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L A M P I R A N

Metode Newton Raphson

```
disp('ALIRAN DAYA SETELAH MASUKNYA SKTT TANJUNG BUNGA-BONTOALA')
basemva = 100;  accuracy = 0.0001;  maxiter = 10;
%       Bus  Bus    |V|  Ang     ---Load---           ---Gen---     Gen
Mvar Injected
%       No.  code p.u.  Deg    MW      Mvar        MW      Mvar  Min    Max
Mvar
busdata=[1    1   1.00   0     26.7    0.056     189.02   0.0    -20     60
0     %Sengkang
         2    0   0.99   0     33.9    4.2         0.0    0.0      0      0
0     %Sidrap
         3    0   1.0    0     17.2    3.3         0.0    0.0      0      0
0     %Soppeng
         4    0   1.0    0     10.2    2.0         0.0    0.0      0      0
0     %Enrekang
         5    2   1.02   0     11.2    2.4         7.08   0.0    -100    100
0     %Makale
         6    2   1.0    0     43.7   14.1         5.53   0.0    -30     60
0     %Palopo
         7    0   1.01   0     10.0    1.6         0.0    0.0      0      0
0     %Siwa
         8    2   0.99   0      0.0    0.0        18.7    0.0    -100    100
0     %PLTB Sidrap
         9    0   0.99   0     35.8    7.1         0.0    0.0      0      0
-0.15 %Bone
         10   2   1.0    0     22.1    2.5         2.0    0.0    -20     60
0     %Sinjai
         11   0   0.98   0     34.9    8.5         0.0    0.0      0      0
-0.15 %Bulukumba
         12   0   0.98   0      0.0    0.0         0.0    0.0      0      0
0     %Bantaeng Switch
         13   0   0.98   0     28.7    0.0         0.0    0.0      0      0
0     %Bantaeng Smelter
         14   0   0.99   0     11.2    8.0         0.0    0.0      0      0
0     %Bantaeng New
         15   0   0.99   0     21.9    3.8         0.0    0.0      0      0
0     %Jeneponto
         16   2   1.0    0      0.0    0.0         0.0    0.0    -100    100
0     %PLTB TOLO
         17   2   1.0    0      0.0    0.0       162.05   0.0    -30     60
0     %PLTU Jeneponto EXP
         18   2   1.0    0      0.0    0.0       180.53   0.0    -20     60
0     %PLTU Jeneponto
         19   2   1.0    0      3.9    0.0       180.56   0.0    -30     60
0     %Punagaya
         20   0   1.0    0     23.7    3.7         0.0    0.0      0      0
0     %Tallasa
         21   0   1.0    0     39.1    8.0         0.0    0.0      0      0
0     %Sungguminasa
         22   0   1.0    0     24.2    6.0         0.0    0.0      0      0
0     %Bolangi
         23   0   1.0    0     22.2    4.3         0.0    0.0      0      0
0     %Maros
         24   0   1.0    0     58.4   14.5         0.0    0.0      0      0
0     %Tanjung Bunga
         25   0   1.0    0     44.8   12.5         0.0    0.0      0      0
0     %Bontoala
         26   0   1.01   0     36.1    8.5         0.0    0.0      0      0
0     %Tallo Lama
         27   0   1.01   0      0.0    0.0         0.0    0.0      0      0
0     %Tallo Lama 70 KV
```

```
         28   0   1.01   0     0.0    0.0          0.0    0.0       0      0
0     %Bontoala 70 KV
         29   2   1.02   0    50.9   10.4          0.0    0.0     -30     60
0     %Tello
         30   0   1.01   0    68.4   13.8          0.0    0.0       0      0
0     %Panakukang
         31   0   1.02   0     0.0    0.0          0.0    0.0       0      0
0     %Tello 30KV
         32   0   1.02   0     0.0    0.0          0.0    0.0       0      0
0     %Barawaja
         33   0   1.03   0     0.0    0.0          0.0    0.0       0      0
0.1   %Tello 70KV
         34   2   0.99   0     1.9    9.4         14.9    0.0    -100    100
0     %Borongloe
         35   0   1.03   0    20.1    2.4          0.0    0.0       0      0
0.1   %Daya
         36   0   1.03   0    23.4    5.1          0.0    0.0       0      0
0     %Mandai
