Multi Body Dynamics : Assignment 3

Numerical Integration Techniques

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state space equation for the system :

$$\begin{bmatrix} \dot{y} \\ y' \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -100 & -1 \end{bmatrix} \begin{bmatrix} y \\ y' \end{bmatrix} = f(t)$$

Euler's first order method for numerical integration :

$$\begin{bmatrix} y(t_0 + hn) \\ y'(t_0 + hn) \end{bmatrix} = \begin{bmatrix} y(t_0 + h(n-1)) \\ y'(t_0 + h(n-1)) \end{bmatrix} + h \cdot f(t_0 + h(n-1))$$

Adams Bashforth second order method for numerical integration :

$$\begin{bmatrix} y(t_0 + hn) \\ y'(t_0 + hn) \end{bmatrix} = \begin{bmatrix} y(t_0 + h(n-1)) \\ y'(t_0 + h(n-1)) \end{bmatrix} + \frac{3h}{2} \cdot f(t_0 + h(n-1)) - \frac{h}{2} \cdot f(t_0 + h(n-2))$$

From the plots below we can observe that Adams Bashforth method has better convergence to the actual solution as compared to Euler method. Adams Bashforth method allows us to choose larger values for step size as compared to Euler's method, thereby reducing the total number of time intervals required

Table 1: Displacement (x) vs time (t)

