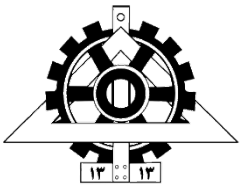
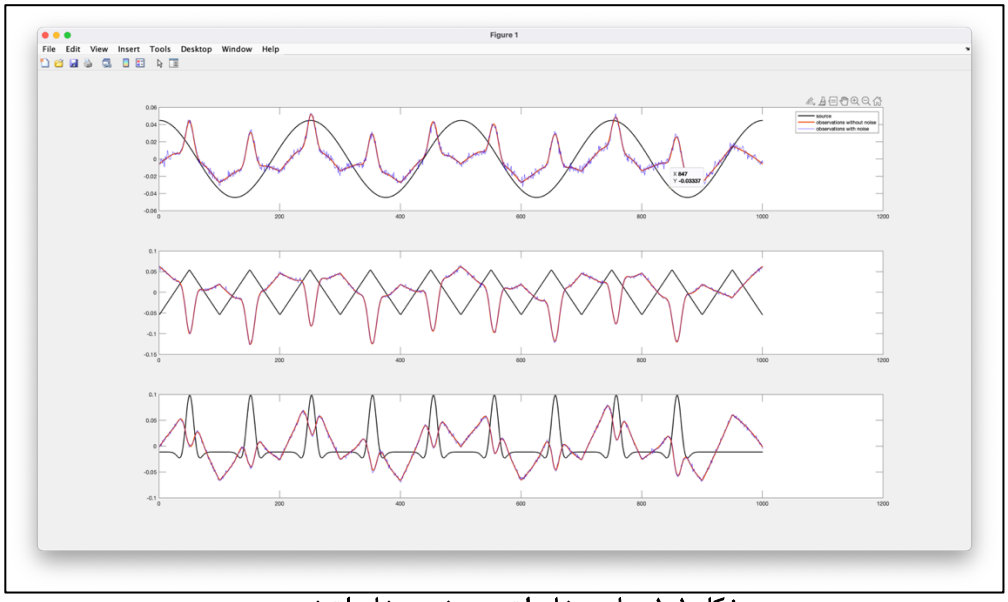
به نام خدا



