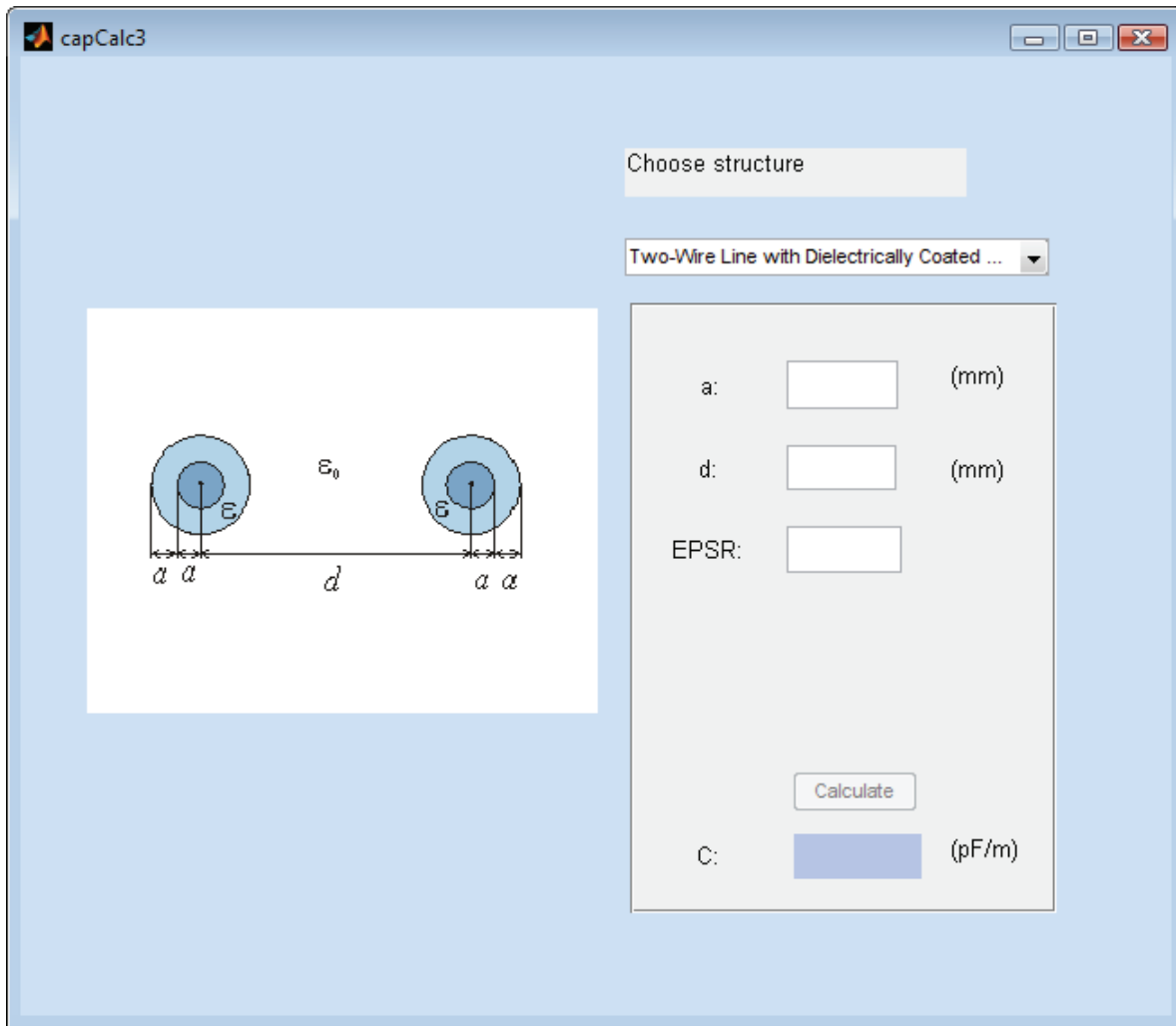


**MATLAB EXERCISE 2.20** GUI for capacitors with inhomogeneous dielectrics. Repeat MATLAB Exercise 2.13 but for the five types of capacitors with inhomogeneous dielectrics in Fig.2.13 (from the book). *[folder ME2\_20(GUI) on IR]*

**SOLUTION:**

Figure S2.11 shows the GUI if, for instance, a two-wire line with dielectrically coated conductors is selected in the pop-up menu.