         37   0   1.04   0     2.5    0.0          0.0    0.0       0      0
0     %Tonasa
         38   0   1.01   0    32.0   10.1          0.0    0.0       0      0
0     %Kima
         39   0   1.01   0    18.9    0.0          0.0    0.0       0      0
0     %Bosowa
         40   0   1.0    0    24.2    5.2          0.0    0.0       0      0
0     %Pangkep
         41   0   1.04   0     0.0    0.0          0.0    0.0       0      0
0.1   %Pangkep 70KV
         42   0   1.0    0    10.6    2.6          0.0    0.0       0      0
0     %Barru
         43   2   1.0    0     1.0    0.1        33.14    0.0     -30     60
0     %GI Balusu
         44   0   1.0    0    24.0    5.7          0.0    0.0       0      0
0     %Pare-pare
         45   2   1.0    0     0.0    0.0          0.0    0.0     -20     60
0     %PLTD Suppa
         46   2   1.0    0    33.2   11.0          0.36   0.0     -30     60
0     %Pinrang
         47   0   1.02   0    18.3    2.4          0.0    0.0       0      0
0     %Polmas
         48   0   1.02   0    16.1    1.7          0.0    0.0       0      0
0     %Majene
         49   2   1.05   0     0.1    0.0        122.0    0.0     -20     60
0     %Bakaru
         50   0   1.02   0    11.8    1.6          0.0    0.0       0      0
-0.25 %Mamuju
         51   0   1.02   0     6.2    0.06         0.0    0.0       0      0
0     %Mamuju Baru
         52   2   1.05   0     0.0    0.0         40.2    0.0     -30     60
0     %PLTU Mamuju
         53   0   0.98   0     7.39   1.03         0.0    0.0       0      0
0     %Topoyo
         54   0   0.95   0    10.8    1.6          0.0    0.0       0      0
0     %Pasang kayu
         55   0   0.93   0    42.6    0.2          0.0    0.0       0      0
0     %Silae
         56   0   0.93   0    25.4    5.1          0.0    0.0       0      0
0     %Sidera
         57   0   0.97   0     0.0    0.0          0.0    0.0       0      0
0     %Sidera 70KV
         58   0   0.95   0    11.85   2.33         0.0    0.0       0      0
0     %Poso
```

```
         59   0   0.98   0     0.21   0.73        0.0    0.0      0     0
0     %Pamona 150KV
         60   2   1.0    0     4.2    8.0         0.0    0.0    -100   100
0     %Tallise
         61   0   0.97   0    16.9    5.5         0.0    0.0      0     0
0     %Parigi
         62   2   1.0    0     0.0    0.0       144.0    0.0    -30     60
0     %Pamona 275KV
         63   2   1.0    0     0.0    0.0        30.6    0.0    -30     60
0     %Slwna
         64   0   0.99   0     0.0    0.0         0.0    0.0      0     0
0     %Latupa 275KV
         65   0   1.01   0     0.0    0.0         0.0    0.0      0     0
0     %Latupa 150KV
         66   0   0.99   0     0.0    0.0         0.0    0.0      0     0
0     %Wotu 275KV
         67   0   0.98   0    17.08   3.37        0.0    0.0      0     0
0     %Wotu 150KV
         68   0   0.97   0     4.7    0.77        0.0    0.0      0     0
0     %Malili
         69   0   0.95   0     7.16   1.3         0.0    0.0      0     0
0     %Lasusua
         70   0   0.94   0    20.79   5.5         0.0    0.0      0     0
0     %Kolaka
         71   0   0.95   0    20.82   6.0         0.0    0.0      0     0
0     %UNNHA
         72   0   0.95   0    40.65  10.4         0.0    0.0      0     0
0     %Kendari
         73   0   0.95   0     0.0    0.0         0.0    0.0      0     0
0     %Pwatu 150KV
         74   0   0.98   0    31.68   8.09        0.0    0.0      0     0
0     %Pwatu 70KV
         75   2   1.0    0     6.89   2.46       13.51   0.0    -100   100
0     %NTNSA
         76   2   1.0    0     9.54   2.37       90.51   0.0    -100   100
0];   %PLTU Maramo

%        Bus    Bus        R           X          1/2B
%        No.    No.      p.u.        p.u.        p.u.