نیم سال دوم ۱۴۰۰-۰۱ – **جداسازی کور منابع**

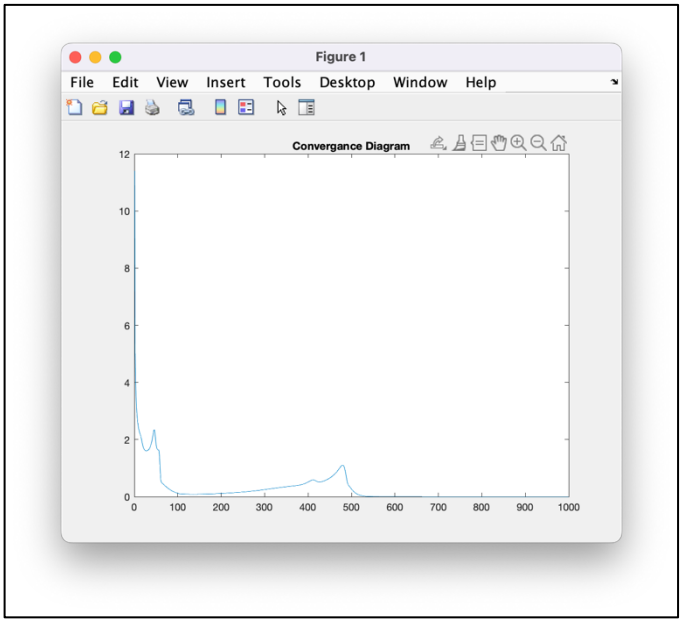
گزارش تمرین چهاردهم

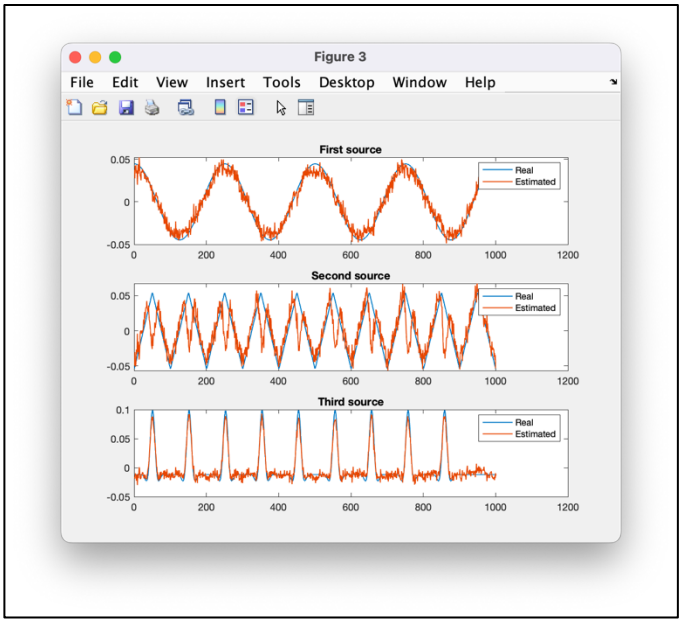
فاطمه صالحی ۸۱۰۱۹۸۴۲۳



شکل ۱-۱: منابع، مشاهدات بدون نویز، مشاهدات نویزی

روش مبتنی بر D_{kl}





شکل ۱-۲: نمودار همگرایی و منابع تخمین زده شده

کد مربوط به بخش اول :

```
clear
load('hw14.mat')
X = A*S + Noise;
without_noise = A*S;
%%
subplot(3,1,1)
plot(S(1,:),'black','LineWidth',1.5)
hold on
plot(without_noise(1,:),'LineWidth',1.75)
plot(X(1,:),'blue')
legend('source','observations without noise','observations with noise')


subplot(3,1,2)
plot(S(2,:),'black','LineWidth',1.5)
hold on
plot(without_noise(2,:),'LineWidth',1.75)
plot(X(2,:),'blue')


subplot(3,1,3)
plot(S(3,:),'black','LineWidth',1.5)
hold on
plot(without_noise(3,:),'LineWidth',1.75)
plot(X(3,:),'blue')
%%
warning('off', 'all')
B =[0.321,0.532,0.533;
    0.227,0.41,0.282;
    0.321,0.821,0.81];
B = B./sqrt(sum(B.^2,2));
Y = B*X;
k = @(Y) [ones(1,1001)
     Y
     Y.^2
     Y.^3
     Y.^4
     Y.^5];
 k_prime = @(Y) [zeros(1,1001)
                 ones(1,1001)
                 2*Y
                 3*Y.^2
                 4*Y.^3
                 5*Y.^4];
Err = zeros(1,1000);
for i =1:1000
    k1 = k(Y(1,:));
    k2 = k(Y(2,:));
    k3 = k(Y(3,:));
```

```
    KK1 = (k1*k1')/1001;
    KK2 = (k2*k2')/1001;
    KK3 = (k3*k3')/1001;

    k1_prime = mean(k_prime(Y(1,:)),2);
    k2_prime = mean(k_prime(Y(2,:)),2);
    k3_prime = mean(k_prime(Y(3,:)),2);

    theta1 = KK1\k1_prime;
    theta2 = KK2\k2_prime;
    theta3 = KK3\k3_prime;


    psi1 = theta1'*k1;
    psi2 = theta2'*k2;
    psi3 = theta3'*k3;


    rond_B = [psi1*X' ;psi2*X'; psi3*X']/1001  - inv(B)';
    B = B - 0.01*rond_B;
    B = B./sqrt(sum(B.^2,2));
      Y = B*X;
    Err(i) = norm(rond_B);
end
%%
figure
plot(Err)
title('Convergance Diagram');


Shat =B*X;


Shatd=Shat; Sd=S;
[~,r1]=max(abs(Shatd(1,:)*Sd'));
Sd(r1,:) =0;
Shat(r1,:)=Shatd(1,:);


[~,r2]=max(abs(Shatd(2,:)*Sd'));
Sd(r2,:) =0;
Shat(r2,:)=Shatd(2,:);


[~,r3]=max(abs(Shatd(3,:)*Sd'));
Sd(r3,:) =0;
Shat(r3,:)=Shatd(3,:);
```

```
figure
subplot(3,1,1)
plot(S(1,:),'LineWidth',1); hold on
plot(Shat(1,:)*2,'LineWidth',1);
legend('Real','Estimated')
title('First source')


subplot(3,1,2)
plot(S(2,:),'LineWidth',1); hold on
plot(Shat(2,:)*(-3),'LineWidth',1);
legend('Real','Estimated')
title('Second source')


subplot(3,1,3)
plot(S(3,:),'LineWidth',1); hold on
plot(Shat(3,:)*(-1.75),'LineWidth',1);
legend('Real','Estimated')
title('Third source')
%%
Shat(1,:)=Shat(1,:)*2;
Shat(3,:)=Shat(3,:)*(-1.75);
Shat(2,:)=Shat(2,:)*(-3);
E = (norm(S-Shat,'fro'))^2 / (norm(S,'fro'))^2
```

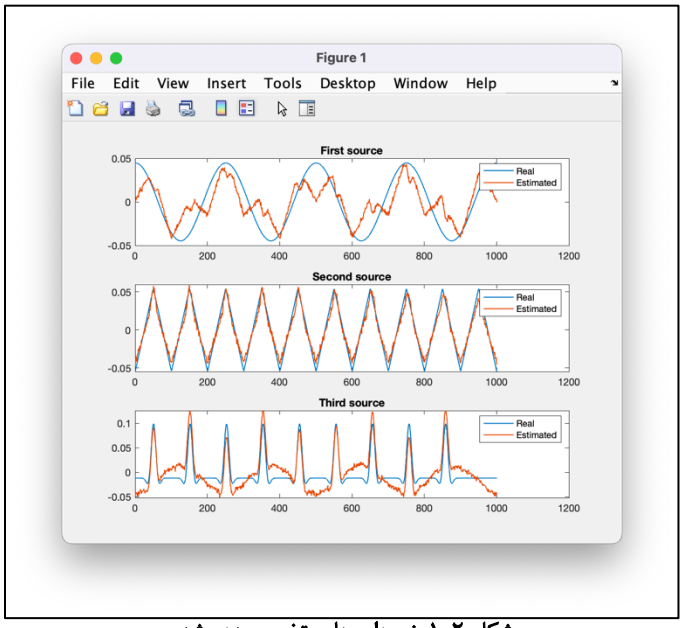
```
E =

    0.2096
```

شکل ۱-۳: مقدار خطا روش اول

```
>> B*A

ans =

    0.4374    0.0420   -0.0426
    0.0127   -0.3192    0.2220
    0.0134   -0.0667   -0.4679
```

