FUZZY SYSTEM PROJECT REPORT

Habibollah Naeimi (SN.:9663124)

Lecturer: Dr. Shahbazian

Petroleum University of Technology

Ahwaz Faculty of Petroleum

Clustering Algorithm Report

Fuzzy Systems Course

Lecturer: Dr.Shahbazian

Designing Fuzzy System using Clustering Report

Habibollah Naeimi & Morteza Ebrazeh

In this technique, like the Gradient Descent technique, we must first specify the structure of the fuzzy system, The details of our fuzzy system are as follows: PIE, Singleton fuzzifier , Center of Average defuzzifier and Gaussian membership function.

In designing a fuzzy system with a clustering method, we see two approaches, offline and online clustering. In the offline approach, first our system is identified and then we control it. And in the online approach, system identification and control is done simultaneously.

Offline Mode

In this mode we generate our data as below:

```
    for k=3:DataPairNu+InpNum
        r = sin(2*pi*k/25);
        g(k) = y(k-1)*y(k-2)*(y(k-1)+2.5)/
(1+y(k-1)^2+y(k-2)^2);
        y(k) = r+g(k);
    end
    for i=1:DataPairNu
        Pairs(i,:)=y(i:i+InpNum);
    end
```

And then we implement our clustering method to them in this way:

```
    x_centr(1,:) = Pairs(1,1:end-1);
    A(1) = Pairs(1,end);
    B(1) = 1;

    for p=2:DataPairNu

        x_x = repmat(Pairs(p,1:end-1),
size(x_centr,1),1);
        FinalVAL = abs(x_centr-
repmat(Pairs(p,1:end-1),size(x_centr,1),1));
        DISTNS = max(FinalVAL,[],2);
        Indx = find(DISTNS<=Radius);

        if isempty(Indx)
           x_centr = [x_centr;Pairs(p,1:end-1)];
           A = [A;Pairs(p,end)];
           B = [B;1];
           n = n+1;
        else

           A(Indx(1),:) =
A(Indx(1),:)+Pairs(p,end);
           B(Indx(1),:) = B(Indx(1),:)+1;
        end
    end
```

Result

Here is the Result of Offline mode with these parameters.

