**1-Line To Ground:**

clear;

clc;

close all;

a= cos(2\*pi/3)+ sin(2\*pi/3)\*1i ;a2 =cos(4\*pi/3)+1i\*sin(4\*pi/3) ;

f\_sampling=1600;

fo=50;

N=f\_sampling/fo;

theta= 2\*pi/N;

% For Wave Current

Delta\_T=1/f\_sampling;

DATA=load('66-L-G.MAT');

T=DATA.t;

S\_a=DATA.iI66baX0015a;

S\_b=DATA.iI66bbX0015b;

S\_c=DATA.iI66bcX0015c;

%For Wave Voltage

S\_A=DATA.vV66bba;

S\_B=DATA.vV66bbb;

S\_C=DATA.vV66bbc;

%Fundamental Basis Functions

cof\_cos=cos(theta\*(0:(320)));

cof\_sin=sin(theta\*(0:(320)));

% DFT for Current

window\_a=zeros(1,N);

Real\_aOld=0;

Imag\_aOld=0;

for kk=1:321

S\_aold=window\_a(N);

S\_anew=S\_a(kk);

for n\_w=N:-1:2

window\_a(n\_w)=window\_a(n\_w-1); % sliding for the window

end

window\_a(1)=S\_a(kk);

Real\_a(kk)=Real\_aOld+(S\_anew-S\_aold)\*cof\_cos(kk)\*2/N;

Imag\_a(kk)=Imag\_aOld+(S\_anew-S\_aold)\*cof\_sin(kk)\*2/N;

Amp\_a(kk)=sqrt(Real\_a(kk)^2+Imag\_a(kk)^2);

Ang\_a(kk)=atan2(Real\_a(kk),Imag\_a(kk))\*180/pi;

Real\_aOld=Real\_a(kk);

Imag\_aOld=Imag\_a(kk);

end

window\_b=zeros(1,N);

Real\_bOld=0;

Imag\_bOld=0;

for kk=1:321

S\_bold=window\_b(N);

S\_bnew=S\_b(kk);

for n\_w=N:-1:2

window\_b(n\_w)=window\_b(n\_w-1); % sliding for the window

end

window\_b(1)=S\_b(kk);

Real\_b(kk)=Real\_bOld+(S\_bnew-S\_bold)\*cof\_cos(kk)\*2/N;

Imag\_b(kk)=Imag\_bOld+(S\_bnew-S\_bold)\*cof\_sin(kk)\*2/N;

Amp\_b(kk)=sqrt(Real\_b(kk)^2+Imag\_b(kk)^2);

Ang\_b(kk)=atan2(Real\_b(kk),Imag\_b(kk))\*180/pi;

Real\_bOld=Real\_b(kk);

Imag\_bOld=Imag\_b(kk);

end

window\_c=zeros(1,N);

Real\_cOld=0;

Imag\_cOld=0;

for kk=1:321

S\_cold=window\_c(N);

S\_cnew=S\_c(kk);

for n\_w=N:-1:2

window\_c(n\_w)=window\_c(n\_w-1); % sliding for the window

end

window\_c(1)=S\_c(kk);

Real\_c(kk)=Real\_cOld+(S\_cnew-S\_cold)\*cof\_cos(kk)\*2/N;

Imag\_c(kk)=Imag\_cOld+(S\_cnew-S\_cold)\*cof\_sin(kk)\*2/N;

Amp\_c(kk)=sqrt(Real\_c(kk)^2+Imag\_c(kk)^2);

Ang\_c(kk)=atan2(Real\_c(kk),Imag\_c(kk))\*180/pi;

Real\_cOld=Real\_c(kk);

Imag\_cOld=Imag\_c(kk);

end

% DFT For Voltage

window\_A=zeros(1,N);

Real\_AOld=0;

Imag\_AOld=0;

for kk=1:321

S\_Aold=window\_A(N);

S\_Anew=S\_A(kk);

for n\_w=N:-1:2

window\_A(n\_w)=window\_A(n\_w-1); % sliding for the window

end

window\_A(1)=S\_A(kk);

Real\_A(kk)=Real\_AOld+(S\_Anew-S\_Aold)\*cof\_cos(kk)\*2/N;

Imag\_A(kk)=Imag\_AOld+(S\_Anew-S\_Aold)\*cof\_sin(kk)\*2/N;

Amp\_A(kk)=sqrt(Real\_A(kk)^2+Imag\_A(kk)^2);

Ang\_A(kk)=atan2(Real\_A(kk),Imag\_A(kk))\*180/pi;

Real\_AOld=Real\_A(kk);

Imag\_AOld=Imag\_A(kk);

end

window\_B=zeros(1,N);

Real\_BOld=0;

Imag\_BOld=0;

for kk=1:321

S\_Bold=window\_B(N);

S\_Bnew=S\_B(kk);

for n\_w=N:-1:2

window\_B(n\_w)=window\_B(n\_w-1); % sliding for the window

end

window\_B(1)=S\_B(kk);

Real\_B(kk)=Real\_BOld+(S\_Bnew-S\_Bold)\*cof\_cos(kk)\*2/N;

Imag\_B(kk)=Imag\_BOld+(S\_Bnew-S\_Bold)\*cof\_sin(kk)\*2/N;

Amp\_B(kk)=sqrt(Real\_B(kk)^2+Imag\_B(kk)^2);

Ang\_B(kk)=atan2(Real\_B(kk),Imag\_B(kk))\*180/pi;

Real\_BOld=Real\_B(kk);

Imag\_BOld=Imag\_B(kk);

end

window\_C=zeros(1,N);

Real\_COld=0;

Imag\_COld=0;

for kk=1:321

S\_Cold=window\_C(N);

S\_Cnew=S\_C(kk);

for n\_w=N:-1:2

window\_C(n\_w)=window\_C(n\_w-1); % sliding for the window

end

window\_C(1)=S\_C(kk);

Real\_C(kk)=Real\_COld+(S\_Cnew-S\_Cold)\*cof\_cos(kk)\*2/N;

Imag\_C(kk)=Imag\_COld+(S\_Cnew-S\_Cold)\*cof\_sin(kk)\*2/N;

Amp\_C(kk)=sqrt(Real\_C(kk)^2+Imag\_C(kk)^2);

Ang\_C(kk)=atan2(Real\_C(kk),Imag\_C(kk))\*180/pi;

Real\_COld=Real\_C(kk);

Imag\_COld=Imag\_C(kk);

end

% Seq. Compantant for Current

S\_a\_dft = Amp\_a.\*exp(i\*Ang\_a\*pi/180) ;

S\_b\_dft = Amp\_b.\*exp(i\*Ang\_b\*pi/180) ;

S\_c\_dft = Amp\_c.\*exp(i\*Ang\_c\*pi/180) ;

S0\_seq = (S\_a\_dft+ S\_b\_dft+S\_c\_dft)/3;

S1\_seq = (S\_a\_dft+a\* S\_b\_dft+a2\*S\_c\_dft)/3;

S2\_seq = (S\_a\_dft+a2\* S\_b\_dft+a\* S\_c\_dft)/3;

Ang0=angle(S0\_seq)\*180/pi;

Ang1=angle(S1\_seq)\*180/pi;

Ang2=angle(S2\_seq)\*180/pi;

% Seq. Compantant for Voltage

S\_A\_dft = Amp\_A.\*exp(i\*Ang\_A\*pi/180) ;

S\_B\_dft = Amp\_B.\*exp(i\*Ang\_B\*pi/180) ;

S\_C\_dft = Amp\_C.\*exp(i\*Ang\_C\*pi/180) ;

S00\_seq = (S\_A\_dft+ S\_B\_dft+S\_C\_dft)/3;

S11\_seq = (S\_A\_dft+a\* S\_B\_dft+a2\*S\_C\_dft)/3;

S22\_seq = (S\_A\_dft+a2\* S\_B\_dft+a\* S\_C\_dft)/3;

Ang00=angle(S00\_seq)\*180/pi;

Ang11=angle(S11\_seq)\*180/pi;

Ang22=angle(S22\_seq)\*180/pi;

figure(1);

plot(T,S\_a,T,S\_b,T,S\_c);

title('Two cycles of Signal s(t)')

xlabel('s(t)');

ylabel('time (sec.)');

figure(2)

plot(T,Amp\_a,T,Amp\_b,T,Amp\_c,'linewidth',2)

title('DFT of the magnuite of Current Prob');

figure(3)

plot(T,Ang\_a,T,Ang\_b,T,Ang\_c,'linewidth',2)

title('DFT of the angle of Current Prob');

figure(4)

plot(T,abs(S0\_seq),T,abs(S1\_seq),T,abs(S2\_seq),'linewidth',2);

xlabel('T(sec.)'); ylabel('magnetuite of Seq. Companant');

title('Magnuite of Seq. Compantant of Current Prob');

figure(5)

plot(T,Ang0,T,Ang1,T,Ang2,'linewidth',2)

xlabel('T(sec.)'); ylabel('Angle of Seq. companant ');

title('Angle of Seq. Compantant of Current Prob');

figure(6)

plot(T,S\_A,T,S\_B,T,S\_C)

figure(7)

plot(T,Amp\_A,T,Amp\_B,T,Amp\_C,'linewidth',2)

title('DFT of the magnuite of Voltage Prob');

figure(8)

plot(T,Ang\_A,T,Ang\_B,T,Ang\_C,'linewidth',2)

title('DFT of the angle of Voltage Prob');

figure(9)

plot(T,abs(S00\_seq),T,abs(S11\_seq),T,abs(S22\_seq),'linewidth',2)

title('Magnuite of Seq. Compantant of Voltage Prob');

xlabel('T(sec.)'); ylabel('Voltage (volt)');

figure(10)

plot(T,Ang00,T,Ang11,T,Ang22,'linewidth',2)

title('Angle of Seq. Compantant of Voltage Prob');

xlabel('T(sec.)'); ylabel('Angle (degree) ');

figure(18);

plot(T,S\_a,T,S\_A);

%Amp\_a is value of magnuite of phase "a" of Current Prob

%Amp\_b is value of magnuite of phase "b" of Current Prob

%Amp\_c is value of magnuite of phase "c" of Current Prob

%Ang\_a is value of angle of phase "a" of Current Prob

%Ang\_b is value of angle of phase "b" of Current Prob

%Ang\_c is value of angle of phase "c" of Current Prob

%abs(Amp0) is value of magnuite of zero seq. of Current Prob

%abs(Amp1) is value of magnuite of +ve seq. of Current Prob

%abs(Amp2) is value of magnuite of -ve seq. of Current Prob

%Ang0 is value of angle of zero seq. of Current Prob

%Ang1 is value of angle of +ve seq. of Current Prob

%Ang2 is value of angle of -ve seq. of Current Prob

%%%

%Amp\_A is value of magnuite of phase "a" of Voltage Prob

%Amp\_B is value of magnuite of phase "b" of Voltage Prob

%Amp\_C is value of magnuite of phase "c" of Voltage Prob

%Ang\_A is value of angle of phase "a" of Voltage Prob

%Ang\_B is value of angle of phase "b" of Voltage Prob

%Ang\_C is value of angle of phase "c" of Voltage Prob

%abs(Amp00) is value of magnuite of zero seq. of Voltage Prob

%abs(Amp11) is value of magnuite of +ve seq. of Voltage Prob

%abs(Amp22) is value of magnuite of -ve seq. of Voltage Prob

%Ang00 is value of angle of zero seq. of Voltage Prob

%Ang11 is value of angle of +ve seq. of Voltage Prob

%Ang22 is value of angle of -ve seq. of Voltage Prob

% 2.13562E-01 8.35281E+02 2.00895E+05

% 6.98695E-02 2.40956E+02 2.78443E+05

% 7.76858E-02 2.98981E+02 2.92468E+05

% 2.13562E-01 8.35281E+02 2.00895E+05 66

% 6.90417E-02 2.41004E+02 2.78387E+05 66

% 2.03684E-01 7.60898E+02 2.09627E+05 220

% 6.38059E-02 3.07577E+02 2.86263E+05 220

l0=8.35281\*10^2/(2.00895\*10^5);

l1=2.41004\*10^2/(2.78387\*10^5);

z0=2.13562\*10^(-1)+314\*l0\*1i;

z1=6.90417\*10^(-2)+314\*l1\*1i;