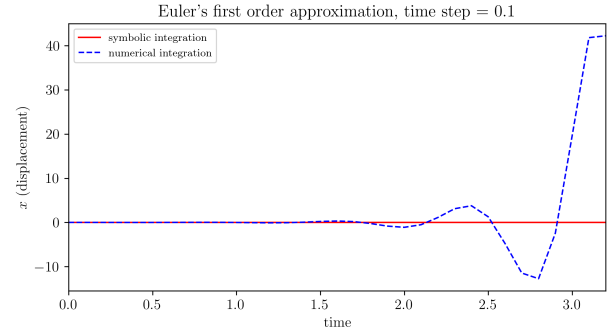
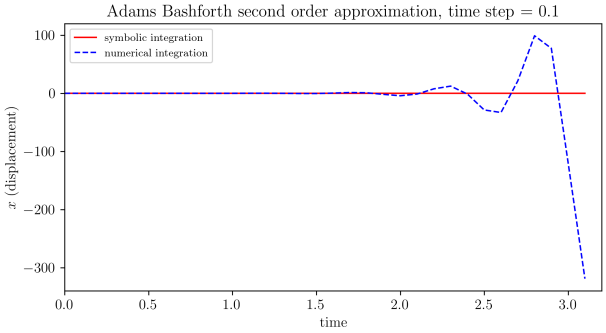
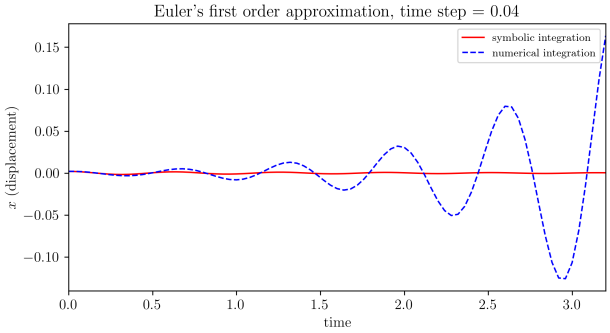
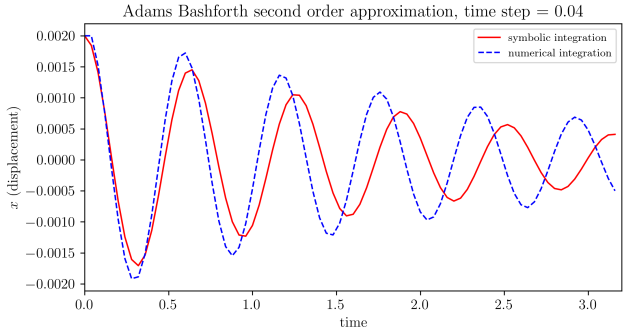
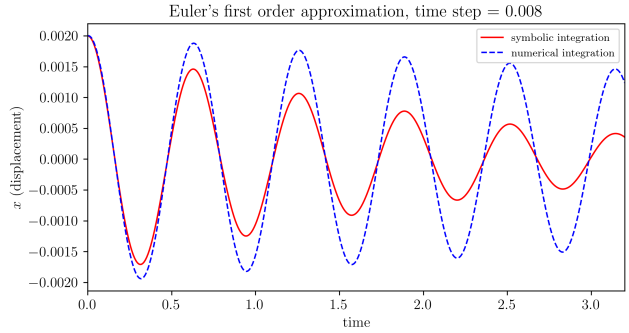
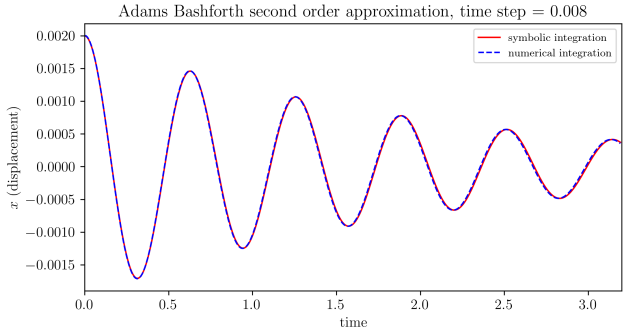
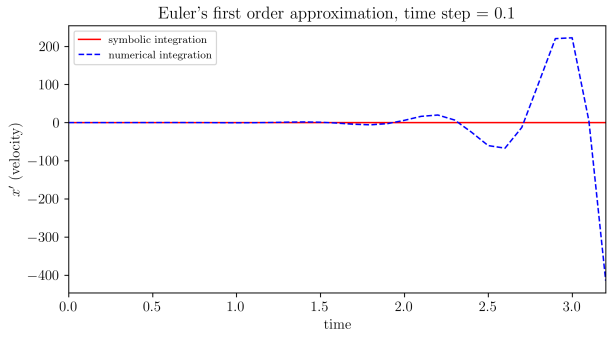
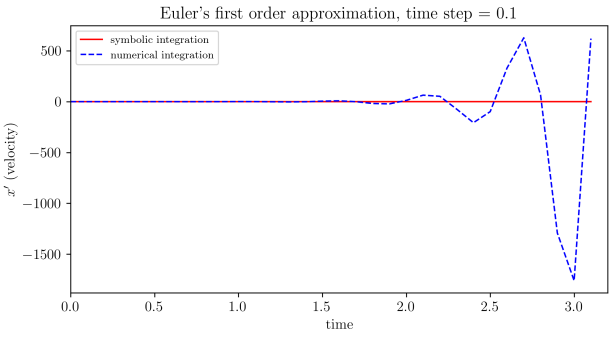
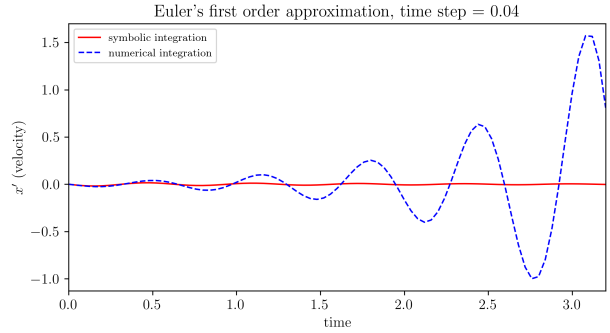
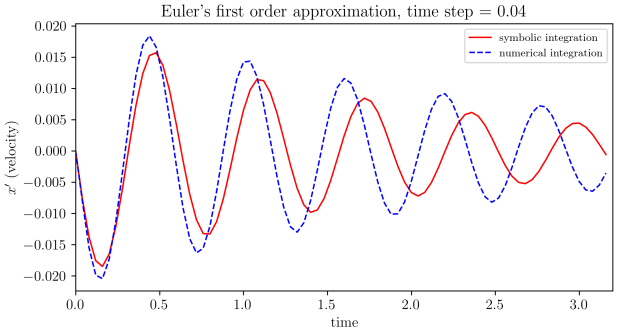
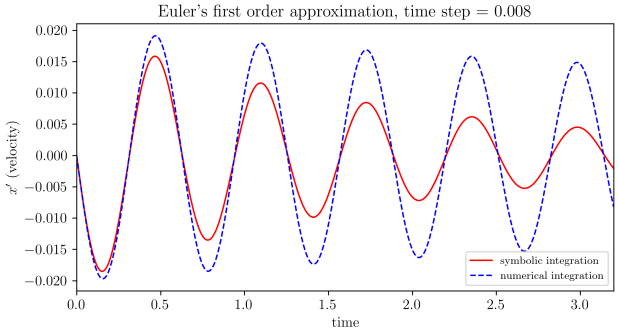
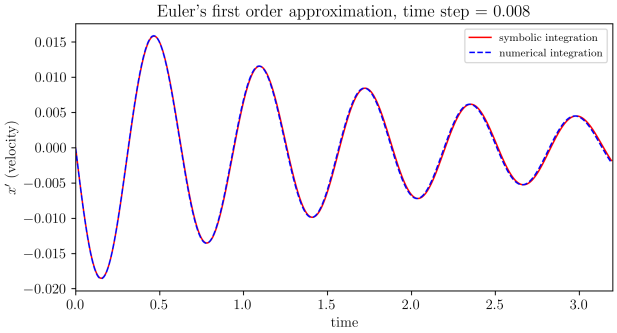
Euler's Method	Adams Bashforth Method
	
	
	

Table 2: Velocity (x') vs time (t)

Euler's Method	Adams Bashforth Method
	
	
	

Thank You