USPAS Fort Collins, June 2013
Design of Electron Storage and Damping Rings

Computer lab:

1. Introduction to Matlab and SAMM

    •   Using Matlab to generate a phase space plot

    •   Using SAMM to generate a phase space plot

2. **Introduction to GUI programming in Matlab**

    •   **Setting up a Graphical User Interface**

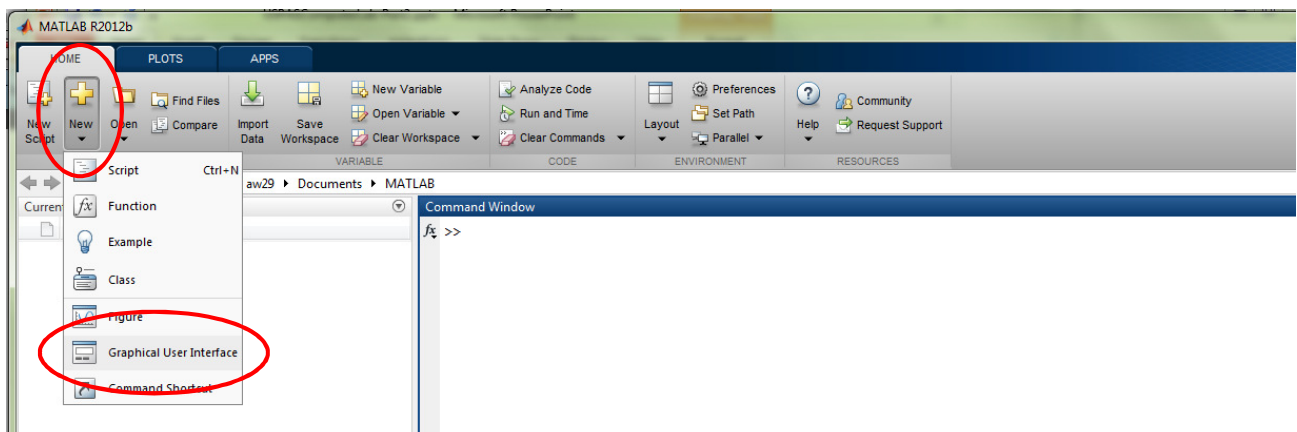   •   **Customising controls**

3. Optimisation routines in Matlab

USPAS Fort Collins, June 2013
Design of Electron Storage and Damping Rings
**Computer Lab 2.1:** Setting up a Graphical User Interface

Create a new Graphical User Interface:

1. Launch Matlab, and set the working directory.

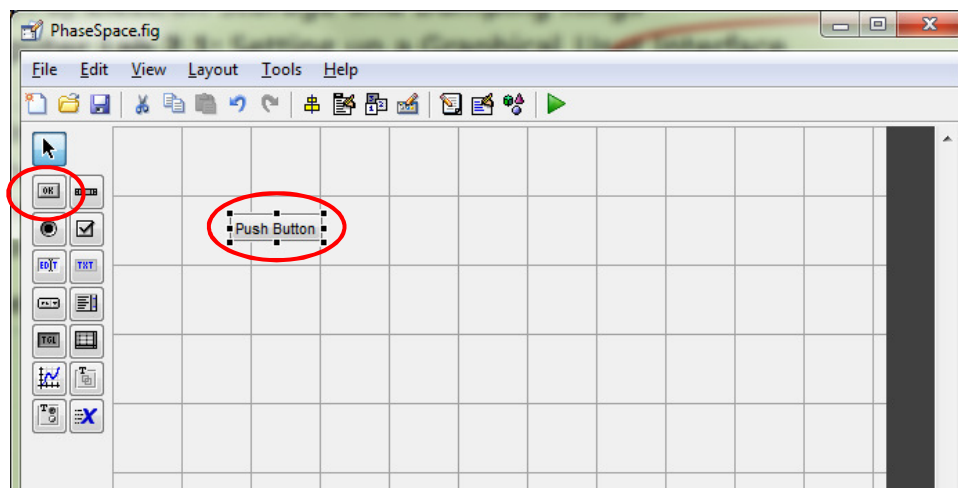2. Click on "New", and select "Graphical User Interface".

