Table of Contents

```
clear all, close all,  clc
% for each part, uncomment and run entire code
```

Load Data

```
load('SYS1.mat')
%load('SYS2.mat')
dt = 0.01; % sample time for data
n=3;
```

Compute Derivative

part a

```
% Beta = [10; 28; 8/3]; % Lorenz's parameters (chaotic)
% for i=1:length(x)
%     dx(i,:) = lorenz(0,x(i,:),Beta);
% end


%////////////////////////////////////
```

part b

```
% for i=1:length(x)
%     dx(i,:) = dynamic_p5(0,x(i,:));
% end
```

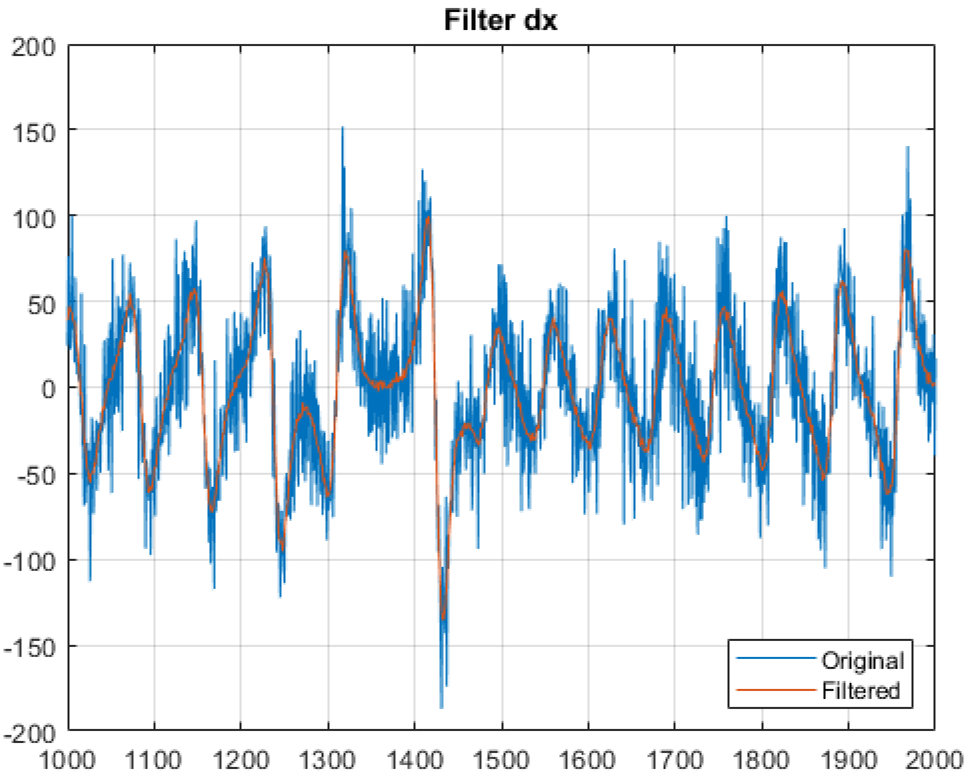
part c

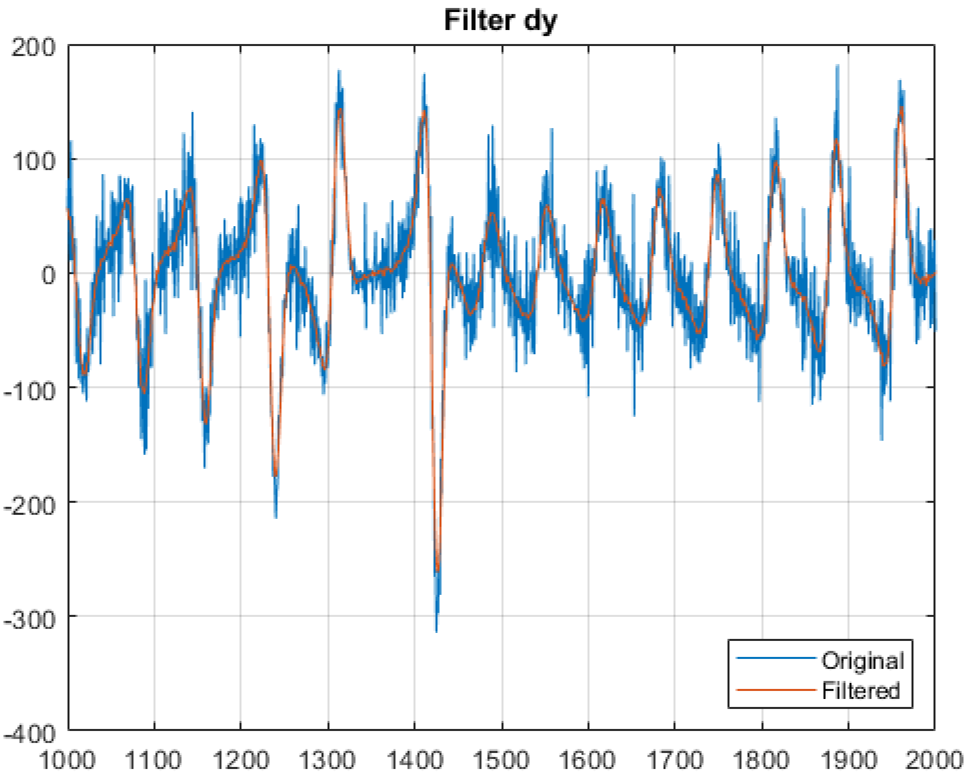
```
% for i=1:3
%     dx(:,i) = diff(x(:,i))/dt;
% end
% dx = [dx; dx(end,:)];
```

