ROLES & RESPONSIBILITIES

•Computed first, second and fourth order approximations of given function at a given point numerically using MATLAB

•Determined the analytical derivative of first, second and fourth order approximations of given function at a given point analytically

•Studied the error between numerical and analytical approximations using plots for different orders of approximations

•Studied the effect of modifying the mesh size on solution for each of these approximations using MATLAB through characteristic plots

RESULTS

•The fourth order approximation was found to have the least error among all the approximation

•The slope of error graph was found to more for first order approximation followed by second order approximation and the least for fourth order approximation

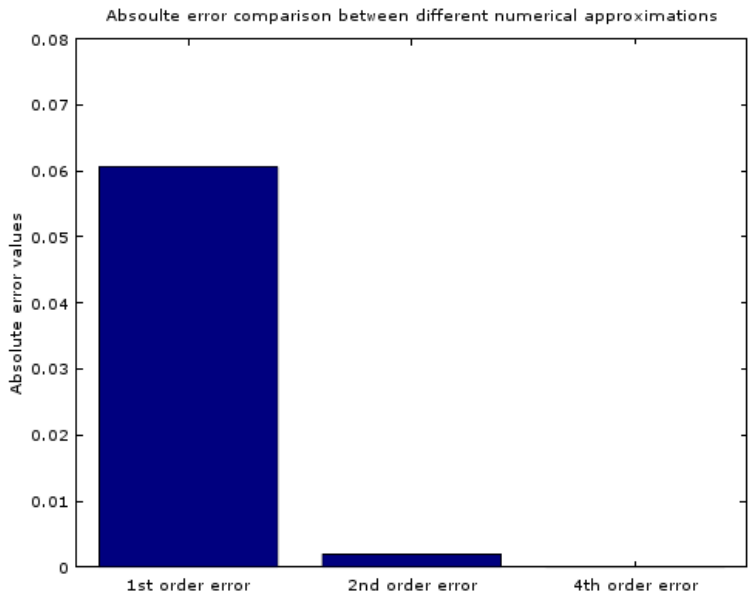

Fig 2. Absolute error values between different numerical approximations

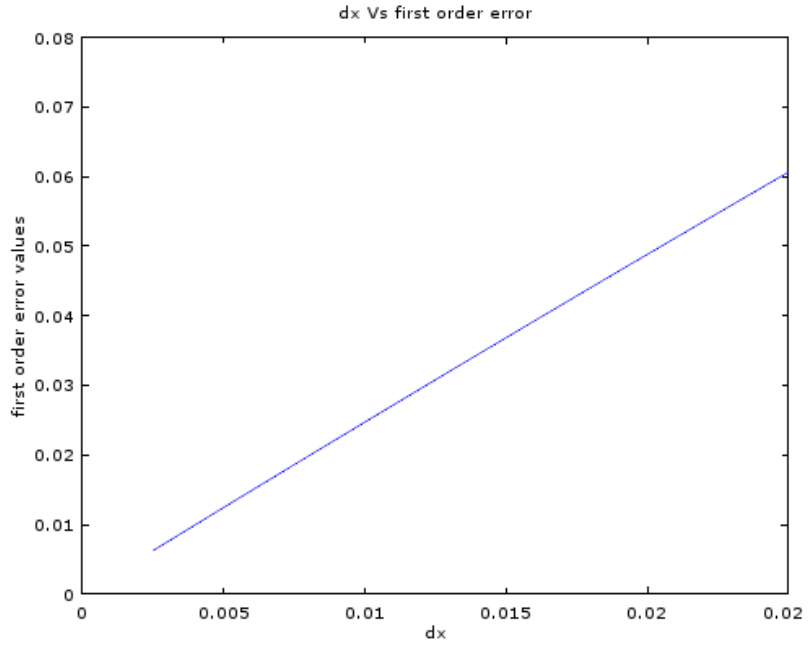

Fig 2.Effect of mesh grid on solution

SAMPLE CODE SNIPPETS

Fourth_order_approx program code

```
function out = fourth_order_approx(x,dx);
analytical_derivative=((x^3*cos(x))-(sin(x)*3*x^2))/x^6;
fourth_order_equation=((sin(x-2*dx)/(x-2*dx)^3)-(8*sin(x-dx)/(x-dx)^3)+(8*sin(x+dx)/(x+dx)^3)-(s
in(x+2*dx)/(x+2*dx)^3))/(12*dx)
out=abs(fourth_order_equation-analytical_derivative);
end
```

Second_order_approx program code

```
function out = second_order_approx(x,dx);
analytical_derivative=((x^3*cos(x))-(sin(x)*3*x^2))/x^6;
second_order_equation=(((sin(x+dx))/((x+dx)^3))-((sin(x-dx))/(x-dx)^3))/(2*dx);
out=abs(second_order_equation-analytical_derivative);
end
```

First_order_approx program code

```
function out = first_order_approx(x,dx);
analytical_derivative=((x^3*cos(x))-(sin(x)*3*x^2))/x^6;
first_order_equation=(((sin(x+dx))/((x+dx)^3))-((sin(x)/x^3)))/(dx)
out=abs(first_order_equation-analytical_derivative);
end
```

Sample code for effect of dx or error

```
close all
clear all
clc
dx=linspace(1/40,1/400,30);
x=pi/3;
for j = 1:length(dx)
  first_order_error(j) =first_order_approx(x,dx(j));
  second_order_error(j)=second_order_approx(x,dx(j));
  fourth_order_error(j)=fourth_order_approx(x,dx(j));
  end
plot(dx,fourth_order_error);
xlabel(\'dx\');
ylabel(\'fourth order error values\');
title(\'dx Vs fourth order error\');
```