USPAS Fort Collins, June 2013
Design of Electron Storage and Damping Rings
Computer Lab 2.1: Setting up a Graphical User Interface

3. In the dialogue box, select "Save new figure as:" and enter a filename.

4. Select "Blank GUI (Default)" and click OK.

USPAS Fort Collins, June 2013
Design of Electron Storage and Damping Rings
Computer Lab 2.1: Setting up a Graphical User Interface
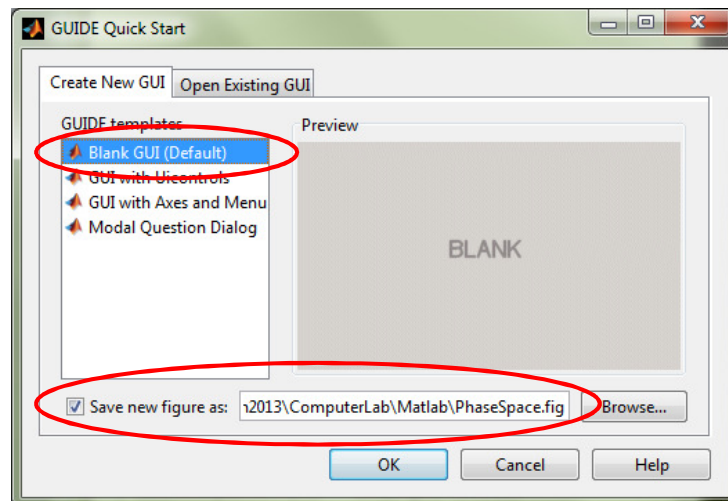
5. On the left hand side of the window that appears (titled "PhaseSpace.fig"), there are a number of buttons corresponding to different controls.
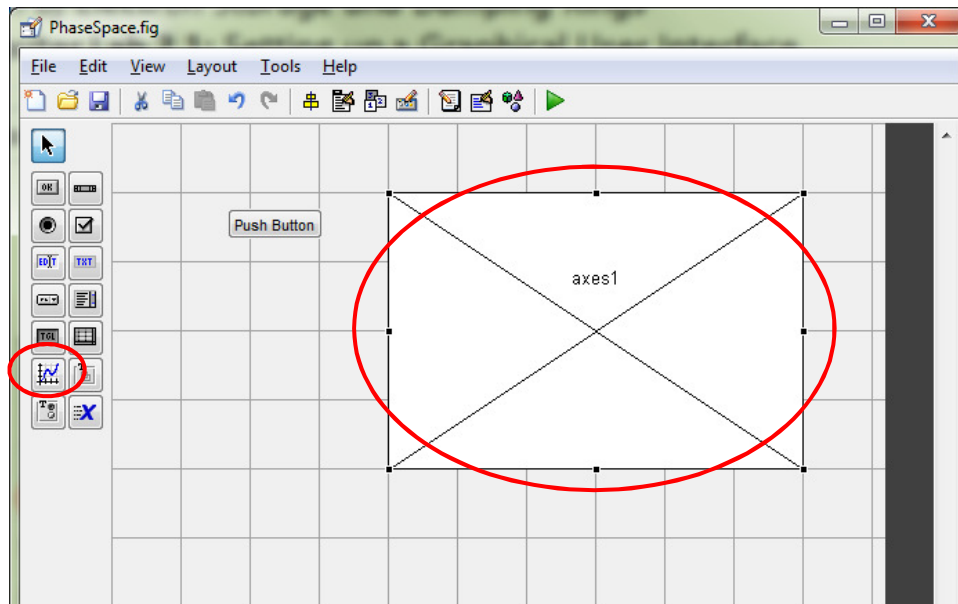
    Select the "Push Button" control (marked "OK"), and click on the desired location for the new control.

