```
function
 [Am,Bm,Cm,Dm,Al,Bl,Cl,Dl,length]=e223226_kilic(text_path,library_path)
     warning('OFF', 'MATLAB:table:ModifiedAndSavedVarnames'); %Just
 for getting rid of a warning. Does not effect the
                                                                %output of
 the function
    raw_data=fopen(text_path);
    count=1;
    Data=cell(1,17);
    while count~= 29
        satir=fgetl(raw_data);
        if count==2
            Data{1,1}=satir;
        elseif count==4
            Data{2,1}=satir;
        elseif count==6
            Data{3,1}=satir;
        elseif count==8
            Data{4,1}=satir;
        elseif count==10
            Data{5,1}=satir;
        elseif count==12
            Data{6,1}=satir;
        elseif count==13
            Data{7,1}=satir;
        elseif count==15
            Data{8,1}=satir;
        elseif count==16
            Data{9,1}=satir;
        elseif count==18
            Data{10,1}=satir;
        elseif count==19
            Data{11,1}=satir;
        elseif count==21
            Data{12,1}=satir;
        elseif count==22
            Data{13,1}=satir;
        elseif count==24
            Data{14,1}=satir;
        elseif count==25
            Data{15,1}=satir;
        elseif count==27
            Data{16,1}=satir;
        elseif count==28
            Data{17,1}=satir;
        end
        count=count+1;
    end

    Ncircuit=str2double(Data{1,1});
    Nbundle=str2double(Data{2,1});
    dbundle=str2double(Data{3,1});
```

```
   length=str2double(Data{4,1}); %left as km for future use
   line_type=convertCharsToStrings(Data{5,1});
   D1AB=sqrt((str2double(Data(6,1))-str2double(Data(8,1)))^2 +
(str2double(Data(7,1))-str2double(Data(9,1)))^2);
   D1AC=sqrt((str2double(Data(6,1))-str2double(Data(10,1)))^2 +
(str2double(Data(7,1))-str2double(Data(11,1)))^2);
   D1BC=sqrt((str2double(Data(8,1))-str2double(Data(10,1)))^2 +
(str2double(Data(9,1))-str2double(Data(11,1)))^2);

   if Ncircuit==1
       D2AB=-1;
       D2AC=-1;
       D2BC=-1;
   else
       D2AB=sqrt((str2double(Data(12,1))-str2double(Data(14,1)))^2 +
(str2double(Data(13,1))-str2double(Data(15,1)))^2);
       D2AC=sqrt((str2double(Data(12,1))-str2double(Data(16,1)))^2 +
(str2double(Data(13,1))-str2double(Data(17,1)))^2);
       D2BC=sqrt((str2double(Data(14,1))-str2double(Data(16,1)))^2 +
(str2double(Data(15,1))-str2double(Data(17,1)))^2);
   end

   %This part below just checks the validity of line type
   library_table=readtable(library_path);
   istrue=0;
   while istrue==0
   for i = 1:15
       if strcmp(line_type,library_table.CodeWord(i,1))
           istrue=1;
       end
   end

   if istrue==0
       line_type=input("Undefined line type. Please try another one:
",'s');   %Please dont use "" while giving the new input.
   end
   end




   %phase 2 starts
   % First, find out where we are in the library.
   for i = 1:15
       if strcmp(line_type,library_table.CodeWord(i,1))
           rownum=i;
       end
   end


   % RESISTANCE
   Rac_per_km = table2array(library_table(rownum,7))/(1.60934);
   R = Rac_per_km/(Nbundle*Ncircuit);
```

```
   %Calculate Ds_bundle for Nbundle=1 to 8. Convert feet to meter
   if Nbundle==1
       Ds_bundle=table2array(library_table(rownum,8))*0.3048;
       Ds_bundle_cap=table2array(library_table(rownum,8))*0.0254/2;

   elseif Nbundle==2

Ds_bundle=sqrt(table2array(library_table(rownum,8))*0.3048*dbundle);

Ds_bundle_cap=sqrt(table2array(library_table(rownum,5))*(0.0254/2)*dbundle);

   elseif Nbundle==3

