2024

POWER REPORT

PRESENTED BY:

MENA BADR HELMY	21011445
SHEHAB ELDEEN AHMED GABER	21010667
MOHAMED NAGUIB ELSAYED	21011235
ZIAD MOHAMED ELSAYED	21010576
MOATAZ MOHAMED KHALED	21011390
MARIAM MOSTAFA MOHAMED	21011334
SHAIMAA AHMED MOSTAFA	21010683
SOJOUD AHMED ALI	21010604
YEHIA SAEED HAMED GEWILY	21010705

Task 1: Transmission Line Parameters

Firstly, the user will be prompted to provide input values for conductor resistivity, conductor length, and conductor diameter in order to calculate the resistance, inductance, and capacitance per phase of a 3-phase Transmission Line system. Following that, the user will be asked to specify whether the transmission system is symmetrical or unsymmetrical. In the case of symmetrical spacing, only one distance will be required, whereas for unsymmetrical spacing, the distances between phases will need to be provided.

Code

resistance_calc.m

```
% Function to calculate resistance
function Resistance = resistance_calc(p,l,d)
d=d/100;
l=l*1000;
    %(p: resistivity,l:length ,d:Diameter) of conductor
    A = pi*(d/2)^2; % Cross-sectional area of the conductor
    Resistance=p*l/A; %DC resistance

    R_AC=1.1*Resistance;
end
```

calc_Deq.m | capacitance_calc.m | inductance_calc.m | calc_abcd.m

```
% Function to calculate inductance per phase
function Lph = inductance_calc(Deq,d)
d=d/100;
    Lph = 2e-7*log(Deq/(0.7788*(d/2))); % Inductance per phase
    Lph=Lph*1000;
end
```

calc_Deq.m | capacitance_calc.m | calc_abcd.m

```
% Function to calculate Capacitance per phase
function cph=capacitance_calc(Deq,d)
d=d/100;
    cph=(2*pi*8.85e-12)/log(Deq/(d/2));%Capacitance per phase
    cph=cph*1000;
end
```

calc_Deq.m calc_abcd.m

```
function Deq = calc_Deq(sym,N,D)

    if N==2||sym==1
        Deq = D(1);%D(1)=....D(N)
    else
        Deq =(prod(D))^(1/N);
    end
end
```

Task 2: ABCD Parameters

Once the R, L, and C parameters have been calculated, the user will proceed to compute the ABCD constants using the line length entered in Task 1. In the case of a medium line length, the user will be prompted to select either the π or T model.

Code

Editor - C:\Users\menab\OneDrive\Pictures\Assi\Power\calc_abcd.m

calc_abcd.m

```
%function to calculate ABCD

function [A,B,C,D]=calc_abcd(capacitance_per_km,inductance_per_km,resistance_dc,conductor_length,type,f) %user take capaci
l=inductance_per_km*conductor_length;           %multiply inductance_per_km with length
c=capacitance_per_km*conductor_length;          %multiply capacitance_per_km with length
xl=2*pi*f*l;      %inductive reactance
resistance_AC=resistance_dc*1.1;
z=(resistance_AC+i*xl); %impedance equation
y=2*pi*f*c*i;    %admidance equation

if(conductor_length<80) %short line
      A=1;
      B=z;
      C=0;
      D=1;




elseif(conductor_length>=80 &&conductor_length<=250 ) %medium line

     % the user  enters the type of medium line pi or T

```

calc_abcd.m

```
     % the user  enters the type of medium line pi or T


     switch(type)
         case "Pi_model"  % pi model
              A=1+((z*y)/2);
              B=z;
              C=y*(1+(z*y)/4);
              D=1+((z*y)/2);

         case "T_model" %T model
             A=1+((z*y)/2);
             B=z*(1+(z*y)/4);
             C=y;
             D=1+((z*y)/2);
         otherwise
           A=0 ;
           B=0;
           C=0;
           D=0;
         end
  else
     disp('invalid length');
 end
```

Task 3: Transmission Line Performance

1. **Input Section**
   - **The user is prompted to choose between "CASE I" and "CASE II" by entering either 1 or 2, respectively.**
   - **The user also inputs the receiving end voltage VR_line.**
2. **Case 1 (choice == 1)**
   - **A range of active powers (PR) from 0 to 100000 is considered.**
   - **The power factor is set to 0.8.**
   - **Efficiency and voltage regulation matrices are initialized.**
   - **Inside a loop over PR, the following calculations are performed:**
     1. **Calculate apparent power S based on active power PR and power factor.**
     2. **Calculate current IR using power triangle relationships.**
     3. **Calculate voltages VS and IS using complex constants.**
     4. **Calculate active power PS.**
     5. **Calculate voltage regulation and efficiency and store them in matrices.**
3. **Case 2 (choice == 2)**
   - **Active power (PR) is set to 100000.**
   - **Power factor ranges from 0.3 to 1 with a step size of 0.01.**
   - **Separate matrices are initialized for lagging and leading power factors.**
   - **Two loops iterate over the power factor range for lagging and leading power factors.**
   - **Similar calculations as in Case 1 are performed for both lagging and leading power factors.**
   - **Separate matrices are updated for each power factor scenario.**

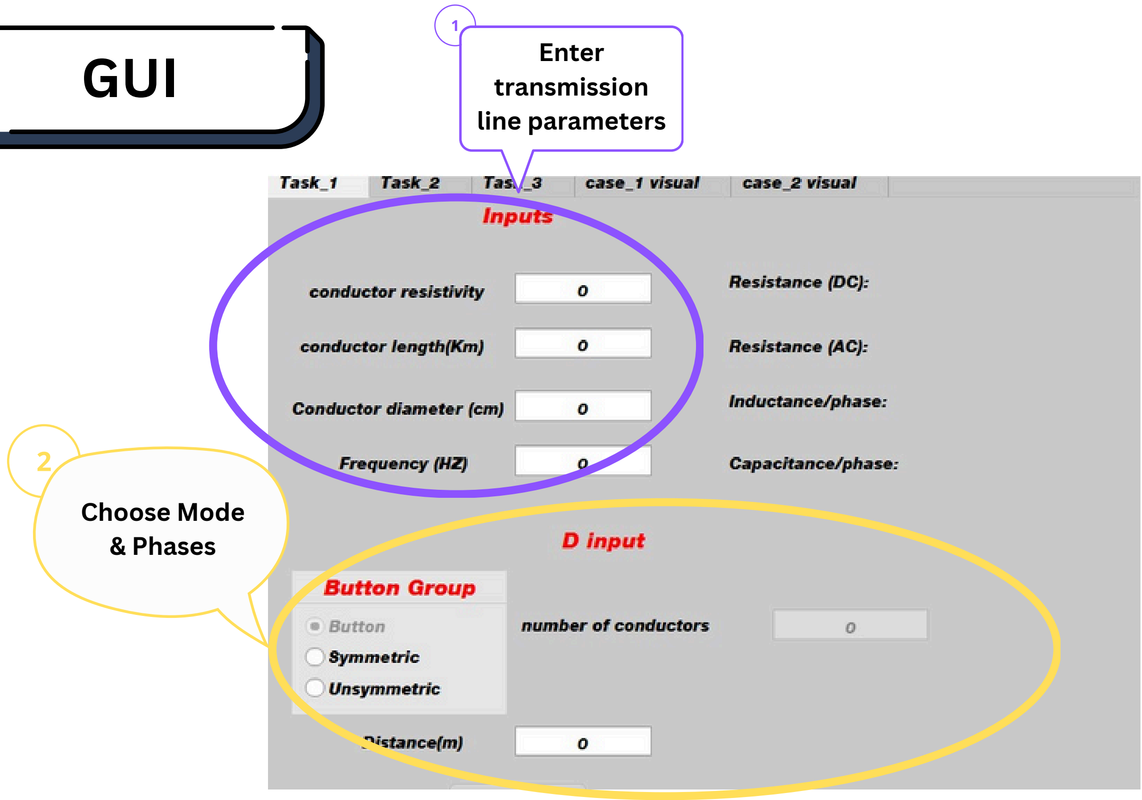
Code

```
function [VReg,efficency]= performance(A,B,C,D,VR_line,choice)
switch(choice)
    case 1
    PR = 0:100;
    powerfactor = 0.8;
    VoltageMatrix = zeros( size(PR) );
    EfficiencyMatrix = zeros( size(PR) );
    VR_line=1000*VR_line;
    for z = 1 : length(PR)
        S = PR(z)*1000 / powerfactor;
        VR = VR_line/sqrt(3);
        IR = (S ./ (3 * VR)) * exp(1i * ( -1 * acos(powerfactor)));
        VS = A * VR + B * IR;
        IS = C * VR + D * IR;
        PS = (3 * (abs(VS)) .* (abs(IS)) .* (cos( angle(VS) - angle(IS) )));
        V_noload= abs(VS) .* sqrt(3)/abs(A);
        VoltageMatrix(z) = (abs(V_noload) - abs(VR_line))./abs(VR_line) * 100;
        EfficiencyMatrix(z) = (PR(z)*1000/abs(PS)) * 100;
    end

    figure;
    subplot(1,2,1);
    plot(PR, EfficiencyMatrix);
    xlabel('Active Power');
    ylabel('Efficiency');
    title('Efficiency vs Active Power');
    subplot(1,2,2);
    plot(PR, VoltageMatrix);
    xlabel('Active Power');
    ylabel('Voltage Regulation');
    title('Voltage Regulation vs Active Power');
```

