



FUZZY SYSTEM PROJECT REPORT

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Clustering Algorithm Report

Fuzzy Systems Course

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Designing Fuzzy System using Clustering Report.

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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
- Gaussian membership function

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

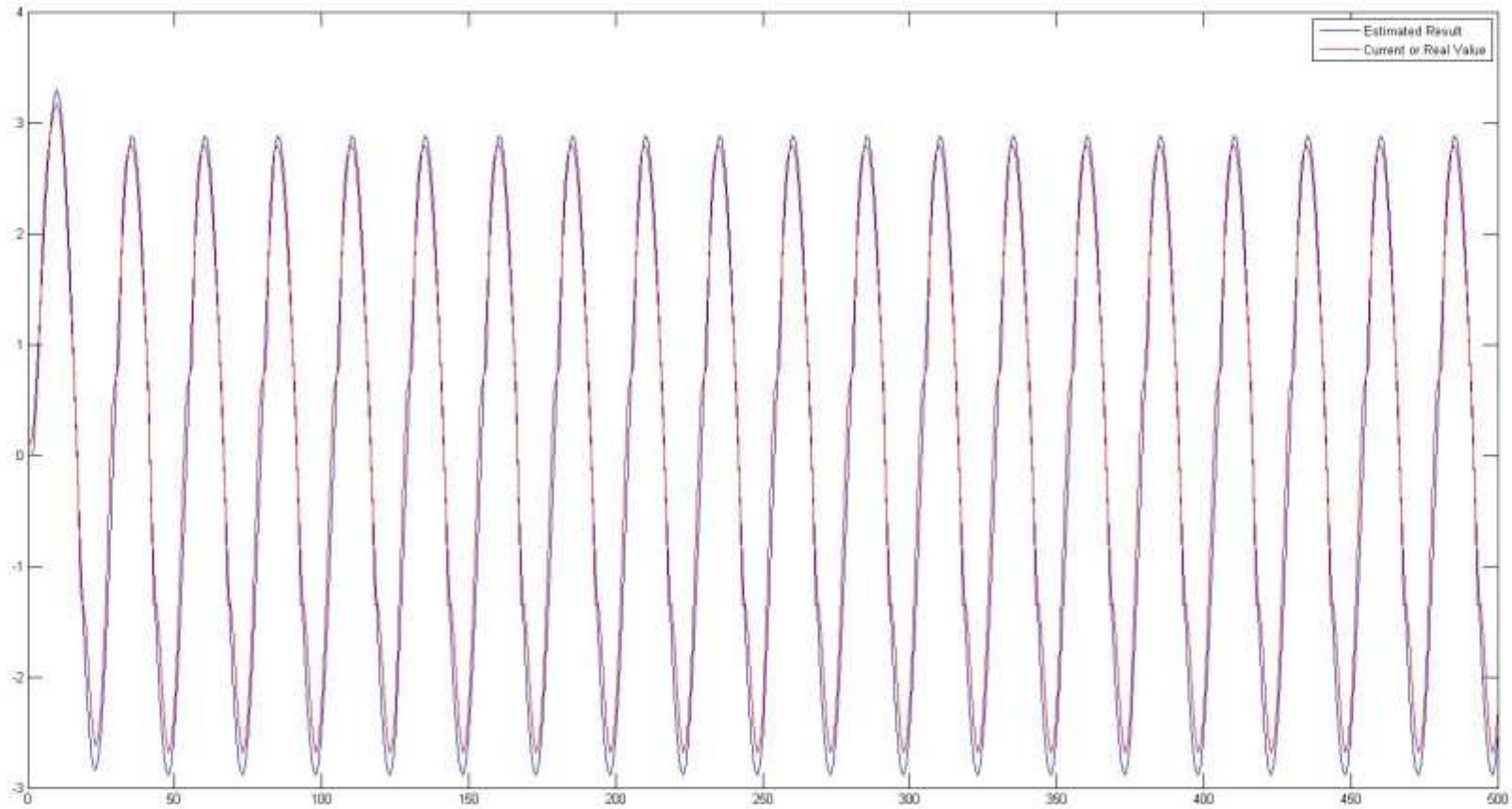
Results

Here are the Results of the 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

