# Discretization of Ordinary and Partial differential Equations of Arbitrary real order

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***Abstract: This paper helps to find the solution to obtain the discretization of partial and ordinary differential equation by replacing derivatives with respective discrete analogs in the form of triangular strip matrices. Here we are introducing a new MATLAB toolbox for matrix approach which implements smooth discretization of partial and ordinary differential equations of arbitrary real order. Here the main objective behind introducing the function is to implement matrix approach to fractional derivatives and to the solution of partial and ordinary differential equations.***

Keywords – *discretization, matrix, fractional derivatives*

## I.INTRODUCTION

Differential equations arises in various contexts some in practical or some purely theoretical. By solving differential equations we are finding the values of dependent variables in terms of independent variable. Example is

dy/dx=sinx$e^{y}$

An ordinary differential equation (ODE) has only derivatives of one variable (no partial derivatives). A Partial Differential Equation (PDE) will have at least one partial derivative. Differential Equations are classified according to the order. This is classified exactly as in case of polynomial equation. First order ODE contains only first derivative. Higher order ODE is classified by greatest order of derivatives. Nowadays as technology advances, we can approach Mathematics with different perspective like use of software tools to solve the discretization of ODE and PDE equations. The MATLAB (Matrix Laboratory) toolboxes can be implemented to solve the discretization of PDE and ODE by replacing the derivatives with triangular strip matrices.MATLAB is basically high level languages which is extensively used in the mathematical equation solving. This matrix approaches avoids the hectic equations solving by use of normal methods.

## II.EXISTING SYSTEM

The existing system solved the delay differential equation by use of software tools using MATLAB.In this model analytical and synthetic model for solving the system of two delay differential equation is been shown. This software tool has huge potential in solving many types of differential equation but existing system utilized only small amount of potential. This overcome in the unutilized potential of MATLAB has been solved in the proposed system.

## III.PROPOSED SYSTEM

In the Proposed system we will obtain the discretization of partial and ordinary differential equation by replacing derivatives with respective discrete analogs in the form of triangular strip matrices. In this method we are solving by use of MATLAB software for evaluating fractional integral equations, ODE with fractional derivatives, PDE with fractional derivatives ( on various forms of Fraction diffusion equations) , First and second order integral derivatives ( using back ward and forward finite difference approximations), Evaluation of left sided and right sided Riemann-liouville fractional derivatives , Fractional integral equations of Riesz Kernel , Riesz derivatives , ordinary fractional derivatives( Bagley-Torvik Equation ) , solving PDE fractional diffusion equation , solving PDE with delayed fractional derivatives. Here Triangular strip matrices have been used.

## IV.METHODOLOGY AND EXPERIMENT ANALYSIS:

To solve the various ODE and PDE fractional derivates we will use certain functions inside MATLAB which will solve the equations for ODE, PDE, fractional derivative problems using triangular strip matrices.

**(a)First and second order derivatives of the function y(t)=4*t*(t-1) having interval [0,1] using backward finite difference approximation**