M=(z0-z1)/z1;

I\_ax=S\_a\_dft + M\*S0\_seq;

Z1a=S\_A\_dft./I\_ax;

zto=z1\*90;

fault\_location=abs(Z1a)/abs(z1);

figure('Name','Z1a Magnitude');

plot(T,abs(Z1a),'linewidth',2);

title('Z1a Magnitude');

xlabel('time (second)')

ylabel('impedance (ohm)')

figure('Name','Z1a Angle');

plot(T,angle((Z1a)\*180/pi),'linewidth',2);

title('Z1a Angle');

xlabel('time (second)')

ylabel('angle (degree)')

I\_bx=S\_b\_dft + M\*S0\_seq;

Z1b=S\_B\_dft./I\_bx;

figure('Name','Z1b Magnitude');

plot(T,abs(Z1b),'linewidth',2);

title('Z1b Magnitude')

xlabel('time (second)')

ylabel('impedance (ohm)')

figure('Name','Z1b Angle');

plot(T,angle((Z1b)\*180/pi),'linewidth',2);

xlabel('time (second)')

ylabel('angle (degree)')

title('Z1b Angle');

I\_cx=S\_c\_dft + M\*S0\_seq;

Z1c=S\_C\_dft./I\_cx;

figure('Name','Z1c Magnitude');

plot(T,abs(Z1c),'linewidth',2);

xlabel('time (second)')

ylabel('impedance (ohm)')

title('Z1c Magnitude')

figure('Name','Z1c Angle');

plot(T,angle((Z1c)\*180/pi),'linewidth',2);

xlabel('time (second)')

ylabel('angle (degree)')

title('Z1c Angle');

figure('Name','Zone');

title('Zone');

chdist1(zto);

hold on

plot([real(Z1a(120:240))],[imag(Z1a(120:240))],'--','linewidth',2);

hold off

figure('Name','MHO Zone');

title('MHO Zone');

chdist(abs(zto),50);

hold on

plot([real(Z1a(120:240))],[imag(Z1a(120:240))],'--','linewidth',2);

hold off

fprintf('fault location is at around :%f km',fault\_location(240));

figure('Name','Both Zones');

title('Zone');

chdist1(zto);

hold on

plot([real(Z1a(120:240))],[imag(Z1a(120:240))],'--','linewidth',2);

hold on

chdist(abs(zto),50);

hold on

plot([real(Z1a(120:240))],[imag(Z1a(120:240))],'--','linewidth',2);

hold off

**2-Line To Line :**

clear;

clc;

close all;

a= cos(2\*pi/3)+ sin(2\*pi/3)\*1i ;a2 =cos(4\*pi/3)+1i\*sin(4\*pi/3) ;

f\_sampling=1600;

fo=50;

N=f\_sampling/fo;

theta= 2\*pi/N;

% For Wave Current

Delta\_T=1/f\_sampling;

DATA=load('66-L-L.MAT');

T=DATA.t;

S\_a=DATA.iI66baX0015a;

S\_b=DATA.iI66bbX0015b;

S\_c=DATA.iI66bcX0015c;

%For Wave Voltage

S\_A=DATA.vV66bba;

S\_B=DATA.vV66bbb;

S\_C=DATA.vV66bbc;

%Fundamental Basis Functions

cof\_cos=cos(theta\*(0:(320)));

cof\_sin=sin(theta\*(0:(320)));

% DFT for Current

window\_a=zeros(1,N);

Real\_aOld=0;

Imag\_aOld=0;

for kk=1:321

S\_aold=window\_a(N);

S\_anew=S\_a(kk);

for n\_w=N:-1:2

window\_a(n\_w)=window\_a(n\_w-1); % sliding for the window

end

window\_a(1)=S\_a(kk);

Real\_a(kk)=Real\_aOld+(S\_anew-S\_aold)\*cof\_cos(kk)\*2/N;

Imag\_a(kk)=Imag\_aOld+(S\_anew-S\_aold)\*cof\_sin(kk)\*2/N;

Amp\_a(kk)=sqrt(Real\_a(kk)^2+Imag\_a(kk)^2);

Ang\_a(kk)=atan2(Real\_a(kk),Imag\_a(kk))\*180/pi;

Real\_aOld=Real\_a(kk);

Imag\_aOld=Imag\_a(kk);

end

window\_b=zeros(1,N);

Real\_bOld=0;

Imag\_bOld=0;

for kk=1:321

S\_bold=window\_b(N);

S\_bnew=S\_b(kk);

for n\_w=N:-1:2

window\_b(n\_w)=window\_b(n\_w-1); % sliding for the window

end

window\_b(1)=S\_b(kk);

Real\_b(kk)=Real\_bOld+(S\_bnew-S\_bold)\*cof\_cos(kk)\*2/N;

Imag\_b(kk)=Imag\_bOld+(S\_bnew-S\_bold)\*cof\_sin(kk)\*2/N;

Amp\_b(kk)=sqrt(Real\_b(kk)^2+Imag\_b(kk)^2);

Ang\_b(kk)=atan2(Real\_b(kk),Imag\_b(kk))\*180/pi;

Real\_bOld=Real\_b(kk);

Imag\_bOld=Imag\_b(kk);

end

window\_c=zeros(1,N);

Real\_cOld=0;

Imag\_cOld=0;

for kk=1:321

S\_cold=window\_c(N);

S\_cnew=S\_c(kk);

for n\_w=N:-1:2

window\_c(n\_w)=window\_c(n\_w-1); % sliding for the window

end

window\_c(1)=S\_c(kk);

Real\_c(kk)=Real\_cOld+(S\_cnew-S\_cold)\*cof\_cos(kk)\*2/N;

Imag\_c(kk)=Imag\_cOld+(S\_cnew-S\_cold)\*cof\_sin(kk)\*2/N;

Amp\_c(kk)=sqrt(Real\_c(kk)^2+Imag\_c(kk)^2);

Ang\_c(kk)=atan2(Real\_c(kk),Imag\_c(kk))\*180/pi;

Real\_cOld=Real\_c(kk);

Imag\_cOld=Imag\_c(kk);

end

% DFT For Voltage

window\_A=zeros(1,N);

Real\_AOld=0;

Imag\_AOld=0;

for kk=1:321

S\_Aold=window\_A(N);

S\_Anew=S\_A(kk);

for n\_w=N:-1:2

window\_A(n\_w)=window\_A(n\_w-1); % sliding for the window

end

window\_A(1)=S\_A(kk);

Real\_A(kk)=Real\_AOld+(S\_Anew-S\_Aold)\*cof\_cos(kk)\*2/N;

Imag\_A(kk)=Imag\_AOld+(S\_Anew-S\_Aold)\*cof\_sin(kk)\*2/N;

Amp\_A(kk)=sqrt(Real\_A(kk)^2+Imag\_A(kk)^2);

Ang\_A(kk)=atan2(Real\_A(kk),Imag\_A(kk))\*180/pi;

Real\_AOld=Real\_A(kk);

Imag\_AOld=Imag\_A(kk);

end

window\_B=zeros(1,N);

Real\_BOld=0;

Imag\_BOld=0;

for kk=1:321

S\_Bold=window\_B(N);

S\_Bnew=S\_B(kk);

for n\_w=N:-1:2

window\_B(n\_w)=window\_B(n\_w-1); % sliding for the window

end

window\_B(1)=S\_B(kk);

Real\_B(kk)=Real\_BOld+(S\_Bnew-S\_Bold)\*cof\_cos(kk)\*2/N;

Imag\_B(kk)=Imag\_BOld+(S\_Bnew-S\_Bold)\*cof\_sin(kk)\*2/N;

Amp\_B(kk)=sqrt(Real\_B(kk)^2+Imag\_B(kk)^2);

Ang\_B(kk)=atan2(Real\_B(kk),Imag\_B(kk))\*180/pi;

Real\_BOld=Real\_B(kk);

Imag\_BOld=Imag\_B(kk);

end

window\_C=zeros(1,N);

Real\_COld=0;

Imag\_COld=0;

for kk=1:321

S\_Cold=window\_C(N);

S\_Cnew=S\_C(kk);

for n\_w=N:-1:2

window\_C(n\_w)=window\_C(n\_w-1); % sliding for the window

end

window\_C(1)=S\_C(kk);

Real\_C(kk)=Real\_COld+(S\_Cnew-S\_Cold)\*cof\_cos(kk)\*2/N;

Imag\_C(kk)=Imag\_COld+(S\_Cnew-S\_Cold)\*cof\_sin(kk)\*2/N;

Amp\_C(kk)=sqrt(Real\_C(kk)^2+Imag\_C(kk)^2);

Ang\_C(kk)=atan2(Real\_C(kk),Imag\_C(kk))\*180/pi;

Real\_COld=Real\_C(kk);

Imag\_COld=Imag\_C(kk);

end

% Seq. Compantant for Current

S\_a\_dft = Amp\_a.\*exp(i\*Ang\_a\*pi/180) ;

S\_b\_dft = Amp\_b.\*exp(i\*Ang\_b\*pi/180) ;

S\_c\_dft = Amp\_c.\*exp(i\*Ang\_c\*pi/180) ;

S0\_seq = (S\_a\_dft+ S\_b\_dft+S\_c\_dft)/3;

S1\_seq = (S\_a\_dft+a\* S\_b\_dft+a2\*S\_c\_dft)/3;

S2\_seq = (S\_a\_dft+a2\* S\_b\_dft+a\* S\_c\_dft)/3;

Ang0=angle(S0\_seq)\*180/pi;

Ang1=angle(S1\_seq)\*180/pi;

Ang2=angle(S2\_seq)\*180/pi;

% Seq. Compantant for Voltage

S\_A\_dft = Amp\_A.\*exp(i\*Ang\_A\*pi/180) ;

S\_B\_dft = Amp\_B.\*exp(i\*Ang\_B\*pi/180) ;

S\_C\_dft = Amp\_C.\*exp(i\*Ang\_C\*pi/180) ;

S00\_seq = (S\_A\_dft+ S\_B\_dft+S\_C\_dft)/3;

S11\_seq = (S\_A\_dft+a\* S\_B\_dft+a2\*S\_C\_dft)/3;

