Assignment 3 Determining and removing drawbacks of exponential and running mean

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Part II

FIRST TRAJECTORY

```
clc;
clear all;
close all;
```

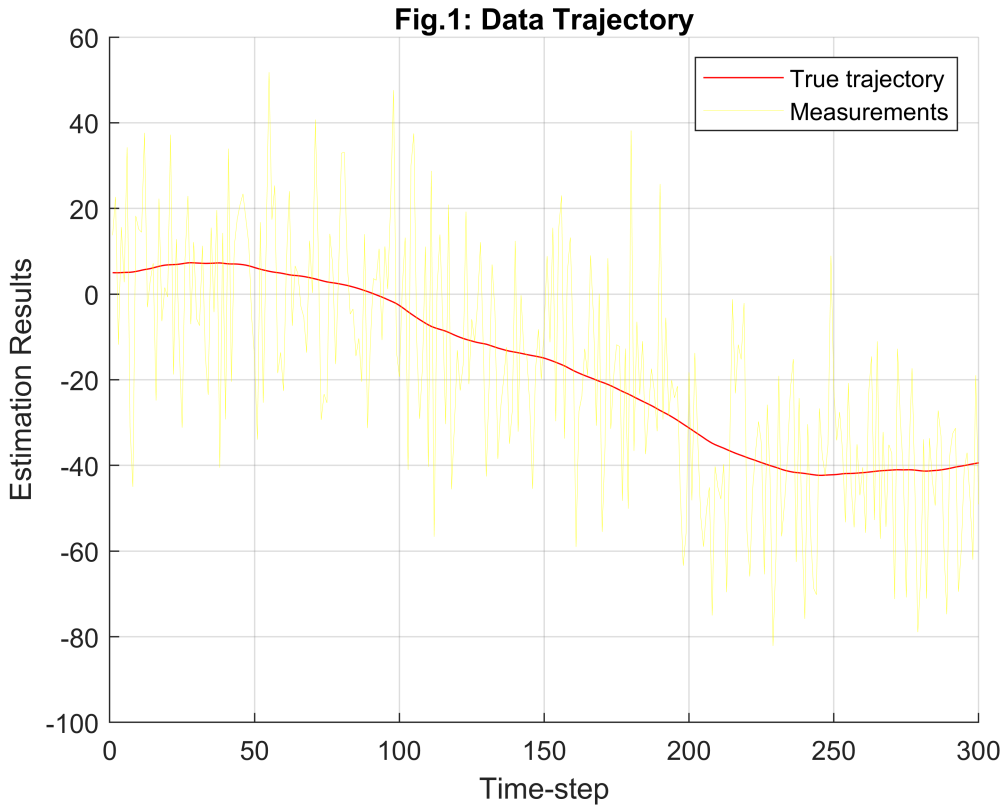
T1: Generate a true trajectory

```
n = 300;
X = 5*ones(n,1);
V = zeros(n,1);
var_a = 10;
a = sqrt(var_a)*randn(n,1);
T = 0.1;

for i = 2:n
    X(i) = X(i-1)+V(i-1)*T+a(i-1)*T^2/2;
    V(i) = V(i-1)+a(i-1)*T;
end
```

T2: Generate measurements

```
var_eta = 500;
eta = sqrt(var_eta)*randn(n,1);
z = eta+X;

figure
hold on
plot(X,'r')
plot(z,'y',"LineWidth",0.1)
title('Fig.1: Data Trajectory')
legend('True trajectory','Measurements')
xlabel('Time-step')
ylabel("Estimation Results")
```