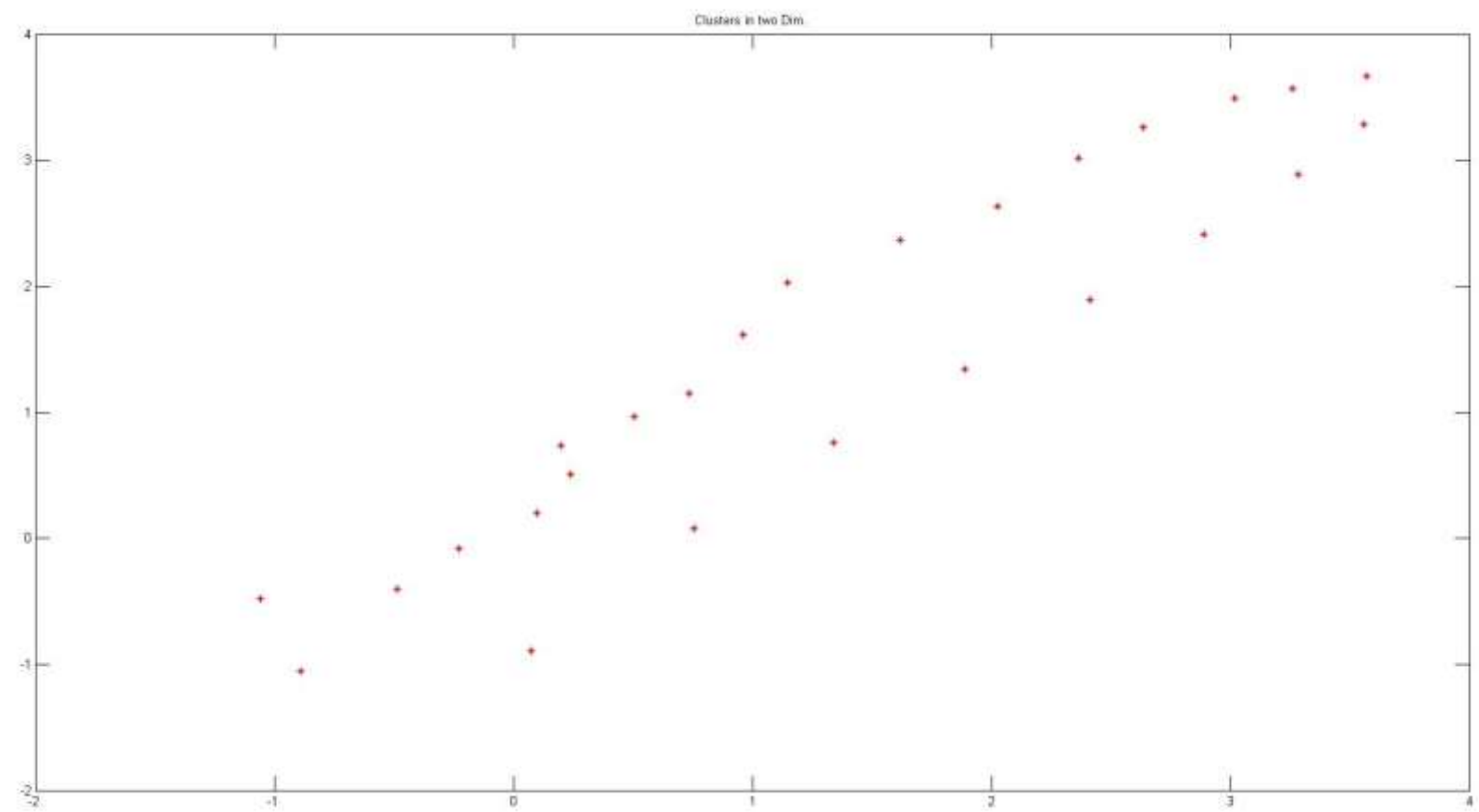
