LAMPIRAN

Lampiran 1**:** *Script Matlab* Pengambilan Data Akusisi.

```
%Script to run data acquisition using National Instrument NI 9234
%Created: July 2018, Ikhsan Aprima Kausar

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 = 100.10E-3; %mV/g Type 4507B
serial:11165
%s.Channels(2).Sensitivity = 95.83E-3; %mV/g Type 4507B
serial:11026
%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=1:50

data = s.startForeground();            % start recording vibration
data
data_ch1 = data(:,1);
%data_ch2 = data(:,2);
%data_ch3 = data(:,3);
%data_ch4 = data(:,4);
%data_ch5 = data(:,5);
%data_ch6 = data(:,6);

rootname = 'E:\Tugas_Akhir';       % drive tujuan dan nama file
extension = '.mat';                % ekstension utk nama file
namafile = [rootname,'Normal_',num2str(i),extension];
data_all = [data_ch1];
```

```
eval(['save ', namafile ,' data_all']);
pause(2)
pesan = ['Acquiring and saving data at loop number: ',num2str(i)];
disp(pesan)
end
```

Lampiran 2**:** *Script Matlab* Pengolahan Data Mentah Menjadi Plot Domain Waktu

```
clear
clc
%Direktori tempat data mentah getaran berada
load('E:\Data Tugas Akhir\2. Data Pakai\2. Testing Data\1.
Normal\Tugas_AkhirNormal1_15.mat')
y1=data_all(:,1); %diberi nama dengan variabel baru dan berbeda
untuk masing-masing variasi bukaan katup

load('E:\Data Tugas Akhir\2. Data Pakai\1. Training Data\2.
Kavitasi Level 1\Tugas_AkhirKavitasiLevel1_15.mat')
y2=data_all(:,1);

load('E:\Data Tugas Akhir\2. Data Pakai\2. Testing Data\3.
Kavitasi Level 2\Tugas_AkhirKavitasiLevel2_15.mat')
y3=data_all(:,1);

load('E:\Data Tugas Akhir\2. Data Pakai\1. Training Data\4.
Kavitasi Level 3\Tugas_AkhirKavitasiLevel3_15.mat')
y4=data_all(:,1);

% plot amplitude time domain
figure
subplot(5,1,1)
plot(y1(1:170660))
axis([0 5000 -5 5])
legend('Normal')
xlabel('Sampel')
ylabel('Amplitudo')


subplot(5,1,2)
plot(y2(1:170660),'r')
axis([0 5000 -5 5])
legend('Level 1')
xlabel('Sampel')
ylabel('Amplitudo')


subplot(5,1,3)
plot(y3(1:170660),'g')
axis([0 5000 -5 5])
legend('Level 2')
xlabel('Sampel')
ylabel('Amplitudo')
```

```
subplot(5,1,4)
plot(y4(1:170660),'b')
axis([0 5000 -5 5])
legend('Level 3')

xlabel('Sampel')
ylabel('Amplitudo')
```

Lampiran 3**:** *Script Matlab* Ekstraksi Parameter Statistik

```
clc
close all
clear

%Normal
for d=(1:250)
signal_in=['E:\Data Tugas Akhir\2. Data Pakai\1. Training Data\1.
Normal\Tugas_AkhirNormal1_',int2str(d),'.mat'];
load (signal_in)

a=data_all(:,1);
R(d)=rms(a);
S(d)=std(a);
P(d)=((max(abs(a))-min(abs(a)))/2);
K(d)=kurtosis(a);
V(d)=var(a);
C(d)=peak2rms(a);
M(d)=mean(a);
x=1:250;

%Kavitasi1
for di=(1:250)
signal_in=['E:\Data Tugas Akhir\2. Data Pakai\1. Training Data\2.
Kavitasi Level 1\Tugas_AkhirKavitasiLevel1_',int2str(di),'.mat'];
load (signal_in)

b=data_all(:,1);
R1(di)=rms(b);
S1(di)=std(b);
P1(di)=((max(abs(b))-min(abs(b)))/2);
K1(di)=kurtosis(b);
V1(di)=var(b);
C1(di)=peak2rms(b);
M1(di)=mean(b);
x1=1:250;

%kavitasi2
for dii=(1:250)
signal_in=['E:\Data Tugas Akhir\2. Data Pakai\1. Training Data\3.
Kavitasi Level 2\Tugas_AkhirKavitasiLevel2_',int2str(dii),'.mat'];
load (signal_in)
```

```
f=data_all(:,1);
R2(dii)=rms(f);
S2(dii)=std(f)
P2(dii)=((max(abs(f))-min(abs(f)))/2);
K2(dii)=kurtosis(f);
V2(dii)=var(f);
C2(dii)=peak2rms(f);
M2(dii)=mean(f);
x2=1:250;

%kavitasi3
for diii=(1:250)
signal_in=['E:\Data Tugas Akhir\2. Data Pakai\1. Training Data\4.
Kavitasi Level
3\Tugas_AkhirKavitasiLevel3_',int2str(diii),'.mat'];
load (signal_in)

e=data_all(:,1);
R3(diii)=rms(e);
S3(diii)=std(e);
P3(diii)=((max(abs(e))-min(abs(e)))/2);
K3(diii)=kurtosis(e);
V3(diii)=var(e);
C3(diii)=peak2rms(e);
M3(diii)=mean(e);
x3=1:250;

%R
figure
s=14;
c='r';
scatter(x,(R),s,c,'v');
hold on
s=14;
c='b';
scatter(x1,(R1),s,c,'x');
hold on
s=14;
c='g';
scatter(x2,(R2),s,c,'o');
hold on
s=14;
c='c';
scatter(x3,(R3),s,c,'+');

axis([0 250 0 1.5])
title('Grafik RMS')
xlabel('Sampel'),ylabel('Amplitudo')
legend ('Normal','Kavitasi1','Kavitasi2','Kavitasi3')

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