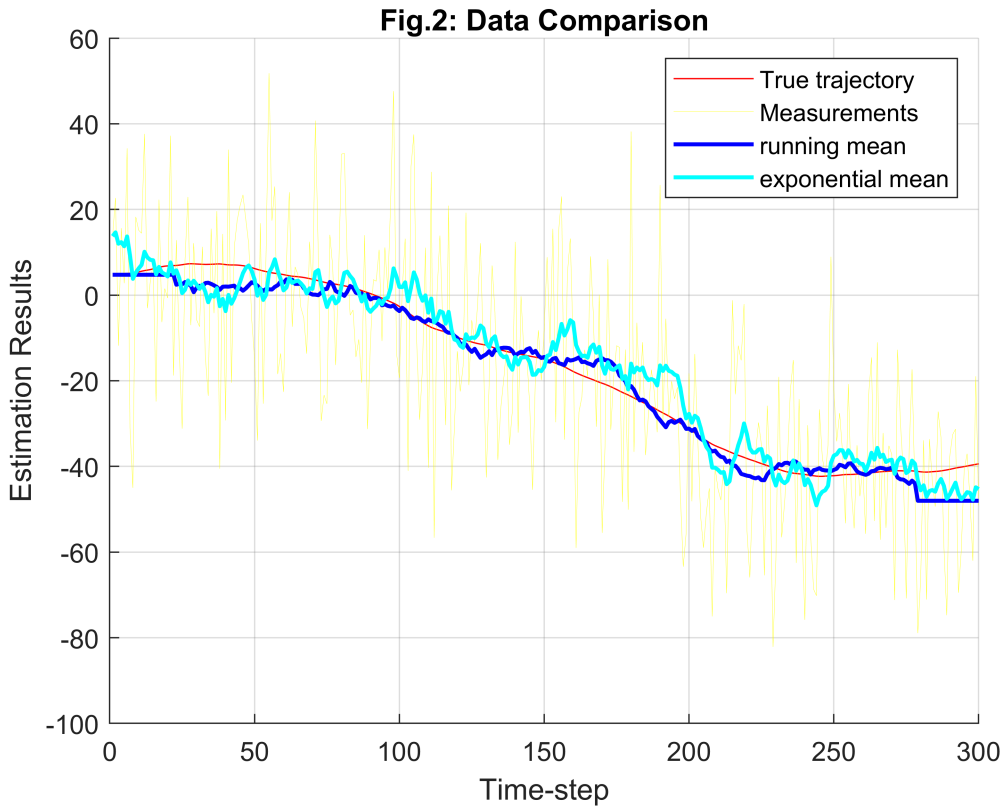
```
grid on
```



T3: Taking empirically the window size M of sunning mean and smoothing coefficient alpha

```
M=45;
win=floor((M-1)/2);
X_rm=zeros(n,1);
for i=win+1:n-win
   sumZ =sum(z(i-win:i+win,1));
   X_rm(i,1)=1/M*sumZ;
end
X_rm(1:win,1)=sum(z(1:win,1))/win;
X_rm(n-win+1:n,1)=sum(z(n-win+1:n,1))/win;

alpha = 0.1;
X_es = z;
for i = 2:n
    X_es(i) = X_es(i-1)+alpha*(z(i)-X_es(i-1));
end

figure
hold on
plot(X,'r')
plot(z,'y',"LineWidth",0.1)
plot(X_rm,'b',"LineWidth",1.5)
plot(X_es,'c',"LineWidth",1.5)
title('Fig.2: Data Comparison')
legend('True trajectory','Measurements','running mean','exponential mean')
```

```
xlabel('Time-step')
ylabel("Estimation Results")
grid on
```



T4: Chose better smoothing method by indicators

```
d_rm=0;
d_es=0;

for i=1:n
    d_rm = d_rm + (z(i,1)-X_rm(i,1))^2;
    d_es = d_es + (z(i,1)-X_es(i,1))^2;
end

out1 = ['Deviation indicator for Running mean is ',num2str(d_rm)];
disp(out1)
```

```
Deviation indicator for Running mean is 122925.6688
```

```
out2 = ['Deviation indicator for Exponential mean at alpha= ',num2str(alpha),' is ',num2str(d_e
disp(out2)
```

```
Deviation indicator for Exponential mean at alpha= 0.1 is 107917.418
```

```
v_rm=0;
v_es=0;

for i=1:n-2
    v_rm = v_rm + (X_rm(i+2,1)-2*X_rm(i+1,1)+X_rm(i,1))^2;
```

```
    v_es = v_es + (X_es(i+2,1)-2*X_es(i+1,1)+X_es(i,1))^2;
end

out3 = ['Variability indicator for Running mean is ',num2str(v_rm)];
disp(out3)
```

```
Variability indicator for Running mean is 238.8353
```

```
out4 = ['Variability indicator for Exponential mean at alpha= ',num2str(alpha),' is ',num2str(v
disp(out4)
```

```
Variability indicator for Exponential mean at alpha= 0.1 is 2818.6019
```

Conclusions:

- The trajectory of the model was created with its measuremnts and noise.
- The values of the window size and smoothing coefficient was taken empirically by comparing different values of window size and smoothing coefficient (code done in ChoosingMandAlpha.m file) and plotting running mean and exponential mean to find the best window size and smoothing coefficient. For this case the window size was taken as 45 and smoothing coefficient as 0.1.
- The ranges for deviation indicator for running mean and expoenetial mean are almost the same but the variabilty indicator of exponential mean is 11 times greater than that of running mean. So, running mean smoothing is better in this case.