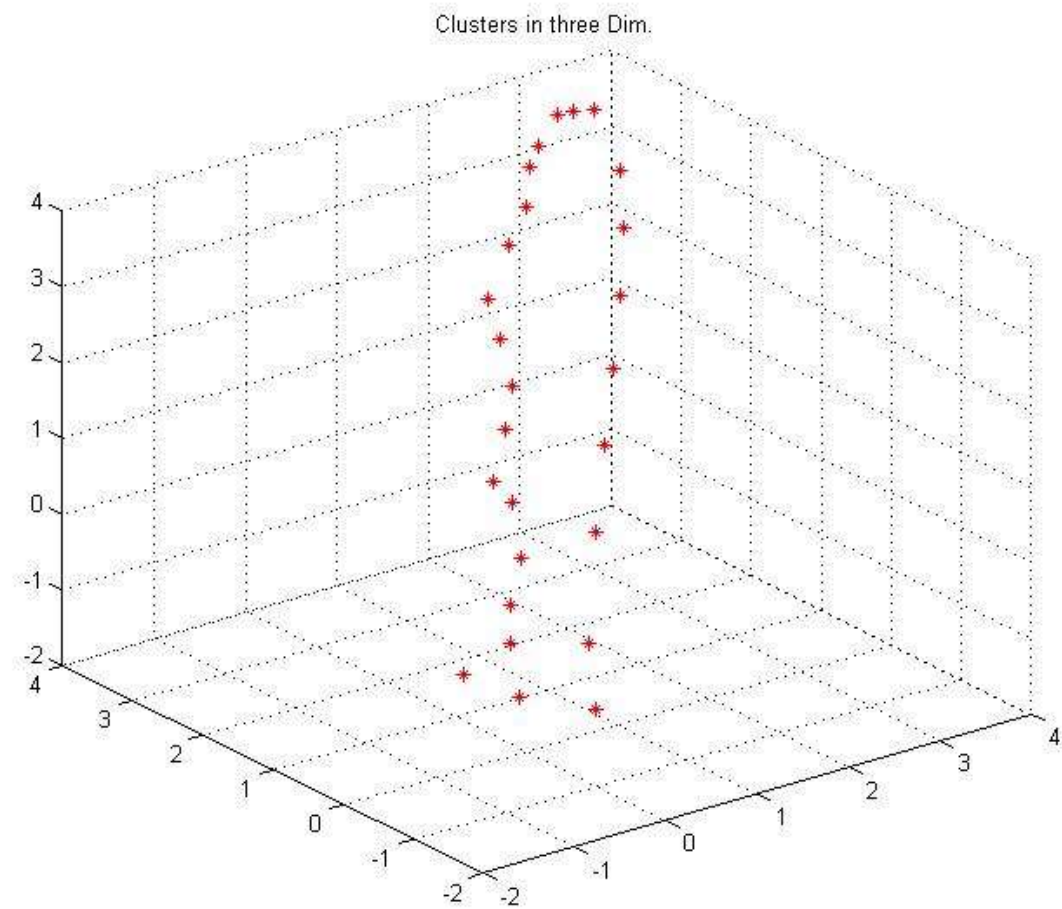
Mode: Offline