شکل ۱-۴: ضرب ماتریس **A** و **B**

روش Deflation



شکل ۲-۱: نمودار منابع تخمین زده شده

```
load('hw14.mat')
X = A*S + Noise;
without_noise = A*S;
%%
[U,D] = eig(X*X');
W = ((D^(-1/2))*U');
Z = W*X;
B =[0.321,0.532,0.533;
    0.227,0.41,0.282;
    0.321,0.821,0.81];
B = B./sqrt(sum(B.^2,2));
Y = B*Z;
mu = 0.01;
k = @(Y) [ones(1,1001)
     Y
     Y.^2
     Y.^3
     Y.^4
     Y.^5];
 k_prime = @(Y) [zeros(1,1001)
                 ones(1,1001)
                 2*Y
                 3*Y.^2
                 4*Y.^3
                 5*Y.^4];
for j=1:1000
    k1 = k(Y(1,:));
    k2 = k(Y(2,:));
    k3 = k(Y(3,:));
```

```
    KK1 = (k1*k1')/1001;
    KK2 = (k2*k2')/1001;
    KK3 = (k3*k3')/1001;

    k1_prime = mean(k_prime(Y(1,:)),2);
    k2_prime = mean(k_prime(Y(2,:)),2);
    k3_prime = mean(k_prime(Y(3,:)),2);

    theta1 = KK1\k1_prime;
    theta2 = KK2\k2_prime;
    theta3 = KK3\k3_prime;

    psi1 = theta1'*k1;
    psi2 = theta2'*k2;
    psi3 = theta3'*k3;

    df1 = psi1*Z';
    df2 = psi2*Z';
    df3 = psi3*Z';

    b1 = B(1,:)';
    b2 = B(2,:)';
    b3 = B(3,:)';

    b1 = b1 - mu* df1';
    b1 = b1./sqrt(sum(b1.^2,1));


    b2 = b2 - mu* df2';
      b2 = (eye(3) - b1*b1')*b2;
    b2 = b2./sqrt(sum(b2.^2,1));

    b3 = b3 - mu* df3';
    b3 = (eye (3) - [b1 b2]*[b1 b2]')*b3;
    b3 = b3./sqrt(sum(b3.^2,1));

    B = [b1';b2';b3'];
    %-----------------------------
    Y = B*Z;
end
%%
Shat =B*X;
Shatd=Shat; Sd=S;
[~,r1]=max(abs(Shatd(1,:)*Sd'));
Sd(r1,:) =0;
Shat(r1,:)=Shatd(1,:);


[~,r2]=max(abs(Shatd(2,:)*Sd'));
```

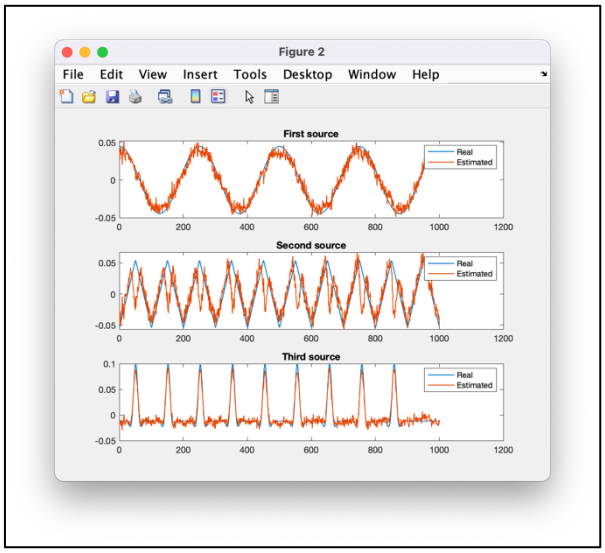
```
Sd(r2,:) =0;
Shat(r2,:)=Shatd(2,:);


[~,r3]=max(abs(Shatd(3,:)*Sd'));
Sd(r3,:) =0;
Shat(r3,:)=Shatd(3,:);


figure
subplot(3,1,1)
plot(S(1,:),'LineWidth',1); hold on
plot(-(2/3)*Shat(1,:),'LineWidth',1);
legend('Real','Estimated')
title('First source')


subplot(3,1,2)
plot(S(2,:),'LineWidth',1); hold on
plot(Shat(2,:),'LineWidth',1);
legend('Real','Estimated')
title('Second source')


subplot(3,1,3)
plot(S(3,:),'LineWidth',1); hold on
plot(-Shat(3,:),'LineWidth',1);
legend('Real','Estimated')
title('Third source')
%%
Shat(3,:)=-Shat(3,:);
Shat(1,:)=-(2/3)*Shat(1,:);
E = (norm(S-Shat,'fro'))^2 / (norm(S,'fro'))^2
```

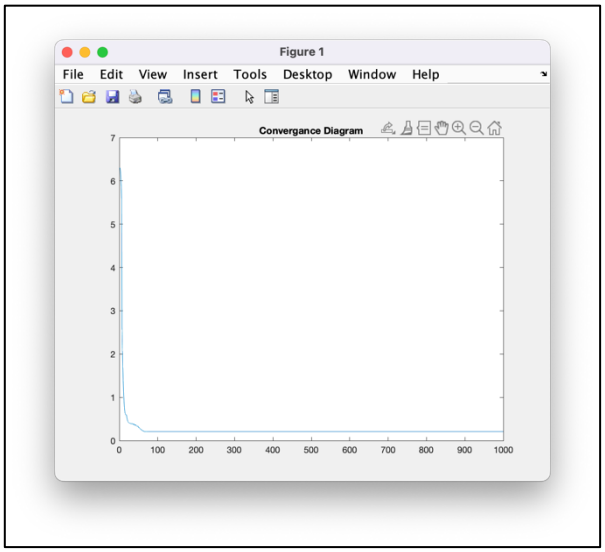
```
>> B*A

ans =

    0.6448   -0.0958   -0.9648
   -0.7643   -0.6498    0.2123
   -0.0084    0.7540    0.1551
```

```
E =

    0.2871
```