S22\_seq = (S\_A\_dft+a2\* S\_B\_dft+a\* S\_C\_dft)/3;

Ang00=angle(S00\_seq)\*180/pi;

Ang11=angle(S11\_seq)\*180/pi;

Ang22=angle(S22\_seq)\*180/pi;

figure(1);

plot(T,S\_a,T,S\_b,T,S\_c);

title('Two cycles of Signal s(t)')

xlabel('s(t)');

ylabel('time (sec.)');

figure(2)

plot(T,Amp\_a,T,Amp\_b,T,Amp\_c)

title('DFT of the magnuite of Current Prob');

figure(3)

plot(T,Ang\_a,T,Ang\_b,T,Ang\_c)

title('DFT of the angle of Current Prob');

figure(4)

plot(T,abs(S0\_seq),T,abs(S1\_seq),T,abs(S2\_seq));

xlabel('T(sec.)'); ylabel('magnetuite of Seq. Companant');

title('Magnuite of Seq. Compantant of Current Prob');

figure(5)

plot(T,Ang0,T,Ang1,T,Ang2)

xlabel('T(sec.)'); ylabel('Angle of Seq. companant ');

title('Angle of Seq. Compantant of Current Prob');

figure(6)

plot(T,S\_A,T,S\_B,T,S\_C)

figure(7)

plot(T,Amp\_A,T,Amp\_B,T,Amp\_C)

title('DFT of the magnuite of Voltage Prob');

figure(8)

plot(T,Ang\_A,T,Ang\_B,T,Ang\_C)

title('DFT of the angle of Voltage Prob');

figure(9)

plot(T,abs(S00\_seq),T,abs(S11\_seq),T,abs(S22\_seq))

title('Magnuite of Seq. Compantant of Voltage Prob');

xlabel('T(sec.)'); ylabel('Voltage (volt)');

figure(10)

plot(T,Ang00,T,Ang11,T,Ang22)

title('Angle of Seq. Compantant of Voltage Prob');

xlabel('T(sec.)'); ylabel('Angle (degree) ');

figure(18);

plot(T,S\_a,T,S\_A);

%Amp\_a is value of magnuite of phase "a" of Current Prob

%Amp\_b is value of magnuite of phase "b" of Current Prob

%Amp\_c is value of magnuite of phase "c" of Current Prob

%Ang\_a is value of angle of phase "a" of Current Prob

%Ang\_b is value of angle of phase "b" of Current Prob

%Ang\_c is value of angle of phase "c" of Current Prob

%abs(Amp0) is value of magnuite of zero seq. of Current Prob

%abs(Amp1) is value of magnuite of +ve seq. of Current Prob

%abs(Amp2) is value of magnuite of -ve seq. of Current Prob

%Ang0 is value of angle of zero seq. of Current Prob

%Ang1 is value of angle of +ve seq. of Current Prob

%Ang2 is value of angle of -ve seq. of Current Prob

%%%

%Amp\_A is value of magnuite of phase "a" of Voltage Prob

%Amp\_B is value of magnuite of phase "b" of Voltage Prob

%Amp\_C is value of magnuite of phase "c" of Voltage Prob

%Ang\_A is value of angle of phase "a" of Voltage Prob

%Ang\_B is value of angle of phase "b" of Voltage Prob

%Ang\_C is value of angle of phase "c" of Voltage Prob

%abs(Amp00) is value of magnuite of zero seq. of Voltage Prob

%abs(Amp11) is value of magnuite of +ve seq. of Voltage Prob

%abs(Amp22) is value of magnuite of -ve seq. of Voltage Prob

%Ang00 is value of angle of zero seq. of Voltage Prob

%Ang11 is value of angle of +ve seq. of Voltage Prob

%Ang22 is value of angle of -ve seq. of Voltage Prob

I\_a=Amp\_a.\*exp(i\*Ang\_a\*pi/180) ;

I\_b=Amp\_b.\*exp(i\*Ang\_b\*pi/180) ;

I\_c=Amp\_c.\*exp(i\*Ang\_c\*pi/180) ;

V\_a=Amp\_A.\*exp(i\*Ang\_A\*pi/180) ;

V\_b=Amp\_B.\*exp(i\*Ang\_B\*pi/180) ;

V\_c=Amp\_C.\*exp(i\*Ang\_C\*pi/180) ;

Z1ab=(V\_a-V\_b)./(I\_a-I\_b);

l1=2.40956\*10^2/(2.78443\*10^5);

z1=6.98695\*10^(-2)+314\*l1\*1i;

zto=z1\*90;

d1=sqrt((2.2\*abs(zto)+(-1.8\*(abs(zto)/2)\*tand(165)-1.8\*(abs(zto)/2)\*tand(75))/tand(75))^2+(0.4\*(abs(zto)/2)\*tand(165)+0.4\*(abs(zto)/2)\*tand(75))^2);

fault\_location=abs(Z1ab)/abs(z1);

figure('Name','Z1ab Magnitude');

plot(T,abs(Z1ab),'linewidth',2);

title('Z1ab Magnitude');

figure('Name','Z1ab Angle');

plot(T,angle(Z1ab),'linewidth',2);

title('Z1ab Angle');

Z1bc=(V\_b-V\_c)./(I\_b-I\_c);

figure('Name','Z1bc Magnitude');

plot(T,abs(Z1bc),'linewidth',2);

title('Z1bc Magnitude')

figure('Name','Z1bc Angle');

plot(T,angle(Z1bc),'linewidth',2);

title('Z1bc Angle');

Z1ca=(V\_c-V\_a)./(I\_c-I\_a);

figure('Name','Z1ca Magnitude');

plot(T,abs(Z1ca),'linewidth',2);

title('Z1ca Magnitude')

figure('Name','Z1ca Angle');

plot(T,angle(Z1ca),'linewidth',2);

title('Z1ca Angle');

figure('Name','Zone');

title('Zone');

chdist1(zto);

hold on

plot([real(Z1ab(120:240))],[imag(Z1ab(120:240))]);

hold off

figure('Name','MHO Zone');

title('MHO Zone');

chdist(abs(zto),angle(zto)\*180/pi);

hold on

plot([real(Z1ab(120:240))],[imag(Z1ab(120:240))]);

hold off

fprintf('fault location is at around :%f km',fault\_location(240));

figure('Name','Both Zones');

title('Both Zones');

chdist1(zto);

hold on

plot([real(Z1ab(120:240))],[imag(Z1ab(120:240))]);

hold on

chdist(abs(zto),angle(zto)\*180/pi);

hold on

plot([real(Z1ab(120:240))],[imag(Z1ab(120:240))]);

hold off

**Code of Function 1 (MHO characteristic):**

function chdist(Z,theta)

t=0:360;

X1=0.8\*(Z/2)\*cosd(theta)+0.8\*(Z/2)\*sind(t);

Y1=0.8\*(Z/2)\*sind(theta)+0.8\*(Z/2)\*cosd(t);

X2=1.2\*(Z/2)\*cosd(theta)+1.2\*(Z/2)\*sind(t);

Y2=1.2\*(Z/2)\*sind(theta)+1.2\*(Z/2)\*cosd(t);

X3=2.2\*(Z/2)\*cosd(theta)+2.2\*(Z/2)\*sind(t);

Y3=2.2\*(Z/2)\*sind(theta)+2.2\*(Z/2)\*cosd(t);

Xrad=2.2\*(Z/2)\*cosd(theta);

Yrad=2.2\*(Z/2)\*sind(theta);

Ymax=max([Y1,Y2,Y3]);

Xmax=max([X1,X2,X3]);

Ymin=min([Y1,Y2,Y3]);

Xmin=min([X1,X2,X3]);

plot(X1,Y1,'r','linewidth',2);

hold on

plot(X2,Y2,'g','linewidth',2);

hold on

plot(X3,Y3,'b','linewidth',2);

hold on

plot([Xmin,Xmax],[0,0],'linewidth',2);

hold on

plot([0,0],[Ymin,Ymax],'linewidth',2);

hold on

plot([0,2\*Xrad],2\*[0,Yrad],'linewidth',2);

axis equal;

**Code of Function 2 (Quadrilateral characteristic):**

function chdist1(Z)

Z=imag(Z);

X1=[0,2.2\*(Z/2),2.2\*Z+(-1.83\*(Z/2)\*tand(165)-1.83\*(Z/2)\*tand(75))/tand(75),-0.37\*(Z/2),0];

Y1=[0,2.2\*(Z/2)\*tand(165),0.37\*(Z/2)\*tand(165)+0.37\*(Z/2)\*tand(75),0.37\*(Z/2)\*tand(165)+0.37\*(Z/2)\*tand(75),0];

X2=[0,2.2\*(Z/2),2.2\*Z+(-1.65\*(Z/2)\*tand(165)-1.65\*(Z/2)\*tand(75))/tand(75),-0.55\*(Z/2),0];

Y2=[0,2.2\*(Z/2)\*tand(165),0.55\*(Z/2)\*tand(165)+0.55\*(Z/2)\*tand(75),0.55\*(Z/2)\*tand(165)+0.55\*(Z/2)\*tand(75),0];

X3=[0,2.2\*(Z/2),2.2\*Z+(-1.2\*(Z/2)\*tand(165)-1.2\*(Z/2)\*tand(75))/tand(75),-1\*(Z/2),0];

Y3=[0,2.2\*(Z/2)\*tand(165),1\*(Z/2)\*tand(165)+1\*(Z/2)\*tand(75),1\*(Z/2)\*tand(165)+1\*(Z/2)\*tand(75),0];

Ymax=max([Y1,Y2,Y3]);

Xmax=max([X1,X2,X3]);

Ymin=min([Y1,Y2,Y3]);

Xmin=min([X1,X2,X3]);

plot(X1,Y1,'r','linewidth',2);

hold on

plot(X2,Y2,'b','linewidth',2);

hold on

plot(X3,Y3,'k','linewidth',2);

plot([Xmin,Xmax],[0,0],'linewidth',2);

hold on

plot([0,0],2\*[Ymin,Ymax],'linewidth',2);

axis equal;

**Determining type of faults in MHO Characterstics:**

clear;

clc;

close all;

a= cos(2\*pi/3)+ sin(2\*pi/3)\*1i ;a2 =cos(4\*pi/3)+1i\*sin(4\*pi/3) ;

f\_sampling=1600;

fo=50;

N=f\_sampling/fo;

theta= 2\*pi/N;

% For Wave Current

Delta\_T=1/f\_sampling;

DATA=load('R3\_inter.MAT');

T=DATA.t;

S\_a=DATA.iI22aaV22aa;

S\_b=DATA.iI22abV22ab;

S\_c=DATA.iI22acV22ac;

%For Wave Voltage

S\_A=DATA.vV22aa;

S\_B=DATA.vV22ab;

S\_C=DATA.vV22ac;

%Fundamental Basis Functions

cof\_cos=cos(theta\*(0:(320)));

cof\_sin=sin(theta\*(0:(320)));

% DFT for Current

window\_a=zeros(1,N);

Real\_aOld=0;

Imag\_aOld=0;

for kk=1:321

S\_aold=window\_a(N);

S\_anew=S\_a(kk);

for n\_w=N:-1:2

window\_a(n\_w)=window\_a(n\_w-1); % sliding for the window

end

window\_a(1)=S\_a(kk);