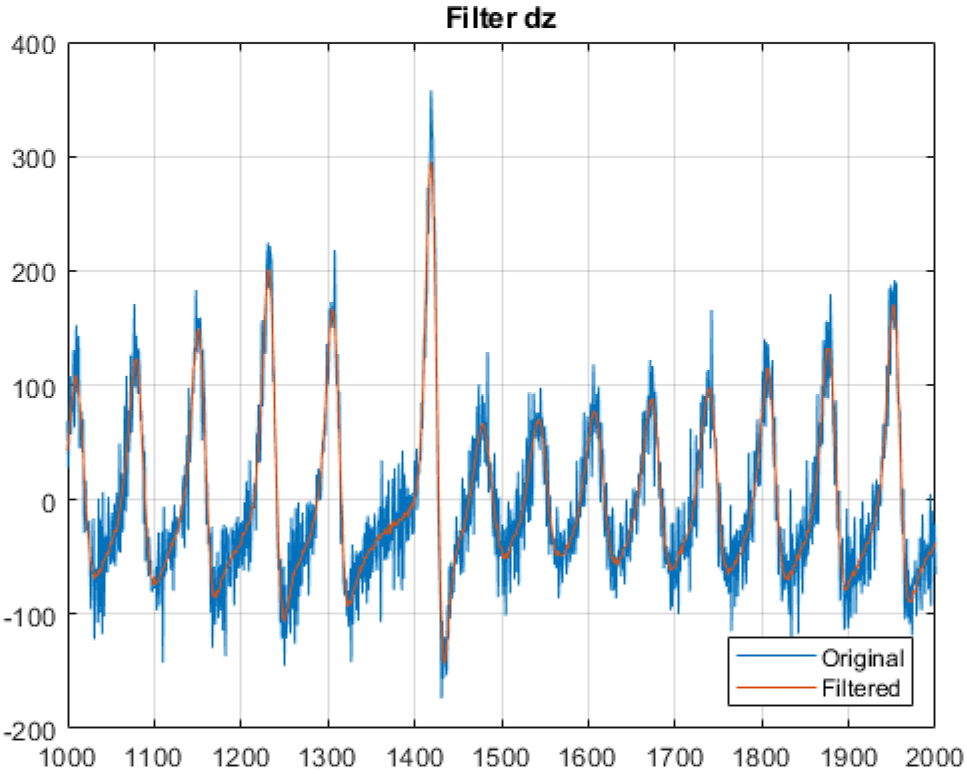
part d

lets add noise for fun :) noise for SYS1

```
noise = normrnd(0.1,0.2, size(x,1), size(x,2));

%noise for SYS2
%noise = normrnd(0.1,0.2, size(x,1), size(x,2))/100;

x = x+noise;

for i=1:3
    dx(:,i) = diff(x(:,i))/dt;
end
dx = [dx; dx(end,:)];

% storage for filtered data
dx_filter = zeros(size(dx,1), size(dx,2));
xyz_str = ['x','y','z'];

% plot data
for i = 1:size(dx,2)
    % plot Original data
    figure
    plot(dx(:,i)); hold on

    % filter data using Savitzky Golay
    rd = 2; % polynomial order (use 2 for SYS2.mat)
    fl = 21; % length of data frames (USE 21 FOR SYS2.mat)
    dx_filter(:,i) = sgolayfilt(dx(:,i),rd,fl);

    % plot filtered data
    plot(dx_filter(:,i)); hold off
    title_str = sprintf('Filter d%1$s', xyz_str(i));
    title(title_str)
    grid
    xlim([1000 2000]) % Add for SYS1.MAT TO BETTER SEE NOISE
    legend({'Original', 'Filtered'},'Location','southeast')
end
```


Filter dx
200
150
100
50
0
-50
-100
-150
-200
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
Original
Filtered


Filter dy
200
100
0
-100
-200
-300
-400
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
Original
Filtered



Build library and compute sparse regression

```
polyorder = 3; % up to third order polynomials
Theta = poolData(x,n,polyorder);
lambda = 0.4;       % lambda is our sparsification knob.
Xi = sparsifyDynamics(Theta,dx_filter,lambda,n)
poolDataLIST({'x','y','z'},Xi,n,polyorder);
```

```
Xi =

            0     -0.46644        9.937
      -9.9163       27.895            0
       9.7879      -1.5375            0
            0            0      -2.9991
            0            0            0
            0            0      0.97436
            0     -0.97825            0
            0            0            0