Here we have used Ban function for above operation

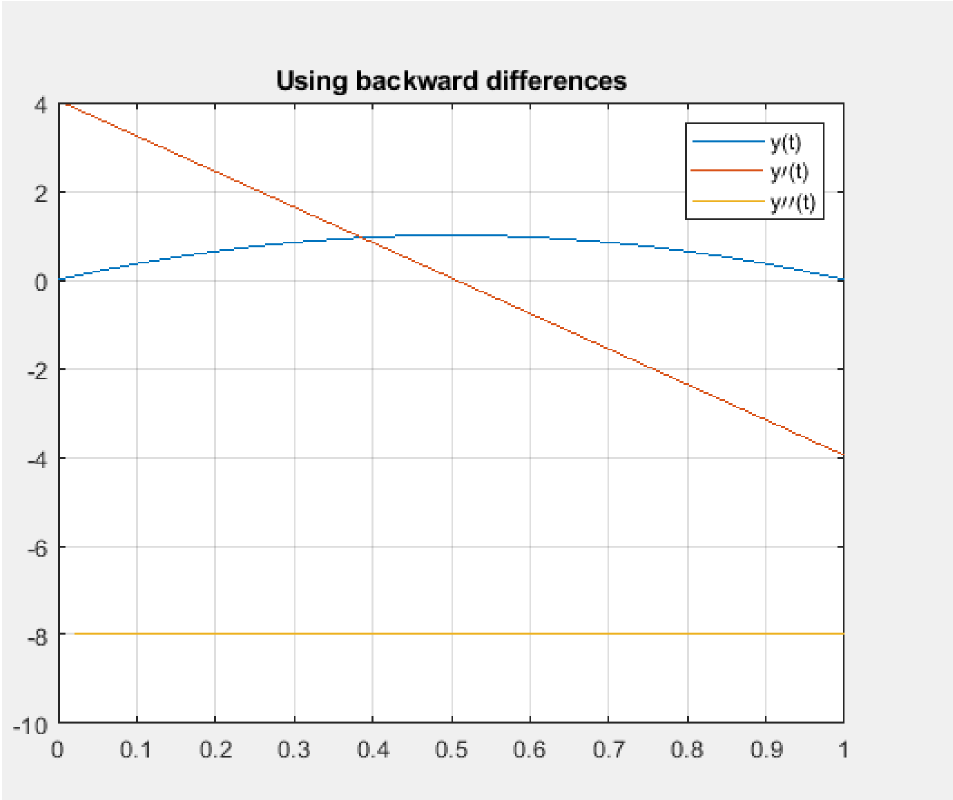


Fig.1. Backward Differences

**(b) First and Second order derivative of function y(t)= 4*t*(t-1) having interval [0,1] using forward finite difference approximation**