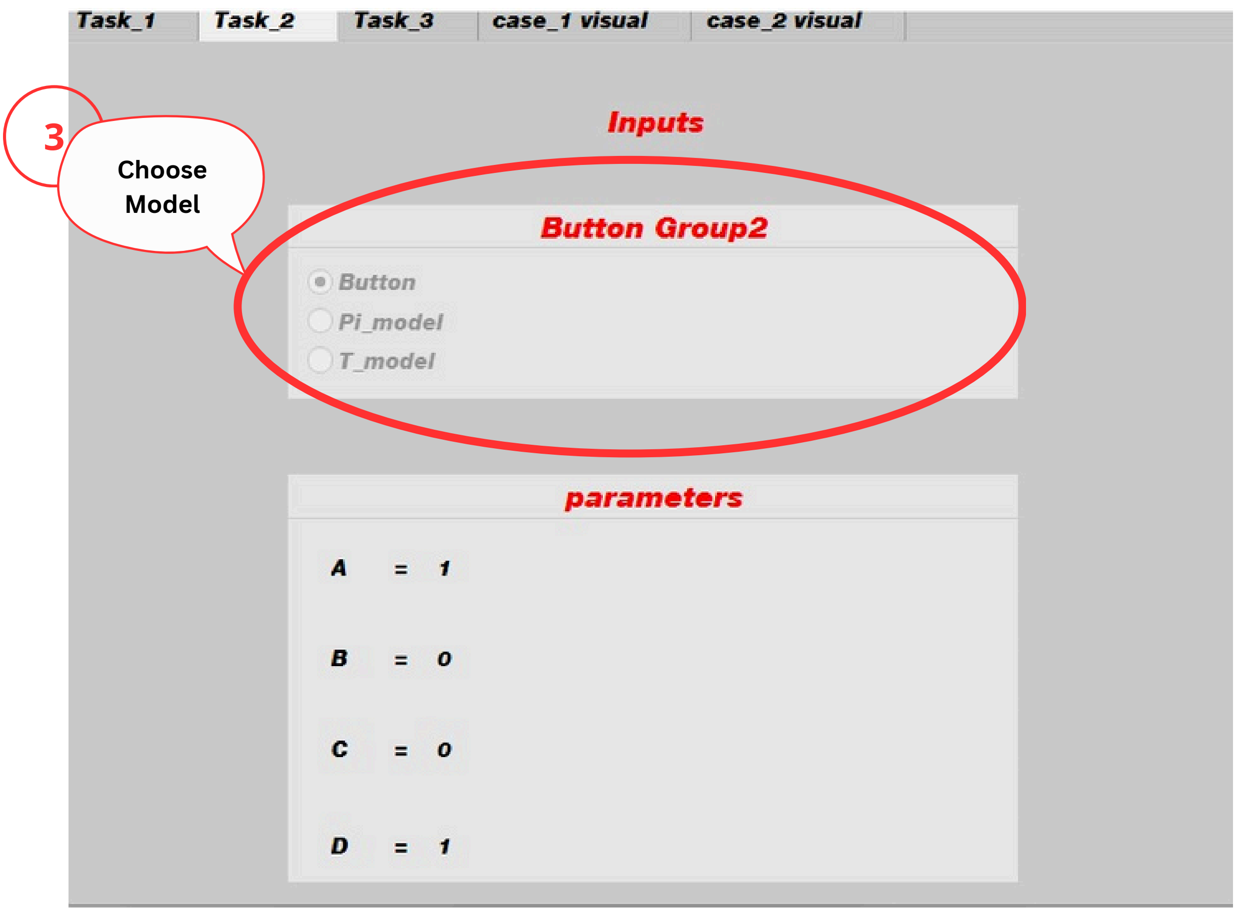
```
case 2
PR =100000;
powerfactor =0.3:0.01:1;
lagVoltageMatrix = zeros( size(powerfactor) );
lagEfficiencyMatrix = zeros( size(powerfactor) );
leadVoltageMatrix = zeros( size(powerfactor) );
leadEfficiencyMatrix = zeros( size(powerfactor) );
VR_line=1000*VR_line;
for z = 1:length(powerfactor)
    S = PR / powerfactor(z);
    VR = VR_line/sqrt(3);
    IR = (S / (3 * VR)) * exp(1i * ( -1 * acos(powerfactor(z))));
    VS = A * VR + B * IR;
    IS = C * VR + D * IR;
    PS = (3 * (abs(VS)) * (abs(IS)) * (cos( angle(VS) - angle(IS) )));
    V_noload= abs(VS) * sqrt(3)/abs(A);
    lagVoltageMatrix(z) = (abs(V_noload) - abs(VR_line))/abs(VR_line) * 100;
    lagEfficiencyMatrix(z) = (PR/abs(PS)) * 100;
end
for z = 1:length(powerfactor)
    S = PR /powerfactor(z);
    VR = VR_line/sqrt(3);
    IR = (S / (3 * VR)) * exp(1i * ( 1 * acos(powerfactor(z))));
    VS = A * VR + B * IR;
    IS = C * VR + D * IR;
    PS = (3 * (abs(VS)) * (abs(IS)) * (cos( angle(VS) - angle(IS) )));
    V_noload= abs(VS) * sqrt(3)/abs(A);
    leadVoltageMatrix(z) = (abs(V_noload) - abs(VR_line))/abs(VR_line) * 100;
    leadEfficiencyMatrix(z) = (PR/abs(PS)) * 100;
end
```

```
    figure;
    subplot(2,2,1);
    plot(powerfactor, lagEfficiencyMatrix);
    xlabel('lag pf');
    ylabel('Efficiency');
    title('Efficiency vs lag pf');
    subplot(2,2,2);
    plot(powerfactor, lagVoltageMatrix);
    xlabel('lag pf');
    ylabel('Voltage Regulation');
    title('Voltage Regulation vs lag pf');
    subplot(2,2,3);
    plot(powerfactor, leadEfficiencyMatrix);
    xlabel('lead pf');
    ylabel('Efficiency');
    title('Efficiency vs lead pf');
    subplot(2,2,4);
    plot(powerfactor, leadVoltageMatrix);
    xlabel('lead pf');
    ylabel('Voltage Regulation');
    title('Voltage Regulation vs lead pf');



end
end
```

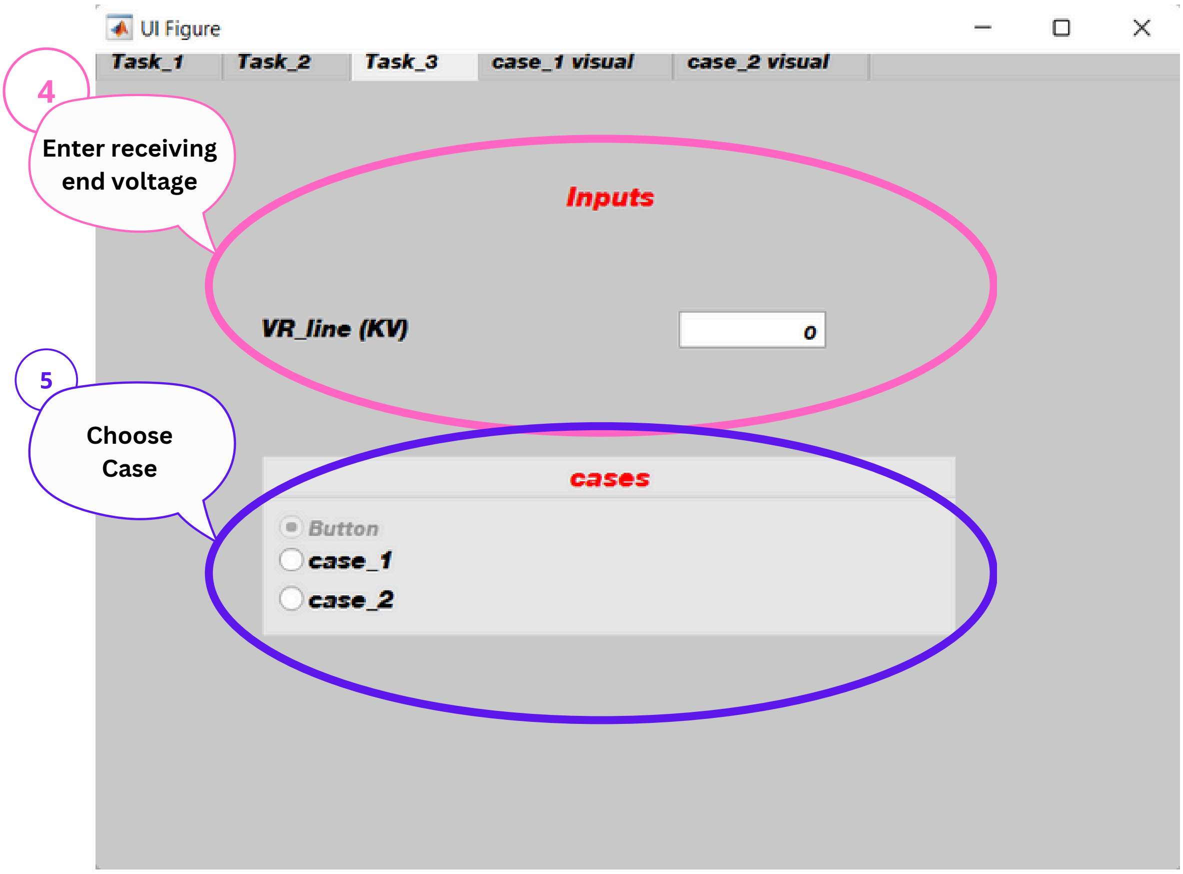
GUI



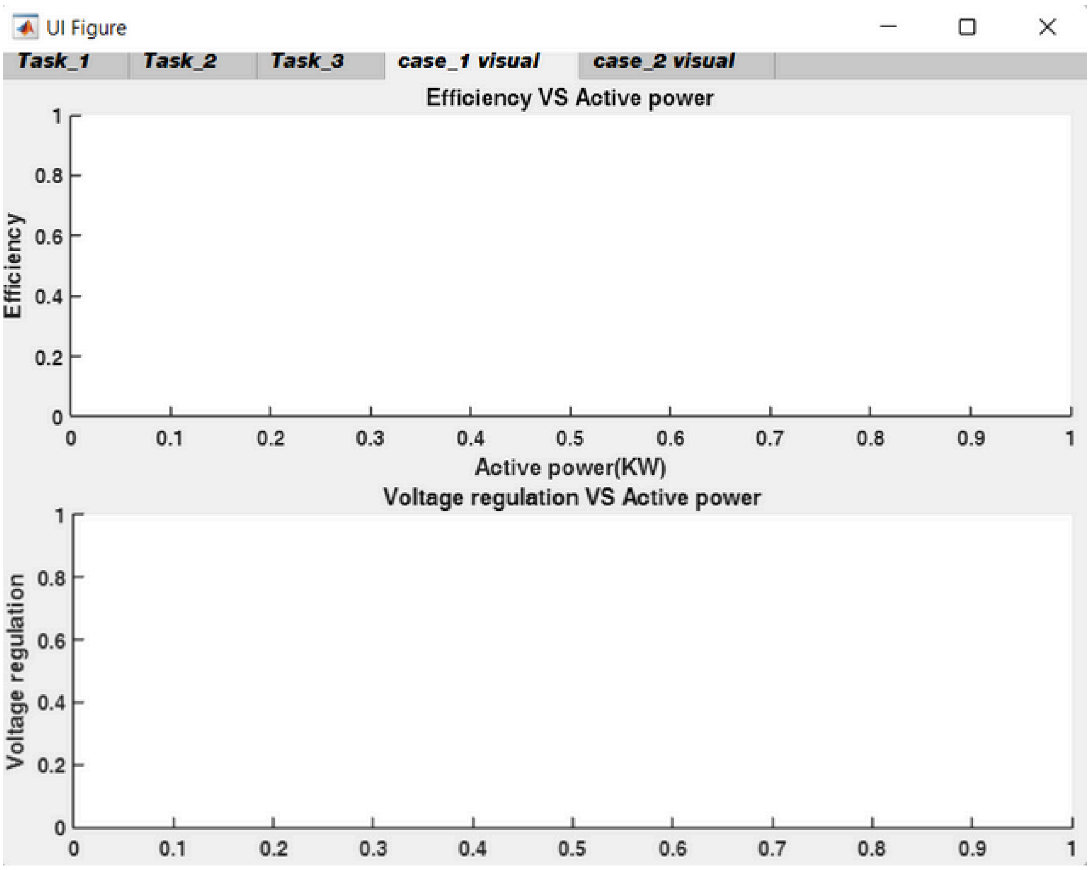
1
Enter transmission line parameters
Task_1
Task_2
Task_3
case_1 visual
case_2 visual
Inputs
conductor resistivity
0
conductor length(Km)
0
Conductor diameter (cm)
0
Frequency (HZ)
0
Resistance (DC):
Resistance (AC):
Inductance/phase:
Capacitance/phase:
2
Choose Mode & Phases
D input
Button Group
Button
Symmetric
Unsymmetric
number of conductors
0
Distance(m)
0



