Lab9: Process reconstruction free from any constraints and assumptions

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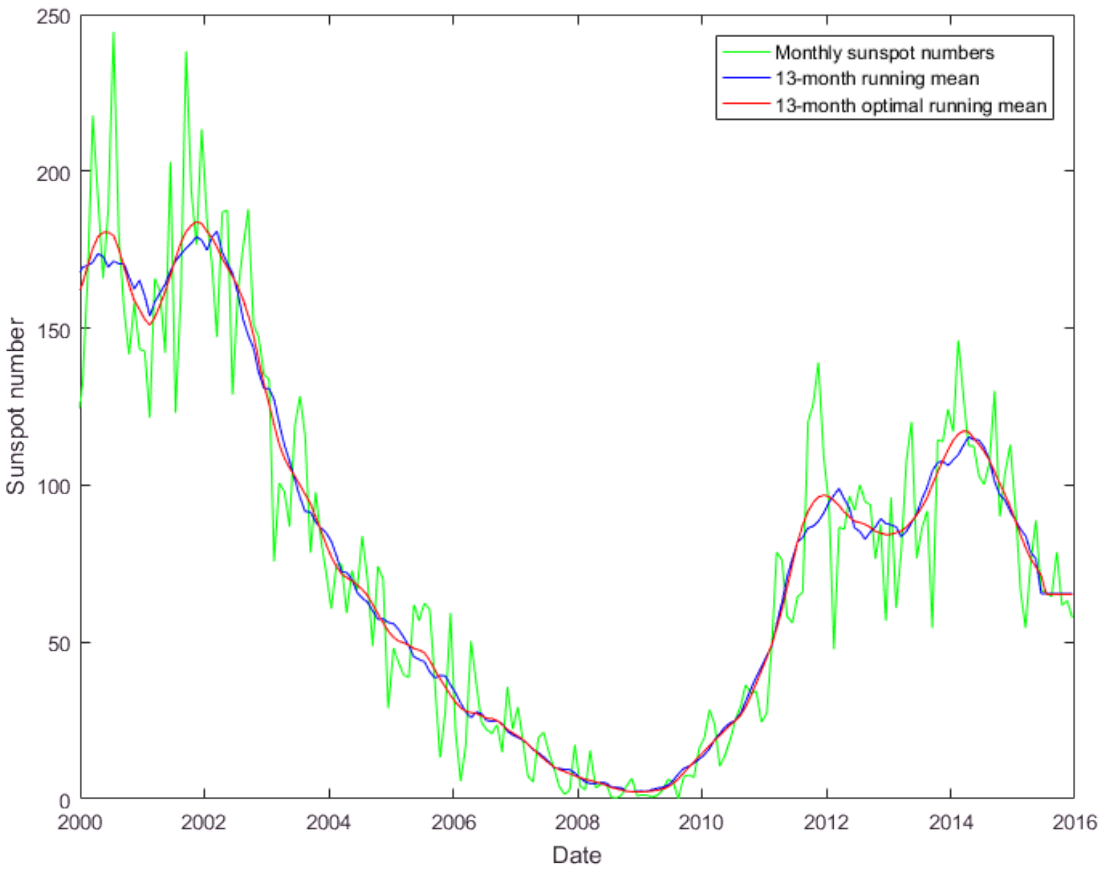
```
clc; clear; close all;
Data = importdata('sunspot.mat');

SunSpots = Data(:,4);
Time = Data(:,3);

SmoothSunSpots = smooth(SunSpots, 13)';
optimalSmoothedSunSpot = smoothOptimal(SunSpots, 0.01);

figure ('position', [0, 0, 800, 600]);
plot(Time, SunSpots, 'green')
hold on
plot(Time, SmoothSunSpots, 'blue')
plot(Time, optimalSmoothedSunSpot, 'red')
lg = legend('Monthly sunspot numbers', '13-month running mean', '13-month optimal running mean
ylabel('Sunspot number')
xlabel('Date')
axis([2000 2016 0 250])
```