**Figure S2.11** MATLAB capacitance calculator and graphical user interface for multiple structures with inhomogeneous dielectrics: GUI in the case a two-wire line with dielectrically coated conductors is selected in the pop-up menu; for MATLAB Exercise 2.20.

```

%
% Book: MATLAB-Based Electromagnetics (Pearson Prentice Hall)
% Author: Branislav M. Notaros
% Instructor Resources
% (c) 2011
%
% This MATLAB code or any part of it may be used only for
% educational purposes associated with the book
%
%
%
% GUI for capacitors with inhomogeneous dielectrics

function varargout = capCalc3(varargin)
% CAPCALC3 M-file for capCalc3.fig
% CAPCALC3, by itself, creates a new CAPCALC3 or raises the existing
% singleton*.
%
% H = CAPCALC3 returns the handle to a new CAPCALC3 or the handle to
% the existing singleton*.
%
% CAPCALC3('CALLBACK',hObject,eventData,handles,...) calls the local
% function named CALLBACK in CAPCALC3.M with the given input arguments.
%
% CAPCALC3('Property','Value',...) creates a new CAPCALC3 or raises the
% existing singleton*. Starting from the left, property value pairs are
% applied to the GUI before capCalc3_OpeningFcn gets called. An
% unrecognized property name or invalid value makes property application
% stop. All inputs are passed to capCalc3_OpeningFcn via varargin.
%
% *See GUI Options on GUIDE's Tools menu. Choose "GUI allows only one
% instance to run (singleton)".
%
% See also: GUIDE, GUIDATA, GUIHANDLES

% Edit the above text to modify the response to help capCalc3

% Last Modified by GUIDE v2.5 03-Jun-2010 15:25:14

% Begin initialization code - DO NOT EDIT
gui_Singleton = 1;
gui_State = struct('gui_Name', mfilename, ...
    'gui_Singleton', gui_Singleton, ...
    'gui_OpeningFcn', @capCalc3_OpeningFcn, ...
    'gui_OutputFcn', @capCalc3_OutputFcn, ...
    'gui_LayoutFcn', [] , ...
    'gui_Callback', []);
if nargin && ischar(varargin{1})
    gui_State.gui_Callback = str2func(varargin{1});