Gaussian Membership function spread: 2

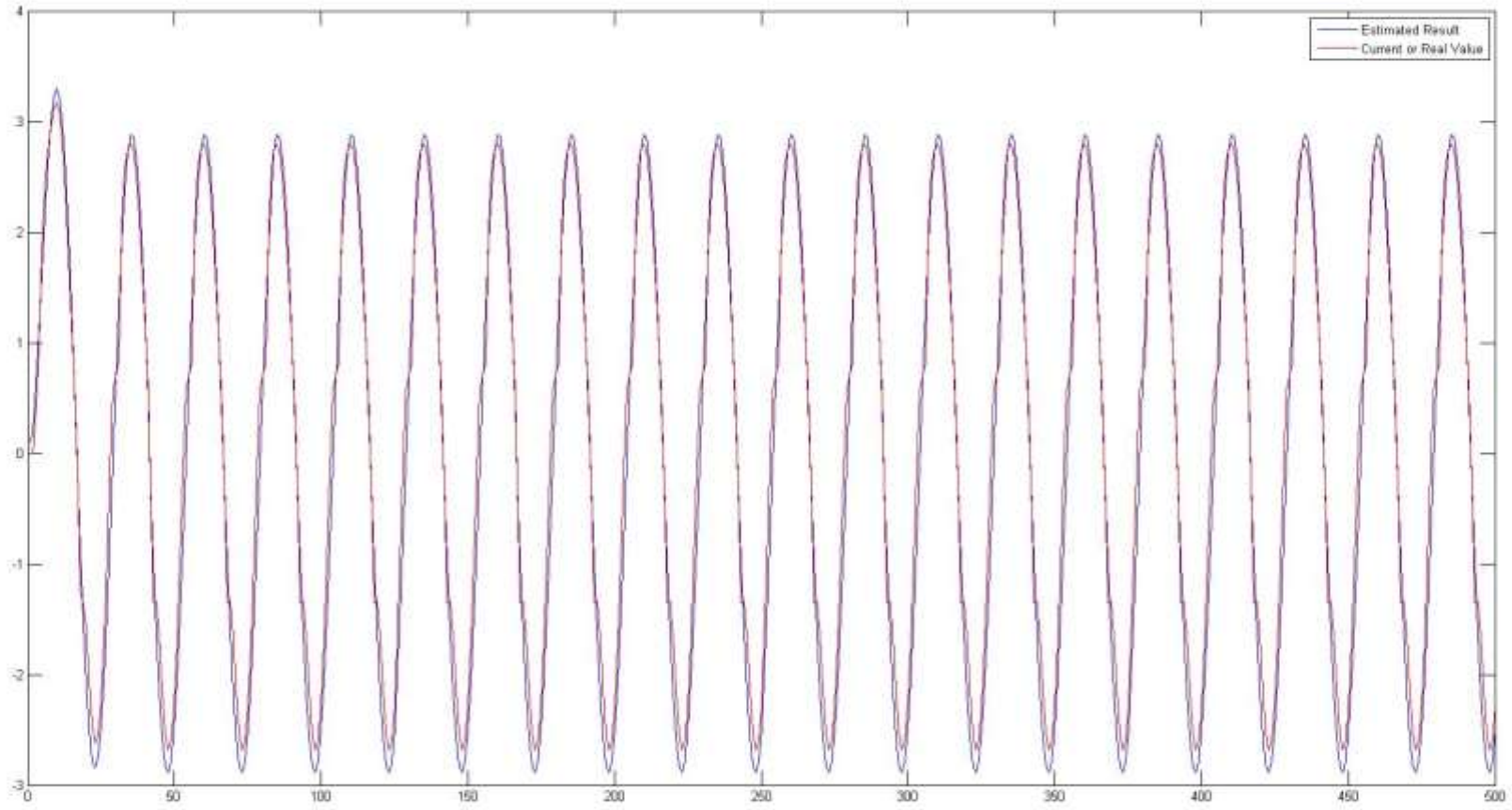
Radius of clusters: 0.2

Number of Data Pairs: 100

Number of Samples: 500

Number of Inputs: 2