linedata=[1      2     0.00955     0.07964     0.01149    1
          1      3     0.01135     0.05852     0.00404    1
          1      7     0.03131     0.11249     0.00885    1
          2      3     0.02882     0.09564     0.00482    1
          2      4     0.01677     0.09037     0.00850    1
          2      5     0.03431     0.18284     0.01203    1
          2      8     0.00203     0.01616     0.00034    1
          2     44     0.01039     0.03390     0.00142    1
          3      9     0.02284     0.07420     0.00804    1
          4      5     0.01737     0.09360     0.00964    1
          5      6     0.01053     0.06335     0.00807    1
          6     65     0.06069     0.11141     0.00034    1
          8     23     0.01795     0.14640     0.00399    1
          9     10     0.04007     0.13473     0.01149    1
          9     11     0.07317     0.24775     0.00882    1
          10    11     0.03549     0.11628     0.00882    1
          11    12     0.00389     0.01318     0.00111    1
          11    15     0.02513     0.08414     0.00344    1
          12    13     0.02023     0.03714     0.00011    1
          14    15     0.01248     0.04225     0.00670    1
          15    16     0.01786     0.05866     0.00314    1
```

```
        15   19     0.01613     0.05466     0.00314    1
        17   19     0.01388     0.04974     0.00670    1
        18   19     0.01388     0.04974     0.00670    1
        19   20     0.00391     0.03288     0.00217    1
        19   24     0.00385     0.02635     0.00124    1
        20   21     0.00434     0.02892     0.00314    1
        21   22     0.00153     0.01277     0.00111    1
        21   23     0.00737     0.05991     0.01756    1
        21   24     0.00361     0.02103     0.00136    1
        21   29     0.00178     0.01360     0.00124    1
        22   23     0.00598     0.04695     0.00807    1
        24   25     0.00145     0.00625     0.00111    1
        25   26     0.02023     0.03714     0.00111    1
        26   27     0.00000     0.41590     0.00000    1  %Tap
Trafo
        26   29     0.00257     0.01061     0.00088    1
        27   28     0.02057     0.06965     0.00006    1
        29   30     0.00173     0.00692     0.00006    1
        29   31     0.00000     0.55350     0.00000    1  %Tap
Trafo
        29   33     0.00000     0.41590     0.00000    1  %Tap
Trafo
        29   38     0.00424     0.01411     0.00380    1
        29   39     0.01687     0.06048     0.00575    1
        31   32     0.09066     0.30700     0.00002    1
        33   34     0.06073     0.20563     0.00034    1
        33   35     0.02681     0.05406     0.00013    1
        33   36     0.05828     0.10699     0.00032    1
        35   36     0.02448     0.08291     0.00019    1
        36   41     0.18789     0.31940     0.00050    1
        37   41     0.01812     0.06136     0.00005    1
        38   40     0.01987     0.06435     0.00380    1
        39   40     0.01136     0.03678     0.00493    1