Real\_a(kk)=Real\_aOld+(S\_anew-S\_aold)\*cof\_cos(kk)\*2/N;

Imag\_a(kk)=Imag\_aOld-(S\_anew-S\_aold)\*cof\_sin(kk)\*2/N;

Amp\_a(kk)=sqrt(Real\_a(kk)^2+Imag\_a(kk)^2);

Ang\_a(kk)=atan2(Imag\_a(kk),Real\_a(kk))\*180/pi;

Real\_aOld=Real\_a(kk);

Imag\_aOld=Imag\_a(kk);

end

window\_b=zeros(1,N);

Real\_bOld=0;

Imag\_bOld=0;

for kk=1:321

S\_bold=window\_b(N);

S\_bnew=S\_b(kk);

for n\_w=N:-1:2

window\_b(n\_w)=window\_b(n\_w-1); % sliding for the window

end

window\_b(1)=S\_b(kk);

Real\_b(kk)=Real\_bOld+(S\_bnew-S\_bold)\*cof\_cos(kk)\*2/N;

Imag\_b(kk)=Imag\_bOld-(S\_bnew-S\_bold)\*cof\_sin(kk)\*2/N;

Amp\_b(kk)=sqrt(Real\_b(kk)^2+Imag\_b(kk)^2);

Ang\_b(kk)=atan2(Imag\_b(kk),Real\_b(kk))\*180/pi;

Real\_bOld=Real\_b(kk);

Imag\_bOld=Imag\_b(kk);

end

window\_c=zeros(1,N);

Real\_cOld=0;

Imag\_cOld=0;

for kk=1:321

S\_cold=window\_c(N);

S\_cnew=S\_c(kk);

for n\_w=N:-1:2

window\_c(n\_w)=window\_c(n\_w-1); % sliding for the window

end

window\_c(1)=S\_c(kk);

Real\_c(kk)=Real\_cOld+(S\_cnew-S\_cold)\*cof\_cos(kk)\*2/N;

Imag\_c(kk)=Imag\_cOld-(S\_cnew-S\_cold)\*cof\_sin(kk)\*2/N;

Amp\_c(kk)=sqrt(Real\_c(kk)^2+Imag\_c(kk)^2);

Ang\_c(kk)=atan2(Imag\_c(kk),Real\_c(kk))\*180/pi;

Real\_cOld=Real\_c(kk);

Imag\_cOld=Imag\_c(kk);

end

% DFT For Voltage

window\_A=zeros(1,N);

Real\_AOld=0;

Imag\_AOld=0;

for kk=1:321

S\_Aold=window\_A(N);

S\_Anew=S\_A(kk);

for n\_w=N:-1:2

window\_A(n\_w)=window\_A(n\_w-1); % sliding for the window

end

window\_A(1)=S\_A(kk);

Real\_A(kk)=Real\_AOld+(S\_Anew-S\_Aold)\*cof\_cos(kk)\*2/N;

Imag\_A(kk)=Imag\_AOld-(S\_Anew-S\_Aold)\*cof\_sin(kk)\*2/N;

Amp\_A(kk)=sqrt(Real\_A(kk)^2+Imag\_A(kk)^2);

Ang\_A(kk)=atan2(Imag\_A(kk),Real\_A(kk))\*180/pi;

Real\_AOld=Real\_A(kk);

Imag\_AOld=Imag\_A(kk);

end

window\_B=zeros(1,N);

Real\_BOld=0;

Imag\_BOld=0;

for kk=1:321

S\_Bold=window\_B(N);

S\_Bnew=S\_B(kk);

for n\_w=N:-1:2

window\_B(n\_w)=window\_B(n\_w-1); % sliding for the window

end

window\_B(1)=S\_B(kk);

Real\_B(kk)=Real\_BOld+(S\_Bnew-S\_Bold)\*cof\_cos(kk)\*2/N;

Imag\_B(kk)=Imag\_BOld-(S\_Bnew-S\_Bold)\*cof\_sin(kk)\*2/N;

Amp\_B(kk)=sqrt(Real\_B(kk)^2+Imag\_B(kk)^2);

Ang\_B(kk)=atan2(Imag\_B(kk),Real\_B(kk))\*180/pi;

Real\_BOld=Real\_B(kk);

Imag\_BOld=Imag\_B(kk);

end

window\_C=zeros(1,N);

Real\_COld=0;

Imag\_COld=0;

for kk=1:321

S\_Cold=window\_C(N);

S\_Cnew=S\_C(kk);

for n\_w=N:-1:2

window\_C(n\_w)=window\_C(n\_w-1); % sliding for the window

end

window\_C(1)=S\_C(kk);

Real\_C(kk)=Real\_COld+(S\_Cnew-S\_Cold)\*cof\_cos(kk)\*2/N;

Imag\_C(kk)=Imag\_COld-(S\_Cnew-S\_Cold)\*cof\_sin(kk)\*2/N;

Amp\_C(kk)=sqrt(Real\_C(kk)^2+Imag\_C(kk)^2);

Ang\_C(kk)=atan2(Imag\_C(kk),Real\_C(kk))\*180/pi;

Real\_COld=Real\_C(kk);

Imag\_COld=Imag\_C(kk);

end

% Seq. Compantant for Current

S\_a\_dft = Amp\_a.\*exp(1i\*Ang\_a\*pi/180) ;

S\_b\_dft = Amp\_b.\*exp(1i\*Ang\_b\*pi/180) ;

S\_c\_dft = Amp\_c.\*exp(1i\*Ang\_c\*pi/180) ;

S0\_seq = (S\_a\_dft+ S\_b\_dft+S\_c\_dft)/3;

S1\_seq = (S\_a\_dft+a\* S\_b\_dft+a2\*S\_c\_dft)/3;

S2\_seq = (S\_a\_dft+a2\* S\_b\_dft+a\* S\_c\_dft)/3;

S0b\_seq = (S\_b\_dft+ S\_c\_dft+S\_a\_dft)/3;

S1b\_seq = (S\_b\_dft+a\* S\_c\_dft+a2\*S\_a\_dft)/3;

S2b\_seq = (S\_b\_dft+a2\* S\_c\_dft+a\* S\_a\_dft)/3;

S0c\_seq = (S\_c\_dft+ S\_a\_dft+S\_b\_dft)/3;

S1c\_seq = (S\_c\_dft+a\* S\_a\_dft+a2\*S\_b\_dft)/3;

S2c\_seq = (S\_c\_dft+a2\* S\_a\_dft+a\* S\_b\_dft)/3;

Ang0=angle(S0\_seq)\*180/pi;

Ang1=angle(S1\_seq)\*180/pi;

Ang2=angle(S2\_seq)\*180/pi;

% Seq. Compantant for Voltage

S\_A\_dft = Amp\_A.\*exp(1i\*Ang\_A\*pi/180) ;

S\_B\_dft = Amp\_B.\*exp(1i\*Ang\_B\*pi/180) ;

S\_C\_dft = Amp\_C.\*exp(1i\*Ang\_C\*pi/180) ;

S00\_seq = (S\_A\_dft+ S\_B\_dft+S\_C\_dft)/3;

S11\_seq = (S\_A\_dft+a\* S\_B\_dft+a2\*S\_C\_dft)/3;

S22\_seq = (S\_A\_dft+a2\* S\_B\_dft+a\* S\_C\_dft)/3;

Ang00=angle(S00\_seq)\*180/pi;

Ang11=angle(S11\_seq)\*180/pi;

Ang22=angle(S22\_seq)\*180/pi;

figure(1);

plot(T,S\_a,T,S\_b,T,S\_c,'linewidth',1.5);

title('Two cycles of Signal s(t)')

xlabel('s(t)');

ylabel('time (sec.)');

figure(2)

plot(T,Amp\_a,T,Amp\_b,T,Amp\_c,'linewidth',2)

title('DFT of the magnuite of Current Prob');

figure(3)

plot(T,Ang\_a,T,Ang\_b,T,Ang\_c,'linewidth',2)

title('DFT of the angle of Current Prob');

figure(4)

plot(T,abs(S0\_seq),T,abs(S1\_seq),T,abs(S2\_seq),'linewidth',2);

xlabel('T(sec.)'); ylabel('magnetuite of Seq. Companant');

title('Magnuite of Seq. Compantant of Current Prob');

legend('zero sequcence of current','positive sequcence of current','Nagatie sequcence of current');

figure(5)

plot(T,Ang0,T,Ang1,T,Ang2,'linewidth',2)

xlabel('T(sec.)'); ylabel('Angle of Seq. companant ');

title('Angle of Seq. Compantant of Current Prob');

legend('zero sequcence of current','positive sequcence of current','Nagatie sequcence of current');

figure(6)

plot(T,S\_A,T,S\_B,T,S\_C,'linewidth',1.5)

figure(7)

plot(T,Amp\_A,T,Amp\_B,T,Amp\_C,'linewidth',2)

title('DFT of the magnuite of Voltage Prob');

figure(8)

plot(T,Ang\_A,T,Ang\_B,T,Ang\_C,'linewidth',2)

title('DFT of the angle of Voltage Prob');

figure(9)

plot(T,abs(S00\_seq),T,abs(S11\_seq),T,abs(S22\_seq),'linewidth',2)

title('Magnuite of Seq. Compantant of Voltage Prob');

xlabel('T(sec.)'); ylabel('Voltage (volt)');

legend('zero sequcence of Voltage','positive sequcence of Voltage','Nagatie sequcence of Voltage')

figure(10)

plot(T,Ang00,T,Ang11,T,Ang22,'linewidth',2)

title('Angle of Seq. Compantant of Voltage Prob');

xlabel('T(sec.)'); ylabel('Angle (degree) ');

legend('zero sequcence of Voltage','positive sequcence of Voltage','Nagatie sequcence of Voltage')

figure(18);

plot(T,S\_a,T,S\_A);

l0=7.60898\*10^2/(2.09627\*10^5);

l1=3.07577\*10^2/(2.86263\*10^5);

z0=2.03684\*10^(-1)+314\*l0\*1i;

z1=6.38059\*10^(-2)+314\*l1\*1i;

M=(z0-z1)/z1;

I\_ax=S\_a\_dft + M\*S0\_seq;

Z1a=S\_A\_dft./I\_ax;

zto=z1\*140;

I\_bx=S\_b\_dft + M\*S0\_seq;

Z1b=S\_B\_dft./I\_bx;

I\_cx=S\_c\_dft + M\*S0\_seq;

Z1c=S\_C\_dft./I\_cx;

I\_a=Amp\_a.\*exp(1i\*Ang\_a\*pi/180) ;

I\_b=Amp\_b.\*exp(1i\*Ang\_b\*pi/180) ;

I\_c=Amp\_c.\*exp(1i\*Ang\_c\*pi/180) ;

V\_a=Amp\_A.\*exp(1i\*Ang\_A\*pi/180) ;

V\_b=Amp\_B.\*exp(1i\*Ang\_B\*pi/180) ;

V\_c=Amp\_C.\*exp(1i\*Ang\_C\*pi/180) ;

Z1ab=(V\_a-V\_b)./(I\_a-I\_b);

Z1bc=(V\_b-V\_c)./(I\_b-I\_c);

