function [T, Y]=FOChen(parameters, orders, TSim, Y0)

%

% Numerical Solution of the Fractional-Order Chen's System

%

% D^q1 x(t) = a(y(t)-x(t))

% D^q2 y(t) = dx(t) - x(t)z(t) + cy(t)

% D^q3 z(t) = x(t)y(t) - bz(t)

%

% function [T, Y] = FOChen(parameters, orders, TSim, Y0)

%

% Input: parameters - model parameters [a, b, c, d]

% orders - derivatives orders [q1, q2, q3]

% TSim - simulation time (0 - TSim) in sec

% Y0 - initial conditions [Y0(1), Y0(2), Y0(3)]

%

% Output: T - simulation time (0 : Tstep : TSim)

% Y - solution of the system (x=Y(1), y=Y(2), z=Y(3))

%

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%

% time step:

h=0.005;

% number of calculated mesh points:

n=round(TSim/h);

%orders of derivatives, respectively:

q1=orders(1); q2=orders(2); q3=orders(3);

% constants of Chen's system:

a=parameters(1); b=parameters(2);

c=parameters(3); d=parameters(4);

% binomial coefficients calculation:

cp1=1; cp2=1; cp3=1;

for j=1:n

c1(j)=(1-(1+q1)/j)\*cp1;

c2(j)=(1-(1+q2)/j)\*cp2;

c3(j)=(1-(1+q3)/j)\*cp3;

cp1=c1(j); cp2=c2(j); cp3=c3(j);

end

% initial conditions setting:

x(1)=Y0(1); y(1)=Y0(2); z(1)=Y0(3);

% calculation of phase portraits /numerical solution/:

for i=2:n

x(i)=(a\*(y(i-1)-x(i-1)))\*h^q1 - memo(x, c1, i);

y(i)=(-d\*x(i)-x(i)\*z(i-1)+c\*y(i-1))\*h^q2 - memo(y, c2, i);

z(i)=(x(i)\*y(i)-b\*z(i-1))\*h^q3 - memo(z, c3, i);

end

for j=1:n

Y(j,1)=x(j);

Y(j,2)=y(j);

Y(j,3)=z(j);

end

T=h:h:TSim;

%