FUZZY SYSTEM PROJECT REPORT

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Gradient Descent Training Algorithm

Fuzzy Systems Course

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Designing Fuzzy System using Gradient Descent Training Report

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In Gradient Descent Training method, the structure of our system must be clear. This system is built on these assumptions: PIE, Singleton fuzzifier , Center of Average defuzzifier and Gaussian Membership Function. Next, using this method, we update the relevant parameters, which are y^l and x_i^l and σ_i^l.

In the first place, we initialize the parameters using on-line initial parameter choosing.

```
x_Bar = Pairs(1:M,1:InpuNum);
y_Bar = Pairs(1:M,end);
Sigma = repmat(((max(x_Bar)-min(x_Bar))/M),M,1);
```

Then we start training the algorithm with this code.

```
for p=1:size(Pairs,1)
     for l=1:M                          % Calculating z.
         for i=1:InpuNum
             iN_z(i) = exp(-(((Pairs(p,i)-
x_Bar(l,i))/Sigma(l,i))^2));
         end
         z(l) = prod(iN_z);
     end

     b = sum(z);                        % Calculating b.
     a = sum(y_Bar.*z);                 % Calculating a.
     f = a/b;                           % Calculating f.
```

```
            for q=1:Q
                for l=1:M
                    y_Bar(l) = y_Bar(l)-Alpha*
(f-Pairs(p,end))/b*z(l);
                    for i=1:InpuNum
                        x_Bar(l,i) = x_Bar(l,i)-
Alpha*(f-Pairs(p,end))/b*(y_Bar(l)-f)*z(l)*
(2*(Pairs(p,i)-x_Bar(l,i))/(Sigma(l,i)^2));
                        Sigma(l,i) = Sigma(l,i)-
Alpha*(f-Pairs(p,end))/b*(y_Bar(l)-f)*z(l)*
(2*((Pairs(p,i)-x_Bar(l,i))^2)/(Sigma(l,i)^3));
                    end
                end

                if (f-Pairs(p,end))<epsilon
                    break;
                end
            end
 end
```

After updating, the fuzzy system is ready for operation. Here is the parameters and the result.

Number of Rules: 30

Training Ratio: 0.5

Number of iteration for each point: 100

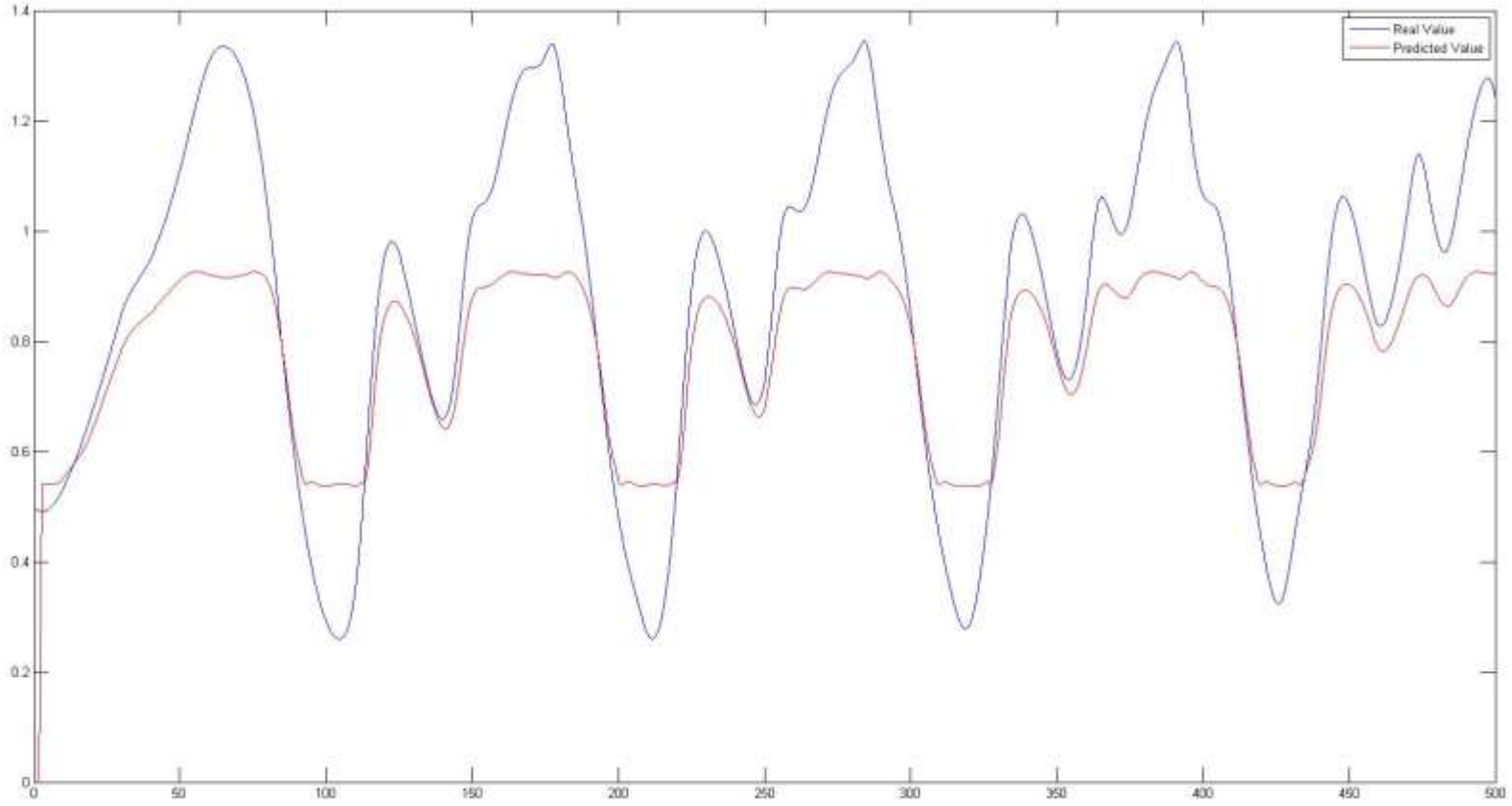
Desired Error: 0

Number of Inputs: 1

Number of Data Pairs: 300

Number of Samples: 500

Results



Mean Square Error: 0.0385

Mean Absolute Error: 0.1558