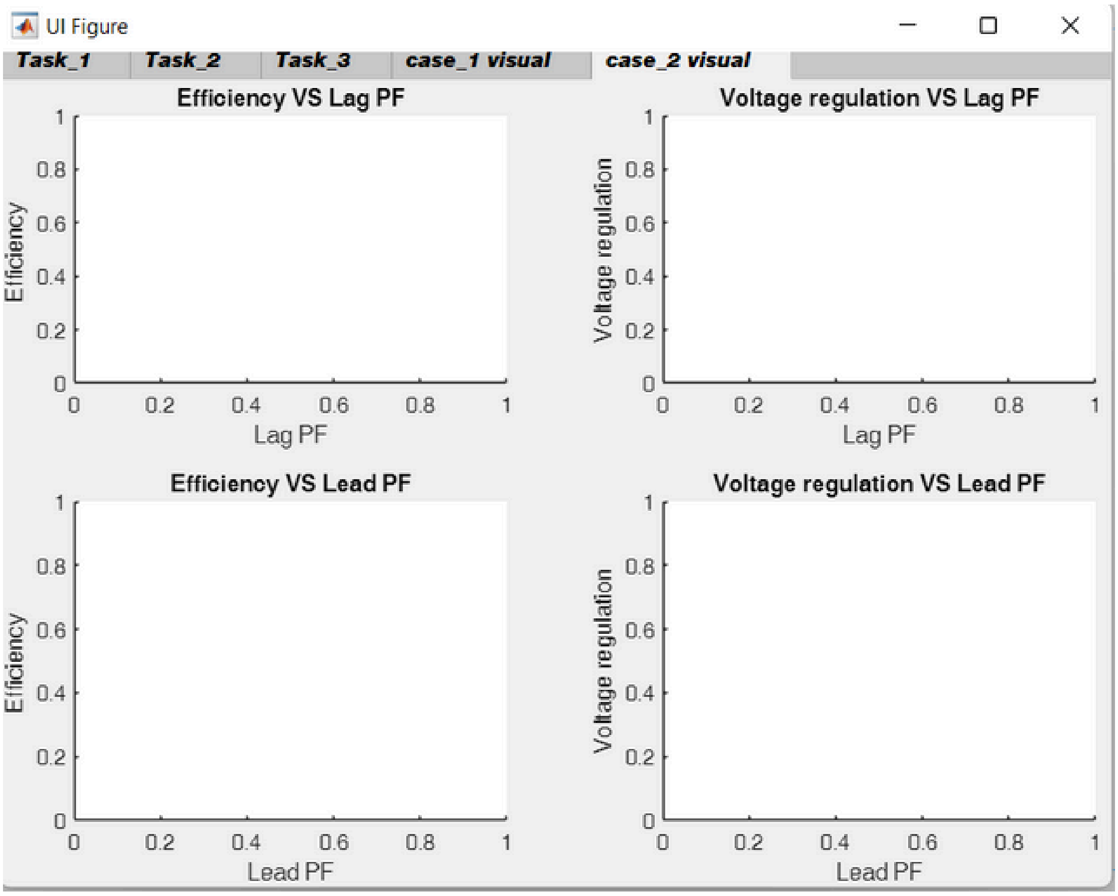
Task_1
Task_2
Task_3
case_1 visual
case_2 visual
3
Choose Model
Inputs
Button Group2
Button
Pi_model
T_model
parameters
A = 1
B = 0
C = 0
D = 1



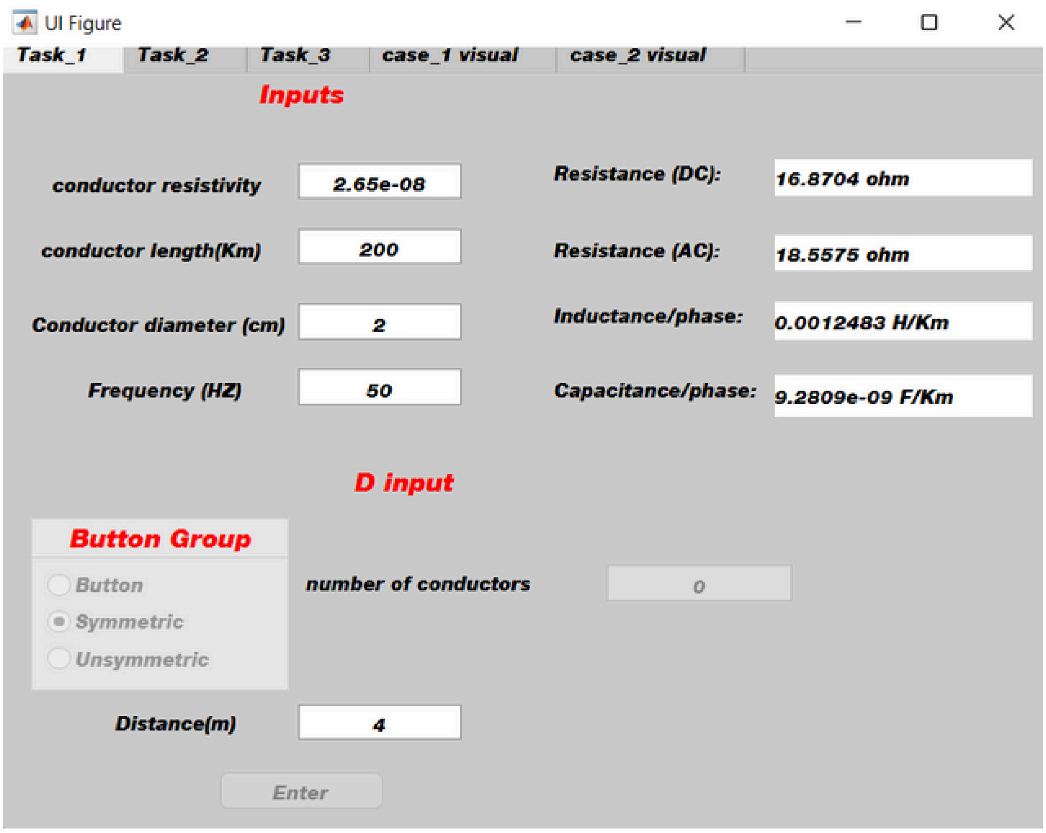
UI Figure
Task_1
Task_2
Task_3
case_1 visual
case_2 visual
4
Enter receiving end voltage
Inputs
VR_line (KV)
0
5
Choose Case
cases
Button
case_1
case_2

