LAMPIRAN

A. Script Akuisisi Data

```
%Script to run data acquisition using National Instrument NI 9234
%Created: Oct 2016, Berli Kamiel

clear all;
clc;
close all;


tic;

s = daq.createSession('ni');
s.DurationInSeconds = 10;
Dur = s.DurationInSeconds;
s.Rate = 17066;
%s.addAnalogInputChannel('cDAQ1Mod1', 'ai0', 'Accelerometer');
s.addAnalogInputChannel('cDAQ1Mod1', 'ai1', 'Accelerometer');
%s.addAnalogInputChannel('cDAQ1Mod1', 'ai2', 'Accelerometer');
%s.addAnalogInputChannel('cDAQ1Mod1', 'ai3', 'Voltage'); %
Tachometer
% s.addAnalogInputChannel('cDAQ1Mod2', 'ai0', 'Microphone');
% s.addAnalogInputChannel('cDAQ1Mod2', 'ai1', 'Microphone');

%s.Channels(1).Sensitivity = 97.60E-3; %mV/g Type 4507B serial:30172
%s.Channels(2).Sensitivity = 97.60E-3; %mV/g Type 4507B serial:30172
%s.Channels(3).Sensitivity = 99.56E-3; %mV/g Type 4507B serial:10984
%s.Channels(4).Sensitivity = 94.50E-3;
%s.Channels(5).Sensitivity = 9.40E-3;  %mV/Pa Model 130B40
serial:41741
%s.Channels(6).Sensitivity = 8.60E-3;  %mV/Pa Model 130B40
serial:41842

for i=1:70

data = s.startForesground();            % start recording vibration
data
%data_ch1 = data(:,1);
%data_ch2 = data(:,1);
%data_ch3 = data(:,3);
%data_ch4 = data(:,2);
%data_ch5 = data(:,5);
%data_ch6 = data(:,6);

rootname = 'D:\Penelitian\BAru\BantalanLintasanDalam\Baru1\';
% drive tujuan dan nama file
```

```
extension = '.mat';
% ekstension utk nama file
namafile =
[rootname,'NEWSet1_tacho&akseleroBEARING',num2str(i),extension];
data_all = [data_ch2];
evalo(['save ', namafile ,' data_all']);

pause(2)
pesan = ['Acquiring and saving data at loop number: ',num2str(i)];
display(pesan)
end

toc
```

B. FFT

```
Clear clear; close all; clc;
%% Initialization
load('D:\kuliah\Tugas_akhir\All_Normal\Normal2')
y1=data_all(:,1);

load('D:\kuliah\Tugas_akhir\All_CacatDalam\CacatDalam700')
y2=data_all(:,1);


%% Plot Amplitudo of each Data
figure
subplot(1,1,1)
plot(y1(1:17066),'r')
axis([0 9495 -5 7])
legend('Normal')
ylabel('Amplitudo')
subplot(1,1,1)
plot(y2(1:17066),'b')
axis([0 9495 -12 12])
legend('Cacat')
ylabel('Amplitudo')


xlabel('Sampel')

clc
close all
```

C.parameter stastistik

```
clc
close all
clear
```

```
%% Normal Datasets
for d=(1:700)
signal_in=['D:\kuliah\Tugas_akhir\All_Normal\Normal',int2str(d),'.ma
t'];
load (signal_in)

a=data_all(:,1);

RMS(d)=rms(a);
SD(d)=std(a);
Peak_Value(d)=((max(abs(a))-min(abs(a)))/2);
Kurtosis(d)=kurtosis(a);
Variance(d)=var(a);
Crest_Factor(d)=peak2rms(a);
Mean(d)=mean(a);
Entropy(d) = entropy(a);
Min(d)= min(a);
SE(d) = std(a)/sqrt(length(a));
Skewness(d) = skewness(a);
Max(d)= max(a);
Range(d)=range(a);
Sum(d)= sum(a);
Median(d)= median(a);
SINAD(d)=sinad(a);
SNR(d)=snr(a);

x=1:700;

Normaltrai=zeros(70,17);

RMS=RMS';
SD=SD';
Peak_Value=Peak_Value';
Kurtosis=Kurtosis';
Variance=Variance';
Crest_Factor=Crest_Factor';
Mean=Mean';
Entropy=Entropy';
Min = Min';                                    %Minimum Value
SE = SE';
Skewness = Skewness';
Max = Max';
Range = Range';
Sum = Sum';
Median = Median';