        40   41     0.00000     0.39490     0.00000    1  %Tap
Trafo
        40   42     0.02419     0.08667     0.01167    1
        40   43     0.02368     0.08013     0.00670    1
        42   43     0.01388     0.04974     0.00670    1
        43   44     0.02389     0.08072     0.00396    1
        44   45     0.00390     0.01363     0.00056    1
        44   46     0.01438     0.04744     0.00067    1
        44   47     0.04786     0.17164     0.01819    1
        46   49     0.03076     0.11023     0.01012    1
        47   48     0.02630     0.09451     0.00744    1
        47   49     0.02627     0.09440     0.00743    1
        48   50     0.07195     0.25851     0.02035    1
        50   51     0.03076     0.11023     0.01012    1
        51   52     0.03105     0.12791     0.01149    1
        51   53     0.04840     0.16133     0.01819    1
        53   54     0.04840     0.16133     0.01819    1
        54   55     0.04840     0.16133     0.01819    1
        55   56     0.01541     0.05137     0.00627    1
        56   57     0.00000     0.50000     0.00000    1  %Tap
Trafo
        56   58     0.04840     0.16133     0.02035    1
        57   60     0.04840     0.16133     0.02035    1
```

```
           58    59      0.04840      0.16133      0.01819     1
           59    62      0.00000      0.13890      0.00000     1   %Tap
Trafo
           60    61      0.09446      0.10775      0.00142     1
           62    63      0.01914      0.06356      0.00018     1
           62    64      0.00967      0.08059      0.02035     1
           62    66      0.00524      0.04371      0.02035     1
           64    65      0.00000      0.13890      0.00000     1   %Tap
Trafo
           64    66      0.01077      0.03687      0.00807     1
           66    67      0.00000      0.13890      0.00000     1   %Tap
Trafo
           67    68      0.01737      0.07157      0.02035     1
           68    69      0.02565      0.11610      0.02035     1
           69    70      0.02418      0.10944      0.02035     1
           70    71      0.02093      0.09251      0.01149     1
           71    72      0.01430      0.06425      0.00744     1
           72    73      0.00384      0.01786      0.00034     1
           72    76      0.02565      0.11610      0.00627     1
           73    74      0.00000      0.50000      0.00000     1   %Tap
Trafo
           74    75      0.04626      0.09510      0.00034     1];
%          Gen.  Ra     Xd'
gendata=[  1     0      0.200  %Pltgu Sengkang
           5     0      0.333  %Plta Malea
           6     0      0.300  %Pltmh Simbuang Dan Siteba
           8     0      0.0    %Pltb Sidrap
           10    0      0.268  %Plta Tangka Manipi
           16    0      0.0    %Pltb Tolo
           17    0      0.300  %Pltu Jeneponto Exp
           18    0      0.385  %Pltu Jeneponto
           19    0      0.300  %Pltu Punagaya
           29    0      0.199  %Tello
           34    0      0.385  %Plta Bili-Bili
           43    0      0.199  %Pltu Barru
           45    0      0.385  %Pltd Suppa