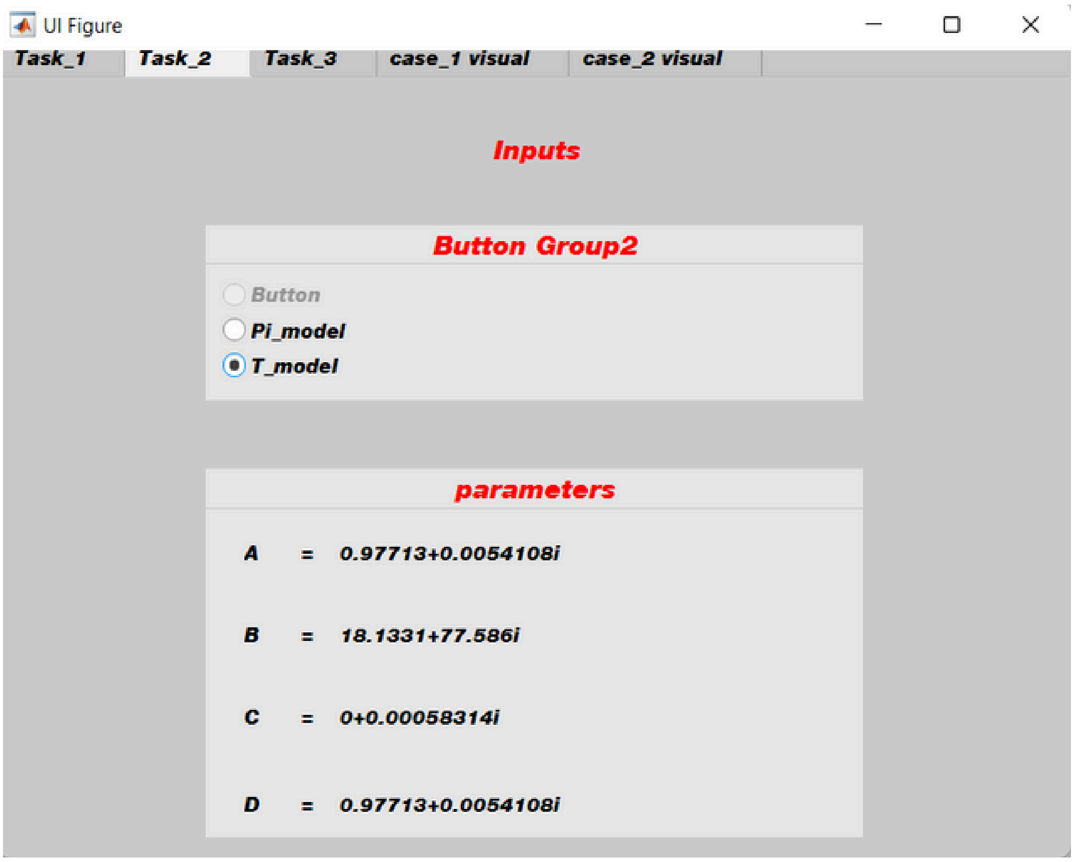


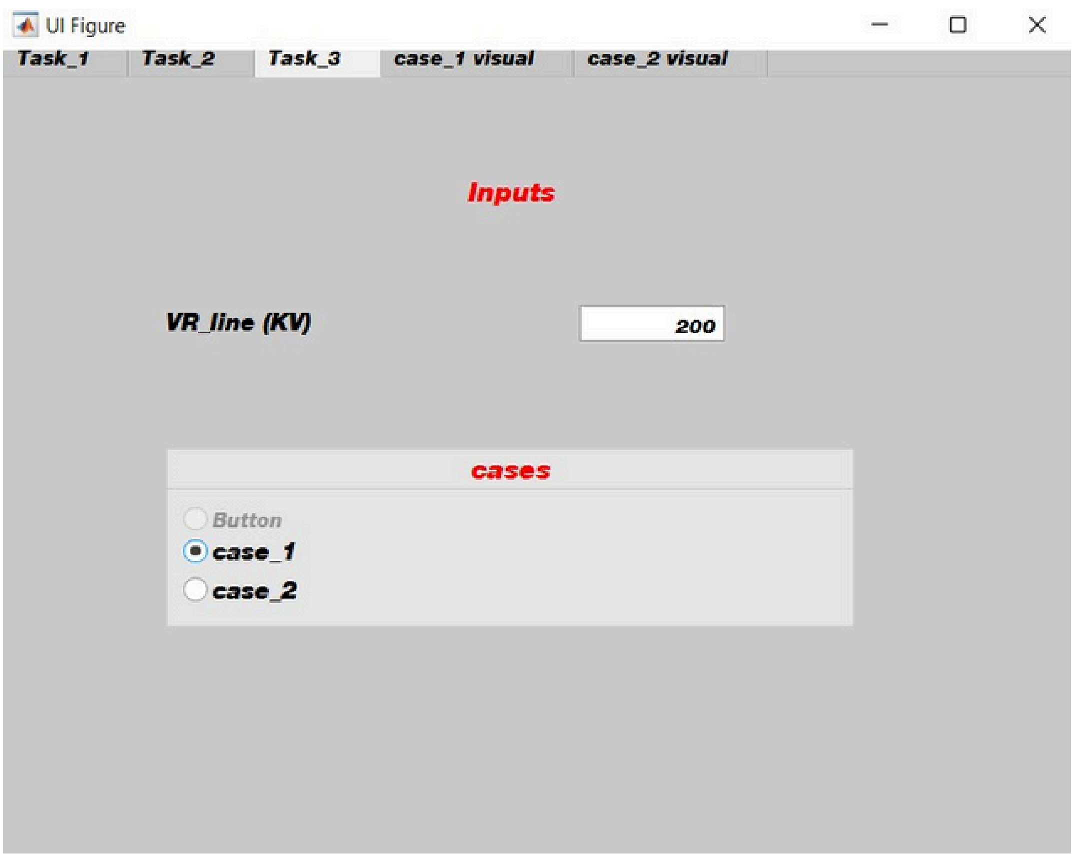
UI Figure
Task_1
Task_2
Task_3
case_1 visual
case_2 visual
Efficiency VS Active power
Efficiency
Active power(KW)
Voltage regulation VS Active power
Voltage regulation

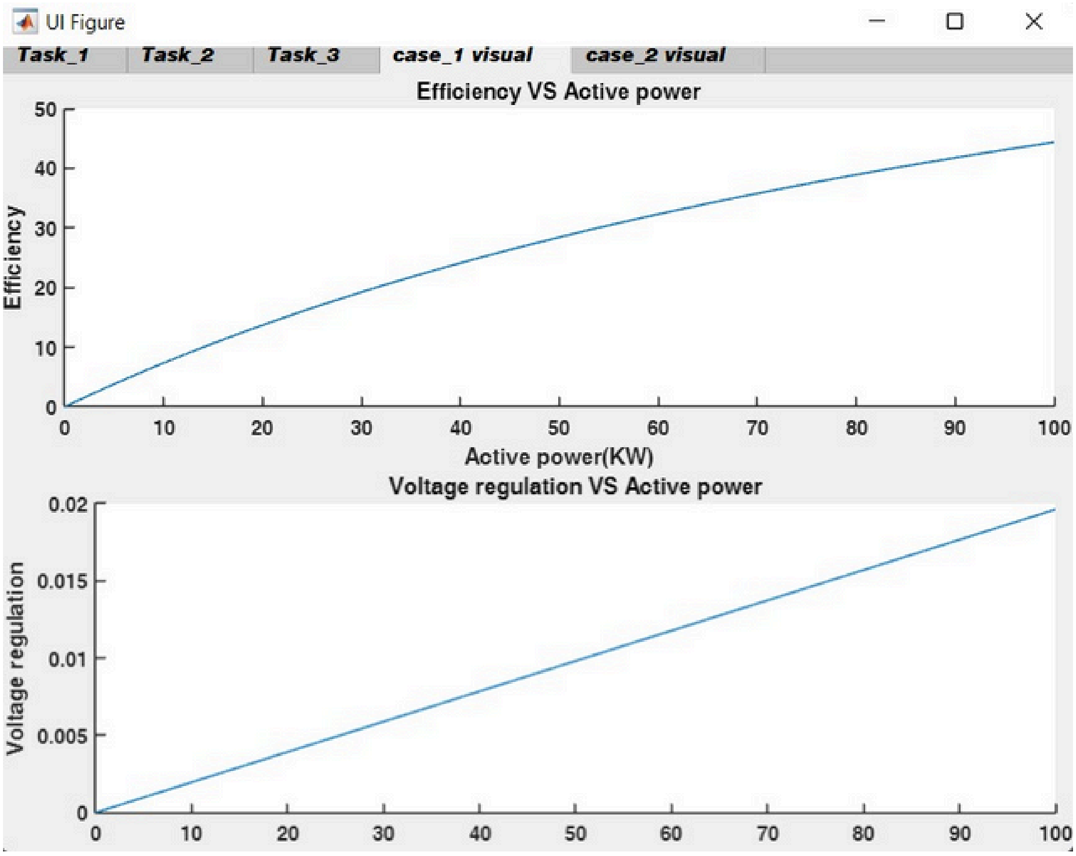

UI Figure
Task_1
Task_2
Task_3
case_1 visual
case_2 visual
Efficiency VS Lag PF
Efficiency
Lag PF
Voltage regulation VS Lag PF
Voltage regulation
Lag PF
Efficiency VS Lead PF
Efficiency
Lead PF
Voltage regulation VS Lead PF
Voltage regulation
Lead PF