Here we used Fan function for above operation

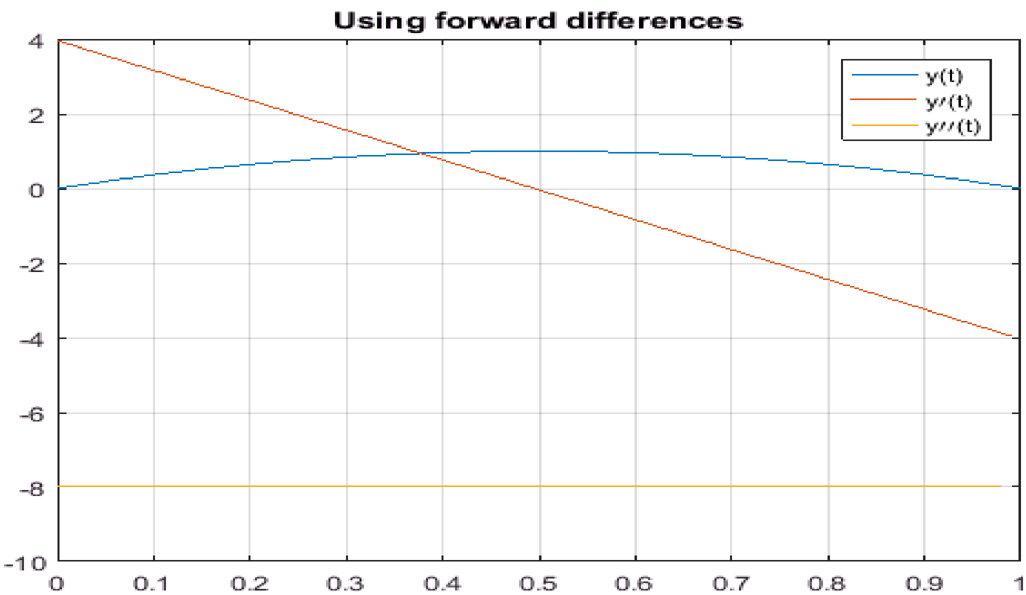


Fig.2. Forward Differences

**( c) Evaluating left sided Riemann-Liouville Fractional Derivatives of a constant**

Here Ban function is used for above purpose

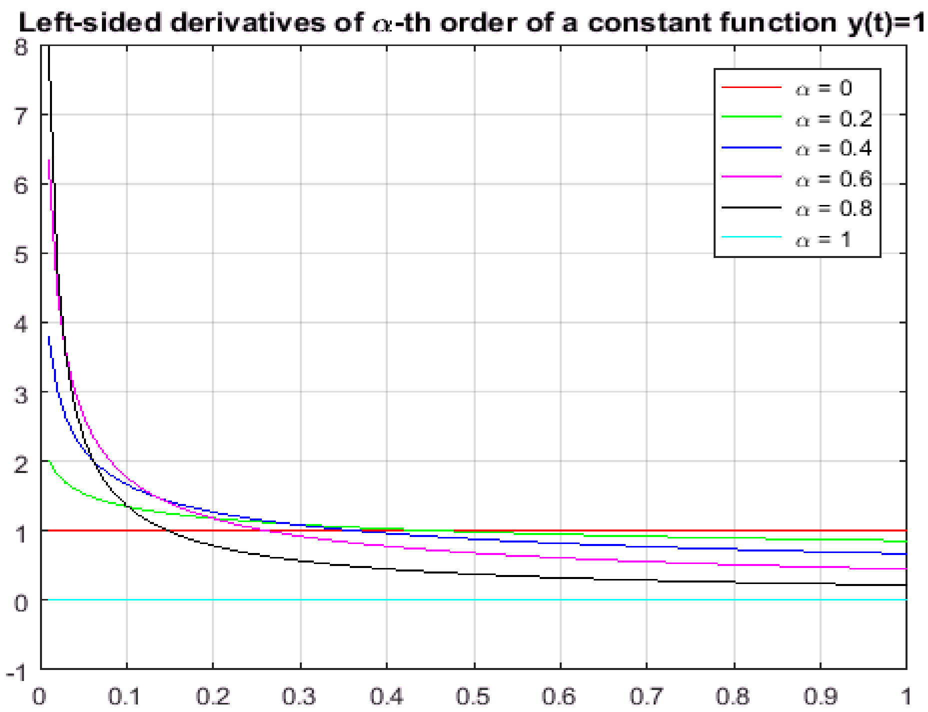


Fig3.Left sided Riemann-Liouville Fractional Derivative

**(d) Evaluating Right sided Riemann-Liouville Fractional Derivatives of a constant**

Here Fan function is used for above purpose

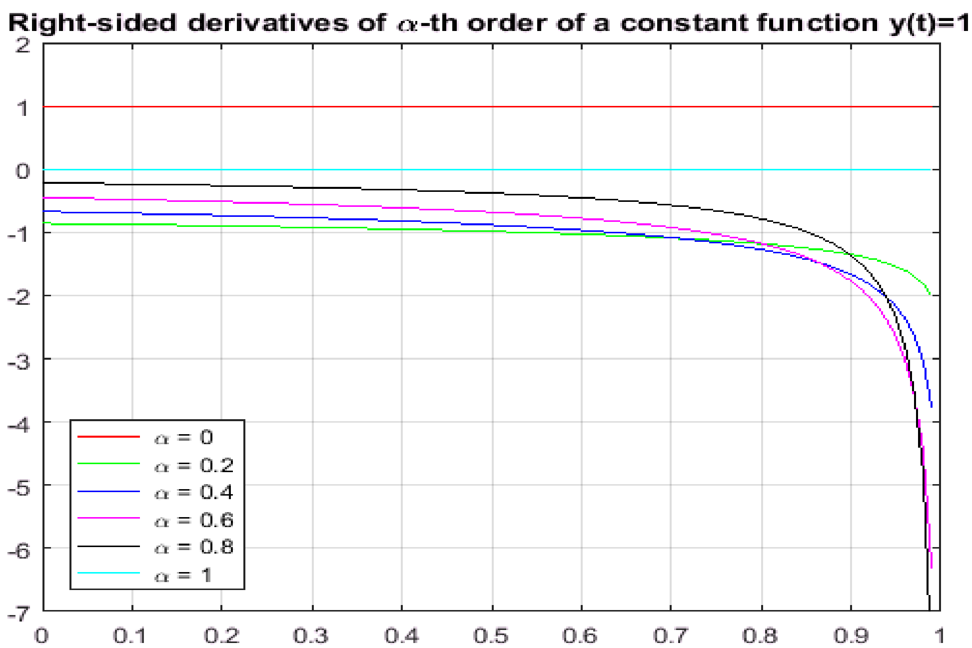


Fig4.Right sided Riemann-Liouville Fractional Derivative

**(e) Fractional Integral equation: Riesz Kernel**

In this comparison of Analytical and numerical method is done for solving above equation.

