Approximating Fitness (Deformation Energy) By A Neural Network

Clearing workspace

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

Reading Dataset

```
filename='Dataset.csv';
data=csvread(filename);
x=data(:,1:13)';    %13 decision variables
y=data(:,14)';      % Dependent variable
```

Building Model Architecture

```
trainFct='trainbr';
hidden_neurons_layer1=20;
hidden_neurons_layer2=20;
hidden_neurons_layer3=20;
hidden_neurons_layer4=20;
hidden_neurons_layer5=20;
```

```
architecture=[hidden_neurons_layer1 hidden_neurons_layer2 hidden_neurons_layer3 hidden_neurons_
```

Fitting the model

```
net=fitnet(architecture,trainFct);
net.layers{2}.transferFcn='tansig';
net.layers{3}.transferFcn='tansig';
net.layers{4}.transferFcn='tansig';
net.layers{5}.transferFcn='tansig';
net.layers{6}.transferFcn='tansig';
net.layers{net.numLayers}.transferFcn = 'purelin';
```

Parametrisation of the model

```
net.divideFcn='dividerand';
net.divideMode='sample';
net.divideParam.trainRatio=0.8;
net.divideParam.valRatio=0.1;
net.divideParam.testRatio=0.1;
net.trainParam.epochs=1000;
net.performFcn='mse';
```

Training of the model

```
[net,tr]=train(net,x,y);
```

Saving the model

```
save ./model/net;
```

Loading the model

```
model = load('./model/net.mat')
```

View the neural network architecture

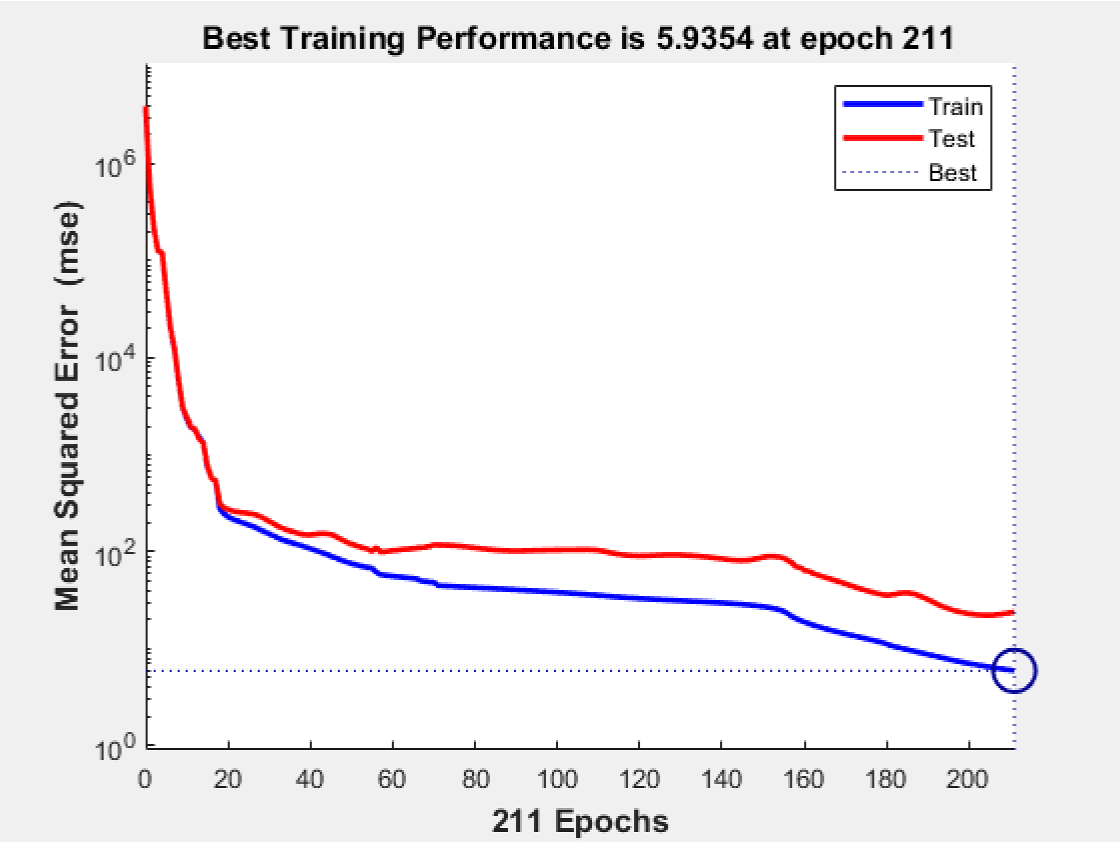
```
view(model.net.net)
```

Evaluating neural network performance

```
tr = model.net.tr
```

```
tr = struct with fields:
        trainFcn: 'trainbr'
      trainParam: [1×1 struct]
      performFcn: 'mse'
    performParam: [1×1 struct]
        derivFcn: 'defaultderiv'
       divideFcn: 'dividerand'
      divideMode: 'sample'
     divideParam: [1×1 struct]
        trainInd: [1×90000 double]
          valInd: []
         testInd: [1×10000 double]
            stop: 'User stop.'
      num_epochs: 211
       trainMask: {[1×100000 double]}
         valMask: {[1×100000 double]}
        testMask: {[1×100000 double]}
      best_epoch: 211
            goal: 0
          states: {'epoch'  'time'  'perf'  'vperf'  'tperf'  'mu'  'gradient'  'gamk'  'ssX'  'val_fail'}
           epoch: [1×212 double]
            time: [1×212 double]
            perf: [1×212 double]
           vperf: [1×212 double]
           tperf: [1×212 double]
              mu: [1×212 double]
        gradient: [1×212 double]
            gamk: [1×212 double]
             ssX: [1×212 double]
        val_fail: [1×212 double]
       best_perf: 5.9354
      best_vperf: NaN
      best_tperf: 24.0032
```

```
plotperform(tr)
```


Best Training Performance is 5.9354 at epoch 211
Train
Test
Best
Mean Squared Error (mse)
10^6
10^4
10^2
10^0
211 Epochs