```

```
end
```

```
if nargin
```

```
    [varargout{1:nargout}] = gui_mainfcn(gui_State, varargin{:});
```

```
else
```

```
    gui_mainfcn(gui_State, varargin{:});
```

```
end
```

```
% End initialization code - DO NOT EDIT
```

```
% --- Executes just before capCalc3 is made visible.
```

```
function capCalc3_OpeningFcn(hObject, eventdata, handles, varargin)
```

```
% This function has no output args, see OutputFcn.
```

```
% hObject    handle to figure
```

```
% eventdata  reserved - to be defined in a future version of MATLAB
```

```
% handles     structure with handles and user data (see GUIDATA)
```

```
% varargin    command line arguments to capCalc3 (see VARARGIN)
```

```
% Import the figure of the current structure
```

```
handles.ppCapD = imread('ppCapD.png');
```

```
handles.ppCapE = imread('ppCapE.png');
```

```
handles.sphCapCon = imread('sphCapCon.png');
```

```
handles.sphCapHalf = imread('sphCapHalf.png');
```

```
handles.twlCoat = imread('twlCoat.png');
```

```
% Set the current data value.
```

```
set(handles.uipanel1, 'Visible', 'off');
```

```
set(handles.axes1, 'Visible', 'off');
```

```
% Choose default command line output for capCalc3
```

```
handles.output = hObject;
```

```
% Update handles structure
```

```
guidata(hObject, handles);
```

```
set(0, 'units', 'inches');
```

```
screenSize = get(0, 'ScreenSize');
```

```
set(hObject, 'Units', 'inches', 'Position', [screenSize(3)/2-(6.6563/2), screenSize(4)/2-  
(5.5417/2), 6.6563, 5.5417]);
```

```
% UIWAIT makes capCalc3 wait for user response (see UIRESUME)
```

```
% uiwait(handles.figure1);
```

```
% --- Outputs from this function are returned to the command line.
```

```
function varargout = capCalc3_OutputFcn(hObject, eventdata, handles)
```

```
% varargout    cell array for returning output args (see VARARGOUT);
```

```
% hObject    handle to figure
```

```
% eventdata  reserved - to be defined in a future version of MATLAB
```

```
% handles     structure with handles and user data (see GUIDATA)
```

```
% Get default command line output from handles structure
```

```
varargout{1} = handles.output;
```

```

% --- Executes on selection change in popupmenu1.
function popupmenu1_Callback(hObject, eventdata, handles)
% hObject      handle to popupmenu1 (see GCBO)
% eventdata    reserved - to be defined in a future version of MATLAB
% handles      structure with handles and user data (see GUIDATA)
global i;
% Set current data to the selected data set.
switch get(handles.popupmenu1, 'Value')
case 1
    set(handles.uipanel1, 'Visible', 'off');
    cla reset; axis off;
case 2
    handles.current_data = handles.ppCapD;
    imshow(handles.current_data);
    set(handles.edit4, 'Visible', 'on');
    set(handles.edit5, 'Visible', 'on');
    set(handles.text2, 'String', 'd1:');
    set(handles.text3, 'String', 'd2:');
    set(handles.text4, 'String', 'S:');
    set(handles.text5, 'Visible', 'on', 'String', 'EPSR1:');
    set(handles.text6, 'Visible', 'on', 'String', 'EPSR2:');
    set(handles.text7, 'String', '(mm)');
    set(handles.text8, 'String', '(mm)');
    set(handles.text9, 'Visible', 'on', 'String', '(mm^2)');
    set(handles.text12, 'String', '(pF)');
    set(handles.uipanel1, 'Visible', 'on');
    i = 1;
case 3
    handles.current_data = handles.ppCapE;
    imshow(handles.current_data);
    set(handles.edit4, 'Visible', 'on');
    set(handles.edit5, 'Visible', 'on');
    set(handles.text2, 'String', 'S1:');
    set(handles.text3, 'String', 'S2:');
    set(handles.text4, 'String', 'd:');
    set(handles.text5, 'Visible', 'on', 'String', 'EPSR1:');
    set(handles.text6, 'Visible', 'on', 'String', 'EPSR2:');
    set(handles.text7, 'String', '(mm^2)');
    set(handles.text8, 'String', '(mm^2)');
    set(handles.text9, 'Visible', 'on', 'String', '(mm)');
    set(handles.text12, 'String', '(pF)');
    set(handles.uipanel1, 'Visible', 'on');
    i = 2;
case 4
    handles.current_data = handles.sphCapCon;
    imshow(handles.current_data);
    set(handles.edit4, 'Visible', 'on');
    set(handles.edit5, 'Visible', 'on');
    set(handles.text2, 'String', 'a:');
    set(handles.text3, 'String', 'b:');

```

```

set(handles.text4,'String','c:');
set(handles.text5,'Visible','on','String','EPSR1:');
set(handles.text6,'Visible','on','String','EPSR2:');
set(handles.text7,'String','(mm)');
set(handles.text8,'String','(mm)');
set(handles.text9,'Visible','on','String','(mm)');
set(handles.text12,'String','(pF)');
set(handles.uipanel1,'Visible','on');
i = 3;
case 5
handles.current_data = handles.sphCapHalf;
imshow(handles.current_data);
set(handles.edit4,'Visible','on');
set(handles.text5,'Visible','on');
set(handles.text2,'String','a:');
set(handles.text3,'String','b:');
set(handles.text4,'String','EPSR1:');
set(handles.text5,'String','EPSR2:');
set(handles.text6,'Visible','off');
set(handles.edit5,'Visible','off');
set(handles.text7,'String','(mm)');
set(handles.text8,'String','(mm)');
set(handles.text9,'Visible','off');
set(handles.text12,'String','(pF)');
set(handles.uipanel1,'Visible','on');
i = 4;
case 6
handles.current_data = handles.twlCoat;
imshow(handles.current_data);
set(handles.text2,'String','a:');
set(handles.text3,'String','d:');
set(handles.text4,'String','EPSR:');
set(handles.text5,'Visible','off');
set(handles.text6,'Visible','off');
set(handles.edit4,'Visible','off');
set(handles.edit5,'Visible','off');
set(handles.text7,'String','(mm)');
set(handles.text8,'String','(mm)');
set(handles.text9,'Visible','off');
set(handles.text12,'String','(pF/m)');
set(handles.uipanel1,'Visible','on');
i = 5;

end
global ready;
global var;
ready = [0 0 0 0 0];
var = [0 0 0 0 0];
set(handles.pushbutton1,'Enable','off');
set(handles.edit1,'String','');
set(handles.edit2,'String','');
set(handles.edit3,'String','');