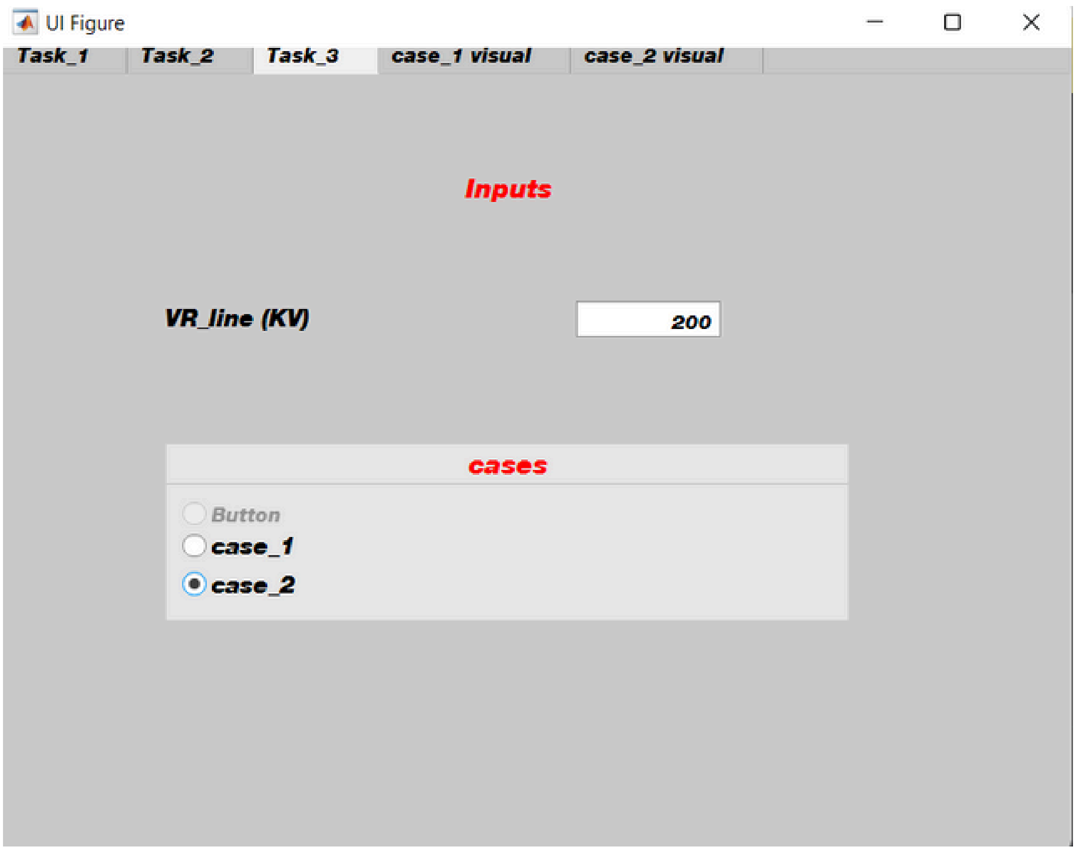
Example 1

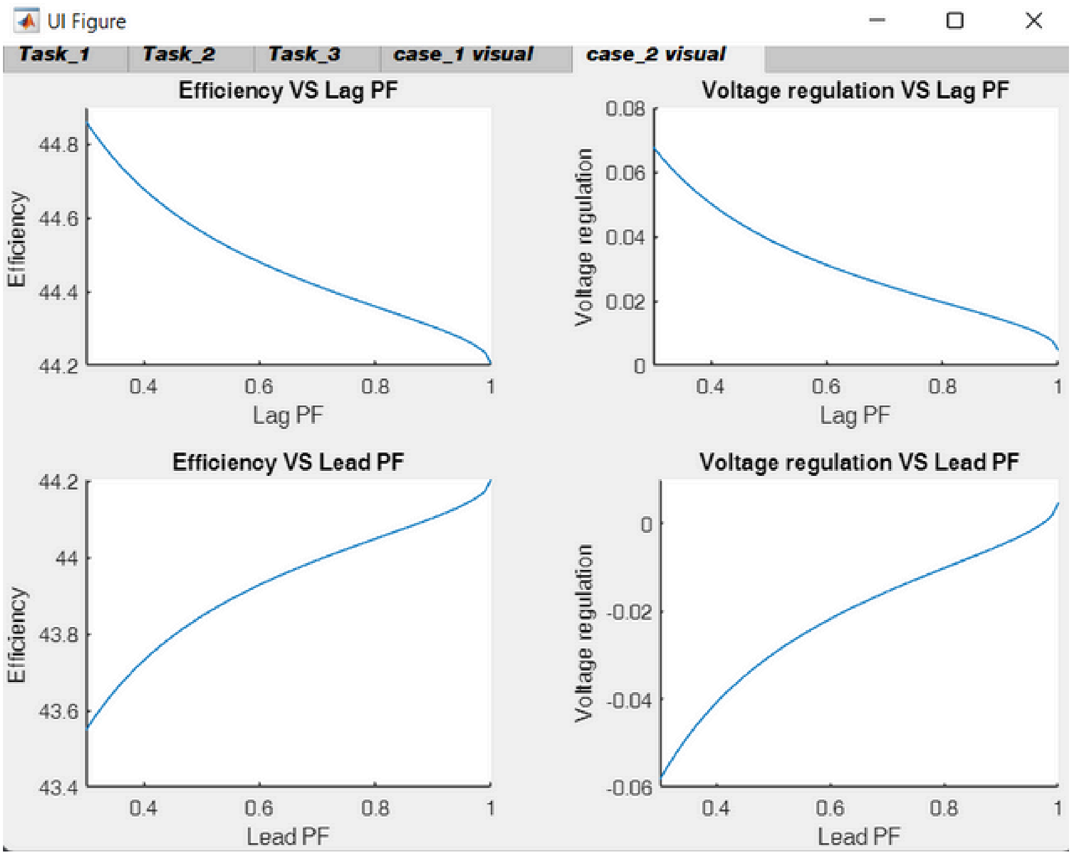

UI Figure
Task_1
Task_2
Task_3
case_1 visual
case_2 visual
Inputs
conductor resistivity
2.65e-08
conductor length(Km)
200
Conductor diameter (cm)
2
Frequency (HZ)
50
Resistance (DC):
16.8704 ohm
Resistance (AC):
18.5575 ohm
Inductance/phase:
0.0012483 H/Km
Capacitance/phase:
9.2809e-09 F/Km
D input
Button Group
Button
Symmetric
Unsymmetric
number of conductors
0
Distance(m)
4
Enter


UI Figure
Task_1
Task_2
Task_3
case_1 visual
case_2 visual
Inputs
Button Group2
Button
Pi_model
T_model
parameters
A = 0.97713+0.0054108i
B = 18.1331+77.586i
C = 0+0.00058314i
D = 0.97713+0.0054108i

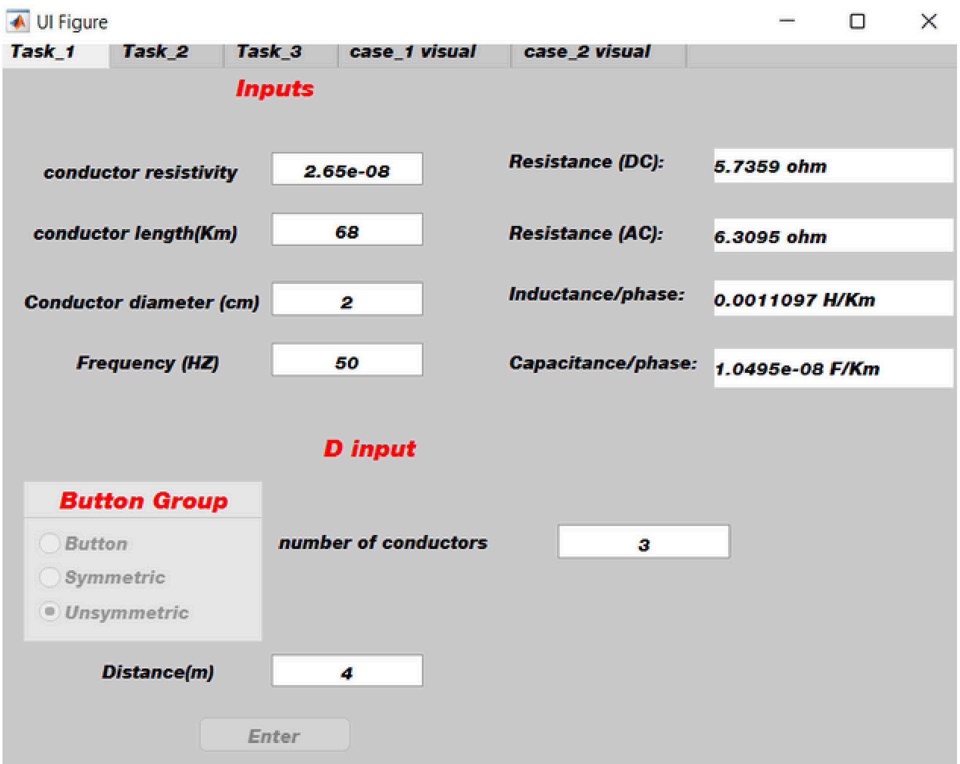

UI Figure
Task_1
Task_2
Task_3
case_1 visual
case_2 visual
Inputs
VR_line (KV)
200
cases
Button
case_1
case_2


UI Figure
Task_1
Task_2
Task_3
case_1 visual
case_2 visual
Efficiency VS Active power
Efficiency
Active power(KW)
Voltage regulation VS Active power
Voltage regulation

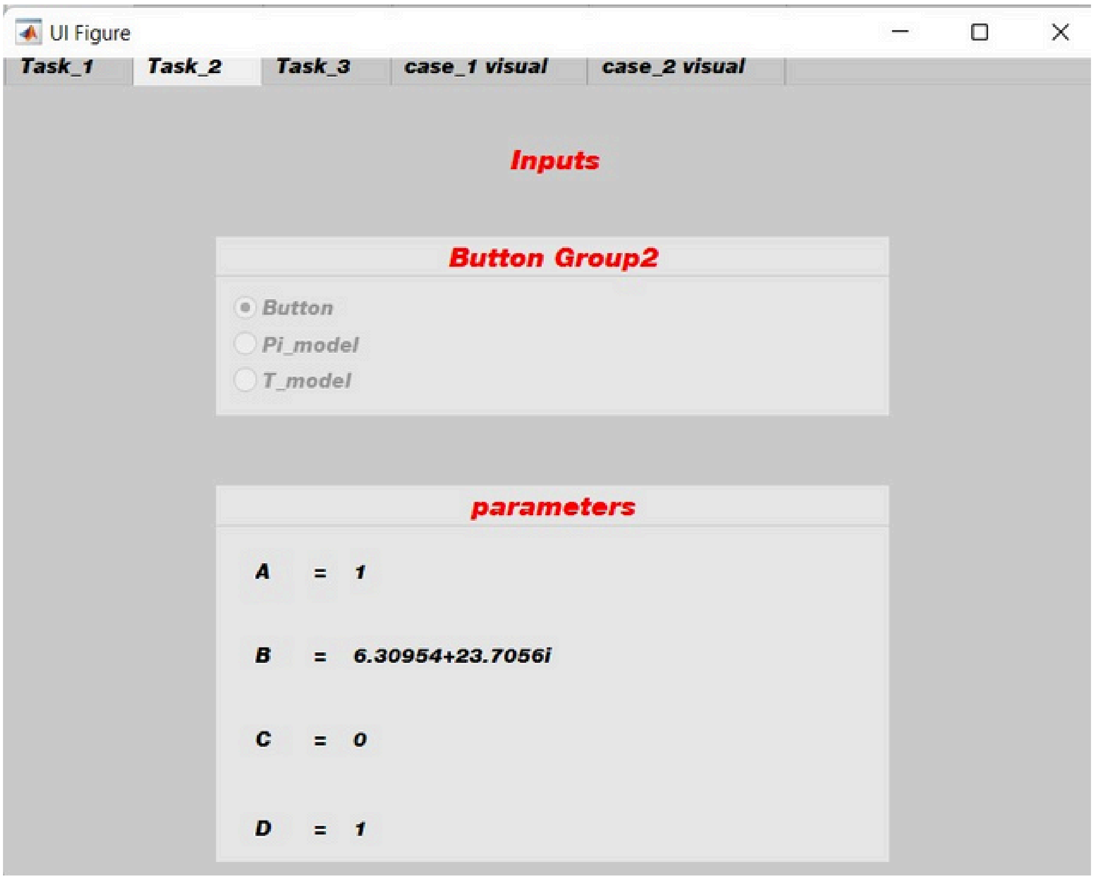

UI Figure
Task_1
Task_2
Task_3
case_1 visual
case_2 visual
Inputs
VR_line (KV)
200
cases
Button
case_1
case_2

