EE1103 A6: NUMERICAL SOLUTION OF LANDAU-LIFSHITZ- GILBERT EQUATION (ODE SOLVER)

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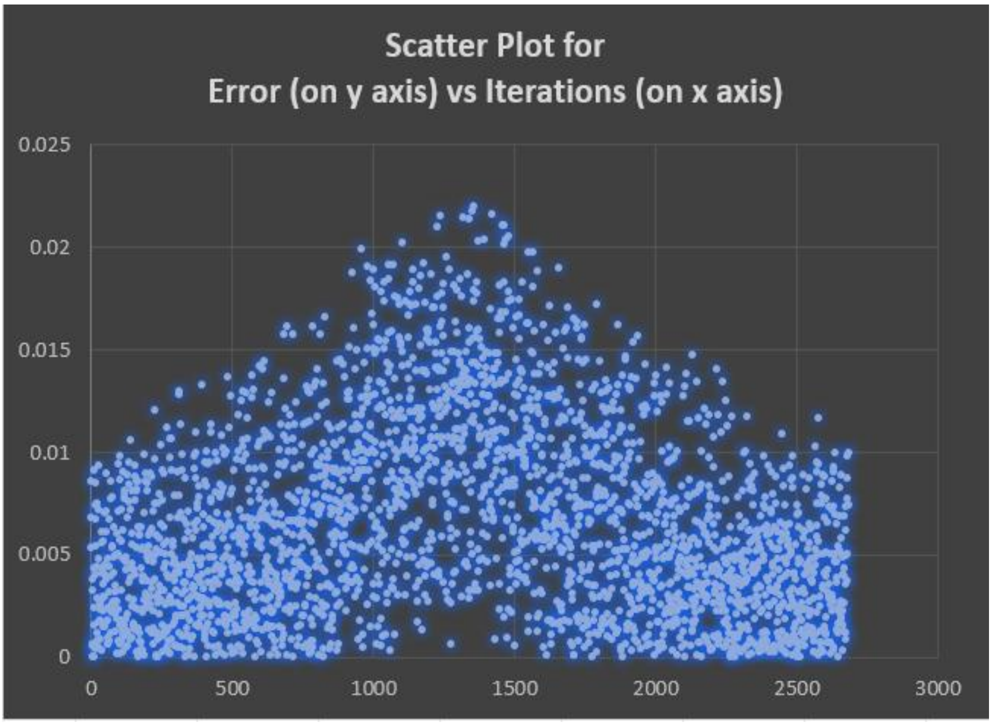
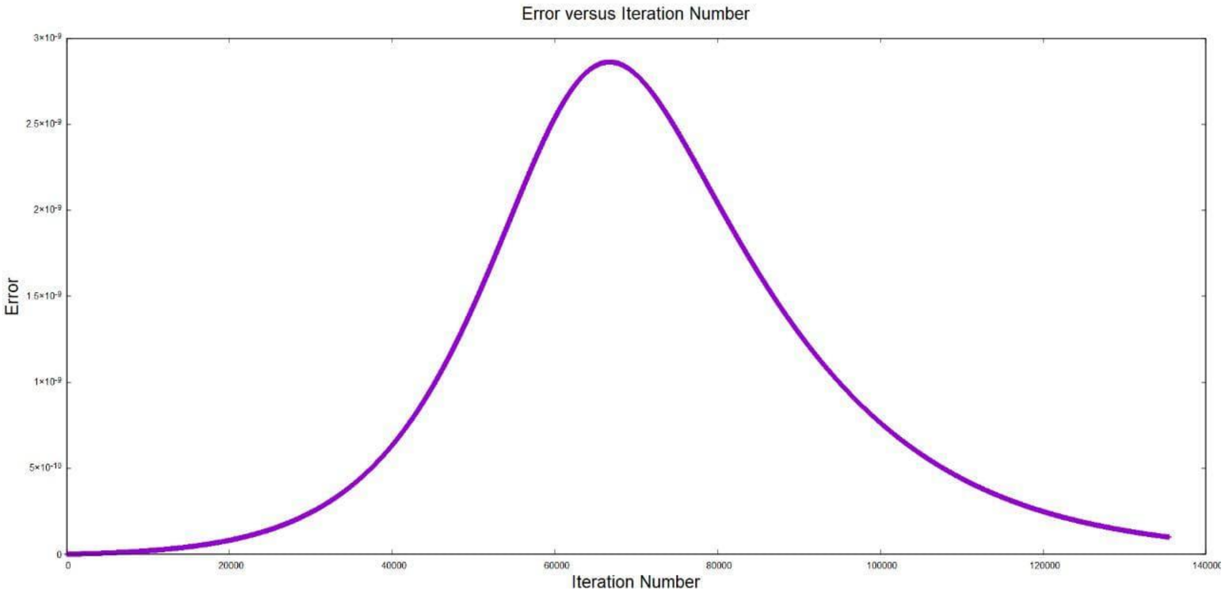
- Plot of Error versus Number of Iteration (for a specific step-size):

1. In the plot for Error vs no. of Iteration curve (for a specific step-size), the error first continuously increases up to a maximum value (for some iteration).
2. After this peak or maxima is reached, the error continuously decreases for the values of iteration(s) corresponding to those after the maxima (value of the number of iteration at which the error is maximum).