Z1ca=(V\_c-V\_a)./(I\_c-I\_a);

zto1=0.8\*zto;

zto2=1.2\*zto;

zto3=2.2\*zto;

fault\_location=zeros(1,18);

Zmc=zeros(18,length(Z1a));

if (abs(Z1a(240))<=abs(zto1)\*cos(angle(zto1)-angle(Z1a(240))))

Zmc(1,1:length(Z1a))=Z1a;

Zc=Z1a;

fault\_location(1)=abs(Zc(240))/abs(z1);

elseif (abs(Z1a(240))<=abs(zto2)\*cos(angle(zto1)-angle(Z1a(240))))

Zmc(2,1:length(Z1a))=Z1a;

Zc=Z1a;

fault\_location(2)=abs(Zc(240))/abs(z1);

elseif (abs(Z1a(240))<=abs(zto3)\*cos(angle(zto1)-angle(Z1a(240))))

Zmc(3,1:length(Z1a))=Z1a;

Zc=Z1a;

fault\_location(3)=abs(Zc(240))/abs(z1);

end

figure('Name','MHO Zone Z1a');

title('MHO Zone Z1a');

chdist(abs(zto),50);

hold on

plot([real(Z1a(120:240))],[imag(Z1a(120:240))],'--','linewidth',1.5);

hold off

if (abs(Z1b(240))<=abs(zto1)\*cos(angle(zto1)-angle(Z1b(240))))

Zmc(4,1:length(Z1b))=Z1b;

Zc=Z1b;

fault\_location(4)=abs(Zc(240))/abs(z1);

elseif (abs(Z1b(240))<=abs(zto2)\*cos(angle(zto1)-angle(Z1b(240))))

Zmc(5,1:length(Z1b))=Z1b;

Zc=Z1b;

fault\_location(5)=abs(Zc(240))/abs(z1);

elseif (abs(Z1b(240))<=abs(zto3)\*cos(angle(zto1)-angle(Z1b(240))))

Zmc(6,1:length(Z1b))=Z1b;

Zc=Z1b;

fault\_location(6)=abs(Zc(240))/abs(z1);

end

figure('Name','MHO Zone Z1b');

title('MHO Zone Z1b');

chdist(abs(zto),50);

hold on

plot([real(Z1b(120:240))],[imag(Z1b(120:240))],'--','linewidth',1.5);

hold off

if (abs(Z1c(240))<=abs(zto1)\*cos(angle(zto1)-angle(Z1c(240))))

Zmc(7,1:length(Z1c))=Z1c;

Zc=Z1c;

fault\_location(7)=abs(Zc(240))/abs(z1);

elseif (abs(Z1c(240))<=abs(zto2)\*cos(angle(zto1)-angle(Z1c(240))))

Zmc(8,1:length(Z1c))=Z1c;

Zc=Z1c;

fault\_location(8)=abs(Zc(240))/abs(z1);

elseif (abs(Z1c(240))<=abs(zto3)\*cos(angle(zto1)-angle(Z1c(240))))

Zmc(9,1:length(Z1c))=Z1c;

Zc=Z1c;

fault\_location(9)=abs(Zc(240))/abs(z1);

end

figure('Name','MHO Zone Z1c');

title('MHO Zone Z1c');

chdist(abs(zto),50);

hold on

plot([real(Z1c(120:240))],[imag(Z1c(120:240))],'--','linewidth',1.5);

hold off

if (abs(Z1ab(240))<=abs(zto1)\*cos(angle(zto1)-angle(Z1ab(240))))

Zmc(10,1:length(Z1ab))=Z1ab;

Zc=Z1ab;

fault\_location(10)=abs(Zc(240))/abs(z1);

elseif (abs(Z1ab(240))<=abs(zto2)\*cos(angle(zto1)-angle(Z1ab(240))))

Zmc(11,1:length(Z1ab))=Z1ab;

Zc=Z1ab;

fault\_location(11)=abs(Zc(240))/abs(z1);

elseif (abs(Z1ab(240))<=abs(zto3)\*cos(angle(zto1)-angle(Z1ab(240))))

Zmc(12,1:length(Z1ab))=Z1ab;

Zc=Z1ab;

fault\_location(12)=abs(Zc(240))/abs(z1);

end

figure('Name','MHO Zone Z1ab');

title('MHO Zone Z1ab');

chdist(abs(zto),50);

hold on

plot([real(Z1ab(120:240))],[imag(Z1ab(120:240))],'--','linewidth',1.5);

hold off

if (abs(Z1bc(240))<=abs(zto1)\*cos(angle(zto1)-angle(Z1bc(240))))

Zmc(13,1:length(Z1bc))=Z1bc;

Zc=Z1bc;

fault\_location(13)=abs(Zc(240))/abs(z1);

elseif (abs(Z1bc(240))<=abs(zto2)\*cos(angle(zto1)-angle(Z1bc(240))))

Zmc(14,1:length(Z1bc))=Z1bc;

Zc=Z1bc;

fault\_location(14)=abs(Zc(240))/abs(z1);

elseif (abs(Z1bc(240))<=abs(zto3)\*cos(angle(zto1)-angle(Z1bc(240))))

Zmc(15,1:length(Z1bc))=Z1bc;

Zc=Z1bc;

fault\_location(15)=abs(Zc(240))/abs(z1);

end

figure('Name','MHO Zone Z1bc');

title('MHO Zone Z1bc');

chdist(abs(zto),50);

hold on

plot([real(Z1bc(120:240))],[imag(Z1bc(120:240))],'--','linewidth',1.5);

hold off

if (abs(Z1ca(240))<=abs(zto1)\*cos(angle(zto1)-angle(Z1ca(240))))

Zmc(16,1:length(Z1ca))=Z1ca;

Zc=Z1ca;

fault\_location(16)=abs(Zc(240))/abs(z1);

elseif (abs(Z1ca(240))<=abs(zto2)\*cos(angle(zto1)-angle(Z1ca(240))))

Zmc(17,1:length(Z1ca))=Z1ca;

Zc=Z1ca;

fault\_location(17)=abs(Zc(240))/abs(z1);

elseif (abs(Z1ca(240))<=abs(zto3)\*cos(angle(zto1)-angle(Z1ca(240))))

Zmc(18,1:length(Z1ca))=Z1ca;

Zc=Z1ca;

fault\_location(18)=abs(Zc(240))/abs(z1);

end

figure('Name','MHO Zone Z1ca');

title('MHO Zone Z1ca');

chdist(abs(zto),50);

hold on

plot([real(Z1ca(120:240))],[imag(Z1ca(120:240))],'--','linewidth',1.5);

hold off

% the next part is a different method to calculate the fault zone it

% uses the circle equation and a square approximation to calculate whether

% the fault is in a zone or not unlike the other method which uses the

% polar equation of the circle this method works with 100% complete

% accuracy and it is comutationaly inefficien in comparison to the polar method

% xmax1=real(zto1)/2+sqrt((abs(zto1/2))^2-(0));

% xmax2=real(zto2)/2+sqrt((abs(zto2/2))^2-(0));

% xmax3=real(zto3)/2+sqrt((abs(zto3/2))^2-(0));

% xmin1=real(zto1)/2-sqrt((abs(zto1/2))^2-(0));

% xmin2=real(zto2)/2-sqrt((abs(zto2/2))^2-(0));

% xmin3=real(zto3)/2-sqrt((abs(zto3/2))^2-(0));

% ymax1=imag(zto1)/2+sqrt((abs(zto1/2))^2-(0));

% ymax2=imag(zto2)/2+sqrt((abs(zto2/2))^2-(0));

% ymax3=imag(zto3)/2+sqrt((abs(zto3/2))^2-(0));

% ymin1=imag(zto1)/2-sqrt((abs(zto1/2))^2-(0));

% ymin2=imag(zto2)/2-sqrt((abs(zto2/2))^2-(0));

% ymin3=imag(zto3)/2-sqrt((abs(zto3/2))^2-(0));

% ka=0;kb=0;kc=0;kc1=0;kc2=0;kc3=0;

% fault\_location=zeros(1,18);

% if ((real(Z1a(end))<=xmax3 && real(Z1a(end))>=xmin3 && imag(Z1a(end))<=ymax3 && imag(Z1a(end))>=ymin3 && real(Z1a(end))<=real(zto3)/2+sqrt((abs(zto3/2))^2-(imag(Z1a(end))-imag(zto3/2))^2) && real(Z1a(end))>=real(zto3)/2-sqrt((abs(zto3/2))^2-(imag(Z1a(end))-imag(zto3/2))^2)))

% if ((real(Z1a(end))<=xmax2 && real(Z1a(end))>=xmin2 && imag(Z1a(end))<=ymax2 && imag(Z1a(end))>=ymin2 && real(Z1a(end))<=real(zto2)/2+sqrt((abs(zto2/2))^2-(imag(Z1a(end))-imag(zto2/2))^2) && real(Z1a(end))>=real(zto2)/2-sqrt((abs(zto2/2))^2-(imag(Z1a(end))-imag(zto2/2))^2)))

% if ((real(Z1a(end))<=xmax1 && real(Z1a(end))>=xmin1 && imag(Z1a(end))<=ymax1 && imag(Z1a(end))>=ymin1)&& real(Z1a(end))<=real(zto1)/2+sqrt((abs(zto1/2))^2-(imag(Z1a(end))-imag(zto1/2))^2) && real(Z1a(end))>=real(zto1)/2-sqrt((abs(zto1/2))^2-(imag(Z1a(end))-imag(zto1/2))^2))

% Zmc(1,1:length(Z1a))=Z1a;

% Zc=Z1a;

% fault\_location(1)=abs(Zc(240))/abs(z1);

% end

% else

% Zmc(2,1:length(Z1a))=Z1a;

% Zc=Z1a;

% fault\_location(2)=abs(Zc(240))/abs(z1);

% end

% else

% Zmc(3,1:length(Z1a))=Z1a;

% Zc=Z1a;

% fault\_location(3)=abs(Zc(240))/abs(z1);

%

% end

% if ((real(Z1b(end))<=xmax3 && real(Z1b(end))>=xmin3 && imag(Z1b(end))<=ymax3 && imag(Z1b(end))>=ymin3 && real(Z1b(end))<=real(zto3)/2+sqrt((abs(zto3/2))^2-(imag(Z1b(end))-imag(zto3/2))^2) && real(Z1b(end))>=real(zto3)/2-sqrt((abs(zto3/2))^2-(imag(Z1b(end))-imag(zto3/2))^2)))

% if ((real(Z1b(end))<=xmax2 && real(Z1b(end))>=xmin2 && imag(Z1b(end))<=ymax2 && imag(Z1b(end))>=ymin2 && real(Z1b(end))<=real(zto2)/2+sqrt((abs(zto2/2))^2-(imag(Z1b(end))-imag(zto2/2))^2) && real(Z1b(end))>=real(zto2)/2-sqrt((abs(zto2/2))^2-(imag(Z1b(end))-imag(zto2/2))^2)))

% if ((real(Z1b(end))<=xmax1 && real(Z1b(end))>=xmin1 && imag(Z1b(end))<=ymax1 && imag(Z1b(end))>=ymin1)&& real(Z1b(end))<=real(zto1)/2+sqrt((abs(zto1/2))^2-(imag(Z1b(end))-imag(zto1/2))^2) && real(Z1b(end))>=real(zto1)/2-sqrt((abs(zto1/2))^2-(imag(Z1b(end))-imag(zto1/2))^2))