            0            0            0
            0            0            0
            0            0            0
            0            0            0
            0            0            0
            0            0            0
            0            0            0
            0            0            0
            0            0            0
            0            0            0
            0            0            0
            0            0            0


newout =

  21×4 cell array

    {0×0 char}    {'xdot'   }    {'ydot'    }    {'zdot'   }
    {'1'     }    {[       0]}    {[-0.46644]}    {[  9.937]}
    {'x'     }    {[-9.9163]}    {[  27.895]}    {[      0]}
    {'y'     }    {[ 9.7879]}    {[ -1.5375]}    {[      0]}
    {'z'     }    {[      0]}    {[       0]}    {[-2.9991]}
    {'xx'    }    {[      0]}    {[       0]}    {[      0]}
    {'xy'    }    {[      0]}    {[       0]}    {[0.97436]}
    {'xz'    }    {[      0]}    {[-0.97825]}    {[      0]}
    {'yy'    }    {[      0]}    {[       0]}    {[      0]}
    {'yz'    }    {[      0]}    {[       0]}    {[      0]}
    {'zz'    }    {[      0]}    {[       0]}    {[      0]}
    {'xxx'   }    {[      0]}    {[       0]}    {[      0]}
    {'xxy'   }    {[      0]}    {[       0]}    {[      0]}
    {'xxz'   }    {[      0]}    {[       0]}    {[      0]}
    {'xyy'   }    {[      0]}    {[       0]}    {[      0]}
    {'xyz'   }    {[      0]}    {[       0]}    {[      0]}
    {'xzz'   }    {[      0]}    {[       0]}    {[      0]}
    {'yyy'   }    {[      0]}    {[       0]}    {[      0]}
    {'yyz'   }    {[      0]}    {[       0]}    {[      0]}
    {'yzz'   }    {[      0]}    {[       0]}    {[      0]}
    {'zzz'   }    {[      0]}    {[       0]}    {[      0]}
```

Published with MATLAB® R2023b