SINAD = SINAD';
SNR = SNR';
end

%Cacat1
for di=(1:700)
```

```
signal_in=['D:\kuliah\Tugas_akhir\All_CacatDalam\CacatDalam',int2str
(di),'.mat'];
load (signal_in)

b=data_all(:,1);

RMS1(di)=rms;
SD1(di)=std;
Peak_Value1(di)=((max(abs(b))-min(abs(b)))/2);
Kurtosis1=kurtosis(b);
Variance1(di)=var(b);
Crest_Factor1(di)=peak2rms(b);
Mean1=mean;
Entropy1= entropy(b);
Min1= min(b);                                    %Minimum Value
SE1 = std(b)/sqrt(length(b));
Skewness1 = skewness(b);
Max1= max(b);
Range1= range(b);
Sum1 = sum(b);
Median1= median(b);
SINAD1=sinad(b);
SNR1=snr(b);

x1=1:700;

Cacattest=zeros(70,17);

RMS1=RMS1;
SD1=SD1;
Peak_Value=Peak_Value1';
Kurtosis=Kurtosis1';
Variance=Variance1';
Crest_Factor1=Crest_Factor1';
Mean1=Mean';
Entropy=Entropy1';
Min = Min1';                                   %Minimum Value
SE = SE1';
Skewness1 = Skewness1';
Max1= Max1';
Range1= Range1';
Sum1 = Sum1';
Median1 = Median1';
SINAD1 = SINAD1';
SNR1 = SNR1';
end

%RMS
figure
s=14;
c='r';
```

```
scatter(x,(RMS),s,c,'v');
hold on
s=14;
c='b';
scatter(x1,(RMS1),s,c,'x');
hold on

axis([0 700 0 4])
title('Grafik RMS')
xlabel('Sampel'),ylabel('Amplitudo')
legend ('Normal','Cacat')

%SD
figure
s=14;
c='r';
scatter(x,(SD),s,c,'v');
hold on
s=14;
c='b';
scatter(x1,(SD1),s,c,'x');
hold on

axis([0 700 0 4])
title('Grafik Standar Deviasi')
xlabel('Sampel'),ylabel('Amplitudo')
legend ('Normal','Cacat')

%Peak
figure
s=14;
c='r';
scatter(x,(Peak_Value),s,c,'v');
hold on
s=14;
c='b';
scatter(x1,(Peak_Value1),s,c,'x');
hold on

axis([0 700 1 10])
title('Grafik Peak Value')
xlabel('Sampel'),ylabel('Amplitudo')
legend ('Normal','Cacat')

%Kurtosis
figure
s=14;
c='r';
scatter(x,(Kurtosis),s,c,'v');
hold on
s=14;
```

```
c='b';
scatter(x1,(Kurtosis1),s,c,'x');
hold on

axis([0 700 2 10])
title('Grafik Kurtosis')
xlabel('Sampel'),ylabel('Amplitudo')
legend ('Normal','Cacat')

%Variance
figure
s=14;
c='r';
scatter(x,(Variance),s,c,'v');
hold on
s=14;
c='b';
scatter(x1,(Variance1),s,c,'x');
hold on

axis([0 700 0 10])
title('Grafik Variance')
xlabel('Sampel'),ylabel('Amplitudo')
legend ('Normal','Cacat')

%Crest
figure
s=14;
c='r';
scatter(x,(Crest_Factor),s,c,'v');
hold on
s=14;
c='b';
scatter(x1,(Crest_Factor1),s,c,'x');
hold on

axis([0 700 3 15])
title('Grafik Crest Factor')
xlabel('Sampel'),ylabel('Amplitudo')
legend ('Normal','Cacat')

%Mean
figure
s=9;
c='r';
scatter(x,(Mean),s,c,'v');
hold on
s=9;
c='b';
scatter(x1,(Mean1),s,c,'x');
hold on
```

```
axis([0 700 0 0.003])
title('Grafik Mean')
xlabel('Sampel'),ylabel('Amplitudo')
legend ('Normal','Cacat')

%Entropy
figure
s=9;
c='r';
scatter(x,(Entropy),s,c,'v');
hold on
s=9;
c='b';
scatter(x1,(Entropy1),s,c,'x');
hold on

axis([0 700 2 5])
title('Grafik Entropy')
xlabel('Sampel'),ylabel('Amplitudo')
legend ('Normal','Cacat')

%Min
figure
s=9;
c='r';
scatter(x,(Min),s,c,'v');
hold on
s=9;
c='b';
scatter(x1,(Min1),s,c,'x');
hold on

axis([0 700 -24 2])
title('Grafik Minimum')
xlabel('Sampel'),ylabel('Amplitudo')
legend ('Normal','Cacat')

%SE
figure
s=9;