```

```

set(handles.edit4,'String','');
set(handles.edit5,'String','');
set(handles.text11,'String','');

% Hints: contents = get(hObject,'String') returns popupmenu1 contents as cell array
%         contents{get(hObject,'Value')} returns selected item from popupmenu1

% --- Executes during object creation, after setting all properties.
function popupmenu1_CreateFcn(hObject, eventdata, handles)
% hObject    handle to popupmenu1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    empty - handles not created until after all CreateFcns called

% Hint: popupmenu controls usually have a white background on Windows.
%         See ISPC and COMPUTER.
if ispc && isequal(get(hObject,'BackgroundColor'), get(
(0,'defaultUiControlBackgroundColor'))
    set(hObject,'BackgroundColor','white');
end
global ready;
    ready = [0 0 0 0 0];
global var;
    var = [0 0 0 0 0];

function edit1_Callback(hObject, eventdata, handles)
% hObject    handle to edit1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

% Hints: get(hObject,'String') returns contents of edit1 as text
%         str2double(get(hObject,'String')) returns contents of edit1 as a double

% --- Executes during object creation, after setting all properties.
handles.edit1 = str2double(get(hObject,'String'));
global ready;
global var;
global i;
if i == 4;
    if (isnan(handles.edit1));
        msgbox('Invalid input','Error');
        ready(1)= 0;
    else
        ready(1)= 1;
        var(1) = handles.edit1;
    end;
if (ready == [1 1 1 1 0])
    set(handles.pushbutton1,'Enable','on');
else
    set(handles.pushbutton1,'Enable','off');

```

```

end;
else if i == 5;
    if (isnan(handles.edit1));
        msgbox('Invalid input','Error');
        ready(1)= 0;
    else
        ready(1)= 1;
        var(1) = handles.edit1;
    end;
if (ready == [1 1 1 0 0])
    set(handles.pushbutton1,'Enable','on');
else
    set(handles.pushbutton1,'Enable','off');
end;
    else
        if (isnan(handles.edit1));
            msgbox('Invalid input','Error');
            ready(1)= 0;
        else
            ready(1)= 1;
            var(1) = handles.edit1;
        end;
if (ready == [1 1 1 1 1])
    set(handles.pushbutton1,'Enable','on');
else
    set(handles.pushbutton1,'Enable','off');
end;
    end;
end

```

```

% --- Executes during object creation, after setting all properties.
function edit1_CreateFcn(hObject, eventdata, handles)
% hObject    handle to edit1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    empty - handles not created until after all CreateFcns called

```

```

% Hint: edit controls usually have a white background on Windows.
%       See ISPC and COMPUTER.

```

```

if ispc && isequal(get(hObject,'BackgroundColor'), get(
(0,'defaultUiControlBackgroundColor'))
    set(hObject,'BackgroundColor','white');
end

```

```

function edit2_Callback(hObject, eventdata, handles)
% hObject    handle to edit2 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

