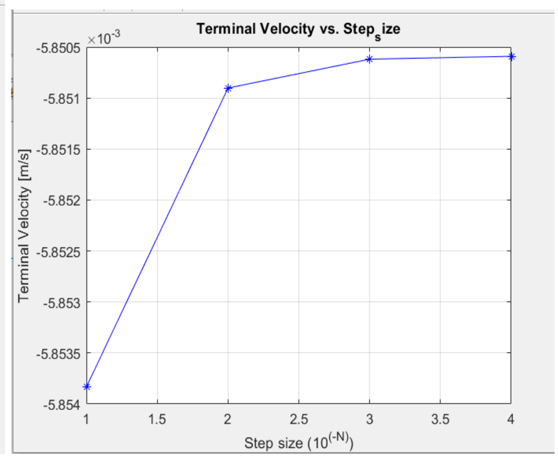


2. the final deformed shape of the beam



3. plots of terminal velocity vs. the number of nodes & terminal velocity vs. the time step size.

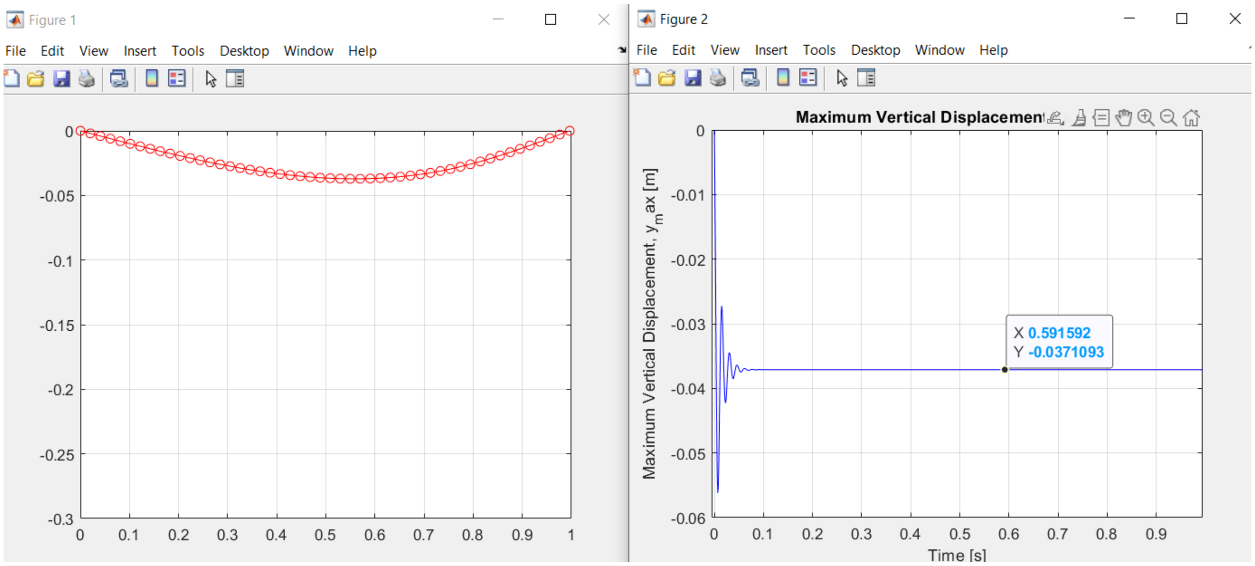




As we can see, the terminal velocity almost keeps the same as number nodes or time step length changes

Problem 3: Section 4.4

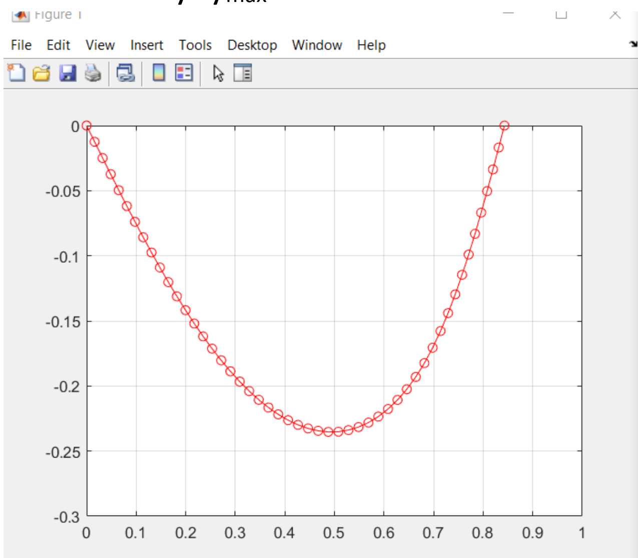
1. When p = 2000N, $y_{max} =$ -0.0371m (as shown)
   Euler theory: $y_{max} =$ -0.0380m

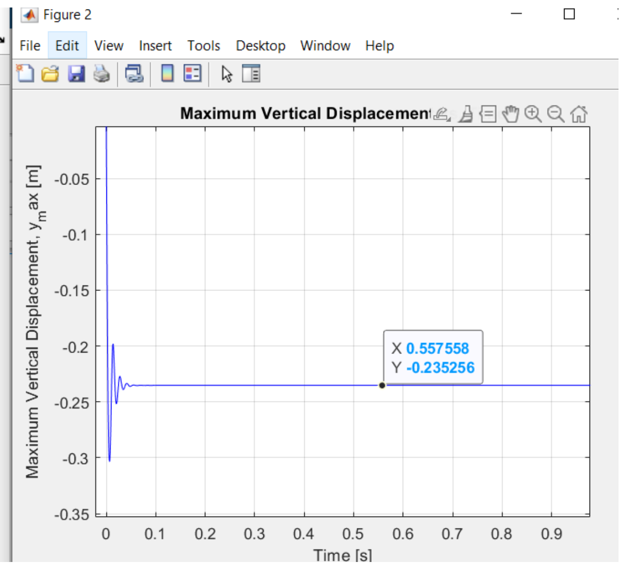


Command Window

```
Time = 0.993000
Time = 0.994000
Time = 0.995000
Time = 0.996000
Time = 0.997000
Time = 0.998000
Time = 0.999000
y_max from Euler beam theory is -0.0380 [m]
fx >>
```

2. When p = 20000N, y_{max} = -0.02352m (as shown)
   Euler theory: y_{max} = -0.03804m






```
164    diff = abs(max_disp - y_euler);
```

Command Window

```
Time = 0.993000
Time = 0.994000
Time = 0.995000
Time = 0.996000
Time = 0.997000
Time = 0.998000
Time = 0.999000
y_max from Euler beam theory is -0.3804 [m]
```

So as we can see the implicit is more tolerant then traditional theoretical analysis when deformation is getting much bigger.