USPAS Fort Collins, June 2013
Design of Electron Storage and Damping Rings
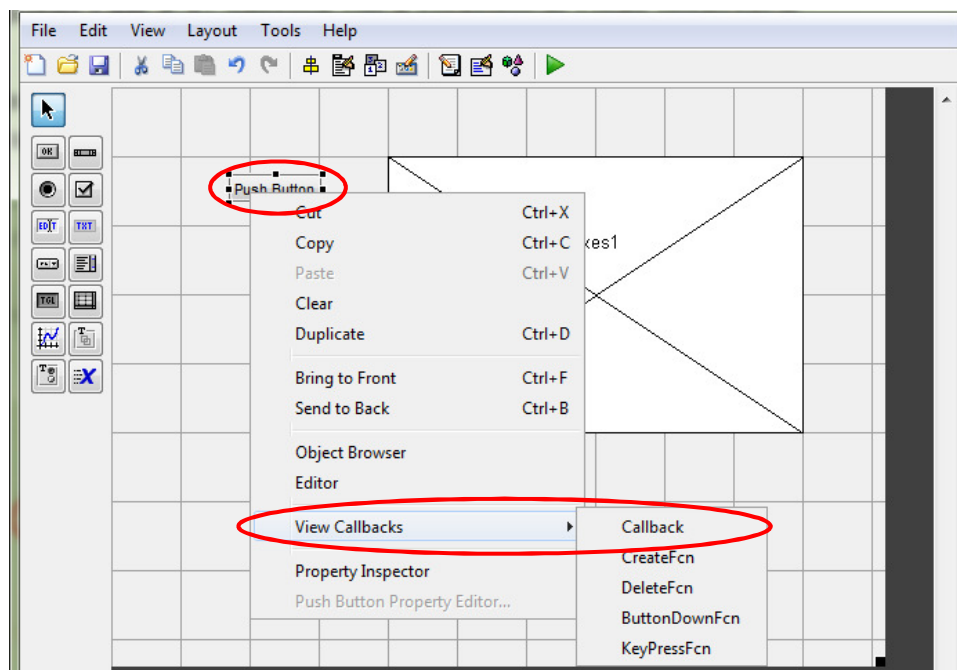**Computer Lab 2.1:** Setting up a Graphical User Interface