Given below is a scatter plot (in Excel) with the error taken on y-axis and the number of iterations taken on the x-axis, for a step-size of 10^{-18}: (alpha = 0.1) (RK4 method as the gold standard)



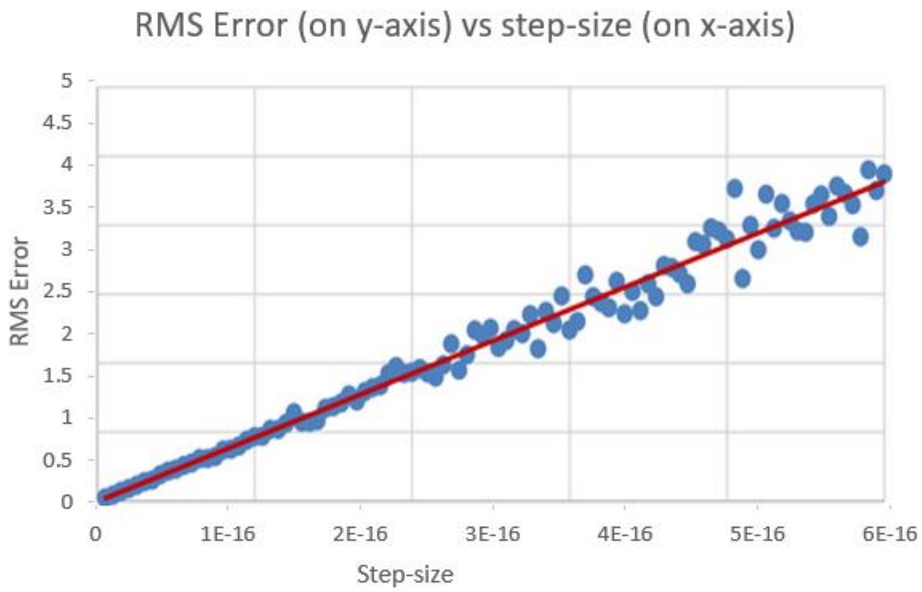
Given below is a line plot of Error versus Number of Iterations (for a step-size of 10^{-17} and alpha = 0.05) :



As we can see, the error increases continuously to reach a maximum at some iteration number and then the error starts decreasing continuously. From the plot, it looks like the error follows a normal distribution.

- Vary the step-size and record root-mean-square error for each step-size. Plot of RMS Error versus step-size: (α = 0.1)

   1. From the plot, we can see that RMS error increases with step size. (with some deviations although the exact nature of increase is unclear).
      Given below is the scatter/line plot for RMS Error versus Step-size:
      (in this case alpha = 0.1, step size is varied as multiples of 10^-18.)