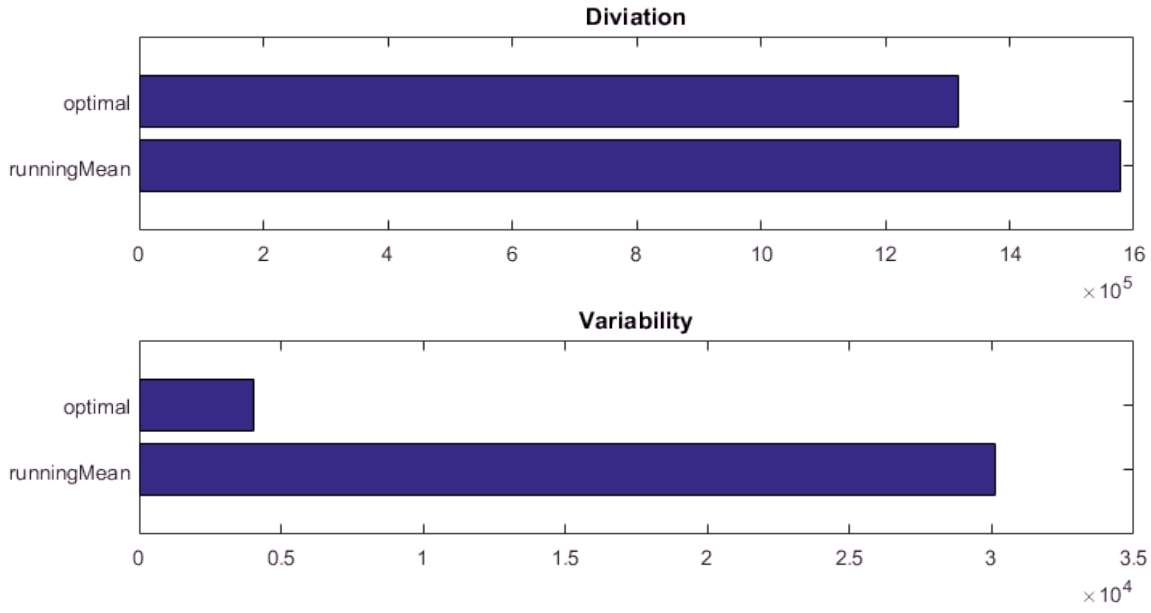


```
runningMeanDiviation = calcDiviation(SmoothSunSpots, SunSpots);
runningMeanVariation = calcVariability(SmoothSunSpots);
optimalDiviation = calcDiviation(optimalSmoothedSunSpot, SunSpots);
optimalVariation = calcVariability(optimalSmoothedSunSpot);
dataVariability = calcVariability(SunSpots);

figure ('position', [0, 0, 800, 400]);
label = cell(1,3);
label{1}='runningMean'; label{2}='optimal'; label{3}='original Data';

subplot(2,1,1)
barh([runningMeanDiviation; optimalDiviation ])
title('Diviation')

set(gca,'yticklabel', label)
subplot(2,1,2)
barh([runningMeanVariation optimalVariation])%+  dataVariability
title('Variability')
set(gca,'yticklabel', label)
```



Conclusion : "Optimal Smoothing" method provides less Diviation and Variability comparing with "13-months running mean method"

```
function smoothedArr = smoothOptimal(Arr, beta)

    d2 = ones(11, 1);
    d1 = [-2; -4*ones(10, 1); -2];
    d0 = [1+beta; 5+beta; (6+beta)*ones(9,1); 5+beta; 1+beta];

    A = diag(d0) + diag(d1, -1) + diag(d1, 1) + diag(d2, -2) +
 diag(d2, 2);
    A_inv = inv(A);

    smoothedArr = zeros(length(Arr),1);

    smoothedArr(1:6) = mean(Arr(1:6));
    for i = 7:length(Arr)-6
        smoothedArr(i) = beta * A_inv(7,:) * Arr(i-6:i+6);
    end
    smoothedArr(end - 5 : end) = mean(Arr(end - 5 : end));

end
```

```
Not enough input arguments.

Error in smoothOptimal (line 5)
    d0 = [1+beta; 5+beta; (6+beta)*ones(9,1); 5+beta; 1+beta];
```

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