6. Place an Axes control in the window, and make it a reasonable size by dragging the corners.

5

7. Right click on the Push Button, then select "View Callbacks ▶ Callback".

6

8. In the text editor, under function pushbutton1_Callback, enter the code:

```
x = 0:2*pi/100:2*pi;
y = sin(x);
plot(handles.axes1,x,y,'-k');
```
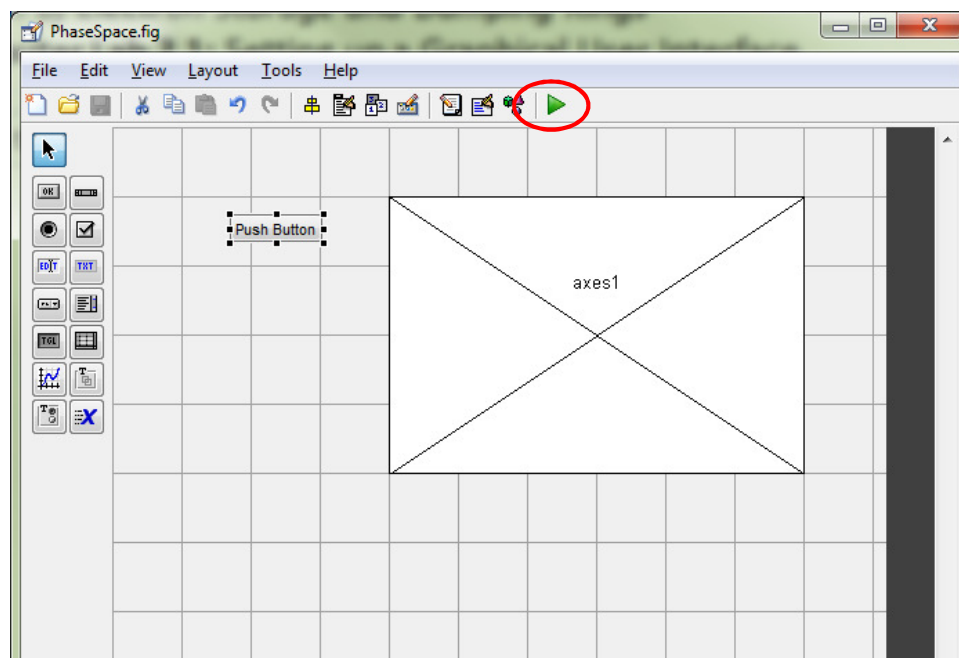
Click "Save".
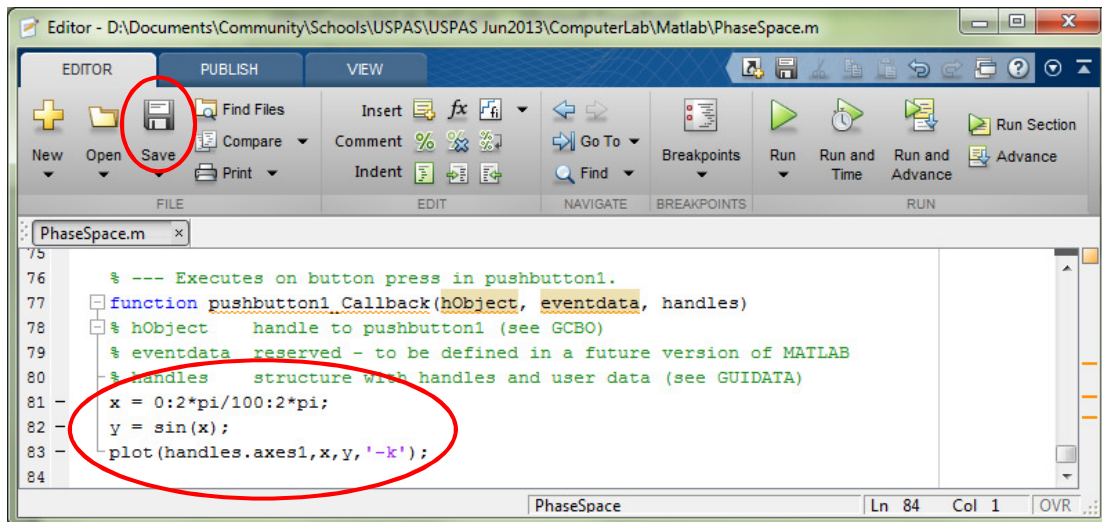
7

---

9. In the window PhaseSpace.fig, click the button with the green arrow:

8

10. In the new window that opens, click on the Push Button:
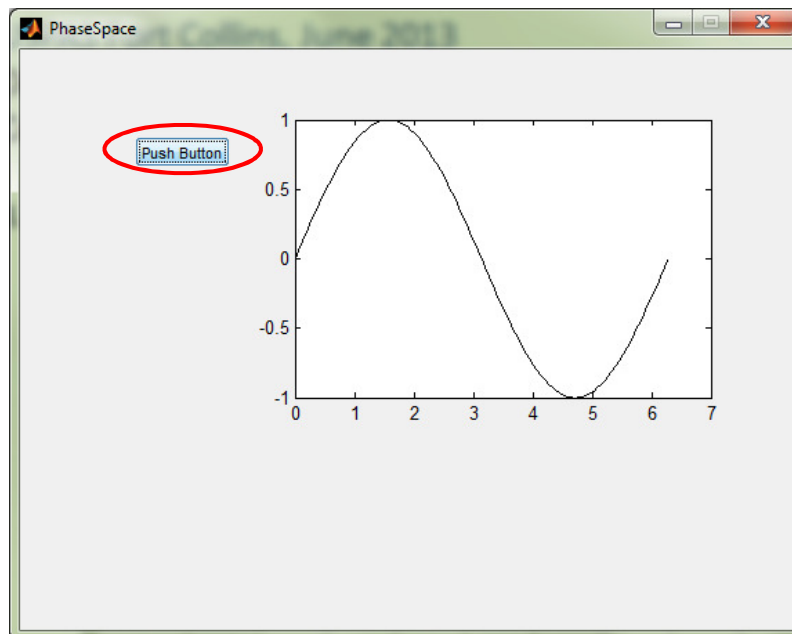
Matlab "handles":

- Each control that you place on your GUI is an object (an instance of some class). When you create a new control, Matlab assigns it a name (a "Tag").