شکل۲-۲: مقدار خطا روش دوم و ضرب ماتریس **A** و **B**

روش Equivariant





شکل ۳-۱: نمودار همگرایی و منابع تخمین زده شده

```
clear
load('hw14.mat')
X = A*S + Noise;
without_noise = A*S;
%%
warning('off', 'all')
B =[0.321,0.532,0.533;
    0.227,0.41,0.282;
    0.321,0.821,0.81];
B = B./sqrt(sum(B.^2,2));
Y = B*X;
k = @(Y) [ones(1,1001)
     Y
     Y.^2
     Y.^3
     Y.^4
     Y.^5];
 k_prime = @(Y) [zeros(1,1001)
                 ones(1,1001)
                 2*Y
                 3*Y.^2
                 4*Y.^3
                 5*Y.^4];
E = zeros(1,1000);
for i =1:1000
    k1 = k(Y(1,:));
    k2 = k(Y(2,:));
    k3 = k(Y(3,:));

    KK1 = (k1*k1')/1001;
```

```
    KK2 = (k2*k2')/1001;
    KK3 = (k3*k3')/1001;

    k1_prime = mean(k_prime(Y(1,:)),2);
    k2_prime = mean(k_prime(Y(2,:)),2);
    k3_prime = mean(k_prime(Y(3,:)),2);

    theta1 = KK1\k1_prime;
    theta2 = KK2\k2_prime;
    theta3 = KK3\k3_prime;


    psi1 = theta1'*k1;
    psi2 = theta2'*k2;
    psi3 = theta3'*k3;


    rond_B = [psi1*X' ;psi2*X'; psi3*X']/1001  - inv(B)';
    B = (eye(3) - 0.1*rond_B*B')*B;
    B = B./sqrt(sum(B.^2,2));
      Y = B*X;

    Shat =B*X;
    Shatd=Shat; Sd=S;
    [~,r1]=max(abs(Shatd(1,:)*Sd'));
    Sd(r1,:) =0;
    Shat(r1,:)=Shatd(1,:);


    [~,r2]=max(abs(Shatd(2,:)*Sd'));
    Sd(r2,:) =0;
    Shat(r2,:)=Shatd(2,:);


    [~,r3]=max(abs(Shatd(3,:)*Sd'));
    Sd(r3,:) =0;
    Shat(r3,:)=Shatd(3,:);

    Shat(1,:)=Shat(1,:)*2;
    Shat(2,:)=Shat(2,:)*(-3);
    Shat(3,:)=Shat(3,:)*(-1.75);
    E(i) = (norm(S-Shat,'fro'))^2 / (norm(S,'fro'))^2;
end
%%
figure
plot(E);
title('Convergance Diagram');


figure
```

```
Shat =B*X;
Shatd=Shat; Sd=S;
[~,r1]=max(abs(Shatd(1,:)*Sd'));
Sd(r1,:) =0;
Shat(r1,:)=Shatd(1,:);


[~,r2]=max(abs(Shatd(2,:)*Sd'));
Sd(r2,:) =0;
Shat(r2,:)=Shatd(2,:);


[~,r3]=max(abs(Shatd(3,:)*Sd'));
Sd(r3,:) =0;
Shat(r3,:)=Shatd(3,:);


subplot(3,1,1)
plot(S(1,:),'LineWidth',1); hold on
plot(Shat(1,:)*2,'LineWidth',1);
legend('Real','Estimated')
title('First source')


subplot(3,1,2)
plot(S(2,:),'LineWidth',1); hold on
plot(Shat(2,:)*(-3),'LineWidth',1);
legend('Real','Estimated')
title('Second source')

subplot(3,1,3)
plot(S(3,:),'LineWidth',1); hold on
plot(Shat(3,:)*(-1.75),'LineWidth',1);
legend('Real','Estimated')
title('Third source')
%%
Shat(1,:)=Shat(1,:)*2;
Shat(2,:)=Shat(2,:)*(-3);
Shat(3,:)=Shat(3,:)*(-1.75);
E = (norm(S-Shat,'fro'))^2 / (norm(S,'fro'))^2
```

```
E =

    0.2096
```

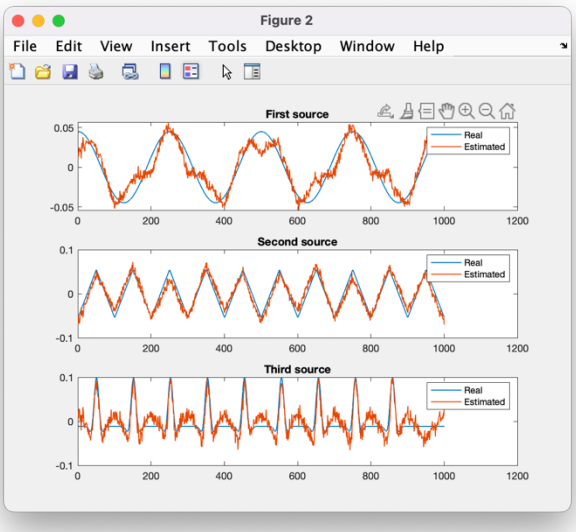
```
>> B*A

ans =

    0.4374    0.0420   -0.0426
    0.0127   -0.3192    0.2220
    0.0134   -0.0667   -0.4679
```

شکل۲-۲: مقدار خطا روش دوم و ضرب ماتریس **A** و **B**

مقایسه ۳ روش انجام شده

با توجه به نمودار های رسم شده میتوان نتیجه گرفت که روش اول و سوم برای بدست آوردن منابع اول و سوم و روش دوم برای بدست آوردن منبع دوم مناسب میباشد؛ بنابراین برای اینکه به روش ایده آل برسیم بهتر است از هر سه این روش های استفاده کنیم و منابع را بدست آوریم و نه فقط یکی از آنها!