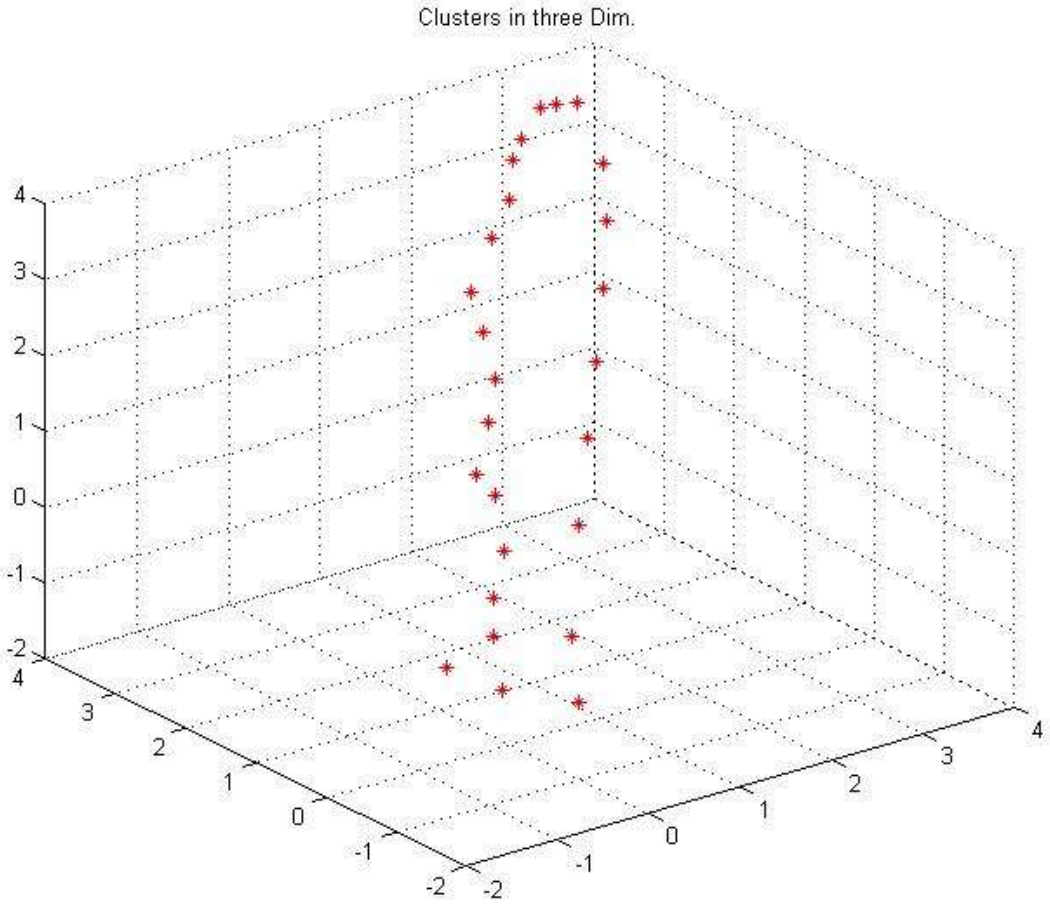
Mode: Offline

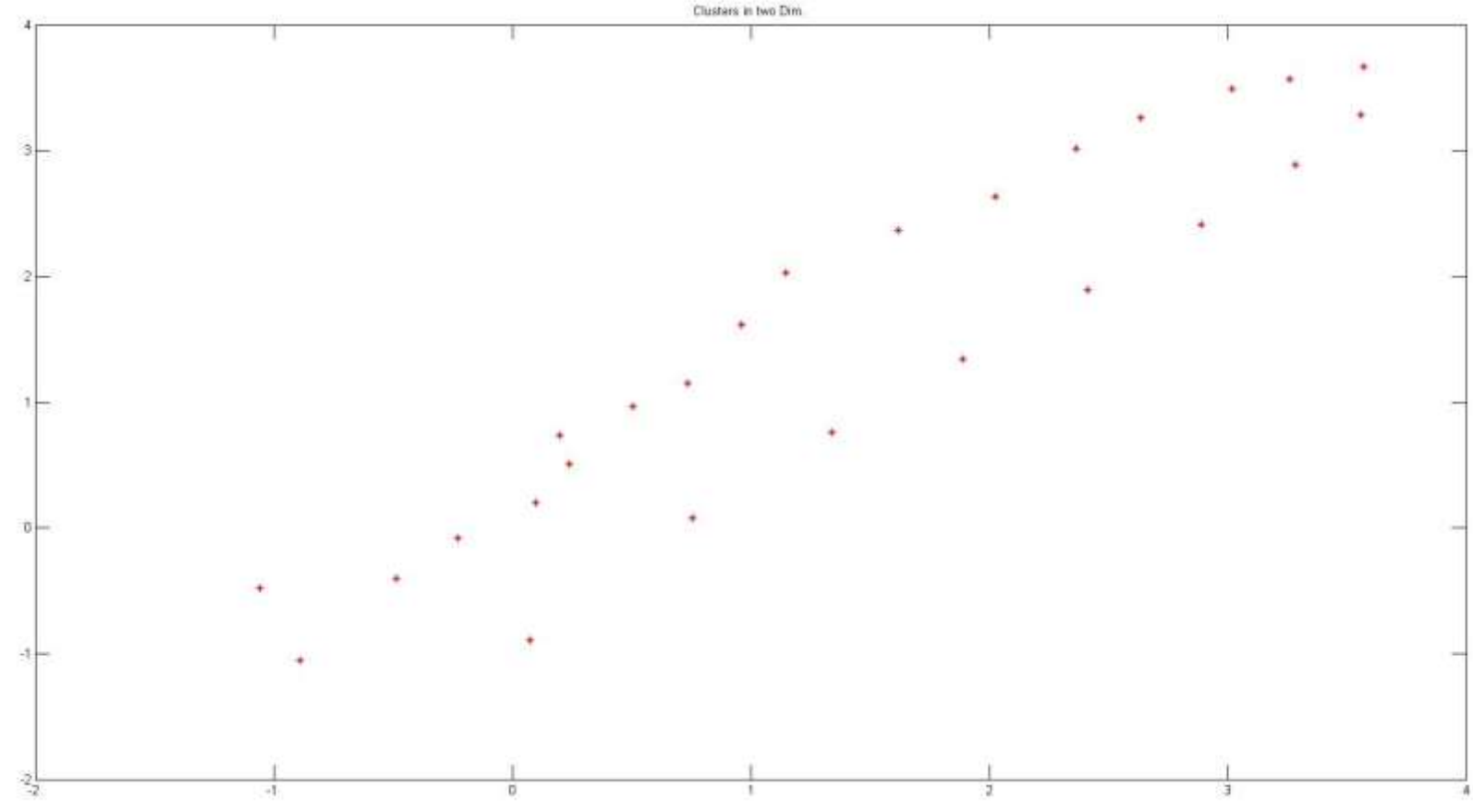


Mean Squared Error: 0.1003

Number of Clusters: 26

Process Time: 0.991779 sec.