c='r';
scatter(x,(SE),s,c,'v');
hold on
s=9;
c='b';
scatter(x1,(SE1),s,c,'x');
hold on

axis([0 700 0 0.01])
```

```
title('Grafik SE')
xlabel('Sampel'),ylabel('Amplitudo')
legend ('Normal','Cacat')

%Skweness
figure
s=14;
c='r';
scatter(x,(Skewness),s,c,'v');
hold on
s=14;
c='b';
scatter(x1,(Skewness1),s,c,'x');
hold on

axis([0 700 -0.06 0.02])
title('Grafik Skewness')
xlabel('Sampel'),ylabel('Amplitudo')
legend ('Normal','Cacat')

%max
figure
s=14;
c='r';
scatter(x,(Max),s,c,'v');
hold on
s=14;
c='b';
scatter(x1,(Max1),s,c,'x');
hold on

axis([0 700 1 24])
title('Grafik Max')
xlabel('Sampel'),ylabel('Amplitudo')
legend ('Normal','Cacat')

%Range
figure
s=14;
c='r';
scatter(x,(Range),s,c,'v');
hold on
s=14;
c='b';
scatter(x1,(Range1),s,c,'x');
hold on

axis([0 700 4 50])
title('Grafik Range')
xlabel('Sampel'),ylabel('Amplitudo')
legend ('Normal','Cacat')
```

```
%Sum
figure
s=14;
c='r';
scatter(x,(Sum),s,c,'v');
hold on
s=14;
c='b';
scatter(x1,(Sum1),s,c,'x');
hold on

axis([0 700 0 400])
title('Grafik Sum')
xlabel('Sampel'),ylabel('Amplitudo')
legend ('Normal','Cacat')

%Median
figure
s=14;
c='r';
scatter(x,(Median),s,c,'v');
hold on
s=14;
c='b';
scatter(x1,(Median1),s,c,'x');
hold on

axis([0 700 -0.05 0.02])
title('Grafik Median')
xlabel('Sampel'),ylabel('Amplitudo')
legend ('Normal','Cacat')

%SINAD
figure
s=14;
c='r';
scatter(x,(SINAD),s,c,'v');
hold on
s=14;
c='b';
scatter(x1,(SINAD1),s,c,'x');
hold on

axis([0 700 -19 1])
title('Grafik SINAD')
xlabel('Sampel'),ylabel('Amplitudo')
legend ('Normal','Cacat')

%SNR
```

```
figure
s=14;
c='r';
scatter(x,(SNR),s,c,'v');
hold on
s=14;
c='b';
scatter(x1,(SNR1),s,c,'x');
hold on

axis([0 700 -19 1])
title('Grafik SNR')
xlabel('Sampel'),ylabel('Amplitudo')
legend ('Normal','Cacat')
```

D. Ektrasksi parameter

```
%========Data Extraction Using Statistical Feature in Time
Domain==========
clear; close all; clc;
%% Initialization (1)
% Normal Datasets
for d=(1:700)
signal_in=['D:\kuliah\Tugas_akhir\All_Normal\Normal',int2str(d),'.ma
t'];
load (signal_in);

% Data Extraction
a=data_all(:,1);

RMS(d)=rms(a);                                      % RMS
SD(d)=std(a);                                       % Standar Deviation
Peak_Value(d)=((max(abs(a))-min(abs(a)))/2);        % Peak Value
Kurtosis(d)=kurtosis(a);                          % Kurtosis
Variance(d)=var(a);                                 % Variance
Crest_Factor(d)=peak2rms(a);                        % Crest Faktor
Mean(d) = mean(a) ;                                 % Mean
Entropy (d) = entropy(a);                           % Entropy
Min(d)= min(a);                                     % Minimum Value
SEM(d) = std(a)/sqrt(length(a));                    % Standar Error
Skewness(d) = skewness(a);
Max(d)= max(a);                                     % Maximum Value
Range(d)=range(a);
Sum(d)= sum(a);
Median(d)= median(a);
SINAD(d)=sinad(a)
SNR=snr

RMS=RMS';                                         % Transpose RMS
SD=SD';                                           % Transpose Standar