لازم به ذکر است که روش اول و سوم خطای کمتری داشتند



روش *Kurt*

شکل ۵-۱: نمودار همگرایی و منابع تخمین زده شده

```
clear
load('hw14.mat')
X = A*S + Noise;
without_noise = A*S;
%%
mu = 0.1;
[U,D] = eig(X*X');
W = ((D^(-1/2))*U');
Z = W*X;
B = [0.3439,0.9063,0.2607
    0.5841,0.8797,0.5944
    0.8078,0.8178,0.0225];


kurty1 = zeros(1,100);
kurty2 = zeros(1,100);
kurty3 = zeros(1,100);
```

```
for j =1:100
    for i=1:3
        b = (B(i,:))';
        save_b = b;
        y=b'*Z;
        kurty = mean(y.^4)-3*(mean(y.^2))^2;
        grad = sign(kurty)*(mean(([y.^3;y.^3;y.^3].*Z),2)-3*b);
        b = b + mu*grad;
        if i==2
            b1 = B(1,:)';
            b = (eye(3) - b1*b1')*b;
        elseif i==3
            b1 = B(1,:)';
            b2 = B(2,:)';
            b = (eye (3) - [b1 b2]*[b1 b2]')*b;
        end
        b = b./sqrt(sum(b.^2,1));
        if i==1
            B = [b';B(2,:);B(3,:)];
            kurty1(j) = kurty;
        elseif i==2
            B = [B(1,:);b';B(3,:)];
            kurty2(j) = kurty;
        elseif i==3
            B = [B(1,:);B(2,:);b'];
            kurty3(j) = kurty;
        end
    end
end


BW = B*W;
BWA=BW*A
Shat =BW*X;


Shatd=Shat; Sd=S;
[~,r1]=max(abs(Shatd(1,:)*Sd'));
Sd(r1,:) =0;
Shat(r1,:)=Shatd(1,:);


[~,r2]=max(abs(Shatd(2,:)*Sd'));
Sd(r2,:) =0;
Shat(r2,:)=Shatd(2,:);


[~,r3]=max(abs(Shatd(3,:)*Sd'));
Sd(r3,:) =0;
Shat(r3,:)=Shatd(3,:);
```

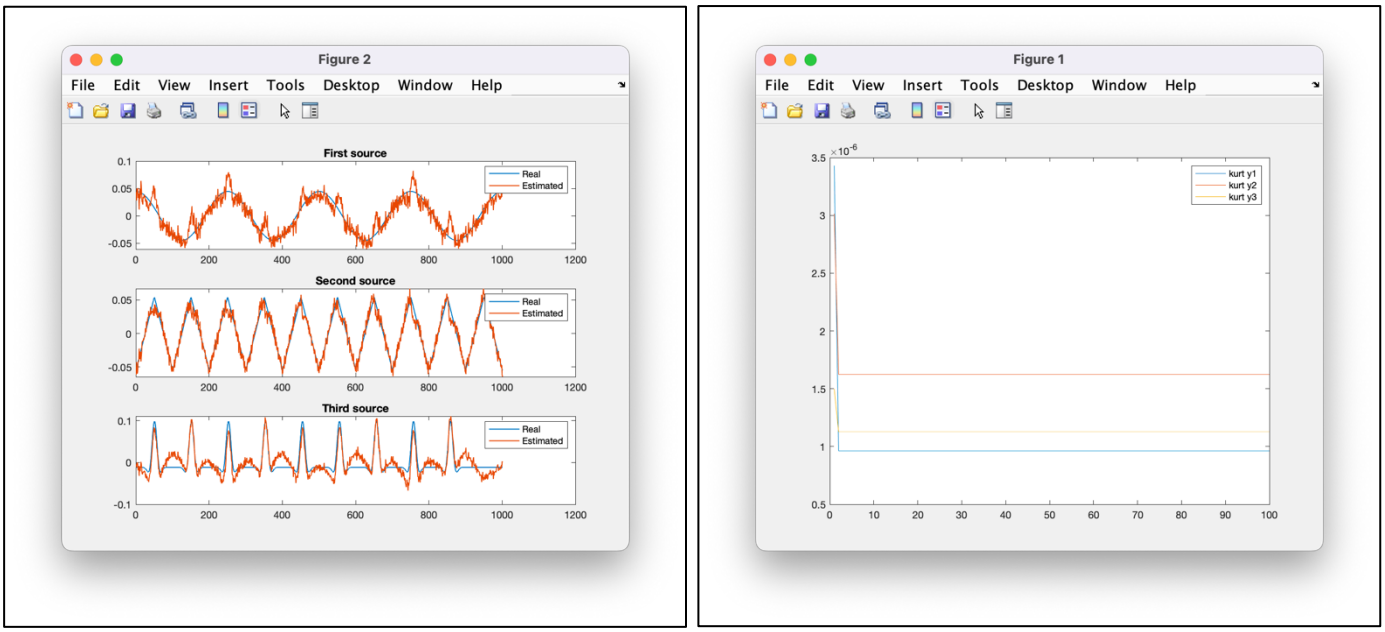
```
%%
figure;
plot([abs(kurty1);abs(kurty2);abs(kurty3)]')
legend('kurt y1','kurt y2','kurt y3');


figure
subplot(3,1,1)
plot(S(1,:),'LineWidth',1); hold on
plot(6/7*Shat(1,:),'LineWidth',1);
legend('Real','Estimated')
title('First source')


subplot(3,1,2)
plot(S(2,:),'LineWidth',1); hold on
plot(-Shat(2,:),'LineWidth',1);
legend('Real','Estimated')
title('Second source')


subplot(3,1,3)
plot(S(3,:),'LineWidth',1); hold on
plot(Shat(3,:),'LineWidth',1);
legend('Real','Estimated')
title('Third source')
%%
Shat(1,:) = 6/7*Shat(1,:);
Shat(2,:) = -Shat(2,:);
E = (norm(S-Shat,'fro'))^2 / (norm(S,'fro'))^2
```

```
BWA =

    0.9249    0.4185   -0.0984
    0.3500   -0.9210   -0.0008
    0.0593   -0.5580    1.1373
```

```
E =

    0.2162
```