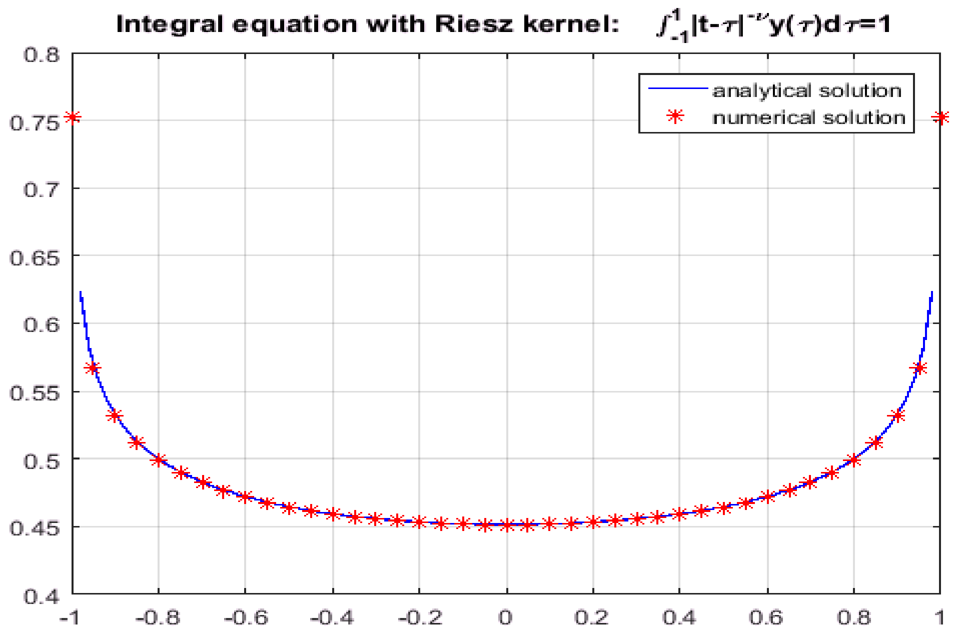


Fig.5. Fractional Integral equation: Riesz Kernel

**(f) Partial Differential equation with delayed fractional derivatives**

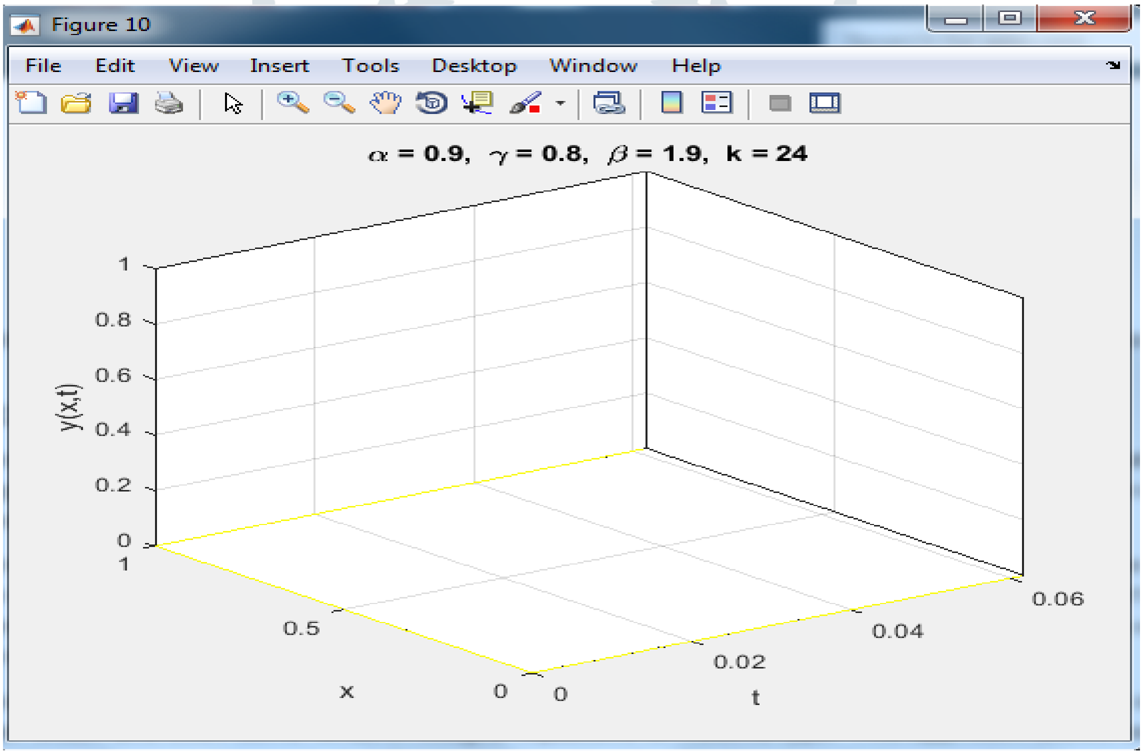


Fig.9. Partial Differential equation with delayed fractional derivatives

## V. CONCLUSION

This Paper shows how the matrix approach can be used to solving Discretization of derivatives and integrals od arbitrary real orders ( integers/ non integers) to numerical solution of frational integral equation , Partial and ordinary derivative equation of arbitrary real order.

## References

**[1]** L.J.Derr, Triangular matrices with the isoclinal property. Pacific Journal of Mathematics 37, No 1 (1971), 41-43.

**[2]** P.P.B.Egger mont, A new analysis of the trapezoidal-discretizationmethod for the numerical solution of Abel-type integral equations. Journal of Integral Equations 3 (1981), 317-332.

**[3]** F.R. Gantmakher, Teoriya matrits (Theory of Matrices). Nauka, Moscow (1988) (In Russian).

**[4]** P.A.W.Holyhead and S. M c K e e, Stability and convergence of multistep methods for linear Volterra integral equations of the first kind. SIAM J. Numer. Anal. 13, No 2 (April 1976), 269-292.

**[5]** P.A.W.Holyhead, S. Mc K e e, and P. J. Taylor, Multistep methods for solving linear Volterra integral equations of the first kind. SIAM J. Numer. Anal. 12, No 5 (October 1975), 698-711.

**[6]** S. Mc K e e, Discretization methods and block isoclinal matrices. IMA Journal of Numerical Analysis 3 (1983), 467-491.