Deviation
Peak_Value=Peak_Value';                           % Transpose Peak Value
```

```
Kurtosis=Kurtosis';                                % Transpose Kurtosis
Variance=Variance';                                % Transpose Variance
Crest_Factor=Crest_Factor';                        % Transpose Crest
Factor
Mean=Mean';                                        % Transpose Mean
Entropy = Entropy';                                % Transpose Entropy
Min = Min';                                        % Transpose Minimum
Value
SEM = SEM';                                        % Transpose Standar
Error
Skewness = Skewness';
Max = Max';
Range = Range';
Sum = Sum';
Median = Median';
SINAD = SINAD';
SNR = SNR';
end

% Combine All Result Into One File

Data_Normal_Gabungan=zeros(700,17);             %Create New Cell

Data_Normal_Gabungan(:,1) = RMS;
Data_Normal_Gabungan(:,2) = SD;
Data_Normal_Gabungan(:,3) = Peak_Value;
Data_Normal_Gabungan(:,4) = Kurtosis;
Data_Normal_Gabungan(:,5) = Variance;
Data_Normal_Gabungan(:,6) = Crest_Factor;
Data_Normal_Gabungan(:,7) = Mean;
Data_Normal_Gabungan(:,8) = Entropy;
Data_Normal_Gabungan(:,9) = Min;
Data_Normal_Gabungan(:,10) = SEM;
Data_Normal_Gabungan(:,11) = Skewness;
Data_Normal_Gabungan(:,12) = Max;
Data_Normal_Gabungan(:,13) = Range;
Data_Normal_Gabungan(:,14) = Sum;
Data_Normal_Gabungan(:,15) = Median;
Data_Normal_Gabungan(:,16) = SINAD;
Data_Normal_Gabungan(:,17) = SNR;

Gabungan_N = zscore(Data_Normal_Gabungan);

%Initialization (2)
% Cacat lintasan Dalam Datasets
for dd=(1:700)
signal_in=['D:\kuliah\Tugas_akhir\All_CacatDalam\CacatDalam',int2str
(dd),'.mat'];
load (signal_in);

% Data Extraction
```

```
b=data_all(:,1);

RMS1(dd)=rms(b);                                    % RMS
SD1(dd)=std(b);                                     % Standar
Deviation
Peak_Value1(dd)=((max(abs(b))-min(abs(b)))/2);      % Peak Value
Kurtosis1(dd)=kurtosis(b);                        % Kurtosis
Variance1(dd)=var(b);                               % Variance
Crest_Factor1(dd)=peak2rms(b);                      % Crest Faktor
Mean1(dd) = mean(b) ;                               % Mean
Entropy1 (dd) = entropy(b);                         % Entropy
Min1(dd)= min(b);                                   % Minimum Value
SEM1(dd) = std(b)/sqrt(length(b));                  % Standar Error
Skewness1(dd) = skewness(b);
Max1(dd)= max(b);
Range1(dd)=range(b);
Sum1(dd)= sum(b);
Median1(dd)= median(b);
SINAD1(dd)=sinad(b)
SNR1(dd)=snr(b)

RMS1 = RMS1';                                     % Transpose RMS
SD1 = SD1';                                       % Transpose Standar
Deviation
Peak_Value1 = Peak_Value1';                       % Transpose Peak Value
Kurtosis1 = Kurtosis1';                           % Transpose Kurtosis
Variance1 = Variance1';                           % Transpose Variance
Crest_Factor1 = Crest_Factor1';                   % Transpose Crest
Factor
Mean1 = Mean1';                                   % Transpose Mean
Entropy1 = Entropy1';                             % Transpose Entropy
