Solving Coupled ODEs

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1   Introduction

In order to solve Simultaneous differential equations using Runge Kutta method we proceed in a manner similar to the end used for solving single differential equation.

We need to apply each step of the algorithm to all the ODEs before moving ahead with the next step.

Here, RK method of order 4 is used.

k1 must be calculated for all the differential equations before k2 is calculated. Similarly, for k2, k3, and k4. For System of ODEs, k1,k2,k3,k4 are vectors.

In the second part of the problem, initial values of x,y,z are Jointly Gaussian with mean (1,1,1) and co-variance of identity matrix

$$f(x1, x2, x3) = \frac{1}{\sqrt{(2\pi)^3 det(C)}} exp(-1/2(X - M)C^-1(X - M)^T)$$

Here, x1=x x2=y x3=z

C: covariance matrix X: variable vector M: Mean vector

Substituting the values of Mean and Covariance matrices, we obtain the following pdf

$$f(x1, x2, x3) = \frac{1}{\sqrt{(2\pi)^3}} exp(-1/2(x - 1)^2 + (y - 1)^2 + (z - 1)^2)$$

In order to sample the pdf, We first integrate the pdf to obtain the CDF.