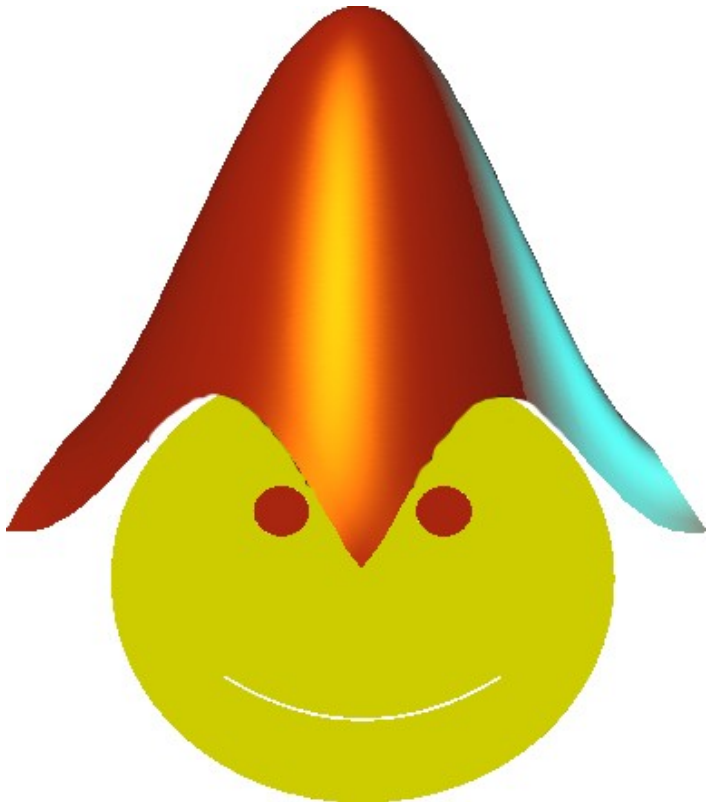
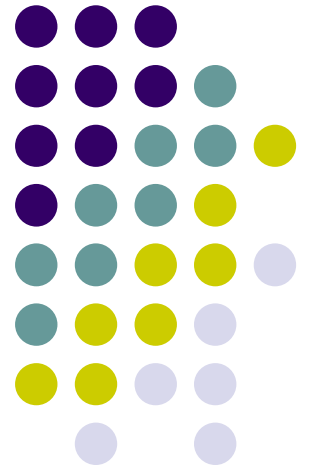
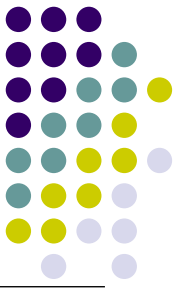


Introduction to Matlab



Boguslaw

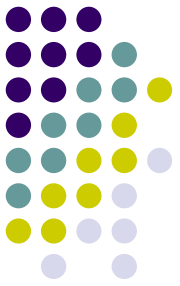




Contents

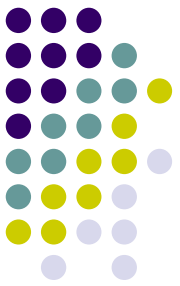
- Matlab - introduction
 - Toolboxes
- Image Processing Toolbox
 - I/O
 - Processing
 - Segmentation
 - Analysis
- Graphical User Interfaces