% Zmc(4,1:length(Z1a))=Z1b;

% Zc=Z1b;

% fault\_location(4)=abs(Zc(240))/abs(z1);

% end

% else

% Zmc(5,1:length(Z1a))=Z1b;

% Zc=Z1b;

% fault\_location(5)=abs(Zc(240))/abs(z1);

% end

% else

% Zmc(6,1:length(Z1a))=Z1b;

% Zc=Z1b;

% fault\_location(6)=abs(Zc(240))/abs(z1);

% end

% if ((real(Z1c(end))<=xmax3 && real(Z1c(end))>=xmin3 && imag(Z1c(end))<=ymax3 && imag(Z1c(end))>=ymin3 && real(Z1c(end))<=real(zto3)/2+sqrt((abs(zto3/2))^2-(imag(Z1c(end))-imag(zto3/2))^2) && real(Z1c(end))>=real(zto3)/2-sqrt((abs(zto3/2))^2-(imag(Z1c(end))-imag(zto3/2))^2)))

% if ((real(Z1c(end))<=xmax2 && real(Z1c(end))>=xmin2 && imag(Z1c(end))<=ymax2 && imag(Z1c(end))>=ymin2 && real(Z1c(end))<=real(zto2)/2+sqrt((abs(zto2/2))^2-(imag(Z1c(end))-imag(zto2/2))^2) && real(Z1c(end))>=real(zto2)/2-sqrt((abs(zto2/2))^2-(imag(Z1c(end))-imag(zto2/2))^2)))

% if ((real(Z1c(end))<=xmax1 && real(Z1c(end))>=xmin1 && imag(Z1c(end))<=ymax1 && imag(Z1c(end))>=ymin1)&& real(Z1c(end))<=real(zto1)/2+sqrt((abs(zto1/2))^2-(imag(Z1c(end))-imag(zto1/2))^2) && real(Z1c(end))>=real(zto1)/2-sqrt((abs(zto1/2))^2-(imag(Z1c(end))-imag(zto1/2))^2))

% Zmc(7,1:length(Z1a))=Z1c;

% Zc=Z1c;

% fault\_location(7)=abs(Zc(240))/abs(z1);

% end

%

% else

% Zmc(8,1:length(Z1a))=Z1c;

% Zc=Z1c;

% fault\_location(8)=abs(Zc(240))/abs(z1);

% end

% else

% Zmc(9,1:length(Z1a))=Z1c;

% Zc=Z1c;

% fault\_location(9)=abs(Zc(240))/abs(z1);

% end

% if ((real(Z1ab(end))<=xmax3 && real(Z1ab(end))>=xmin3 && imag(Z1ab(end))<=ymax3 && imag(Z1ab(end))>=ymin3 && real(Z1ab(end))<=real(zto3)/2+sqrt((abs(zto3/2))^2-(imag(Z1ab(end))-imag(zto3/2))^2) && real(Z1ab(end))>=real(zto3)/2-sqrt((abs(zto3/2))^2-(imag(Z1ab(end))-imag(zto3/2))^2)))

% if ((real(Z1ab(end))<=xmax2 && real(Z1ab(end))>=xmin2 && imag(Z1ab(end))<=ymax2 && imag(Z1ab(end))>=ymin2 && real(Z1ab(end))<=real(zto2)/2+sqrt((abs(zto2/2))^2-(imag(Z1ab(end))-imag(zto2/2))^2) && real(Z1ab(end))>=real(zto2)/2-sqrt((abs(zto2/2))^2-(imag(Z1ab(end))-imag(zto2/2))^2)))

% if ((real(Z1ab(end))<=xmax1 && real(Z1ab(end))>=xmin1 && imag(Z1ab(end))<=ymax1 && imag(Z1ab(end))>=ymin1)&& real(Z1ab(end))<=real(zto1)/2+sqrt((abs(zto1/2))^2-(imag(Z1ab(end))-imag(zto1/2))^2) && real(Z1ab(end))>=real(zto1)/2-sqrt((abs(zto1/2))^2-(imag(Z1ab(end))-imag(zto1/2))^2))

% Zmc(10,1:length(Z1a))=Z1ab;

% Zc=Z1ab;

% fault\_location(10)=abs(Zc(240))/abs(z1);

% end

%

% else

% Zmc(11,1:length(Z1a))=Z1ab;

% Zc=Z1ab;

% fault\_location(11)=abs(Zc(240))/abs(z1);

% end

% else

% Zmc(12,1:length(Z1a))=Z1ab;

% Zc=Z1ab;

% fault\_location(12)=abs(Zc(240))/abs(z1);

% end

% if ((real(Z1bc(end))<=xmax3 && real(Z1bc(end))>=xmin3 && imag(Z1bc(end))<=ymax3 && imag(Z1bc(end))>=ymin3 && real(Z1bc(end))<=real(zto3)/2+sqrt((abs(zto3/2))^2-(imag(Z1bc(end))-imag(zto3/2))^2) && real(Z1bc(end))>=real(zto3)/2-sqrt((abs(zto3/2))^2-(imag(Z1bc(end))-imag(zto3/2))^2)))

% if ((real(Z1bc(end))<=xmax2 && real(Z1bc(end))>=xmin2 && imag(Z1bc(end))<=ymax2 && imag(Z1bc(end))>=ymin2 && real(Z1bc(end))<=real(zto2)/2+sqrt((abs(zto2/2))^2-(imag(Z1bc(end))-imag(zto2/2))^2) && real(Z1bc(end))>=real(zto2)/2-sqrt((abs(zto2/2))^2-(imag(Z1bc(end))-imag(zto2/2))^2)))

% if ((real(Z1bc(end))<=xmax1 && real(Z1bc(end))>=xmin1 && imag(Z1bc(end))<=ymax1 && imag(Z1bc(end))>=ymin1)&& real(Z1bc(end))<=real(zto1)/2+sqrt((abs(zto1/2))^2-(imag(Z1bc(end))-imag(zto1/2))^2) && real(Z1bc(end))>=real(zto1)/2-sqrt((abs(zto1/2))^2-(imag(Z1bc(end))-imag(zto1/2))^2))

% Zmc(13,1:length(Z1a))=Z1bc;

% Zc=Z1bc;

% fault\_location(13)=abs(Zc(240))/abs(z1);

% end

%

% else

% Zmc(14,1:length(Z1a))=Z1bc;

% Zc=Z1bc;

% fault\_location(14)=abs(Zc(240))/abs(z1);

% end

% else

% Zmc(15,1:length(Z1a))=Z1bc;

% Zc=Z1bc;

% fault\_location(15)=abs(Zc(240))/abs(z1);

% end

% if ((real(Z1ca(end))<=xmax3 && real(Z1ca(end))>=xmin3 && imag(Z1ca(end))<=ymax3 && imag(Z1ca(end))>=ymin3 && real(Z1ca(end))<=real(zto3)/2+sqrt((abs(zto3/2))^2-(imag(Z1ca(end))-imag(zto3/2))^2) && real(Z1ca(end))>=real(zto3)/2-sqrt((abs(zto3/2))^2-(imag(Z1ca(end))-imag(zto3/2))^2)))

% if ((real(Z1ca(end))<=xmax2 && real(Z1ca(end))>=xmin2 && imag(Z1ca(end))<=ymax2 && imag(Z1ca(end))>=ymin2 && real(Z1ca(end))<=real(zto2)/2+sqrt((abs(zto2/2))^2-(imag(Z1ca(end))-imag(zto2/2))^2) && real(Z1ca(end))>=real(zto2)/2-sqrt((abs(zto2/2))^2-(imag(Z1ca(end))-imag(zto2/2))^2)))

% if ((real(Z1ca(end))<=xmax1 && real(Z1ca(end))>=xmin1 && imag(Z1ca(end))<=ymax1 && imag(Z1ca(end))>=ymin1)&& real(Z1ca(end))<=real(zto1)/2+sqrt((abs(zto1/2))^2-(imag(Z1ca(end))-imag(zto1/2))^2) && real(Z1ca(end))>=real(zto1)/2-sqrt((abs(zto1/2))^2-(imag(Z1ca(end))-imag(zto1/2))^2))

% Zmc(16,1:length(Z1a))=Z1ca;

% Zc=Z1ca;

% fault\_location(16)=abs(Zc(240))/abs(z1);

% end

%

% else

% Zmc(17,1:length(Z1a))=Z1ca;

% Zc=Z1ca;

% fault\_location(17)=abs(Zc(240))/abs(z1);

% end

% else

% Zmc(18,1:length(Z1a))=Z1ca;

% Zc=Z1ca;

% fault\_location(18)=abs(Zc(240))/abs(z1);

% end

fault\_location(fault\_location == 0 ) = NaN;

[M,I]= min(fault\_location);

if isnan(M)

fprintf('Nothing\n')

elseif I==1

fprintf('L-G fault Line a zone 1\n')

elseif I==2

fprintf('L-G fault Line a zone 2\n')

elseif I==3

fprintf('L-G fault Line a zone 3\n')

elseif I==4

fprintf('L-G fault Line b zone 1\n')

elseif I==5

fprintf('L-G fault Line b zone 2\n')

elseif I==6

fprintf('L-G fault Line b zone 3\n')

elseif I==7

fprintf('L-G fault Line c zone 1\n')

elseif I==8

fprintf('L-G fault Line c zone 2\n')

elseif I==9

fprintf('L-G fault Line c zone 3\n')

elseif I==10

fprintf('L-L fault Line a-b zone 1\n')

elseif I==11

fprintf('L-L fault Line a-b zone 2\n')

elseif I==12

fprintf('L-L fault Line a-b zone 3\n')

elseif I==13

fprintf('L-L fault Line b-c zone 1\n')

elseif I==14

fprintf('L-L fault Line b-c zone 2\n')

elseif I==15

fprintf('L-L fault Line b-c zone 3\n')

elseif I==16

fprintf('L-L fault Line a-c zone 1\n')

elseif I==17

fprintf('L-L fault Line a-c zone 2\n')

elseif I==18

fprintf('L-L fault Line a-c zone 3\n')

end

fprintf('fault location is %f\n',M)

figure('Name','MHO Zone');

title('MHO Zone');

chdist(abs(zto),50);

hold on

Zc=Zmc(I,1:length(Z1a));

plot([real(Zc(120:240))],[imag(Zc(120:240))],'--','linewidth',1.5);

hold off

**Determining type of faults in Quadritral Characterstics:**

clear;

clc;

close all;

a= cos(2\*pi/3)+ sin(2\*pi/3)\*1i ;a2 =cos(4\*pi/3)+1i\*sin(4\*pi/3) ;

f\_sampling=1600;

fo=50;

N=f\_sampling/fo;

theta= 2\*pi/N;

% For Wave Current

Delta\_T=1/f\_sampling;

DATA=load('66-before-INTER.MAT');

T=DATA.t;

S\_a=DATA.iI66baX0014a;

S\_b=DATA.iI66bbX0014b;

S\_c=DATA.iI66bcX0014c;