شکل۵-۲: مقدار خطا روش دوم و ضرب ماتریس **A** و **W** و **B**

روش $fixed - point$



شکل ۶-۱: نمودار همگرایی و منابع تخمین زده شده

```
clear
load('hw14.mat')
X = A*S + Noise;
[U,D] = eig(X*X');
W = ((D^(-1/2))*U');
Z = W*X;
%%
B = [1,0.9063,0.2607
    0.5841,0.8797,0.5944
    0.1078,0.8178,1];

kurty1 = zeros(1,100);
kurty2 = zeros(1,100);
kurty3 = zeros(1,100);

for j =1:100
    for i=1:3
        b = (B(i,:))';
        save_b = b;
        y=b'*Z;
        b = mean(([y.^3;y.^3;y.^3].*Z),2)-3*b;
        kurty = mean(y.^4)-3*(mean(y.^2))^2;
        if i==2
            b1 = B(1,:)';
            b = (eye(3) - b1*b1')*b;
        elseif i==3
```

```
            b1 = B(1,:)';
            b2 = B(2,:)';
            b = (eye (3) - [b1 b2]*[b1 b2]')*b;
        end
        b = b./sqrt(sum(b.^2,1));
        if i==1
            B = [b';B(2,:);B(3,:)];
            kurty1(j) = kurty;

        elseif i==2
            B = [B(1,:);b';B(3,:)];
            kurty2(j) = kurty;
        elseif i==3
            B = [B(1,:);B(2,:);b'];
            kurty3(j) = kurty;
        end
    end
end
%%
BW = B*W;
BWA=BW*A
Shat =BW*X;


Shatd=Shat; Sd=S;
[~,r1]=max(abs(Shatd(1,:)*Sd'));
Sd(r1,:) =0;
Shat(r1,:)=Shatd(1,:);


[~,r2]=max(abs(Shatd(2,:)*Sd'));
Sd(r2,:) =0;
Shat(r2,:)=Shatd(2,:);


[~,r3]=max(abs(Shatd(3,:)*Sd'));
Sd(r3,:) =0;
Shat(r3,:)=Shatd(3,:);
%%
figure;
plot([abs(kurty1);abs(kurty2);abs(kurty3)]')
legend('kurt y1','kurt y2','kurt y3');


figure
subplot(3,1,1)
plot(S(1,:),'LineWidth',1); hold on
plot(Shat(1,:),'LineWidth',1);
legend('Real','Estimated')
title('First source')
```

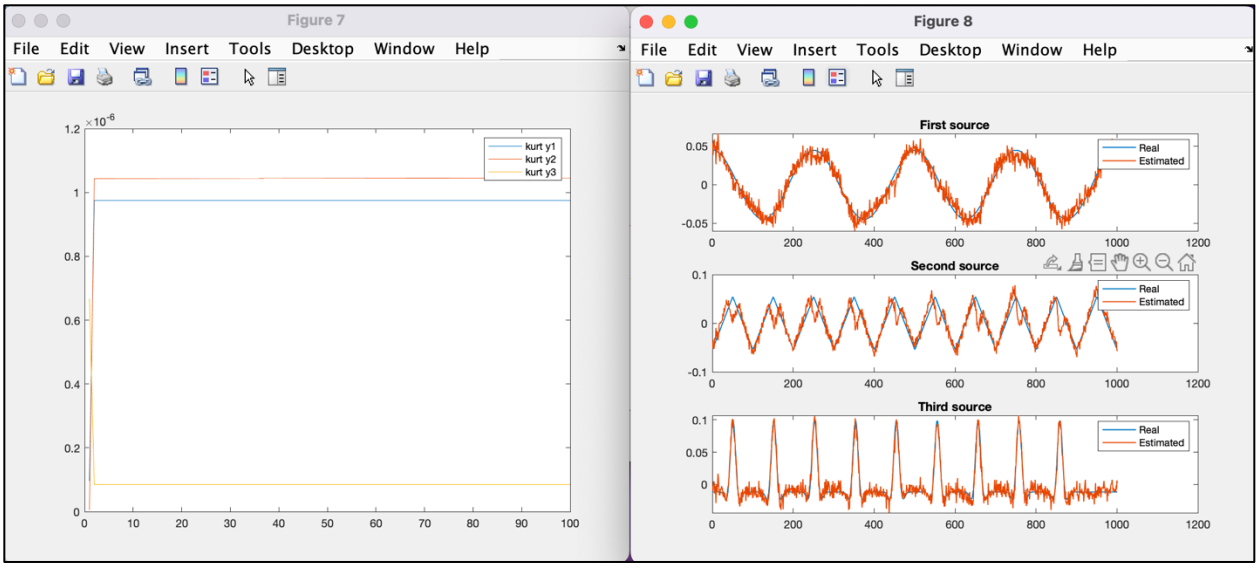
```
subplot(3,1,2)
plot(S(2,:),'LineWidth',1); hold on
plot(-Shat(2,:),'LineWidth',1);
legend('Real','Estimated')
title('Second source')


subplot(3,1,3)
plot(S(3,:),'LineWidth',1); hold on
plot(-Shat(3,:),'LineWidth',1);
legend('Real','Estimated')
title('Third source')
%%
Shat(2,:)=-Shat(2,:);
Shat(3,:)=-Shat(3,:);
E = (norm(S-Shat,'fro'))^2 / (norm(S,'fro'))^2
```

```
BWA =

    0.9319   -0.0560    0.3456
    0.3332    0.4019   -1.0676
    0.0463   -1.0817    0.2095
```

```
E =

    0.1767
```