Matlab - introduction

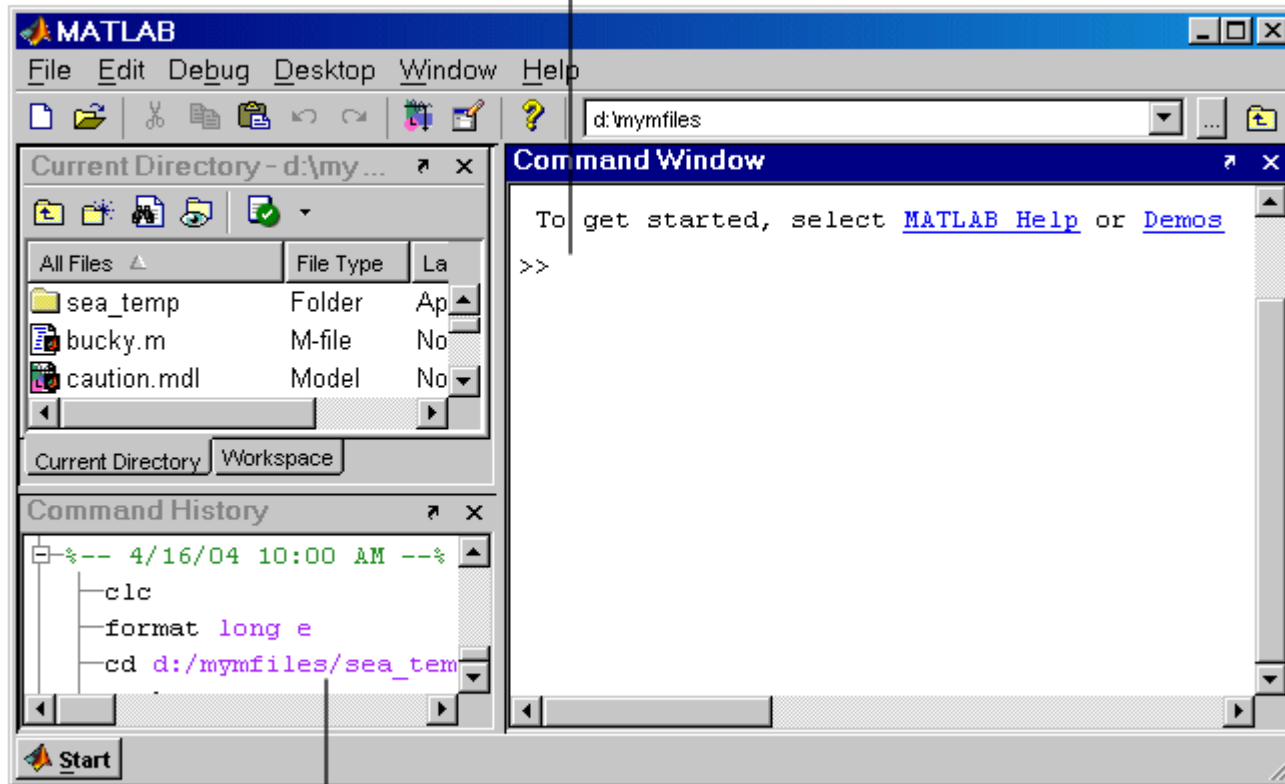


- Windows XP (Service Pack 1 or 2)
- Windows 2000 (Service Pack 3 or 4)
- 2003 Server Windows NT 4.0 (Service Pack 5 or 6a)
- Linux x86 2.4.x, glibc 2.3.2
- Linux x86 2.4.x, glibc 2.2.5
- Linux x86 2.6.x, glibc 2.3.2
- Linux x86_64 2.4.x, glibc 2.3.2
- Linux x86_64 2.6.x, glibc 2.3.2
- Sun Solaris 2.8 and 2.9
- HPUX 11.0 and 11.i
- Mac OS X 10.3.2, 10.3.4, 10.3.5, 10.3.6, and 10.3.7
- **Bioinformatics Toolbox**
- Communications Toolbox
- Control System Toolbox
- Curve Fitting Toolbox
- **Data Acquisition Toolbox**
- Database Toolbox
- Distributed Computing Toolbox
- Filter Design Toolbox
- **Image Acquisition Toolbox**
- **Image Processing Toolbox**
- Instrument Control Toolbox
- Optimization Toolbox
- Robust Control Toolbox
- **Signal Processing Toolbox**
- Statistics Toolbox
- Symbolic Math Toolbox
- Virtual Reality Toolbox

Matlab - introduction

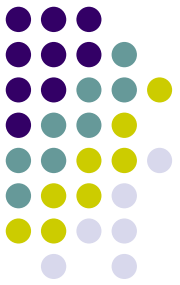


Enter MATLAB functions at the Command Window prompt.



The **Command History** maintains a record of the **MATLAB** functions you ran.

Matlab - introduction



A =

```
16  3  2 13
 5 10 11  8
 9  6  7 12
 4 15 14  1
```

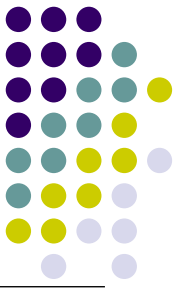
```
13  8 12  1
 2 11  7 14
 3 10  6 15
16  5  9  4
```

A' =

sum(A) = 34 34 34 34

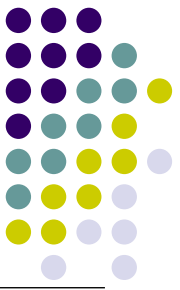
A(1,4) + A(2,4) + A(3,4) + A(4,4) = 34

1:10 = 1 2 3 4 5 6 7 8 9 10



Matlab - introduction

- + Addition
- - Subtraction
- * Multiplication
- / Division
- ^ Power
- ' Complex conjugate transpose
- () Specify evaluation order
- When they are taken away from the world of linear algebra, matrices become two-dimensional numeric arrays.
- + Addition
- - Subtraction
- .* Element-by-element multiplication
- ./ Element-by-element division
- .^ Element-by-element power
- .' Unconjugated array transpose