- A Matlab GUI consists of two files with the same name, but different extensions:

  - The ".fig" file contains the layout of the GUI with various controls.

  - The ".m" file contains the code underlying the controls.

- To refer to a particular control within the ".m" file, use the syntax:
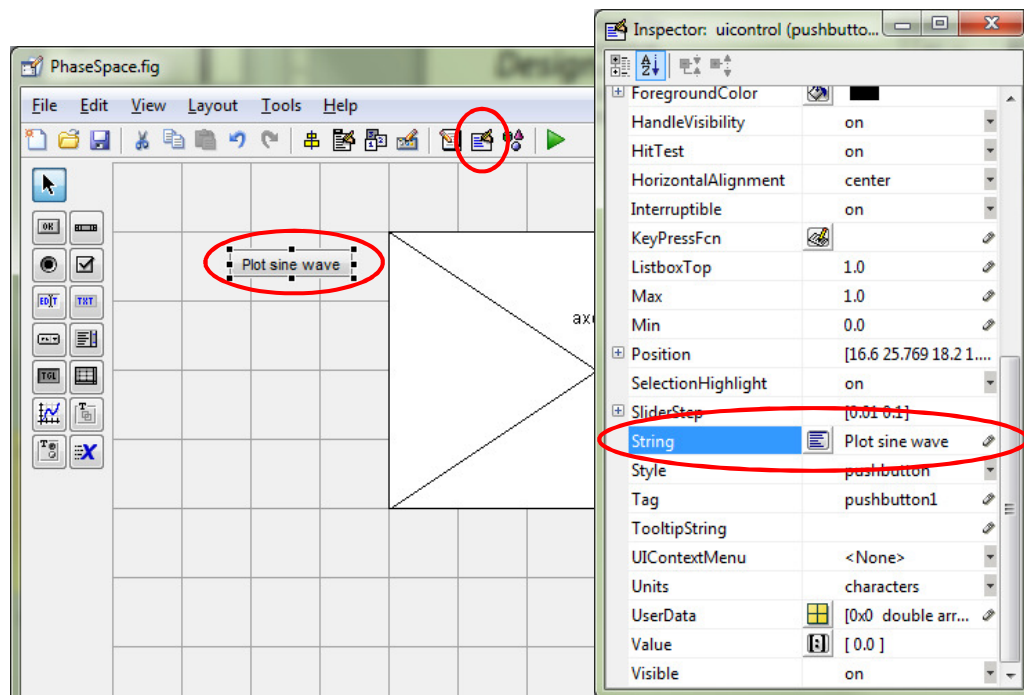
  ```
  handles.Tag
  ```

  where *Tag* is the tag (name) of the control.

- To find the tag of a particular control, just click on the control in the ".fig" file: the tag is displayed in the bottom left corner of the window.

To change the properties of a control, use the "Property Inspector":

To get and set the properties of a control from within the ".m" file, use the "get" and "set" commands. For example:

11. Add an "Edit Text" control to your GUI, and using the Property Inspector, set the "String" property to "2.0" (without the quotes).

12. Edit the function pushbutton1_Callback in the ".m" file as follows:

```
% --- 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)
f = str2double(get(handles.edit1,'String'));

x = 0:2*pi/100:2*pi;
y = sin(f*x);
plot(handles.axes1,x,y,'-k');

set(handles.pushbutton1,'String','Done!');
```

Sharing data between functions in a GUI:

- Any variable defined within a function is (by default) local to that function. Once execution of the function completes, the variable is deleted.

- To "preserve" a variable and share it with other functions, you can use the "handles" object. For example:

```
% --- 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)

handles.newvariable = 3.14;

guidata(hObect,handles); % required to update the handles object.
```

USPAS Fort Collins, June 2013
Design of Electron Storage and Damping Rings
Computer Lab 2: Introduction to GUI programming

Some exercises for the student:

A. Set up a GUI to generate horizontal and vertical phase space plots for a FODO cell with quadrupole strengths that can be entered in "Edit Text" controls.

B. Extend the GUI from (A) to generate a plot of the beta functions through the FODO cell.