The MATLAB files:

- *a8sde.m* is a code to solve SDEs for a damped harmonic oscillator with added noise.

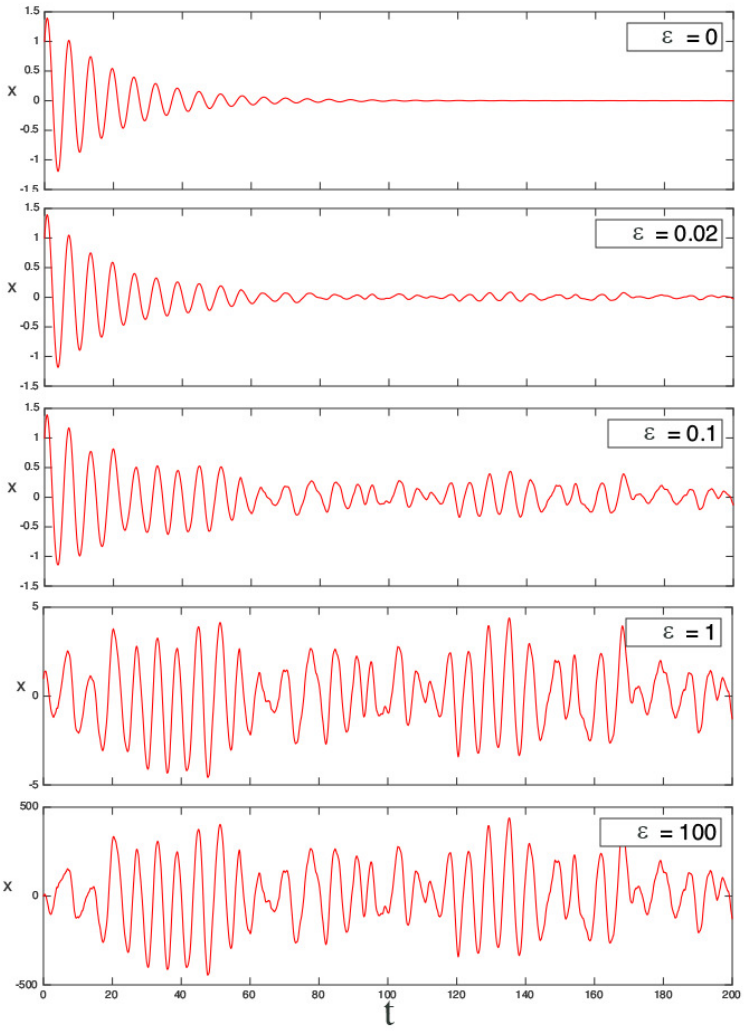

Figure 1: Solutions of the damped harmonic oscillator for different values of ϵ. The value of parameters are: $k = 1, m = 1, f = 0.1, v(0) = 0, x(0) = 1$, $\Delta t = \frac{T}{N} = \frac{200}{2^{20}}$.

Figure 1 shows the solutions of the damped harmonic oscillator with added noise for different values of ϵ. We can see how increasing the noise can affect the solution of damped harmonic oscillator.

1. Do larger values of ϵ require adjustments to Δt?

I didn't get this question. If you mean whether changes in Δt can affect the solution at large value of ϵ, the answer is yes.

