AMATH 301
Homework 4: Autumn 2021

DUE: Midnight on Thursday, November 4

Consider the velocity function on the interval $t \in [0, 4]$.

$$v(t) = \exp(-0.1t)\cos(5t) + (t^2 - 0.1t^4) \tag{1}$$

(a) Using $\Delta t = 0.01$, compute the cummulative distance traveled over the time interval by computing the integral as a function of time. First use a trapezoidal rule to compute the distance, then a Simpson's rule. (NOTE: the Simpson's rule vector will be about half as long as the trapezoidal rule vector.)

ANSWERS: Save your answers as row vectors A1 (trapezoidal rule) and A2 (Simpson's rule)

(b) Compute the acceleration by computing the derivative of the velocity using second-order accurate center-differencing. Use a second-order accurate forward- and backward-differencing scheme for the two end-points.

ANSWER: Save your answer as a row vector A3.

(c) Compute the acceleration by computing the derivative of the velocity using fourth-order accurate center-differencing. Use a second-order accurate forward- and backward-differencing scheme for the first two points on each end of the interval.

ANSWER: Save your answer as a row vector A4.

(d) The derivative of acceleration is called the jerk. Compute the jerk by differentiating A4 above using a fourth-order accurate center-differencing. Use a second-order accurate forward- and backward-differencing scheme for the first two points on each end of the interval.

ANSWER: Save your answer as a row vector A5.

(e) Compute the jerk by differentiating the velocity directly using a fourth-order accurate second derivate center-differencing scheme. Use a second-order accurate forward- and backward-differencing scheme for the first two points on each end of the interval.

ANSWER: Save your answer as a row vector A6.

(e) Compare the two jerk approximations by computing the norm of the difference between A5 and A6.

ANSWER: Save your answer as A7.