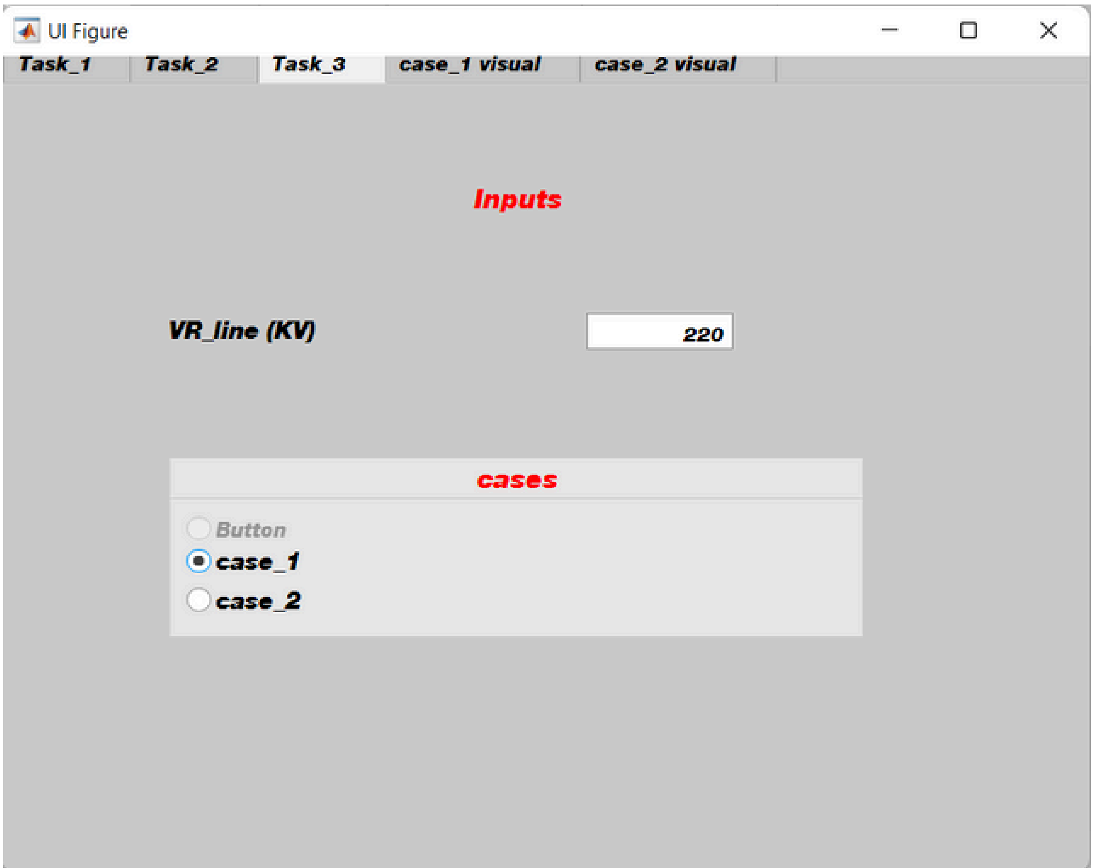


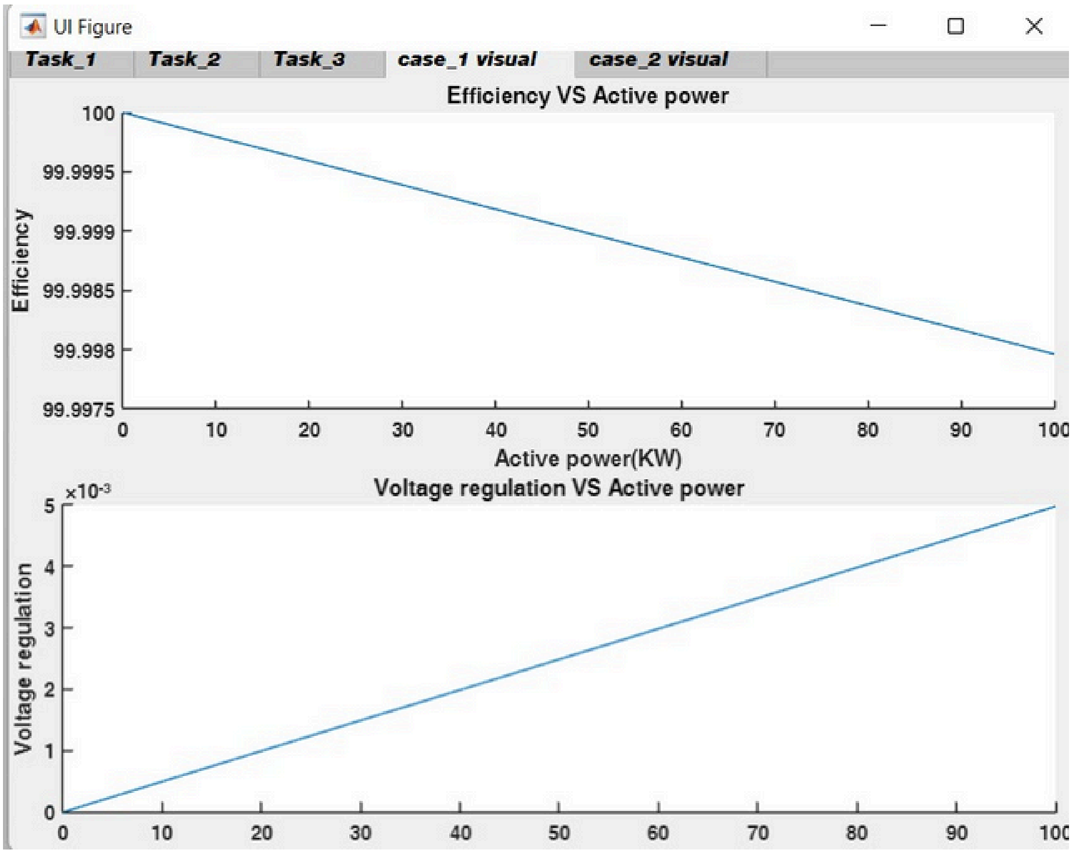
Example 2

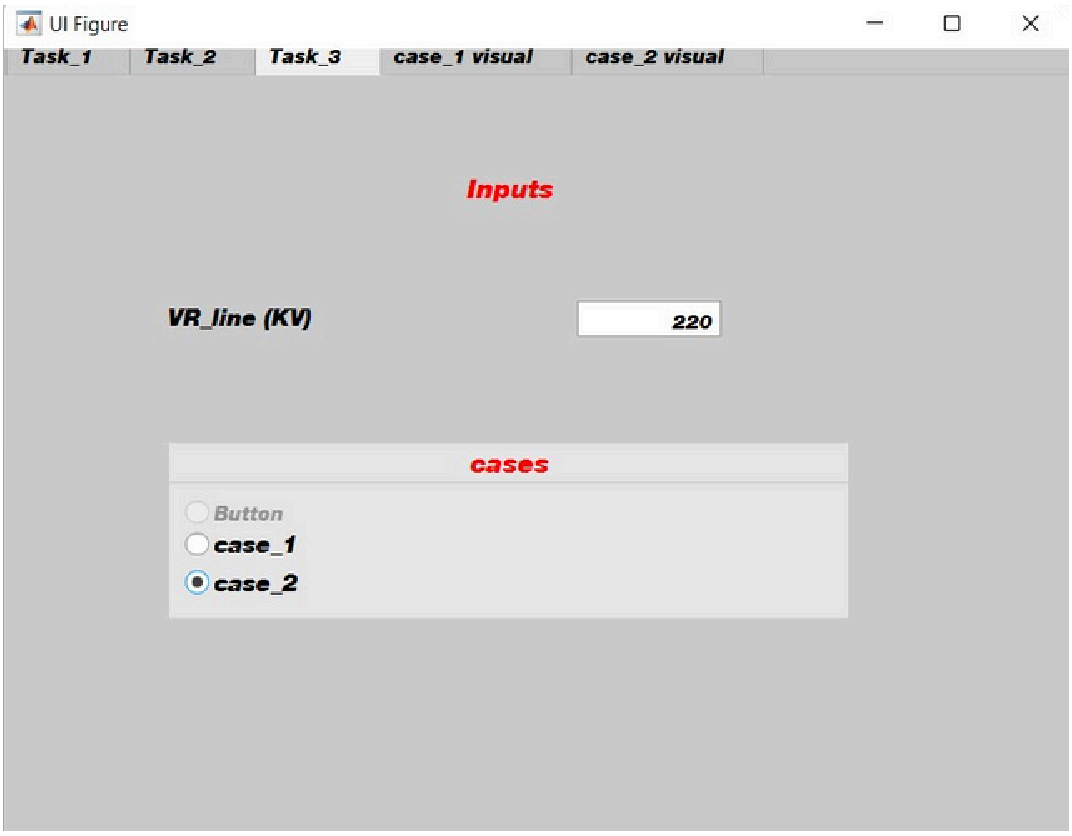


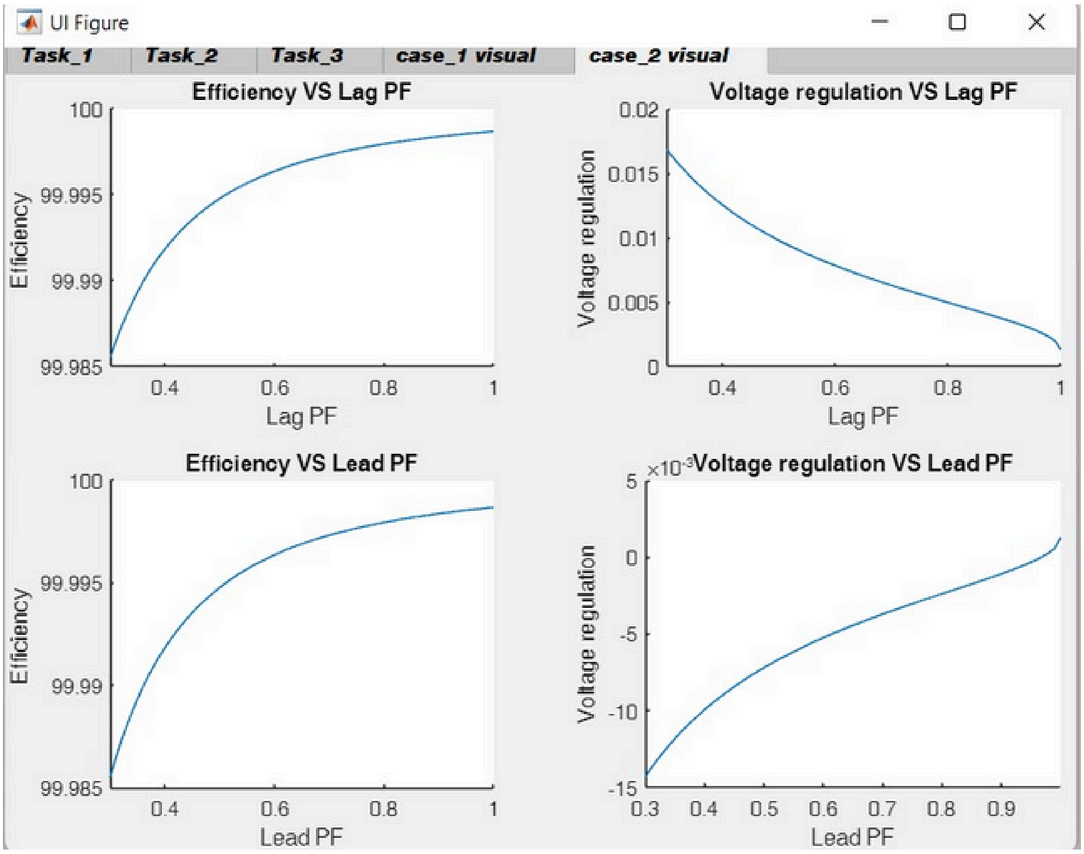
In this example we entered the d1=1, d2=2, d3=4