```

```
% Hints: get(hObject,'String') returns contents of edit2 as text
%         str2double(get(hObject,'String')) returns contents of edit2 as a double

% --- Executes during object creation, after setting all properties.
handles.edit2 = str2double(get(hObject,'String'));
global ready;
global var;
global i;
if i == 4;
    if (isnan(handles.edit2));
        msgbox('Invalid input','Error');
        ready(2)= 0;
    else
        ready(2)= 1;
        var(2) = handles.edit2;
    end;
if (ready == [1 1 1 1 0])
    set(handles.pushbutton1,'Enable','on');
else
    set(handles.pushbutton1,'Enable','off');
end;
else if i == 5;
    if (isnan(handles.edit2));
        msgbox('Invalid input','Error');
        ready(2)= 0;
    else
        ready(2)= 1;
        var(2) = handles.edit2;
    end;
if (ready == [1 1 1 0 0])
    set(handles.pushbutton1,'Enable','on');
else
    set(handles.pushbutton1,'Enable','off');
end;
    else
        if (isnan(handles.edit2));
            msgbox('Invalid input','Error');
            ready(2)= 0;
        else
            ready(2)= 1;
            var(2) = handles.edit2;
        end;
if (ready == [1 1 1 1 1])
    set(handles.pushbutton1,'Enable','on');
else
    set(handles.pushbutton1,'Enable','off');
end;
    end;
end

% --- Executes during object creation, after setting all properties.
```



```

function edit2_CreateFcn(hObject, eventdata, handles)
% hObject      handle to edit2 (see GCBO)
% eventdata    reserved - to be defined in a future version of MATLAB
% handles      empty - handles not created until after all CreateFcns called

% Hint: edit controls usually have a white background on Windows.
%         See ISPC and COMPUTER.
if ispc && isequal(get(hObject,'BackgroundColor'), get(
(0,'defaultUiControlBackgroundColor'))
    set(hObject,'BackgroundColor','white');
end

function edit3_Callback(hObject, eventdata, handles)
% hObject      handle to edit3 (see GCBO)
% eventdata    reserved - to be defined in a future version of MATLAB
% handles      structure with handles and user data (see GUIDATA)

% Hints: get(hObject,'String') returns contents of edit3 as text
%         str2double(get(hObject,'String')) returns contents of edit3 as a double
% --- Executes during object creation, after setting all properties.
handles.edit3 = str2double(get(hObject,'String'));
global ready;
global var;
global i;
if i == 4;
    if (isnan(handles.edit3));
        msgbox('Invalid input','Error');
        ready(3)= 0;
else
    ready(3)= 1;
    var(3) = handles.edit3;
end;
if (ready == [1 1 1 1 0])
    set(handles.pushbutton1,'Enable','on');
else
    set(handles.pushbutton1,'Enable','off');
end;
else if i == 5;
    if (isnan(handles.edit3));
        msgbox('Invalid input','Error');
        ready(3)= 0;
else
    ready(3)= 1;
    var(3) = handles.edit3;
end;
if (ready == [1 1 1 0 0])
    set(handles.pushbutton1,'Enable','on');
else
    set(handles.pushbutton1,'Enable','off');
end;

```

```

        else
            if (isnan(handles.edit3));
                msgbox('Invalid input','Error');
                ready(3)= 0;
        else
            ready(3)= 1;
            var(3) = handles.edit3;
        end;
    if (ready == [1 1 1 1 1])
        set(handles.pushbutton1,'Enable','on');
    else
        set(handles.pushbutton1,'Enable','off');
    end;
    end;
end

% --- Executes during object creation, after setting all properties.
function edit3_CreateFcn(hObject, eventdata, handles)
% hObject    handle to edit3 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    empty - handles not created until after all CreateFcns called

% Hint: edit controls usually have a white background on Windows.
%         See ISPC and COMPUTER.
if ispc && isequal(get(hObject,'BackgroundColor'), get(
(0,'defaultUiControlBackgroundColor'))
    set(hObject,'BackgroundColor','white');
end

function edit4_Callback(hObject, eventdata, handles)
% hObject    handle to edit4 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

% Hints: get(hObject,'String') returns contents of edit4 as text
%         str2double(get(hObject,'String')) returns contents of edit4 as a double

% --- Executes during object creation, after setting all properties.
handles.edit4 = str2double(get(hObject,'String'));
global ready;
global var;
global i;
if i == 4;
    if (isnan(handles.edit4));
        msgbox('Invalid input','Error');
        ready(4)= 0;
    else
        ready(4)= 1;
        var(4) = handles.edit4;
    end;
end;
end;
end

