

EE 554 Homework Assignment 3
September 24, 2009

1. Investigate the numerical integration schemes presented in class for the following three functions:

$$e = \sin(100t) \tag{1}$$

$$e = e^{-10t} \sin(100t) \tag{2}$$

$$e = \frac{1}{1+t^2} \tag{3}$$

- (a) Numerically integrate the three functions from $t = 0$ to 1 second using sampling times $T = 0.001, 0.01$ and 0.1 second. Use the three integration schemes (Euler, Trapezoidal and Simpson's) with the three sampling periods and compare to that found using Matlab's *ode23()*. Comment on whether the integral is as expected, the effect of sampling time, and performance of each scheme.
 - (b) Add normally distributed random noise (see *randn()*) to the functions with a standard deviation of 0.01 and study the impact of the noise on the different schemes.
2. Investigate the numerical differentiation schemes presented in class for the same three functions.
 - (a) Numerically differentiate the three functions from $t = 0$ to 1 second using sampling times $T = 0.001, 0.01$ and 0.1 second. Use the three derivative schemes (backward difference, inverse Trapezoidal ($a = 0.5$ and other values) and backward difference with low-pass filter (choose appropriate ω_c)) with the three sampling periods. Comment on whether the derivative is as expected, the effect of sampling time, and performance of each scheme.
 - (b) Add normally distributed random noise (see *randn()*) to the functions with a standard deviation of 0.01 and study the impact of the noise on the different schemes.
 3. Is numerical integration or differentiation affected more by sampling time? Which is affected more by noise?