           46    0      0.300  %Pltm Sawitto
           49    0      0.268  %Plta Bakaru
           52    0      0.300  %Pltu Mamuju
           60    0      0.300  %Pltd Silae
           62    0      0.268  %Plta Poso
           63    0      0.300  %Plta Poso 2
           75    0      0.300  %Pltu Nii Tanasa
           58    0      0.300];  %Pltu Maramo
lfybus                          % Forms the bus admittance
matrix
lfnewton              % Power flow solution by Newton-Raphson
method
busout                % Prints the power flow solution on the
screen
```

Metode Artificial Neural Network

```
close all
clc

raw_data = [1.00,-3.35,33.90,4.20
0.99,-2.88,17.20,3.30
1.01,-4.13,10.20,2.00
1.00,-0.63,10.00,1.60
0.99,-5.53,35.80,7.10
0.98,-6.47,34.90,8.50
0.97,-7.34,28.70,0.00
0.99,-3.48,11.20,8.00
0.99,-3.26,21.90,3.80
0.99,-2.99,23.70,3.70
0.99,-5.17,39.10,8.00
0.99,-5.33,24.20,6.00
0.99,-5.26,22.20,4.30
0.99,-4.05,58.40,14.50
0.99,-4.46,44.80,12.50
0.99,-6.20,36.10,8.50
0.99,-6.70,68.40,13.80
0.96,-11.95,20.10,2.40
0.96,-11.97,23.40,5.10
0.99,-9.95,2.50,0.00
0.99,-6.67,32.00,10.10
0.99,-6.83,18.90,0.00
0.99,-6.65,24.20,5.20
0.99,-5.93,10.60,2.60
1.00,-3.90,24.00,5.70
1.03,-3.68,18.30,2.40
1.02,-5.88,16.10,1.70
1.02,-9.58,11.80,1.60
1.02,-10.42,6.20,0.06
0.99,-14.34,7.39,1.03
0.96,-17.73,10.80,1.60
0.94,-20.14,42.60,0.20
0.94,-19.48,25.40,5.10
0.95,-12.34,11.85,2.33
0.99,-4.38,0.21,0.73
0.98,-29.27,16.90,5.50
0.99,-3.93,17.08,3.37
0.98,-5.64,4.70,0.77
0.97,-8.11,7.16,1.30
0.96,-9.97,20.79,5.50
0.96,-10.40,20.82,6.00
0.96,-9.90,40.65,10.40
0.98,-17.84,31.68,8.09];

data_size = size(raw_data);

P_Q = raw_data(:,3:4);
V_T = raw_data(:,1:2);

clear raw_data;
```

```
[dim_c, dim_r] = size(P_Q);

P_Q_Fit = zeros([dim_c dim_r]);

for i = 1:2
    P_Q_Fit(:,i)=(P_Q(:,i)-min(P_Q(:,i)))/(max(P_Q(:,i))-
min(P_Q(:,i)));
end

P_Q_TP = P_Q_Fit';
V_T_TP = V_T';

neuron_size = 5;

net = fitnet(neuron_size);
net.divideParam.trainRatio = 80/100;
net.divideParam.valRatio = 20/100;
net.divideParam.testRatio = 0/100;

start_train_time = cputime;

[net, tr] = train(net, P_Q_TP, V_T_TP);

end_train_time = cputime;

Y_VnT = net(P_Q_TP)';
Y_VnT_Train = exp(net(P_Q_TP(:,tr.trainInd))) - 1;
Y_VnT_TrainTrue = exp(V_T_TP(:, tr.trainInd)) - 1;

rmse_V = sqrt(mean((Y_VnT_Train(1,:) - Y_VnT_TrainTrue(1,:)).^2));
rmse_T = sqrt(mean((Y_VnT_Train(2,:) - Y_VnT_TrainTrue(2,:)).^2));

[acc_V, acc_T, MAPE, MAE, MSE, RMSE] = accuracy_score(V_T, Y_VnT,
data_size(1));

total_time = end_train_time - start_train_time;

fprintf("\nAkurasi Output Tegangan   : %.2f %c", acc_V * 100, '%');
fprintf("\nAkurasi Output Sudut Fasa : %.2f %c", acc_T * 100, '%');
fprintf("\nMAPE : %.2f", MAPE);
fprintf("\nMAE  : %.2f", MAE);
fprintf("\nMSE  : %.2f", MSE);
fprintf("\nRMSE : %.2f", RMSE);
fprintf("\nWaktu Training            : %.2f s\n", total_time);


fprintf("\nV Aktual\tSudut Fasa Aktual\tV Prediksi\tSudut Fasa
Prediksi\n");
fprintf("========\t================\t==========\t================
==\n");

for i=1:size(P_Q, 1)
```

```
