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# LAMPIRAN I

## CODING MATLAB PENGOLAHAN DATA EKSPERIMEN DAN NUMERIK

```
clear
close all
clc

warning off
filename = uigetfile('.xls','pilihfile');
A        = xlsread(filename);
t        = A(2:end,1); %waktu letakan di kolom 1
f        = A(2:end,2); %data roll letakan di kolom 2
k        = (1:length(t));

%--------inclinometer
sfr      = 100; %frekuensi 100 Hz

%--Cut Grafik
figure(1)
subplot(2,1,1)
plot(k,f);grid

[xx,yy]    = ginput(2);
BatasBawah = max(round(xx(1)),1);
BatasAtas  = min(round(xx(2)),length(f));
K          = BatasBawah:BatasAtas;
lenk       = length(K);
yf         = f(K);
tf         = 1:lenk;
plot(k,f,K,yf,'r');grid

subplot (2,1,2)
plot(tf,yf,'r');grid

%filter data utuk membuat grafik lebih halus
fil        = ones(1,8)/8;
afix       = filtfilt(fil,1,yf);
afil       = afix-mean(afix);

figure(2);
subplot (2,1,1)
plot(k,f,k(K),afil,'r');grid
subplot (2,1,2)
plot(afil,'r');grid

%zero upcrossing -
jup      = find((afil(1:lenk-1)<0)&(afil(2:lenk)>0));
njup     = length(jup); %jumlah upcrossing
nwave    = njup-1;  %mencari banyak gelombang
xf1      = k(jup)+afil(jup)'./(afil(jup)'-afil(1+jup)');
T1       = diff(xf1);
```

```
T        = T1/sfr;
Tn       = mean(T) %periode natural
%Tx      = mean(Tx);
Am       = max(afil) %amplitudo awal
Amin     = min(afil)

for ii = 1:nwave
    jj                    = [jup(ii):jup(ii+1)];
    [y2max(ii),x2max(ii)] = max(afil(jj));
    [y2min(ii),x2min(ii)] = min(afil(jj));
end

Q = [y2max',y2min']; %y2max nilai diatas titik nol, y2min nilai dibawah titik nol
%--------
for i = 1:length(Q)
    pmax     = find(afil==y2max(i));
    pmaxi(i) = pmax(end);
    pmin     = find(afil==y2min(i));
    pmini(i) = pmin(end);
end
%--------

%positif
qp   = Q(:,1);
qmp  = abs(qp(1:end-1)+qp(2:end))/2;
dqmp = abs(qp(1:end-1)-qp(2:end));

%negatif
qn   = Q(:,2);
qmn  = abs(qn(1:end-1)+qn(2:end))/2;
dqmn = abs(qn(1:end-1)-qn(2:end));

y0   = y2max(1);
yn   = y2max(end);
py0  = find(y2max==y0);
n    = length (y2max)-py0;
d    = 1/n*log(y0/yn);
s    = 1/sqrt(1+(2*pi/d)^2); %damping ratio

figure(3)
subplot(2,2,[1 2]);
plot(tf,afil,tf(pmaxi),y2max,'o',tf(pmini),y2min,'o');grid
text(10,1.2,['Tn = ',num2str(Tn),' sec, Damp.ratio = ',num2str(s)]);

%linear damping
X    = 0:0.25:5;
p1   = polyfit(qmp,dqmp./qmp,1);
```

```
a    = p1(1); b    = p1(2); % y = ax + b
Y    = a*X+b;

%figure(4)
subplot(2,2,3)
h    = plot (qmp,dqmp./qmp,'ko',X,Y,'k-');
pn   = {'linewidth'};
pv   = {2};

set(h,pn,pv);
set(gca,'FontWeight','bold','FontSize',12,'LineWidth',2);
grid;xlabel('\phi_m','FontWeight','bold','FontSize',14);
ylabel('\Delta\theta / \theta_m','FontWeight','bold','FontSize',14);
text(2,0.22,['y =',num2str(b),'+',num2str(a),'x']);

%quadratic damping
p2  = polyfit([qmp;qmn;0],[dqmp;dqmn;0],2);
a   = p2(2); b = p2(1);
Y   = b*X.^2 + a*X; % y = bx^2 + ax

Nm  = dqmp./qmp.^2;
Nmn = dqmn./qmn.^2;
N   = a./X(2:end) + b;

%figure(5)
subplot(2,2,4)
h   = plot(qmp,dqmp,'ko',qmn,dqmn,'ks',X,Y,'k-');
pn  = {'Linewidth'};
pv  = {2};

set(h,pn,pv);
set(gca,'FontWeight','bold','FontSize',12,'LineWidth',2);
legend('maxima','minima');
grid;xlabel('\phi_m','FontWeight','bold','FontSize',14);
ylabel('\Delta\phi / \phi_m','FontWeight','bold','FontSize',14);
text(2,1,['y =',num2str(b),'+',num2str(a),'x']);

XY  = [X',Y'];
XN  = [(X(2:end))',N'];
qmqmndqmdqmnNmNmn = [qmp,qmn,dqmp,dqmn,Nm,Nmn];
```