%For Wave Voltage

S\_A=DATA.vV66bba;

S\_B=DATA.vV66bbb;

S\_C=DATA.vV66bbc;

%Fundamental Basis Functions

cof\_cos=cos(theta\*(0:(320)));

cof\_sin=sin(theta\*(0:(320)));

% DFT for Current

window\_a=zeros(1,N);

Real\_aOld=0;

Imag\_aOld=0;

for kk=1:321

S\_aold=window\_a(N);

S\_anew=S\_a(kk);

for n\_w=N:-1:2

window\_a(n\_w)=window\_a(n\_w-1); % sliding for the window

end

window\_a(1)=S\_a(kk);

Real\_a(kk)=Real\_aOld+(S\_anew-S\_aold)\*cof\_cos(kk)\*2/N;

Imag\_a(kk)=Imag\_aOld-(S\_anew-S\_aold)\*cof\_sin(kk)\*2/N;

Amp\_a(kk)=sqrt(Real\_a(kk)^2+Imag\_a(kk)^2);

Ang\_a(kk)=atan2(Imag\_a(kk),Real\_a(kk))\*180/pi;

Real\_aOld=Real\_a(kk);

Imag\_aOld=Imag\_a(kk);

end

window\_b=zeros(1,N);

Real\_bOld=0;

Imag\_bOld=0;

for kk=1:321

S\_bold=window\_b(N);

S\_bnew=S\_b(kk);

for n\_w=N:-1:2

window\_b(n\_w)=window\_b(n\_w-1); % sliding for the window

end

window\_b(1)=S\_b(kk);

Real\_b(kk)=Real\_bOld+(S\_bnew-S\_bold)\*cof\_cos(kk)\*2/N;

Imag\_b(kk)=Imag\_bOld-(S\_bnew-S\_bold)\*cof\_sin(kk)\*2/N;

Amp\_b(kk)=sqrt(Real\_b(kk)^2+Imag\_b(kk)^2);

Ang\_b(kk)=atan2(Imag\_b(kk),Real\_b(kk))\*180/pi;

Real\_bOld=Real\_b(kk);

Imag\_bOld=Imag\_b(kk);

end

window\_c=zeros(1,N);

Real\_cOld=0;

Imag\_cOld=0;

for kk=1:321

S\_cold=window\_c(N);

S\_cnew=S\_c(kk);

for n\_w=N:-1:2

window\_c(n\_w)=window\_c(n\_w-1); % sliding for the window

end

window\_c(1)=S\_c(kk);

Real\_c(kk)=Real\_cOld+(S\_cnew-S\_cold)\*cof\_cos(kk)\*2/N;

Imag\_c(kk)=Imag\_cOld-(S\_cnew-S\_cold)\*cof\_sin(kk)\*2/N;

Amp\_c(kk)=sqrt(Real\_c(kk)^2+Imag\_c(kk)^2);

Ang\_c(kk)=atan2(Imag\_c(kk),Real\_c(kk))\*180/pi;

Real\_cOld=Real\_c(kk);

Imag\_cOld=Imag\_c(kk);

end

% DFT For Voltage

window\_A=zeros(1,N);

Real\_AOld=0;

Imag\_AOld=0;

for kk=1:321

S\_Aold=window\_A(N);

S\_Anew=S\_A(kk);

for n\_w=N:-1:2

window\_A(n\_w)=window\_A(n\_w-1); % sliding for the window

end

window\_A(1)=S\_A(kk);

Real\_A(kk)=Real\_AOld+(S\_Anew-S\_Aold)\*cof\_cos(kk)\*2/N;

Imag\_A(kk)=Imag\_AOld-(S\_Anew-S\_Aold)\*cof\_sin(kk)\*2/N;

Amp\_A(kk)=sqrt(Real\_A(kk)^2+Imag\_A(kk)^2);

Ang\_A(kk)=atan2(Imag\_A(kk),Real\_A(kk))\*180/pi;

Real\_AOld=Real\_A(kk);

Imag\_AOld=Imag\_A(kk);

end

window\_B=zeros(1,N);

Real\_BOld=0;

Imag\_BOld=0;

for kk=1:321

S\_Bold=window\_B(N);

S\_Bnew=S\_B(kk);

for n\_w=N:-1:2

window\_B(n\_w)=window\_B(n\_w-1); % sliding for the window

end

window\_B(1)=S\_B(kk);

Real\_B(kk)=Real\_BOld+(S\_Bnew-S\_Bold)\*cof\_cos(kk)\*2/N;

Imag\_B(kk)=Imag\_BOld-(S\_Bnew-S\_Bold)\*cof\_sin(kk)\*2/N;

Amp\_B(kk)=sqrt(Real\_B(kk)^2+Imag\_B(kk)^2);

Ang\_B(kk)=atan2(Imag\_B(kk),Real\_B(kk))\*180/pi;

Real\_BOld=Real\_B(kk);

Imag\_BOld=Imag\_B(kk);

end

window\_C=zeros(1,N);

Real\_COld=0;

Imag\_COld=0;

for kk=1:321

S\_Cold=window\_C(N);

S\_Cnew=S\_C(kk);

for n\_w=N:-1:2

window\_C(n\_w)=window\_C(n\_w-1); % sliding for the window

end

window\_C(1)=S\_C(kk);

Real\_C(kk)=Real\_COld+(S\_Cnew-S\_Cold)\*cof\_cos(kk)\*2/N;

Imag\_C(kk)=Imag\_COld-(S\_Cnew-S\_Cold)\*cof\_sin(kk)\*2/N;

Amp\_C(kk)=sqrt(Real\_C(kk)^2+Imag\_C(kk)^2);

Ang\_C(kk)=atan2(Imag\_C(kk),Real\_C(kk))\*180/pi;

Real\_COld=Real\_C(kk);

Imag\_COld=Imag\_C(kk);

end

% Seq. Compantant for Current

S\_a\_dft = Amp\_a.\*exp(1i\*Ang\_a\*pi/180) ;

S\_b\_dft = Amp\_b.\*exp(1i\*Ang\_b\*pi/180) ;

S\_c\_dft = Amp\_c.\*exp(1i\*Ang\_c\*pi/180) ;

S0\_seq = (S\_a\_dft+ S\_b\_dft+S\_c\_dft)/3;

S1\_seq = (S\_a\_dft+a\* S\_b\_dft+a2\*S\_c\_dft)/3;

S2\_seq = (S\_a\_dft+a2\* S\_b\_dft+a\* S\_c\_dft)/3;

S0b\_seq = (S\_b\_dft+ S\_c\_dft+S\_a\_dft)/3;

S1b\_seq = (S\_b\_dft+a\* S\_c\_dft+a2\*S\_a\_dft)/3;

S2b\_seq = (S\_b\_dft+a2\* S\_c\_dft+a\* S\_a\_dft)/3;

S0c\_seq = (S\_c\_dft+ S\_a\_dft+S\_b\_dft)/3;

S1c\_seq = (S\_c\_dft+a\* S\_a\_dft+a2\*S\_b\_dft)/3;

S2c\_seq = (S\_c\_dft+a2\* S\_a\_dft+a\* S\_b\_dft)/3;

Ang0=angle(S0\_seq)\*180/pi;

Ang1=angle(S1\_seq)\*180/pi;

Ang2=angle(S2\_seq)\*180/pi;

% Seq. Compantant for Voltage

S\_A\_dft = Amp\_A.\*exp(1i\*Ang\_A\*pi/180) ;

S\_B\_dft = Amp\_B.\*exp(1i\*Ang\_B\*pi/180) ;

S\_C\_dft = Amp\_C.\*exp(1i\*Ang\_C\*pi/180) ;

S00\_seq = (S\_A\_dft+ S\_B\_dft+S\_C\_dft)/3;

S11\_seq = (S\_A\_dft+a\* S\_B\_dft+a2\*S\_C\_dft)/3;

S22\_seq = (S\_A\_dft+a2\* S\_B\_dft+a\* S\_C\_dft)/3;

Ang00=angle(S00\_seq)\*180/pi;

Ang11=angle(S11\_seq)\*180/pi;

Ang22=angle(S22\_seq)\*180/pi;

figure(1);

plot(T,S\_a,T,S\_b,T,S\_c);

title('Two cycles of Signal s(t)')

xlabel('s(t)');

ylabel('time (sec.)');

figure(2)

plot(T,Amp\_a,T,Amp\_b,T,Amp\_c)

title('DFT of the magnuite of Current Prob');

figure(3)

plot(T,Ang\_a,T,Ang\_b,T,Ang\_c)

title('DFT of the angle of Current Prob');

figure(4)

plot(T,abs(S0\_seq),T,abs(S1\_seq),T,abs(S2\_seq));

xlabel('T(sec.)'); ylabel('magnetuite of Seq. Companant');

title('Magnuite of Seq. Compantant of Current Prob');

figure(5)

plot(T,Ang0,T,Ang1,T,Ang2)

xlabel('T(sec.)'); ylabel('Angle of Seq. companant ');

title('Angle of Seq. Compantant of Current Prob');

figure(6)

plot(T,S\_A,T,S\_B,T,S\_C)

figure(7)

plot(T,Amp\_A,T,Amp\_B,T,Amp\_C)

title('DFT of the magnuite of Voltage Prob');

figure(8)

plot(T,Ang\_A,T,Ang\_B,T,Ang\_C)

title('DFT of the angle of Voltage Prob');

figure(9)

plot(T,abs(S00\_seq),T,abs(S11\_seq),T,abs(S22\_seq))

title('Magnuite of Seq. Compantant of Voltage Prob');

xlabel('T(sec.)'); ylabel('Voltage (volt)');

figure(10)

plot(T,Ang00,T,Ang11,T,Ang22)

title('Angle of Seq. Compantant of Voltage Prob');

xlabel('T(sec.)'); ylabel('Angle (degree) ');

figure(18);

plot(T,S\_a,T,S\_A);

l0=7.60898\*10^2/(2.09627\*10^5);

l1=3.07577\*10^2/(2.86263\*10^5);

z0=2.03684\*10^(-1)+314\*l0\*1i;

Z1=6.38059\*10^(-2)+314\*l1\*1i;

M=(z0-Z1)/Z1;

I\_ax=S\_a\_dft + M\*S0\_seq;

Z1a=S\_A\_dft./I\_ax;

zto=Z1\*140;

I\_bx=S\_b\_dft + M\*S0\_seq;

Z1b=S\_B\_dft./I\_bx;

I\_cx=S\_c\_dft + M\*S0\_seq;

Z1c=S\_C\_dft./I\_cx;

I\_a=Amp\_a.\*exp(1i\*Ang\_a\*pi/180) ;

I\_b=Amp\_b.\*exp(1i\*Ang\_b\*pi/180) ;

I\_c=Amp\_c.\*exp(1i\*Ang\_c\*pi/180) ;

V\_a=Amp\_A.\*exp(1i\*Ang\_A\*pi/180) ;

V\_b=Amp\_B.\*exp(1i\*Ang\_B\*pi/180) ;

V\_c=Amp\_C.\*exp(1i\*Ang\_C\*pi/180) ;

Z1ab=(V\_a-V\_b)./(I\_a-I\_b);

Z1bc=(V\_b-V\_c)./(I\_b-I\_c);