Ds_bundle=nthroot(table2array(library_table(rownum,8))*0.3048*(dbundle^2),3);

Ds_bundle_cap=nthroot(table2array(library_table(rownum,5))*(0.0254/2)*(dbundle^2)

   elseif Nbundle==4

Ds_bundle=nthroot(table2array(library_table(rownum,8))*0.3048*(dbundle^2)*(dbundl

Ds_bundle_cap=nthroot(table2array(library_table(rownum,5))*(0.0254/2)*(dbundle^2)

   elseif Nbundle==5

Ds_bundle=nthroot(table2array(library_table(rownum,8))*0.3048*(dbundle^2)*((dbund

Ds_bundle_cap=nthroot(table2array(library_table(rownum,5))*(0254/2)*(dbundle^2)*(

  elseif Nbundle==6

Ds_bundle=nthroot(table2array(library_table(rownum,8))*0.3048*(dbundle^2)*(2*dbun

Ds_bundle_cap=nthroot(table2array(library_table(rownum,5))*(0.0254/2)*(dbundle^2)

  elseif Nbundle==7
      d=dbundle/(2*sin(pi/2/7));
      e=2*dbundle*cos(pi/7);

Ds_bundle=nthroot(table2array(library_table(rownum,8))*0.3048*(dbundle^2)*(d^2)*(

Ds_bundle_cap=nthroot(table2array(library_table(rownum,5))*(0.0254/2)*(dbundle^2)

  elseif Nbundle==8
      a=dbundle*sqrt(2);
      b=dbundle(1+2/sqrt(2));
      c=2*dbundle;

Ds_bundle=nthroot(table2array(library_table(rownum,8))*0.3048*(dbundle^2)*(b^2)*(

Ds_bundle_cap=nthroot(table2array(library_table(rownum,5))*(0.0254/2)*(dbundle^2)
   end
```

```
    %GMR and GMD values

    if Ncircuit==2

        %GMR in three different positions;
        dist_a1_a2=sqrt((str2double(Data(6,1))-
str2double(Data(12,1)))^2 + (str2double(Data(7,1))-
str2double(Data(13,1)))^2);
        GMR_a1_a2=sqrt(Ds_bundle*dist_a1_a2);
        GMR_a1_a2_cap=sqrt(Ds_bundle_cap*dist_a1_a2);

        dist_b1_b2=sqrt((str2double(Data(8,1))-
str2double(Data(14,1)))^2 + (str2double(Data(9,1))-
str2double(Data(15,1)))^2);
        GMR_b1_b2=sqrt(Ds_bundle*dist_b1_b2);
        GMR_b1_b2_cap=sqrt(Ds_bundle_cap*dist_b1_b2);

        dist_c1_c2=sqrt((str2double(Data(10,1))-
str2double(Data(16,1)))^2 + (str2double(Data(11,1))-
str2double(Data(17,1)))^2);
        GMR_c1_c2=sqrt(Ds_bundle*dist_c1_c2);
        GMR_c1_c2_cap=sqrt(Ds_bundle_cap*dist_c1_c2);

        GMR_p=nthroot((GMR_a1_a2*GMR_b1_b2*GMR_c1_c2),3);

 GMR_p_cap=nthroot((GMR_a1_a2_cap*GMR_b1_b2_cap*GMR_c1_c2_cap),3);


        %GMD timee!!
        % GMD-AB
        Da1_b2=sqrt((str2double(Data(6,1))-str2double(Data(14,1)))^2 +
 (str2double(Data(7,1))-str2double(Data(15,1)))^2);
        Da2_b1=sqrt((str2double(Data(12,1))-str2double(Data(8,1)))^2 +
 (str2double(Data(13,1))-str2double(Data(9,1)))^2);
        GMD_ab=nthroot(D1AB*Da1_b2*Da2_b1*D2AB,4);
        % GMD-BC
        Db1_c2=sqrt((str2double(Data(8,1))-str2double(Data(16,1)))^2 +
 (str2double(Data(9,1))-str2double(Data(17,1)))^2);
        Db2_c1=sqrt((str2double(Data(14,1))-str2double(Data(10,1)))^2
 + (str2double(Data(15,1))-str2double(Data(11,1)))^2);
        GMD_bc=nthroot(D1BC*Db1_c2*Db2_c1*D2BC,4);
        % GMD-CA
        Dc1_a2=sqrt((str2double(Data(10,1))-str2double(Data(12,1)))^2
 + (str2double(Data(11,1))-str2double(Data(13,1)))^2);
        Dc2_a1=sqrt((str2double(Data(16,1))-str2double(Data(6,1)))^2 +
 (str2double(Data(17,1))-str2double(Data(7,1)))^2);
        GMD_cap=nthroot(D1AC*Dc1_a2*Dc2_a1*D2AC,4);

        GMD_2cct=nthroot((GMD_ab*GMD_bc*GMD_cap),3);
```

```
        %EFFECT OF EARTH FOR 2CCT
        ha1=2*(str2double(Data(7,1)));
        hb1=2*(str2double(Data(9,1)));
        hc1=2*(str2double(Data(11,1)));
        ha2=2*str2double(Data(13,1));
        hb2=2*str2double(Data(15,1));
        hc2=2*str2double(Data(17,1));
        ha1a2=sqrt((str2double(Data(6,1))-str2double(Data(12,1)))^2 +
 (str2double(Data(7,1))+str2double(Data(13,1)))^2);