شکل۶-۲: مقدار خطا روش دوم و ضرب ماتریس A و W و B

روش G_GP



شکل ۷-۱: نمودار همگرایی و منابع تخمین زده شده

```
clear
load('hw14.mat')
```

```
X = A*S + Noise;
%%
B =[0.321,0.32,0.33;
    0.227,0.41,0.282;
    0.321,0.821,0.81];
[U,D] = eig(X*X');
W = ((D^(-1/2))*U');
Z = W*X;
v = randn(1,1001);
kurty1 = zeros(1,100);
kurty2 = zeros(1,100);
kurty3 = zeros(1,100);
for j =1:100
    for i=1:3
        b = (B(i,:))';
        save_b = b;
        y=b'*X;
        fb = (mean(-exp((-y.^2)/2))-mean(-exp((-v.^2)/2)))^2;
        gradf = fb*(mean(([y.*exp((-y.^2)/2);y.*exp((-y.^2)/2);y.*exp((-
y.^2)/2)]).*Z,2));
        b = b + 0.1*gradf;
        kurty = mean(y.^4)-3*(mean(y.^2))^2;
        if i==2
            b1 = B(1,:)';
            b = (eye(3) - b1*b1')*b;
        elseif i==3
            b1 = B(1,:)';
            b2 = B(2,:)';
            b = (eye (3) - [b1 b2]*[b1 b2]')*b;
        end
        b = b./sqrt(sum(b.^2,1));
        if i==1
            B = [b';B(2,:);B(3,:)];
            kurty1(j) = kurty;
        elseif i==2
            B = [B(1,:);b';B(3,:)];
            kurty2(j) = kurty;
        elseif i==3
            B = [B(1,:);B(2,:);b'];
            kurty3(j) = kurty;
        end
    end
end
%%
BW = B*W;
BWA = BW*A
Shat =BW*X;


Shatd=Shat; Sd=S;
```

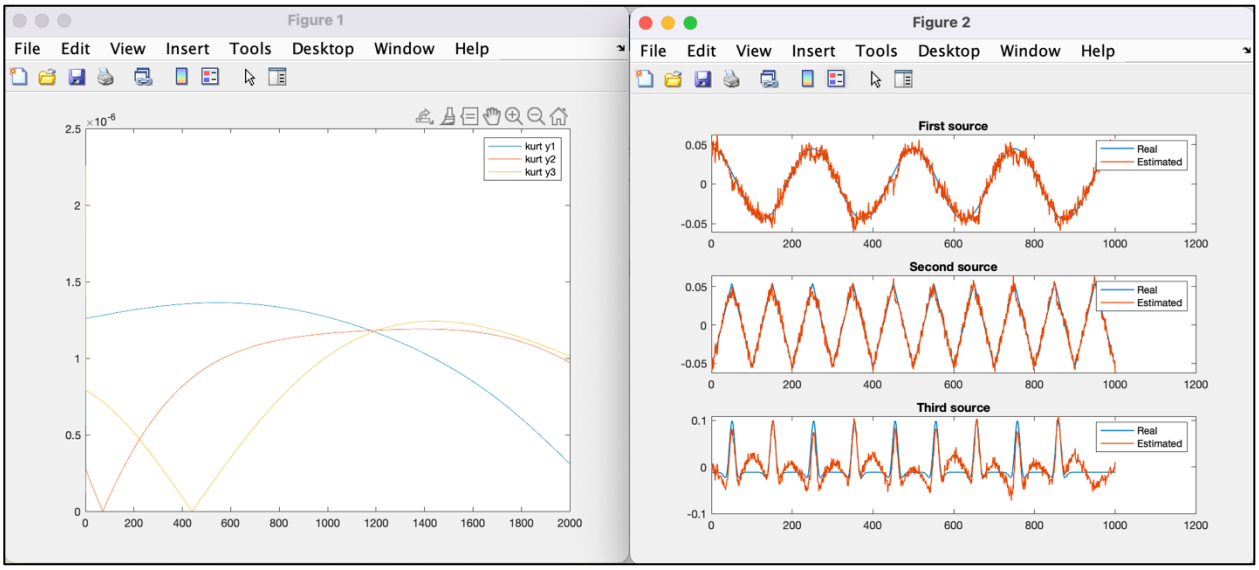
```
[~,r1]=max(abs(Shatd(1,:)*Sd'));
Sd(r1,:) =0;
Shat(r1,:)=Shatd(1,:);
[~,r2]=max(abs(Shatd(2,:)*Sd'));
Sd(r2,:) =0;
Shat(r2,:)=Shatd(2,:);
[~,r3]=max(abs(Shatd(3,:)*Sd'));
Sd(r3,:) =0;
Shat(r3,:)=Shatd(3,:);
%%
figure;
plot([abs(kurty1);abs(kurty2);abs(kurty3)]')
legend('kurt y1','kurt y2','kurt y3');
figure
subplot(3,1,1)
plot(S(1,:),'LineWidth',1); hold on
plot(Shat(1,:),'LineWidth',1);
legend('Real','Estimated')
title('First source')
subplot(3,1,2)
plot(S(2,:),'LineWidth',1); hold on
plot(Shat(2,:),'LineWidth',1);
legend('Real','Estimated')
title('Second source')
subplot(3,1,3)
plot(S(3,:),'LineWidth',1); hold on
plot(-Shat(3,:),'LineWidth',1);
legend('Real','Estimated')
title('Third source')
%%
Shat(2,:)=Shat(2,:);
Shat(3,:)=-Shat(3,:);
E = (norm(S-Shat,'fro'))^2 / (norm(S,'fro'))^2
```

```
BWA =

    0.9772   -0.1199   -0.0453
    0.1351    1.1471   -0.5339
   -0.0917    0.0675   -1.0079
```

```
E =

    0.1381
```