Clusters in three Dim.
4
3
2
1
0
-1
-2
4
3
2
1
0
-1
-2
-2
-1
0
1
2
3
4


Clusters in two Dim
4
3
2
1
0
-1
-2
-2
-1
0
1
2
3
4

Online

In this mode we generate our data as below:

```
y(1:2)=[0.5 1];
    R = sin(2*pi*[1:DataPairNu]/25);
    x_centr(:,1) = [y(1);y(2)];
    A(1) =
(y(1)*y(2)*(y(2)+2.5))/(1+y(1)^2+y(2)^2);
    B(1) = 1;
    M = 1;
```

And then we implement our clustering method to them in this way:

```
   for k = 2:DataPairNu-1
        f = OnlineF(x_centr,y(k-1),y(k)
,Sigma,A,B);
        p = (y(k-1)*y(k)*(y(k)+2.5))/(1+y(k-1)^2
+y(k)^2);
        y(k+1) = p-f+0.6*y(k)+0.2*y(k-1)+R(k);

        for i= 1:M
            Dist(i) = (sqrt((y(k-1)-
x_centr(1,i))^2+(y(k)-x_centr(2,i))^2)-Radius);
        end

        [disValue,index] = min(Dist);

        if disValue < 0

            A(index) = A(index)+(y(k-1)*y(k)*
(y(k)+2.5))/(1+y(k-1)^2+y(k)^2);
            B(index) = B(index)+1;
        else

            M = M+1;
            x_centr(:,M) = [y(k-1);y(k)];
```

```
                A(M) = (y(k-1)*y(k)*(y(k)+2.5))
/(1+y(k-1)^2+y(k)^2);
                B(M) = 1;
            end
        end
```

Result

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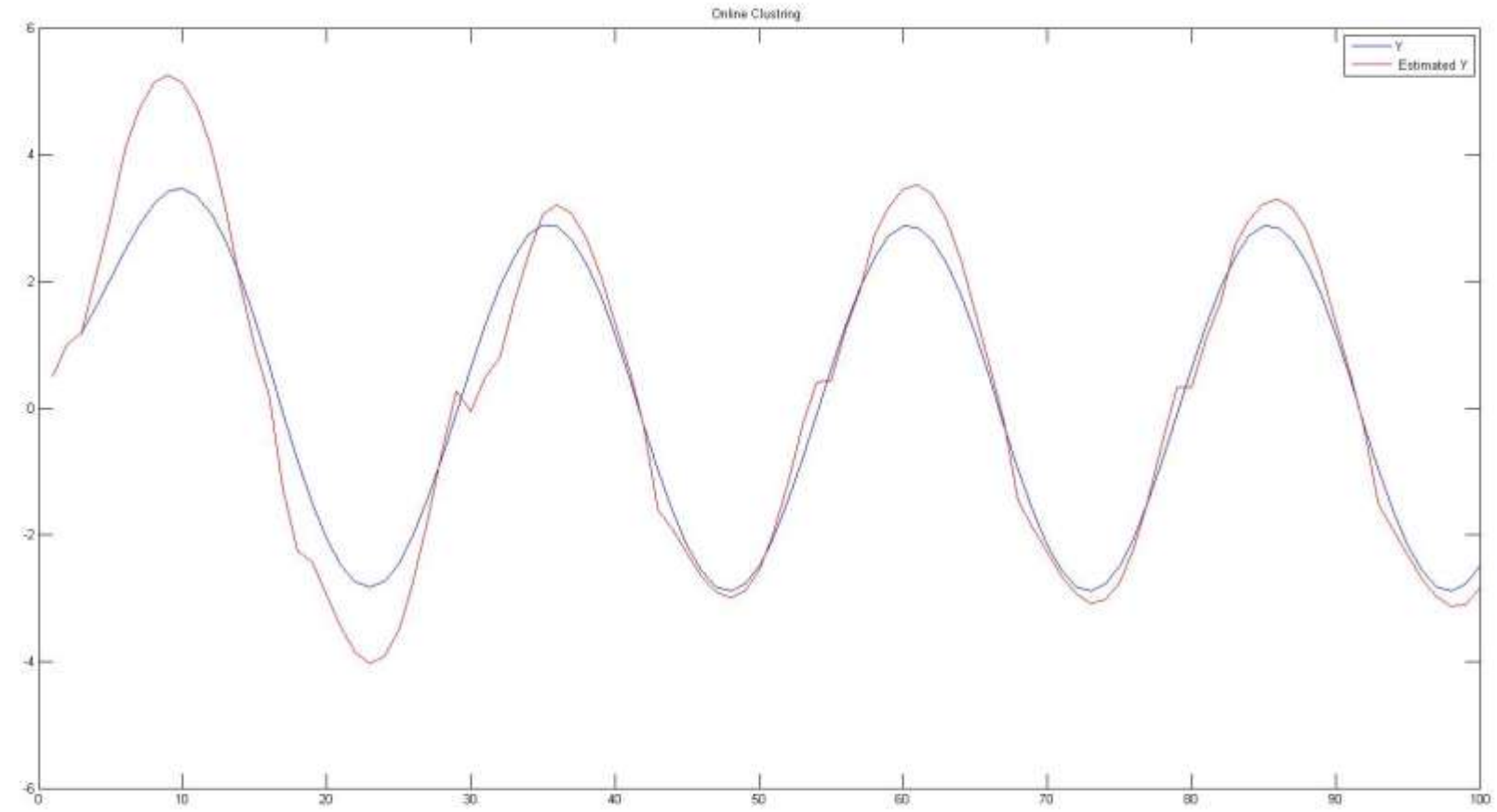