        hb1b2=sqrt((str2double(Data(8,1))-str2double(Data(14,1)))^2 +
 (str2double(Data(9,1))+str2double(Data(15,1)))^2);
        hc1c2=sqrt((str2double(Data(10,1))-str2double(Data(16,1)))^2 +
 (str2double(Data(11,1))+str2double(Data(17,1)))^2);

 hden=nthroot(ha1*hb1*hc1*ha2*hb2*hc2*(ha1a2^2)*(hb1b2^2)*(hc1c2^2),12);

        ha1b1=sqrt((str2double(Data(6,1))-str2double(Data(8,1)))^2 +
 (str2double(Data(7,1))+str2double(Data(9,1)))^2);
        ha1c1=sqrt((str2double(Data(6,1))-str2double(Data(10,1)))^2 +
 (str2double(Data(7,1))+str2double(Data(11,1)))^2);
        hb1c1=sqrt((str2double(Data(8,1))-str2double(Data(10,1)))^2 +
 (str2double(Data(9,1))+str2double(Data(11,1)))^2);
        ha1b2=sqrt((str2double(Data(6,1))-str2double(Data(14,1)))^2 +
 (str2double(Data(7,1))+str2double(Data(15,1)))^2);
        ha1c2=sqrt((str2double(Data(16,1))-str2double(Data(6,1)))^2 +
 (str2double(Data(17,1))+str2double(Data(7,1)))^2);
        hb1c2=sqrt((str2double(Data(8,1))-str2double(Data(16,1)))^2 +
 (str2double(Data(9,1))+str2double(Data(17,1)))^2);
        hb1a2=sqrt((str2double(Data(12,1))-str2double(Data(8,1)))^2 +
 (str2double(Data(13,1))+str2double(Data(9,1)))^2);
        hc1a2=sqrt((str2double(Data(10,1))-str2double(Data(12,1)))^2 +
 (str2double(Data(11,1))+str2double(Data(13,1)))^2);
        hc1b2=sqrt((str2double(Data(14,1))-str2double(Data(10,1)))^2 +
 (str2double(Data(15,1))+str2double(Data(11,1)))^2);
        ha2b2=sqrt((str2double(Data(12,1))-str2double(Data(14,1)))^2 +
 (str2double(Data(13,1))+str2double(Data(15,1)))^2);
        ha2c2=sqrt((str2double(Data(12,1))-str2double(Data(16,1)))^2 +
 (str2double(Data(13,1))+str2double(Data(17,1)))^2);
        hb2c2=sqrt((str2double(Data(14,1))-str2double(Data(16,1)))^2 +
 (str2double(Data(15,1))+str2double(Data(17,1)))^2);

 hnum=nthroot(ha1b1*ha1c1*hb1c1*ha1b2*ha1c2*hb1c2*hb1a2*hc1a2*hc1b2*ha2b2*ha2c2*hb

        L=2*(10^(-7))*log(GMD_2cct/GMR_p);
        C=2*pi*8.8541878128*(10^-12)/(log(GMD_2cct/GMR_p_cap)-
log(hnum/hden));


    elseif Ncircuit==1

        GMD_1cct=nthroot((D1AB*D1AC*D1BC),3);

        %EFFECT OF EARTH FOR 1CCT
        ha=2*(str2double(Data(7,1)));
```

```
        hb=2*(str2double(Data(9,1)));
        hc=2*(str2double(Data(11,1)));
        hden=nthroot(ha*hb*hc,3);

        hab=sqrt((str2double(Data(6,1))-str2double(Data(8,1)))^2 +
 (str2double(Data(7,1))+str2double(Data(9,1)))^2);
        hac=sqrt((str2double(Data(6,1))-str2double(Data(10,1)))^2 +
 (str2double(Data(7,1))+str2double(Data(11,1)))^2);
        hbc=sqrt((str2double(Data(8,1))-str2double(Data(10,1)))^2 +
 (str2double(Data(9,1))+str2double(Data(11,1)))^2);
        hnum=nthroot(hab*hac*hbc,3);

        C=2*pi*8.85*(10^-12)/(log(GMD_1cct/Ds_bundle_cap)-log(hnum/
hden));
        L=2*(10^(-7))*log(GMD_1cct/Ds_bundle);
    end


    X=2*pi*50*L*1000;
    B=2*pi*50*C*1000;
    XBonus=-1;
    BBonus=-1;

        %phase 3 starts here

    series_impedance=(R+1i*X)*length; %ohm/km * km
    shunt_admittance = 1i*B*length; % mho/km * km

    %MEDIUM LINE MODEL
    Am = (1+(series_impedance*shunt_admittance)/2);
    Dm=Am; %unitless
    Bm = series_impedance; %ohm
    Cm =
 shunt_admittance*(1+(series_impedance*shunt_admittance)/4); %mho

    %LONG LINE MODEL
    Zo=sqrt(series_impedance/shunt_admittance); %characteristic
 impedance
    gamma=sqrt(series_impedance*shunt_admittance); %propogation const.

    Al=cosh(gamma);
    Bl=Zo*sinh(gamma);
    Cl=sinh(gamma)/Zo;
    Dl=cosh(gamma);
end
```

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