Z1ca=(V\_c-V\_a)./(I\_c-I\_a);

Y11=tand(165)\*real(Z1a(240));

Y21=tand(75)\*real(Z1a(240))-2.2\*(zto/2)\*tand(75)+2.2\*(zto/2)\*tand(165);

Y31=tand(105)\*real(Z1a(240));

X11=cot(165)\*imag(Z1a(240));

X21=(imag(Z1a(240))+2.2\*(zto/2)\*tand(75)-2.2\*(zto/2)\*tand(165))\*cot(75);

X31=cot(105)\*imag(Z1a(240));

Y12=tand(165)\*real(Z1b(240));

Y22=tand(75)\*real(Z1b(240))-2.2\*(zto/2)\*tand(75)+2.2\*(zto/2)\*tand(165);

Y32=tand(105)\*real(Z1b(240));

X12=cot(165)\*imag(Z1b(240));

X22=(imag(Z1b(240))+2.2\*(zto/2)\*tand(75)-2.2\*(zto/2)\*tand(165))\*cot(75);

X32=cot(105)\*imag(Z1b(240));

Y13=tand(165)\*real(Z1c(240));

Y23=tand(75)\*real(Z1c(240))-2.2\*(zto/2)\*tand(75)+2.2\*(zto/2)\*tand(165);

Y33=tand(105)\*real(Z1c(240));

X13=cot(165)\*imag(Z1c(240));

X23=(imag(Z1c(240))+2.2\*(zto/2)\*tand(75)-2.2\*(zto/2)\*tand(165))\*cot(75);

X33=cot(105)\*imag(Z1c(240));

Y14=tand(165)\*real(Z1ab(240));

Y24=tand(75)\*real(Z1ab(240))-2.2\*(zto/2)\*tand(75)+2.2\*(zto/2)\*tand(165);

Y34=tand(105)\*real(Z1ab(240));

X14=cot(165)\*imag(Z1ab(240));

X24=(imag(Z1ab(240))+2.2\*(zto/2)\*tand(75)-2.2\*(zto/2)\*tand(165))\*cot(75);

X34=cot(105)\*imag(Z1ab(240));

Y15=tand(165)\*real(Z1ca(240));

Y25=tand(75)\*real(Z1ca(240))-2.2\*(zto/2)\*tand(75)+2.2\*(zto/2)\*tand(165);

Y35=tand(105)\*real(Z1ca(240));

X15=cot(165)\*imag(Z1ca(240));

X25=(imag(Z1ca(240))+2.2\*(zto/2)\*tand(75)-2.2\*(zto/2)\*tand(165))\*cot(75);

X35=cot(105)\*imag(Z1ca(240));

Y16=tand(165)\*real(Z1bc(240));

Y26=tand(75)\*real(Z1bc(240))-2.2\*(zto/2)\*tand(75)+2.2\*(zto/2)\*tand(165);

Y36=tand(105)\*real(Z1bc(240));

X16=cot(165)\*imag(Z1bc(240));

X26=(imag(Z1bc(240))+2.2\*(zto/2)\*tand(75)-2.2\*(zto/2)\*tand(165))\*cot(75);

X36=cot(105)\*imag(Z1bc(240));

y1max=0.37\*(zto/2)\*tand(165)+0.37\*(zto/2)\*tand(75);

y2max=0.55\*(zto/2)\*tand(165)+0.55\*(zto/2)\*tand(75);

y3max=1\*(zto/2)\*tand(165)+1\*(zto/2)\*tand(75);

ymin=2.2\*(zto/2)\*tand(165);

fault\_location=zeros(1,18);

Zmc=zeros(18,length(Z1a(120:240)));

if (Y11<=imag(Z1a(240)))

if (Y21<=imag(Z1a(240)))

if (Y31<=imag(Z1a(240)))

if (imag(Z1a(240))<=y1max)

Zmc(1,1:length(Z1a))=Z1a;

Zc=Z1a;

fault\_location(1)=abs(Zc(240))/abs(Z1);

elseif(imag(Z1a(240))<=y2max)

Zmc(2,1:length(Z1a))=Z1a;

Zc=Z1a;

fault\_location(2)=abs(Zc(240))/abs(Z1);

elseif(imag(Z1a(240))<=y3max)

Zmc(3,1:length(Z1a))=Z1a;

Zc=Z1a;

fault\_location(3)=abs(Zc(240))/abs(Z1);

end

end

end

end

figure('Name','Zone Z1c');

title('Zone Z1c');

chdist1(zto);

hold on

plot([real(Z1a(120:240))],[imag(Z1a(120:240))],'--','linewidth',1.5);

hold off

if (Y12<=imag(Z1b(240)))

if (Y22<=imag(Z1b(240)))

if (Y32<=imag(Z1b(240)))

if (imag(Z1b(240))<=y1max)

Zmc(4,1:length(Z1b))=Z1b;

Zc=Z1b;

fault\_location(4)=abs(Zc(240))/abs(Z1);

elseif(imag(Z1b(240))<=y2max)

Zmc(5,1:length(Z1b))=Z1b;

Zc=Z1a;

fault\_location(5)=abs(Zc(240))/abs(Z1);

elseif(imag(Z1b(240))<=y3max)

Zmc(6,1:length(Z1b))=Z1b;

Zc=Z1b;

fault\_location(6)=abs(Zc(240))/abs(Z1);

end

end

end

end

figure('Name','Zone Z1b');

title('Zone Z1b');

chdist1(zto);

hold on

plot([real(Z1b(120:240))],[imag(Z1b(120:240))],'--','linewidth',1.5);

hold off

if (Y13<=imag(Z1c(240)))

if (Y23<=imag(Z1c(240)))

if (Y33<=imag(Z1c(240)))

if (imag(Z1c(240))<=y1max)

Zmc(7,1:length(Z1c))=Z1c;

Zc=Z1c;

fault\_location(7)=abs(Zc(240))/abs(Z1);

elseif(imag(Z1c(240))<=y2max)

Zmc(8,1:length(Z1c))=Z1c;

Zc=Z1a;

fault\_location(8)=abs(Zc(240))/abs(Z1);

elseif(imag(Z1c(240))<=y3max)

Zmc(9,1:length(Z1c))=Z1c;

Zc=Z1c;

fault\_location(9)=abs(Zc(240))/abs(Z1);

end

end

end

end

figure('Name','Zone Z1a');

title('Zone Z1a');

chdist1(zto);

hold on

plot([real(Z1c(120:240))],[imag(Z1c(120:240))],'--','linewidth',1.5);

hold off

if (Y14<=imag(Z1ab(240)))

if (Y24<=imag(Z1ab(240)))

if (Y34<=imag(Z1ab(240)))

if (imag(Z1ab(240))<=y1max)

Zmc(10,1:length(Z1ab))=Z1ab;

Zc=Z1ab;

fault\_location(10)=abs(Zc(240))/abs(Z1);

elseif(imag(Z1ab(240))<=y2max)

Zmc(11,1:length(Z1ab))=Z1ab;

Zc=Z1a;

fault\_location(11)=abs(Zc(240))/abs(Z1);

elseif(imag(Z1ab(240))<=y3max)

Zmc(12,1:length(Z1ab))=Z1ab;

Zc=Z1ab;

fault\_location(12)=abs(Zc(240))/abs(Z1);

end

end

end

end

figure('Name','Zone Z1ab');

title('Zone Z1ab');

chdist1(zto);

hold on

plot([real(Z1ab(120:240))],[imag(Z1ab(120:240))],'--','linewidth',1.5);

hold off

if (Y15<=imag(Z1ca(240)))

if (Y25<=imag(Z1ca(240)))

if (Y35<=imag(Z1ca(240)))

if (imag(Z1ca(240))<=y1max)

Zmc(13,1:length(Z1ca))=Z1ca;

Zc=Z1ca;

fault\_location(13)=abs(Zc(240))/abs(Z1);

elseif(imag(Z1ca(240))<=y2max)

Zmc(14,1:length(Z1ca))=Z1ca;

Zc=Z1a;

fault\_location(14)=abs(Zc(240))/abs(Z1);

elseif(imag(Z1ca(240))<=y3max)

Zmc(15,1:length(Z1ca))=Z1ca;

Zc=Z1ca;

fault\_location(15)=abs(Zc(240))/abs(Z1);

end

end

end

end

figure('Name','Zone Z1ca');

title('Zone Z1ca');

chdist1(zto);

hold on

plot([real(Z1ca(120:240))],[imag(Z1ca(120:240))],'--','linewidth',1.5);

hold off

if (Y16<=imag(Z1bc(240)))

if (Y26<=imag(Z1bc(240)))

if (Y36<=imag(Z1bc(240)))

if (imag(Z1bc(240))<=y1max)

Zmc(16,1:length(Z1bc))=Z1bc;

Zc=Z1bc;

fault\_location(16)=abs(Zc(240))/abs(Z1);

elseif(imag(Z1bc(240))<=y2max)

Zmc(17,1:length(Z1bc))=Z1bc;

Zc=Z1a;

fault\_location(17)=abs(Zc(240))/abs(Z1);

elseif(imag(Z1bc(240))<=y3max)

Zmc(18,1:length(Z1bc))=Z1bc;

Zc=Z1bc;

fault\_location(18)=abs(Zc(240))/abs(Z1);

end

end

end

end

figure('Name','Zone Z1bc');

title('Zone Z1bc');

chdist1(zto);

hold on

plot([real(Z1bc(120:240))],[imag(Z1bc(120:240))],'--','linewidth',1.5);

hold off

fault\_location(fault\_location == 0 ) = NaN;

[M,I]= min(fault\_location);

if isnan(M)

fprintf('Nothing\n')

Zmc=Z1a;

elseif I==1

fprintf('L-G fault Line a zone 1\n')

elseif I==2

fprintf('L-G fault Line a zone 2\n')

elseif I==3

fprintf('L-G fault Line a zone 3\n')

elseif I==4

fprintf('L-G fault Line b zone 1\n')

elseif I==5

fprintf('L-G fault Line b zone 2\n')

elseif I==6

fprintf('L-G fault Line b zone 3\n')

elseif I==7

fprintf('L-G fault Line c zone 1\n')

elseif I==8

fprintf('L-G fault Line c zone 2\n')

elseif I==9

fprintf('L-G fault Line c zone 3\n')

elseif I==10

fprintf('L-L fault Line a-b zone 1\n')

elseif I==11

fprintf('L-L fault Line a-b zone 2\n')

elseif I==12

fprintf('L-L fault Line a-b zone 3\n')

elseif I==13

fprintf('L-L fault Line a-c zone 1\n')

elseif I==14

fprintf('L-L fault Line a-c zone 2\n')

elseif I==15

fprintf('L-L fault Line a-c zone 3\n')

elseif I==16

fprintf('L-L fault Line b-c zone 1\n')

elseif I==17

fprintf('L-L fault Line b-c zone 2\n')

elseif I==18

fprintf('L-L fault Line b-c zone 3\n')

end

fprintf('fault location is %f\n',M)

figure('Name','Zone');

title('Zone');

chdist1(zto);

hold on

Zc=Zmc(I,1:length(Z1a));

plot([real(Zc(120:240))],[imag(Zc(120:240))],'--','linewidth',1.5);

hold off