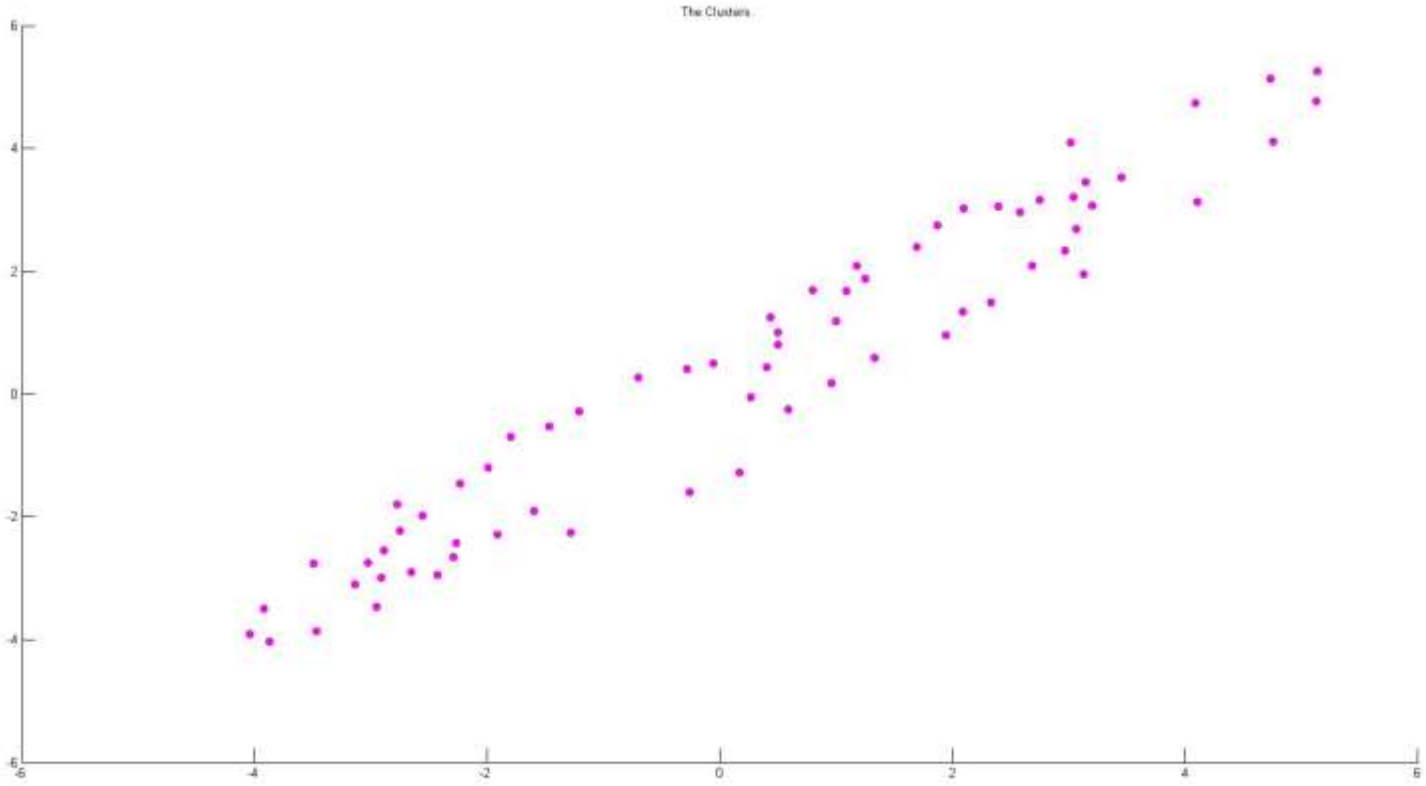

Mean Squared Error: 0.4387

Number of Clusters: 67

Process Time: 0.974700 sec.