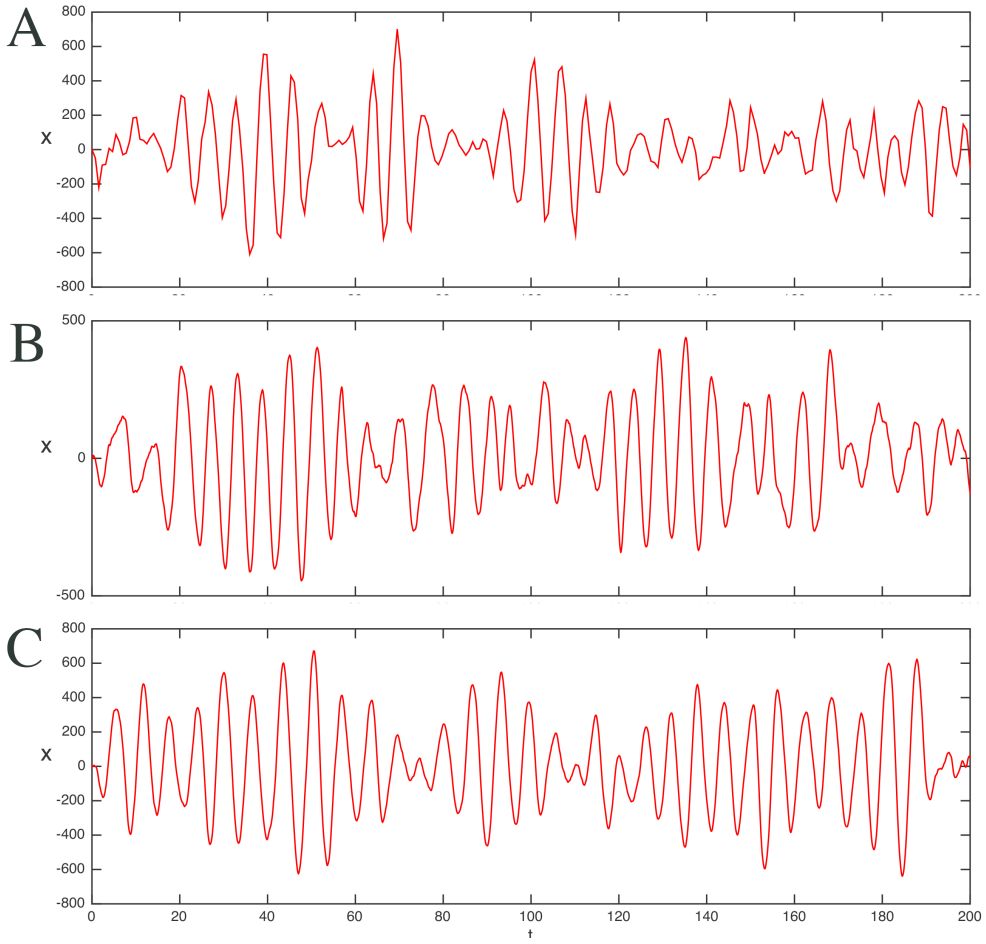

Figure 2: Solutions of the damped harmonic oscillator for different values of Δt: (A) $\Delta t = \frac{T}{N} = \frac{200}{2^{10}}$, (B) $\Delta t = \frac{200}{2^{20}}$, (C) $\Delta t = \frac{200}{2^{25}}$. The value of parameters are: $\epsilon = 100, k = 1, m = 1, f = 0.1, v(0) = 0, x(0) = 1$.

Figure 2 shows the solutions for different values of Δt at $\epsilon = 100$. If we change the value of Δt at a fixed value of ϵ, the solutions will change.

2. Are there any qualitative changes in the solutions as you increase ϵ? It is clear from figure 1 that for $\epsilon > 1$, there is no qualitative changes in the solutions. In other words, at larger values of ϵ, we won't see any changes in the solutions.

3. Does the average energy at long time depend on ϵ? Figure 3 shows the average energy as a function of ϵ. The mean energy depends on the value of ϵ and will increase by increasing the ϵ value.

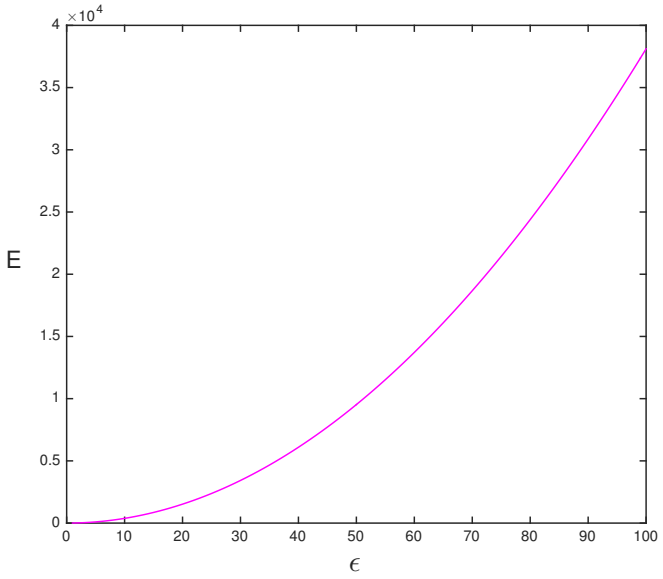

Figure 3: mean energy against ϵ. The value of parameters are: $k = 1, m = 1, f = 0.1, v(0) = 0, x(0) = 1$, $\Delta t = \frac{200}{2^{20}}$.