    fprintf("%.4f\t\t%.4f    \t\t%.4f\t\t%.4f\n", V_T(i,1),
V_T(i,2), Y_VnT(i,1), Y_VnT(i,2));
end

%
% subplot(2,1,1)
% hold on;
% v1 = plot(V_actual);
% v2 = plot(V_predict);
% legend([v1, v2], ["V Actual", "V Predict"]);
% hold off;
% title("Magnitude Voltage");
%
% subplot(2,1,2)
% hold on
% t1 = plot(T_actual);
% t2 = plot(T_predict);
% legend([t1, t2], ["\Theta Actual", "\Theta Predict"]);
% hold off;
% title("Sudut Fasa");



function x = change_zero(y)
    ind = (y == 0);
    y(ind) = 0.1;
    x = y;
end
function x = remove_zero(y)
    ind = (y == 0);
    y(ind) = [];
    x = y;
end

function [v, t, mape, mae, mse, rmse] = accuracy_score(y,z,s)
    V_actual_total = abs(y(:,1));
    T_actual_total = abs(y(:,2));
    V_pred_total = abs(z(:,1));
    T_pred_total = abs(z(:,2));
    dV = zeros(s,1);
    dT = zeros(s,1);
    for i=1:s
        if(V_actual_total(i) == V_pred_total(i))
            dV(i) = 1;
        elseif(V_actual_total(i) > V_pred_total(i))
            dV(i) = V_pred_total(i)/V_actual_total(i);
        else
            dV(i) = V_actual_total(i)/V_pred_total(i);
        end
        if(T_actual_total(i) == T_pred_total(i))
            dT(i) = 1;
        elseif(T_actual_total(i) > T_pred_total(i))
            dT(i) = T_pred_total(i)/T_actual_total(i);
        else
            dT(i) = T_actual_total(i)/T_pred_total(i);
```

```
        end
    end
    disp(dV);
    v = abs(remove_zero(mean(dV)));
    t = abs(remove_zero(mean(dT)));
    mape =
remove_zero(mean((abs(change_zero([V_pred_total;T_pred_total]) -
change_zero([V_actual_total;T_actual_total])))./change_zero([V_actu
al_total;T_actual_total])));
    mae = sum(abs([V_pred_total;T_pred_total] -
[V_actual_total;T_actual_total])) / (s*2);
    mse =
immse([V_pred_total;T_pred_total],[V_actual_total;T_actual_total]);
    rmse = sqrt(mse);
end
```

Metode Extreme Learning Machine

```
close all
clc

%raw_data = load("Data/Data39.csv");

raw_data = [1.00,-3.35,33.90,4.20
0.99,-2.88,17.20,3.30
1.01,-4.13,10.20,2.00
1.00,-0.63,10.00,1.60
0.99,-5.53,35.80,7.10
0.98,-6.47,34.90,8.50
0.97,-7.34,28.70,0.00
0.99,-3.48,11.20,8.00
0.99,-3.26,21.90,3.80
0.99,-2.99,23.70,3.70
0.99,-5.17,39.10,8.00
0.99,-5.33,24.20,6.00
0.99,-5.26,22.20,4.30
0.99,-4.05,58.40,14.50
0.99,-4.46,44.80,12.50
0.99,-6.20,36.10,8.50
0.99,-6.70,68.40,13.80
0.96,-11.95,20.10,2.40
0.96,-11.97,23.40,5.10
0.99,-9.95,2.50,0.00
0.99,-6.67,32.00,10.10
0.99,-6.83,18.90,0.00
0.99,-6.65,24.20,5.20
0.99,-5.93,10.60,2.60
1.00,-3.90,24.00,5.70
1.03,-3.68,18.30,2.40
1.02,-5.88,16.10,1.70
1.02,-9.58,11.80,1.60
1.02,-10.42,6.20,0.06
0.99,-14.34,7.39,1.03
0.96,-17.73,10.80,1.60
0.94,-20.14,42.60,0.20
0.94,-19.48,25.40,5.10
0.95,-12.34,11.85,2.33
0.99,-4.38,0.21,0.73
0.98,-29.27,16.90,5.50
0.99,-3.93,17.08,3.37
0.98,-5.64,4.70,0.77
0.97,-8.11,7.16,1.30
0.96,-9.97,20.79,5.50
0.96,-10.40,20.82,6.00
0.96,-9.90,40.65,10.40
0.98,-17.84,31.68,8.09];

P_Q = raw_data(:,3:4);
V_T = raw_data(:,1:2);

data_size = size(P_Q,1);
```

```
g_len = length(raw_data(:,1));
train_80 = int64(g_len*8/10);