شکل۷-۲: مقدار خطا روش دوم و ضرب ماتریس **A** و **W** و **B**

روش $Fast - ICA$



شکل ۸-۱: نمودار همگرایی و منابع تخمین زده شده

```
clear
load('hw14.mat')
X = A*S + Noise;
%%
B =[0.321,0.532,0.533;
    0.227,0.41,0.282;
    0.321,0.821,0.81];


[U,D] = eig(X*X');
W = ((D^(-1/2))*U');
Z = W*X;


kurty1 = zeros(1,2000);
kurty2 = zeros(1,2000);
kurty3 = zeros(1,2000);


for j =1:2000
    for i=1:3
        b = (B(i,:))';
        save_b = b;
        y=b'*Z;
        b =mean(([y.*exp((-y.^2)/2);y.*exp((-y.^2)/2);y.*exp((-
y.^2)/2)]).*X,2)  -  mean((-(y.^2 -1).*exp((-y.^2)/2)))*b ;
        kurty = mean(y.^4)-3*(mean(y.^2))^2;
        if i==2
            b1 = B(1,:)';
```

```
            b = (eye(3) - b1*b1')*b;
        elseif i==3
            b1 = B(1,:)';
            b2 = B(2,:)';
            b = (eye (3) - [b1 b2]*[b1 b2]')*b;
        end
        b = b./sqrt(sum(b.^2,1));
        new_b = b;


        if i==1
            B = [b';B(2,:);B(3,:)];
            kurty1(j) = kurty;
            if j == 395
                save1 = b;
            elseif j == 2000
                B = [save1';B(2,:);B(3,:)];
            end
        elseif i==2
            B = [B(1,:);b';B(3,:)];
            kurty2(j) = kurty;
            if j == 1549
                save2 = b;
            elseif j == 2000
                B = [B(1,:);save2';B(3,:)];
            end
        elseif i==3
            B = [B(1,:);B(2,:);b'];
            kurty3(j) = kurty;
            if j == 1373
                save3 = b;
            elseif j == 2000
                B = [B(1,:);B(2,:);save3'];
            end
        end
    end
end


%%
BW = B*W;
BWA = BW*A
Shat =BW*X;


Shatd=Shat; Sd=S;
[~,r1]=max(abs(Shatd(1,:)*Sd'));
Sd(r1,:) =0;
Shat(r1,:)=Shatd(1,:);
```

```
[~,r2]=max(abs(Shatd(2,:)*Sd'));
Sd(r2,:) =0;
Shat(r2,:)=Shatd(2,:);


[~,r3]=max(abs(Shatd(3,:)*Sd'));
Sd(r3,:) =0;
Shat(r3,:)=Shatd(3,:);
%%
figure;
plot([abs(kurty1);abs(kurty2);abs(kurty3)]')
legend('kurt y1','kurt y2','kurt y3');


figure
subplot(3,1,1)
plot(S(1,:),'LineWidth',1); hold on
plot(-Shat(1,:),'LineWidth',1);
legend('Real','Estimated')
title('First source')


subplot(3,1,2)
plot(S(2,:),'LineWidth',1); hold on
plot(-Shat(2,:),'LineWidth',1);
legend('Real','Estimated')
title('Second source')


subplot(3,1,3)
plot(S(3,:),'LineWidth',1); hold on
plot(Shat(3,:),'LineWidth',1);
legend('Real','Estimated')
title('Third source')
%%
Shat(2,:)=-Shat(2,:);
Shat(1,:)=-Shat(1,:);
E = (norm(S-Shat,'fro'))^2 / (norm(S,'fro'))^2
```

```
BWA =

   -0.9819    0.0198    0.1208
    0.0291   -1.0453    0.1138
   -0.3027   -0.5072    1.0916
```

```
E =

    0.1464
```

شکل۸-۲: مقدار خطا روش دوم و ضرب ماتریس A و W و B

مقایسه ۴ روش انجام شده

با توجه به نتایج میتوان نتیجه گرفت که روش $Fast\_ICA$ از همه سریع تر و خطایش کمتر هست، ولی بهتر است برای بدست آوردن منبع سوم از روش G_GP استفاده کنیم و برای دو منبع دیگر از که روش $Fast\_ICA$.