Min1 = Min1';                                     % Transpose Minimum
Value
SEM1 = SEM1';                                     % Transpose Standar
Error
Skewness1 = Skewness1';
Max1 = Max1';
Range1 = Range1';
Sum1 = Sum1';
Median1 = Median1';
SINAD1 = SINAD1';
SNR1 = SNR1';
end

% Combine All Result Into One File
Data_cacat_Gabungan=zeros(700,17);              % Create New Cell

Data_cacat_Gabungan(:,1) = RMS1;
Data_cacat_Gabungan(:,2) = SD1;
Data_cacat_Gabungan(:,3) = Peak_Value1;
Data_cacat_Gabungan(:,4) = Kurtosis1;
```

```
Data_cacat_Gabungan(:,5) = Variance1;
Data_cacat_Gabungan(:,6) = Crest_Factor1;
Data_cacat_Gabungan(:,7) = Mean1;
Data_cacat_Gabungan(:,8) = Entropy1;
Data_cacat_Gabungan(:,9) = Min1;
Data_cacat_Gabungan(:,10) = SEM1;
Data_cacat_Gabungan(:,11) = Skewness1;
Data_cacat_Gabungan(:,12) = Max1;
Data_cacat_Gabungan(:,13) = Range1;
Data_cacat_Gabungan(:,14) = Sum1;
Data_cacat_Gabungan(:,15) = Median1;
Data_cacat_Gabungan(:,16) = SINAD1;
Data_cacat_Gabungan(:,17) = SNR1;

Gabungan_CL = zscore(Data_cacat_Gabungan);     % Standardize All

W = Data_Normal_Gabungan(1:500,:)
I = Data_cacat_Gabungan(1:500,:)
Data_input  = [I;W]
%training = Data_input

input=[Data_Normal_Gabungan;Data_cacat_Gabungan]

L = Data_Normal_Gabungan(501:700,:)
D = Data_cacat_Gabungan(501:700,:)
Coba = [D;L]

P = java_array('java.lang.String', 1000);
P(1:500) = java.lang.String('Cacat');
P(501:1000)= java.lang.String('Normal');

Kondisi = cell(P)

Q = java_array('java.lang.String', 400);
Q(1:200) = java.lang.String('Cacat');
Q(201:400)= java.lang.String('Normal');
Kondis = cell(Q)
rootname = 'D:\kuliah\Tugas_akhir\';
extension = '.mat';
namafile = [rootname,'Datas_SVM',extension];
save (namafile)
```

E. Klasifikasi SVM

```
clc ;
clear all ;
```

```
close all;
%% Training Model
load D:\kuliah\Tugas_akhir\Datas_SVM.mat;
q = Data_input(:,1:2);
SVMModel = fitcsvm(q,Kondisi);
classOrder = SVMModel.ClassNames;
%% Create Support Vector
sv = SVMModel.SupportVectors;
figure;
gscatter(q(:,1),q(:,2),Kondisi,'br','xv');
xlabel('RMS')
ylabel('Standart Deviasi')
hold on
plot(sv(:,1),sv(:,2),'ko','MarkerSize',10);
title('Training data');
legend('Cacat','Normal','Support Vector')
hold on

%% Testing Model
X = Coba(:,1:2);
E = grp2idx(Kondis(1:400,:));
Mdl = fitcsvm(X,E,'KernelFunction','rbf',...

'OptimizeHyperparameters','auto','HyperparameterOptimizationOption',
...
    struct('AcquisitionFunctionName','expected-improvement-plus',...
    'ShowPlots',true));

ClassOrder1 = Mdl.ClassNames;

%% Testing Model Evaluation Process
[Label,Score] = predict(Mdl,X);
Accuracy = sum(predict(Mdl,X)== E)/length(E)*100;

%% Create Support Vector
%sv1 = Mdl.SupportVectors;

figure;
gscatter(X(:,1),X(:,2),Kondis,'br','xv')
xlabel('RMS')
ylabel('Standart Deviasi')
hold on
%plot(sv1(:,1),sv1(:,2))
title('Testing data');
legend('Cacat','Normal')
hold on
```

KLASIFIKASI CACAT LINTASAN DALAM BANTALAN BOLA BERBASIS SUPPORT VECTOR MACHINE (SVM) PADA FAN INDUSTRI

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