UI Figure
Task_1
Task_2
Task_3
case_1 visual
case_2 visual
Inputs
Button Group2
Button
Pi_model
T_model
parameters
A = 1
B = 6.30954+23.7056i
C = 0
D = 1

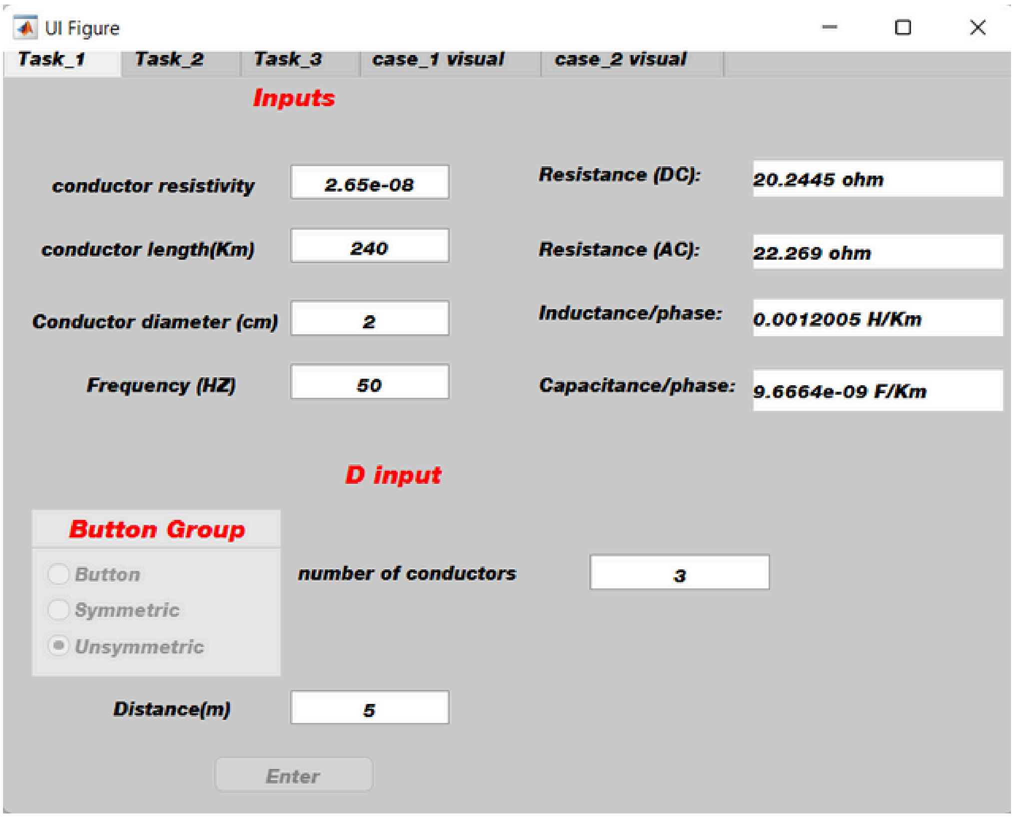

UI Figure
Task_1
Task_2
Task_3
case_1 visual
case_2 visual
Inputs
VR_line (KV)
220
cases
Button
case_1
case_2


UI Figure
Task_1
Task_2
Task_3
case_1 visual
case_2 visual
Efficiency VS Active power
Efficiency
Active power(KW)
Voltage regulation VS Active power
Voltage regulation

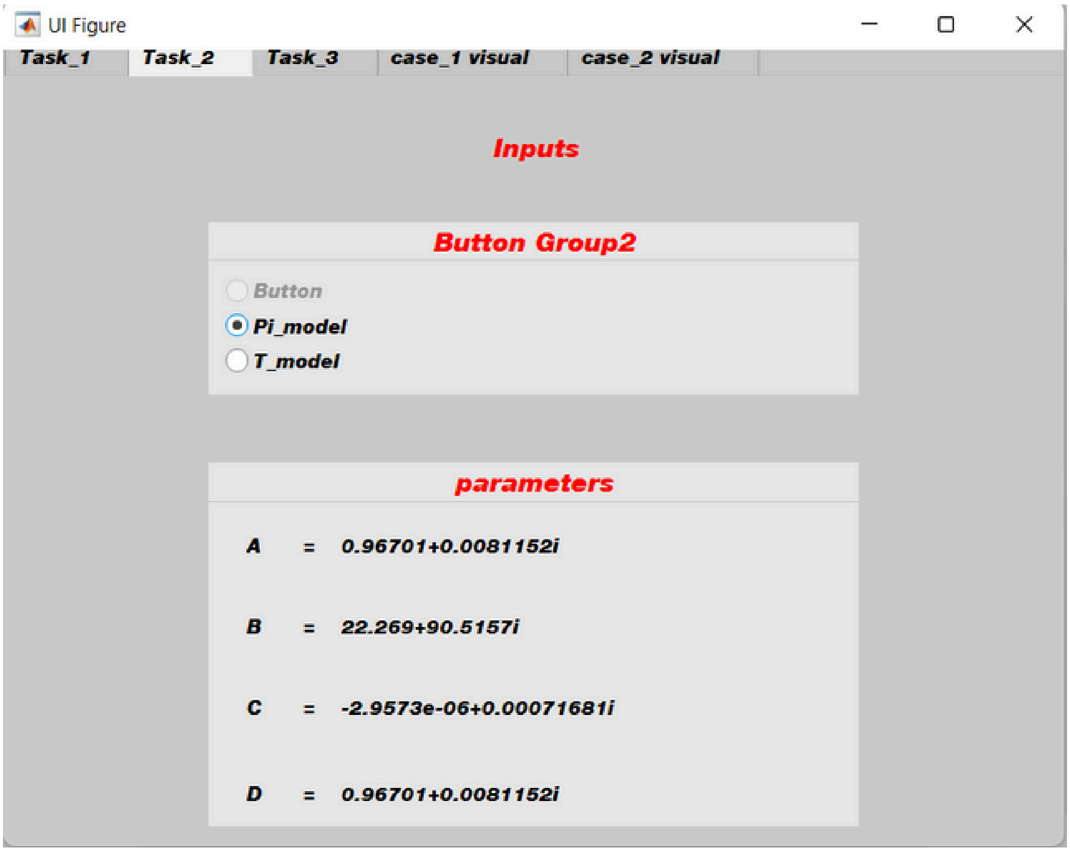

UI Figure
Task_1
Task_2
Task_3
case_1 visual
case_2 visual
Inputs
VR_line (KV)
220
cases
Button
case_1
case_2