P_Q_test = raw_data(:, 3:4);
V_T_test = raw_data(:, 1:2);

clear raw_data;

P_Q_size = size(P_Q, 2);
hidden_layer_neurons = 25;

W = zeros(hidden_layer_neurons, P_Q_size);
r_min = -0.5;
r_max = 0.5;

for i=1:P_Q_size
    cnt = 0;
    for j=1:hidden_layer_neurons
       r1 = randi([-1, 1]);
       r2 = rand(1,1, 'double');
       r3 = r1 * r2;
       if r3 > 0.5 || r3 < 0.5
           r3 = r3/2;
       end
       if(r3 == 0)
           if(cnt >= 1)
               r3 = rand(1,1,'double') / 2;
           else
               cnt = cnt + 1;
           end
       end
       W(j,i) =  r3;
    end
end

start_train_time = cputime;

H_init = P_Q * W';
H = 1 ./ (1 + exp(-H_init));
H_plus = (H' * H)^-1 * H';
beta = H_plus * V_T;

Y_VnT = H * beta;

end_train_time = cputime;

H_init_test = P_Q_test * W';
H_test = 1 ./ (1 + exp(-H_init_test));
Y_VnT_test = H_test * beta;

[acc_V, acc_T, MAPE, MAE, MSE, RMSE] = accuracy_score(V_T,
Y_VnT_test, data_size);

total_time = end_train_time - start_train_time;
```

```
fprintf("\nAkurasi Output Tegangan   : %.2f %c", acc_V * 100, '%');
fprintf("\nAkurasi Output Sudut Fasa : %.2f %c", acc_T * 100, '%');
fprintf("\nMAPE : %.2f", MAPE);
fprintf("\nMAE  : %.2f", MAE);
fprintf("\nMSE  : %.2f", MSE);
fprintf("\nRMSE : %.2f", RMSE);
fprintf("\nWaktu Training            : %.2f s\n", total_time);


fprintf("\nV Aktual\tSudut Fasa Aktual\tV Prediksi\tSudut Fasa
Prediksi\n");
fprintf("========\t================\t==========\t================
==\n");

for i=1:size(P_Q, 1)
    fprintf("%.4f\t\t%.4f   \t\t%.4f\t\t%.4f\n", V_T(i,1),
V_T(i,2), Y_VnT(i,1), Y_VnT(i,2));
end

function x = change_zero(y)
    ind = (y == 0);
    y(ind) = 0.1;
    x = y;
end
function x = remove_zero(y)
    ind = (y == 0);
    y(ind) = [];
    x = y;
end

function [v, t, mape, mae, mse, rmse] = accuracy_score(y,z,
data_size)
    V_actual_total = abs(y(:,1));
    T_actual_total = abs(y(:,2));
    V_pred_total = abs(z(:,1));
    T_pred_total = abs(z(:,2));
    dV = zeros(data_size,1);
    dT = zeros(data_size,1);
    for i=1:data_size
        if(V_actual_total(i) == V_pred_total(i))
            dV(i) = 1;
        elseif(V_actual_total(i) > V_pred_total(i))
            dV(i) = V_pred_total(i)/V_actual_total(i);
        else
            dV(i) = V_actual_total(i)/V_pred_total(i);
        end
        if(T_actual_total(i) == T_pred_total(i))
            dT(i) = 1;
        elseif(T_actual_total(i) > T_pred_total(i))
            dT(i) = T_pred_total(i)/T_actual_total(i);
        else
            dT(i) = T_actual_total(i)/T_pred_total(i);
        end
    end
```

```
    v = abs(remove_zero(mean(dV)));
    t = abs(remove_zero(mean(dT)));
    mape =
remove_zero(mean((abs(change_zero([V_pred_total;T_pred_total]) -
change_zero([V_actual_total;T_actual_total]))))./change_zero([V_actu
al_total;T_actual_total])));
    mae = sum(abs([V_pred_total;T_pred_total] -
[V_actual_total;T_actual_total])) / (data_size*2);
    mse =
immse([V_pred_total;T_pred_total],[V_actual_total;T_actual_total]);
    rmse = sqrt(mse);
end
```