```
scatter(x,(S),s,c,'v');
hold on
s=14;
c='b';
scatter(x1,(S1),s,c,'x');
hold on
s=14;
c='g';
scatter(x2,(S2),s,c,'o');
hold on
s=14;
c='c';
scatter(x3,(S3),s,c,'+');

axis([0 250 0 1.5])
title('Grafik Standar Deviasi')
xlabel('Sampel'),ylabel('Amplitudo')
legend ('Normal','Kavitasi1','Kavitasi2','Kavitasi3')

%P
figure
s=14;
c='r';
scatter(x,(P),s,c,'v');
hold on
s=14;
c='b';
scatter(x1,(P1),s,c,'x');
hold on
s=14;
c='g';
scatter(x2,(P2),s,c,'o');
hold on
s=14;
c='c';
scatter(x3,(P3),s,c,'+');

axis([0 250 0 3.5])
title('Grafik Peak Value')
xlabel('Sampel'),ylabel('Amplitudo')
legend ('Normal','Kavitasi1','Kavitasi2','Kavitasi3')

%K
figure
s=14;
c='r';
scatter(x,(K),s,c,'v');
hold on
s=14;
c='b';
scatter(x1,(K1),s,c,'x');
hold on
s=14;
c='g';
scatter(x2,(K2),s,c,'o');
hold on
```

```
s=14;
c='c';
scatter(x3,(K3),s,c,'+');

axis([0 250 2.5 4])
title('Grafik Kurtosis')
xlabel('Sampel'),ylabel('Amplitudo')
legend ('Normal','Kavitasi1','Kavitasi2','Kavitasi3')

%V
figure
s=14;
c='r';
scatter(x,(V),s,c,'v');
hold on
s=14;
c='b';
scatter(x1,(V1),s,c,'x');
hold on
s=14;
c='g';
scatter(x2,(V2),s,c,'o');
hold on
s=14;
c='c';
scatter(x3,(V3),s,c,'+');

axis([0 250 0 2])
title('Grafik Varians')
xlabel('Sampel'),ylabel('Amplitudo')
legend ('Normal','Kavitasi1','Kavitasi2','Kavitasi3')

%C
figure
s=14;
c='r';
scatter(x,(C),s,c,'v');
hold on
s=14;
c='b';
scatter(x1,(C1),s,c,'x');
hold on
s=14;
c='g';
scatter(x2,(C2),s,c,'o');
hold on
s=14;
c='c';
scatter(x3,(C3),s,c,'+');

axis([0 250 4 6])
title('Grafik Crest Factor')
xlabel('Sampel'),ylabel('Amplitudo')
legend ('Normal','Kavitasi1','Kavitasi2','Kavitasi3')
```

```
%M
figure
s=9;
c='r';
scatter(x,(M),s,c,'v');
hold on
s=9;
c='b';
scatter(x1,(M1),s,c,'x');
hold on
s=9;
c='g';
scatter(x2,(M2),s,c,'o');
hold on
s=9;
c='c';
scatter(x3,(M3),s,c,'+');

axis([0 250 -0.01 0.01])
title('Grafik Mean')
xlabel('Sampel'),ylabel('Amplitudo')
legend ('Normal','Kavitasi1','Kavitasi2','Kavitasi3')
```

Lampiran 4**:** *Script Matlab Principal Component Analysis (PCA)*

```
vector_ch1234(:,:,1)=Normaltrai;
vector_ch1234(:,:,2)=Kavitasi1trai;
vector_ch1234(:,:,3)=Kavitasi2trai;
vector_ch1234(:,:,4)=Kavitasi3trai;
for i=1:4
eval (
['[LOADING_ch',int2str(i),',SCORE_ch',int2str(i),',latent_ch',int2
str(i),',T2_ch',int2str(i),']
=princomp(zscore(vector_ch1234(:,:,',int2str(i),')));']);
eval ( [
'[norm_vector_ch1234(:,:,',int2str(i),'),MU(i,:),SIGMA(i,:)]=
zscore(vector_ch1234(:,:,',int2str(i),'));' ])
eval ( ['loading(:,:,',int2str(i),')=LOADING_ch',int2str(i),';'])
eval ( ['score(:,:,',int2str(i),')=SCORE_ch',int2str(i),';'])
eval ( ['latent(:,',int2str(i),')=latent_ch',int2str(i),';'])

end

 figure()
pareto(LATENT)
xlabel('Principal Component')
ylabel('Variance Explained (%)')
```