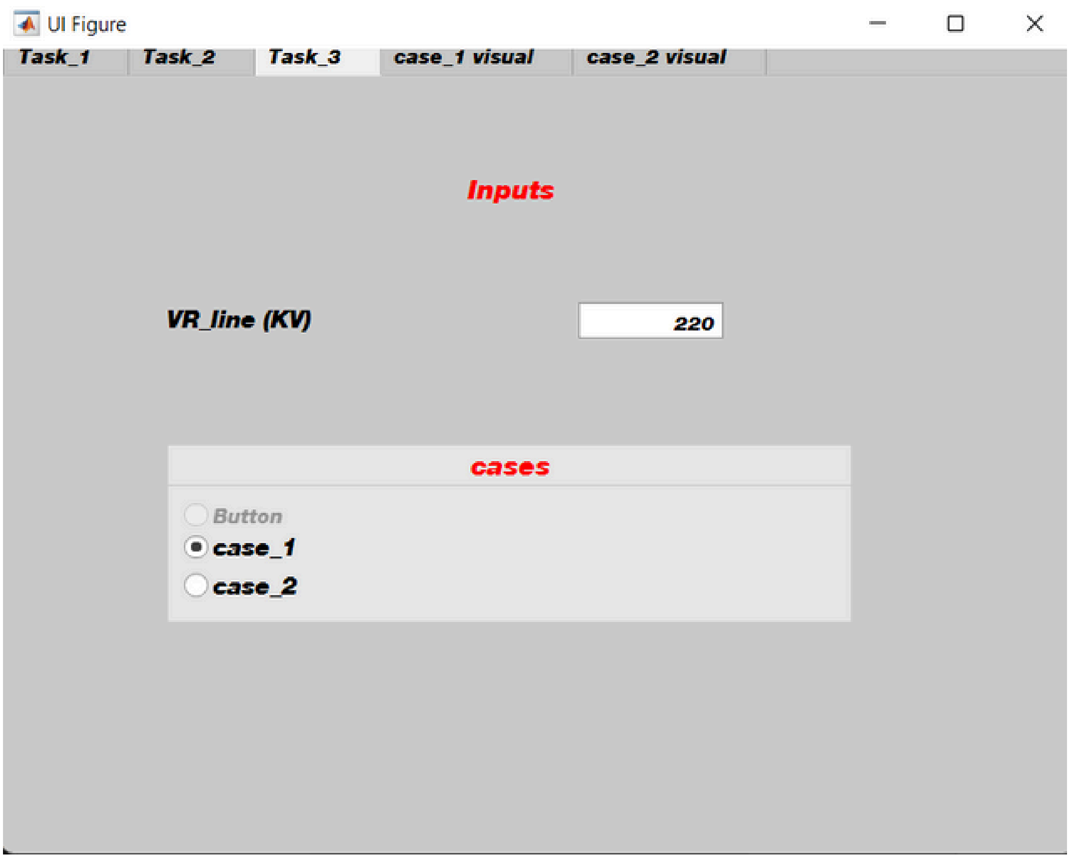


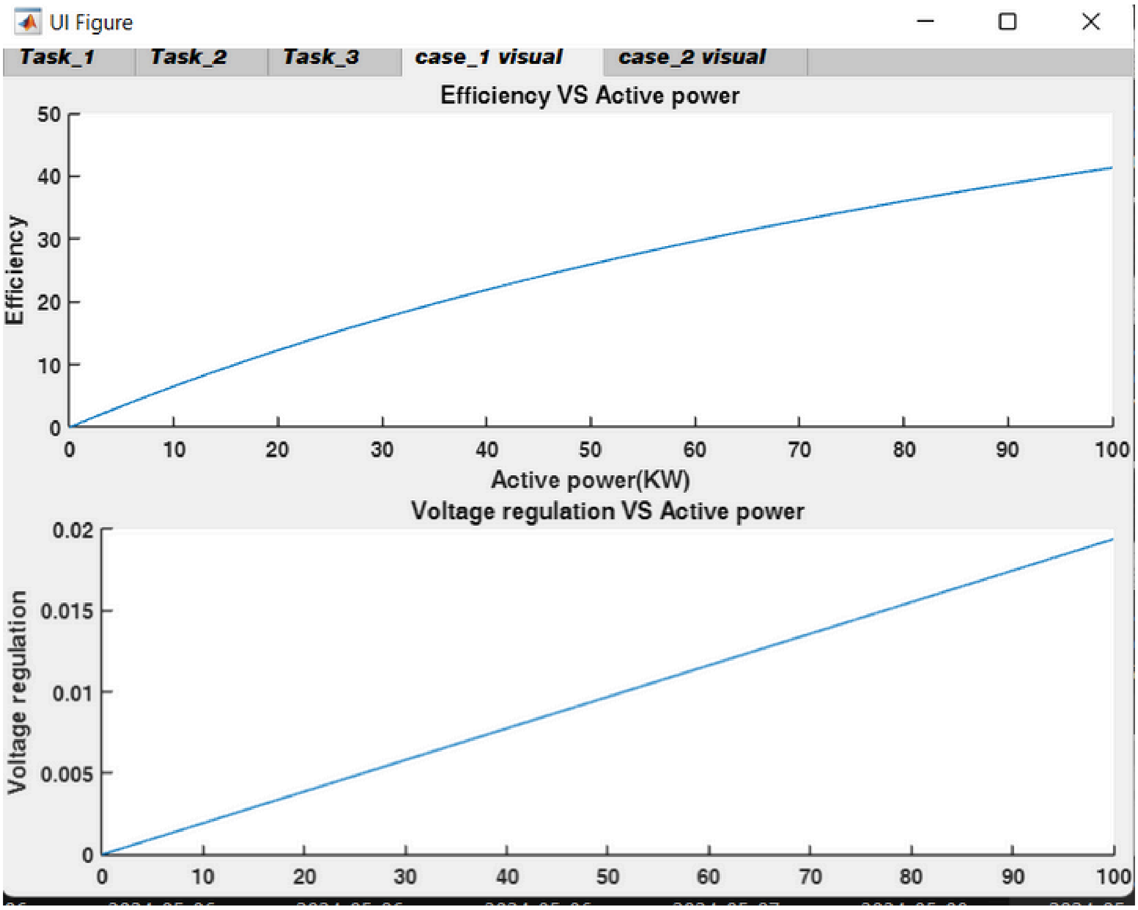
Example 3

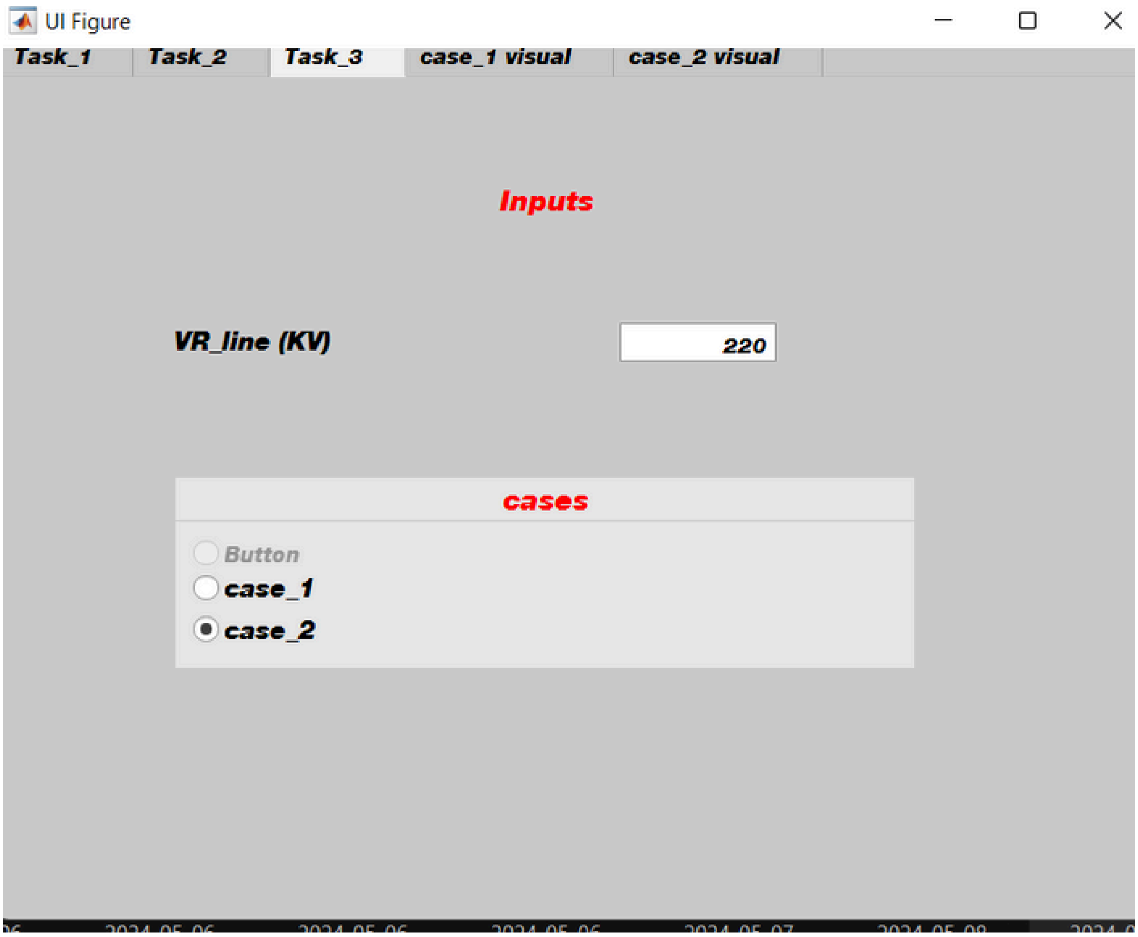


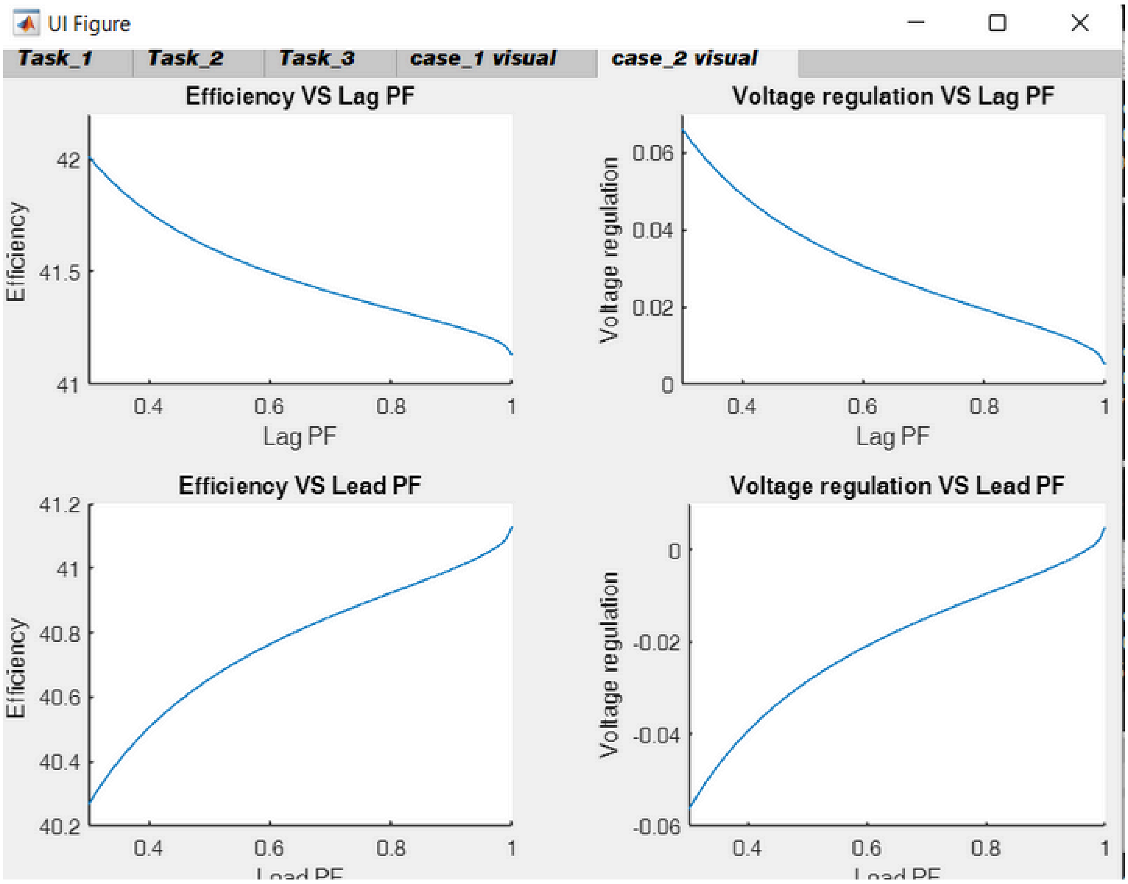
In this example we entered the d1=2.5, d2=2.5, d3=5


UI Figure
Task_1
Task_2
Task_3
case_1 visual
case_2 visual
Inputs
Button Group2
Button
Pi_model
T_model
parameters
A = 0.96701+0.0081152i
B = 22.269+90.5157i
C = -2.9573e-06+0.00071681i
D = 0.96701+0.0081152i


UI Figure
Task_1
Task_2
Task_3
case_1 visual
case_2 visual
Inputs
VR_line (KV)
220
cases
Button
case_1
case_2


UI Figure
Task_1
Task_2
Task_3
case_1 visual
case_2 visual
Efficiency VS Active power
Efficiency
Active power(KW)
Voltage regulation VS Active power
Voltage regulation


UI Figure
Task_1
Task_2
Task_3
case_1 visual
case_2 visual
Inputs
VR_line (KV)
220
cases
Button
case_1
case_2



UI Figure
Task_1
Task_2
Task_3
case_1 visual
case_2 visual
Efficiency VS Lag PF
Efficiency
Lag PF
Voltage regulation VS Lag PF
Voltage regulation
Lag PF
Efficiency VS Lead PF
Efficiency
Voltage regulation VS Lead PF
Voltage regulation