```

```

end;
if (ready == [1 1 1 1 0])
    set(handles.pushbutton1, 'Enable', 'on');
else
    set(handles.pushbutton1, 'Enable', 'off');
end;
else
    if (isnan(handles.edit4));
        msgbox('Invalid input', 'Error');
        ready(4)= 0;
    else
        ready(4)= 1;
        var(4) = handles.edit4;
    end;
if (ready == [1 1 1 1 1])
    set(handles.pushbutton1, 'Enable', 'on');
else
    set(handles.pushbutton1, 'Enable', 'off');
end;
end

% --- Executes during object creation, after setting all properties.
function edit4_CreateFcn(hObject, eventdata, handles)
% hObject    handle to edit4 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    empty - handles not created until after all CreateFcns called

% Hint: edit controls usually have a white background on Windows.
%         See ISPC and COMPUTER.
if ispc && isequal(get(hObject, 'BackgroundColor'), get(
(0, 'defaultUiControlBackgroundColor'))
    set(hObject, 'BackgroundColor', 'white');
end

function edit5_Callback(hObject, eventdata, handles)
% hObject    handle to edit5 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

% Hints: get(hObject, 'String') returns contents of edit5 as text
%         str2double(get(hObject, 'String')) returns contents of edit5 as a double

% --- Executes during object creation, after setting all properties.
handles.edit5 = str2double(get(hObject, 'String'));
global ready;
global var;

if (isnan(handles.edit5));
    msgbox('Invalid input', 'Error');
    ready(5)= 0;

```

```

else
    ready(5)= 1;
    var(5) = handles.edit5;
end;
if (ready == [1 1 1 1 1])
    set(handles.pushbutton1, 'Enable', 'on');
else
    set(handles.pushbutton1, 'Enable', 'off');
end;

% --- Executes during object creation, after setting all properties.
function edit5_CreateFcn(hObject, eventdata, handles)
% hObject    handle to edit5 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    empty - handles not created until after all CreateFcns called

% Hint: edit controls usually have a white background on Windows.
%         See ISPC and COMPUTER.
if ispc && isequal(get(hObject, 'BackgroundColor'), get(
(0, 'defaultUiControlBackgroundColor'))
    set(hObject, 'BackgroundColor', 'white');
end

% --- Executes on button press in pushbutton1.
function pushbutton1_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
% --- Executes during object creation, after setting all properties.
global var;
global i;
EPS0 = 8.8542*10^(-12);
mm2m = 10^(-3);
mmsq2msq = 10^(-6);
if i == 1;
    d1 = var(1)*mm2m;
    d2 = var(2)*mm2m;
    S = var(3)*mmsq2msq;
    EPSR1 = var(4);
    EPSR2 = var(5);
    C = EPS0*EPSR1*EPSR2*S/(EPSR2*d1 + EPSR1*d2);
else if i == 2;
    S1 = var(1)*mmsq2msq;
    S2 = var(2)*mmsq2msq;
    d = var(3)*mm2m;
    EPSR1 = var(4);
    EPSR2 = var(5);
    C = EPS0*(EPSR1*S1 + EPSR2*S2)/d;
else if i == 3;
    a = var(1)*mm2m;
    b = var(2)*mm2m;

```

```
c = var(3)*mm2m;
EPSR1 = var(4);
EPSR2 = var(5);
C = 4*pi*EPS0*((b-a)/(EPSR1*a*b) + (c-b)/(EPSR2*b*c))^( -1);
else if i == 4;
    a = var(1)*mm2m;
    b = var(2)*mm2m;
    EPSR1 = var(3);
    EPSR2 = var(4);
    C = 2*pi*EPS0*(EPSR1 + EPSR2)*a*b/(b-a);
else
    a = var(1)*mm2m;
    d = var(2)*mm2m;
    EPSR = var(3);
    C = pi*(log(2)/(EPSR*EPS0) + log(d/(2*a))/EPS0)^( -1);
end;
end
end
end
C = C*10^12;
set(handles.text11, 'String', num2str(C, '%.4e'));
```