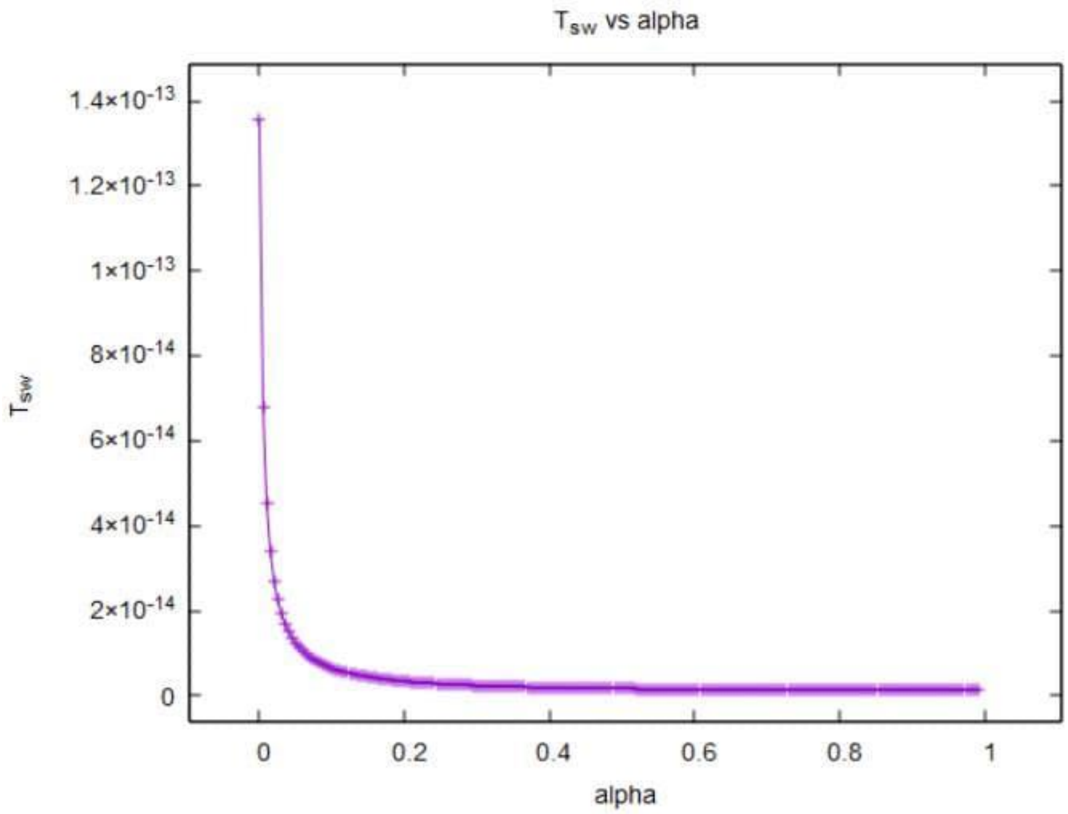


From the above plot, we can see RMS Error almost linearly increases with step-size. (A line can be fitted so as to pass through most of the points on the curve, with some lying above/below the line.)

- Vary α and record the switching time T_{sw} for each α. Plot α vs T_{sw}. Plot of switching time (T_{sw}) vs alpha:

  1. **1.** Switching time is defined as the time taken for the z-component of the magnetisation to change it's sign or for theta to become 90 degrees, and α has been taken in intervals of 0.005.
  2. **2.** The switching time (T_{sw}) decreases rapidly with increase in alpha.

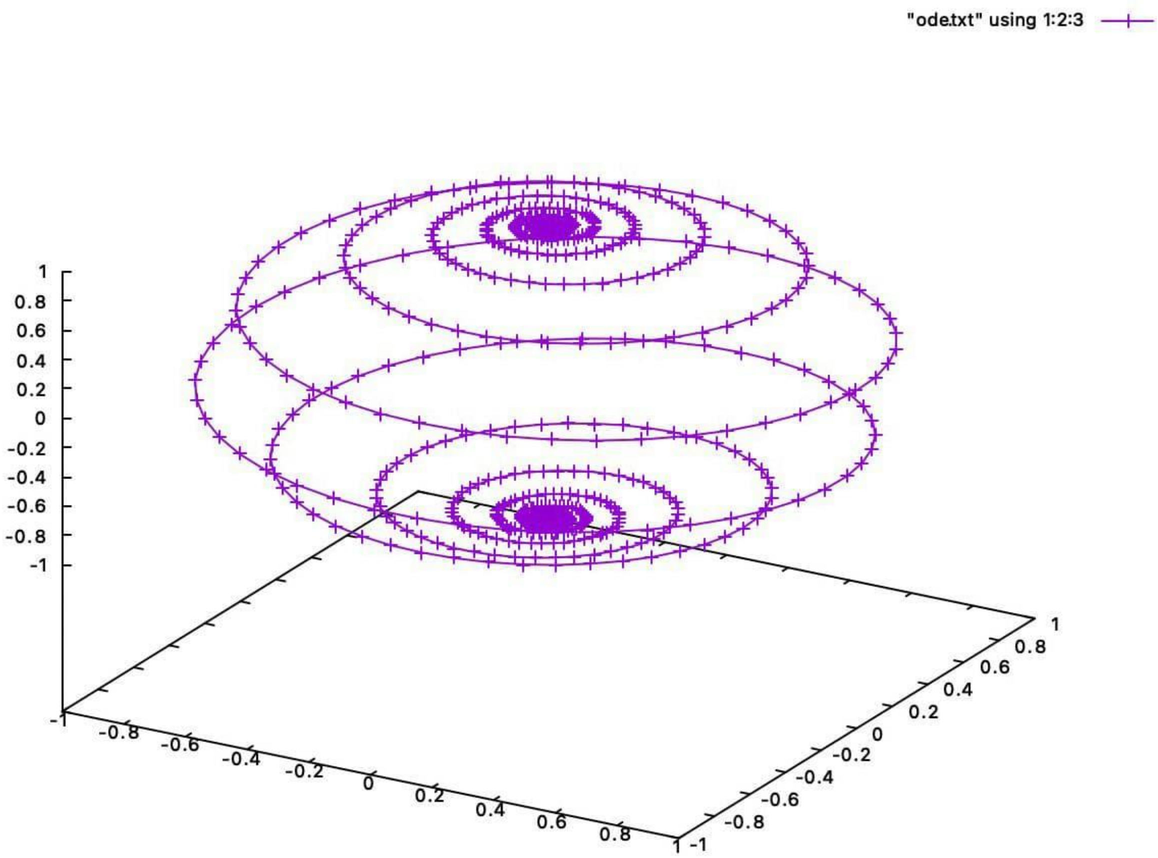
Given below is the plot for variation of switching time (T_{sw}) with alpha:



- Plot reduced magnetization vector ($\vec{m}$) in three dimensions.
  1. By reducing the step size, we can get smoother plots which are more accurate.
  2. By reducing the value of alpha, the switching time increases, and it gives us more number of spirals in the plot.

Given below is the plot for value of step size = 10^{-17}, and alpha = 0.1:

(Here r is taken as 1 and the plot is plotted using the ode.txt file containing set of values of m_x, m_y, m_z.)



Thank you.