Mean Squared Error: 0.1003



Number of Clusters: 26

Process Time: 0.991779 sec.



Online

In this mode, we generate our data as below:

```
y(1:2)=[0.5 1];  
R = sin(2*pi*[1:DataPairNu]/25);  
x_central(:,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_central,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_central(1,i))^2+(y(k)-x_central(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_central(:,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

```

Results

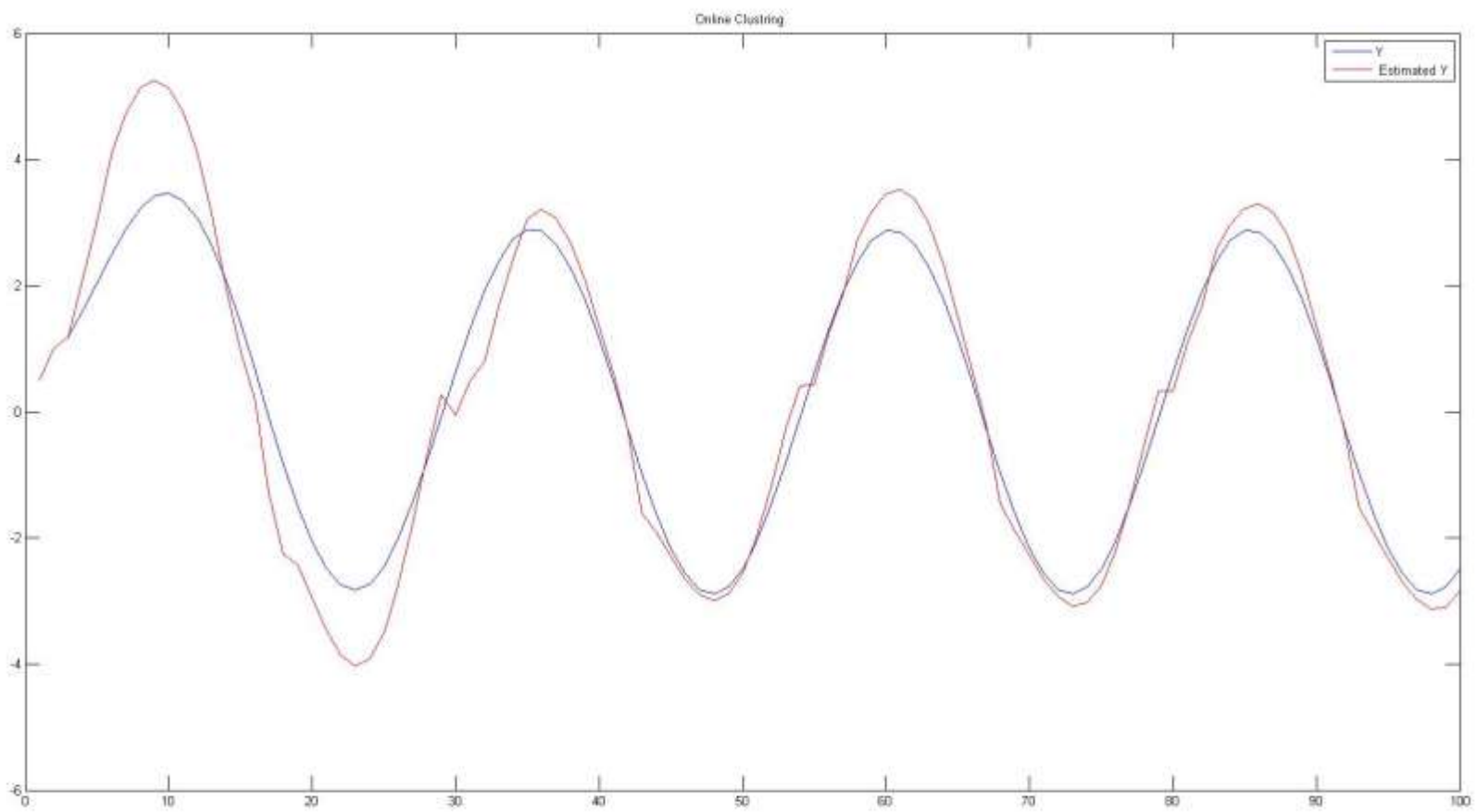
Here are the results of the Online mode with these parameters:

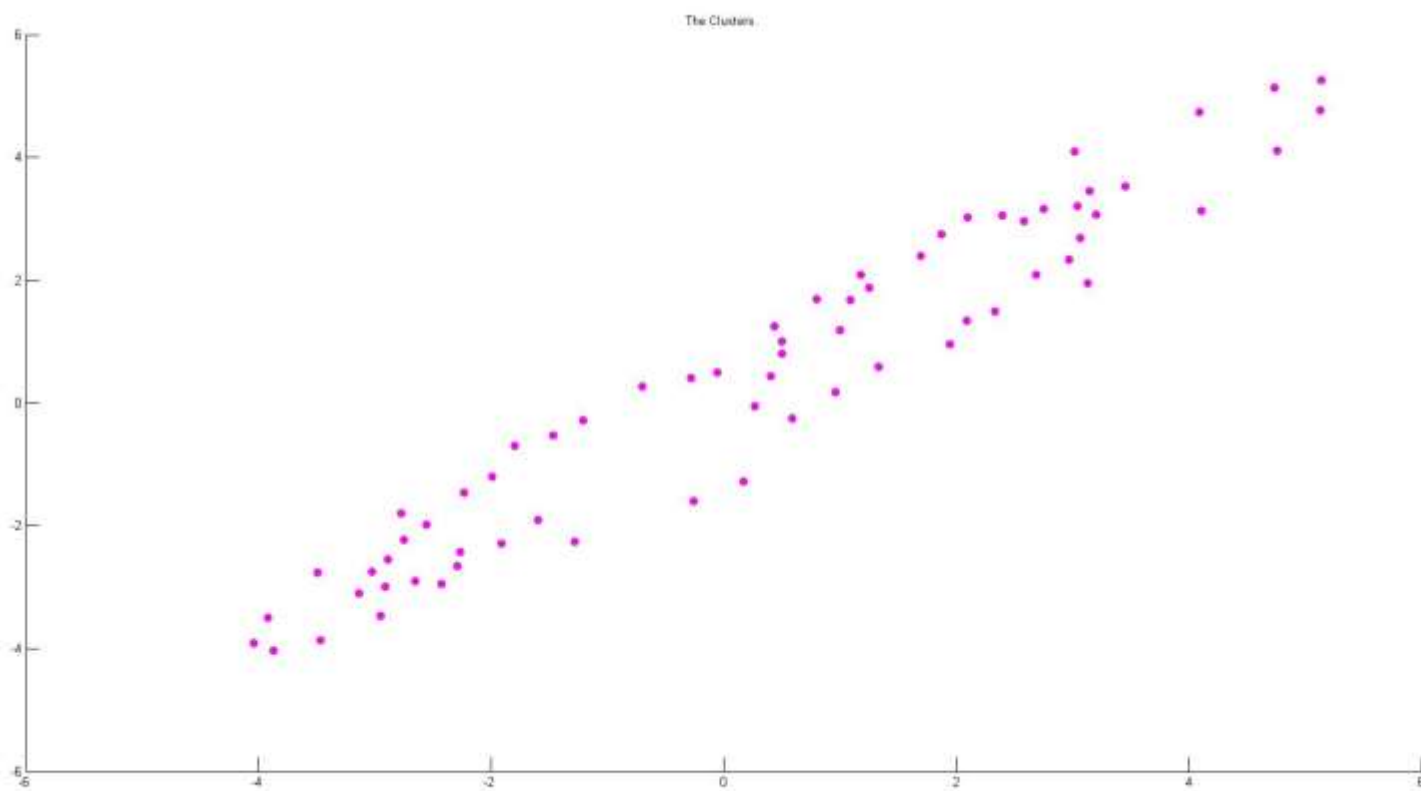
- Gaussian Membership function spread: 2
- Radius of clusters: 0.2
- Number of Data Pairs: 100
- Number of Samples: 500
- Number of Inputs: 2

Mode: Online

Mean Squared Error: 0.4387

Number of Clusters: 67





Process Time: 0.974700 sec.