Matlab - introduction

- **zeros** - All zeros
- **ones** - All ones
- **rand** - Uniformly distributed random elements
- **randn** - Normally distributed random elements

```
Z = zeros(2,4) =  
  0  0  0  0  
  0  0  0  0
```

```
F = 5*ones(3,3) =  
  5  5  5  
  5  5  5  
  5  5  5
```

```
R = randn(4,4)  
R =  
  0.6353  0.0860 -0.3210 -1.2316  
 -0.6014 -2.0046  1.2366  1.0556  
  0.5512 -0.4931 -0.6313 -0.1132  
 -1.0998  0.4620 -2.3252  0.3792
```

- When they are taken away from the world of linear algebra, matrices become two-dimensional numeric arrays.
- + Addition
- Subtraction
- .* Element-by-element multiplication
- ./ Element-by-element division
- .^ Element-by-element power
- .' Unconjugated array transpose

Matlab - graphics

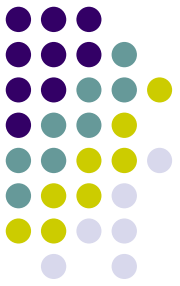
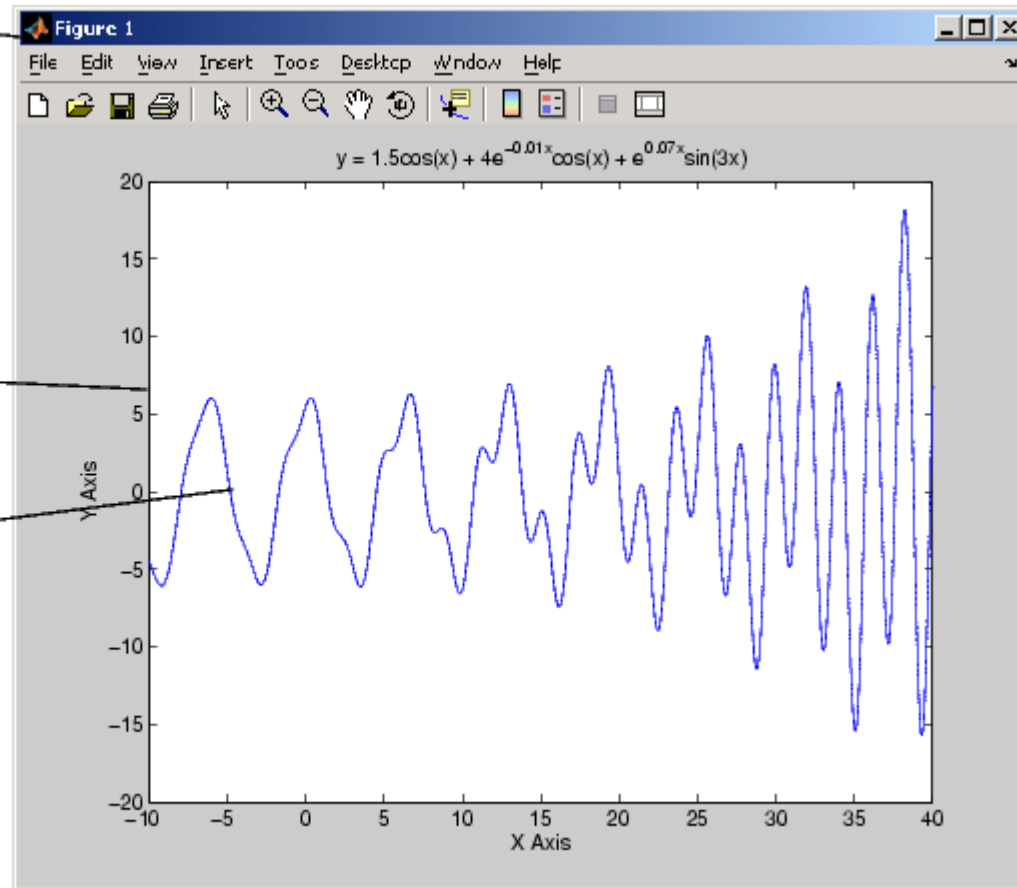


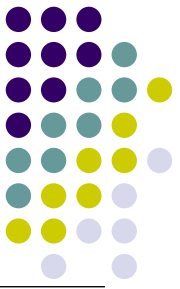
Figure window displays graphs.



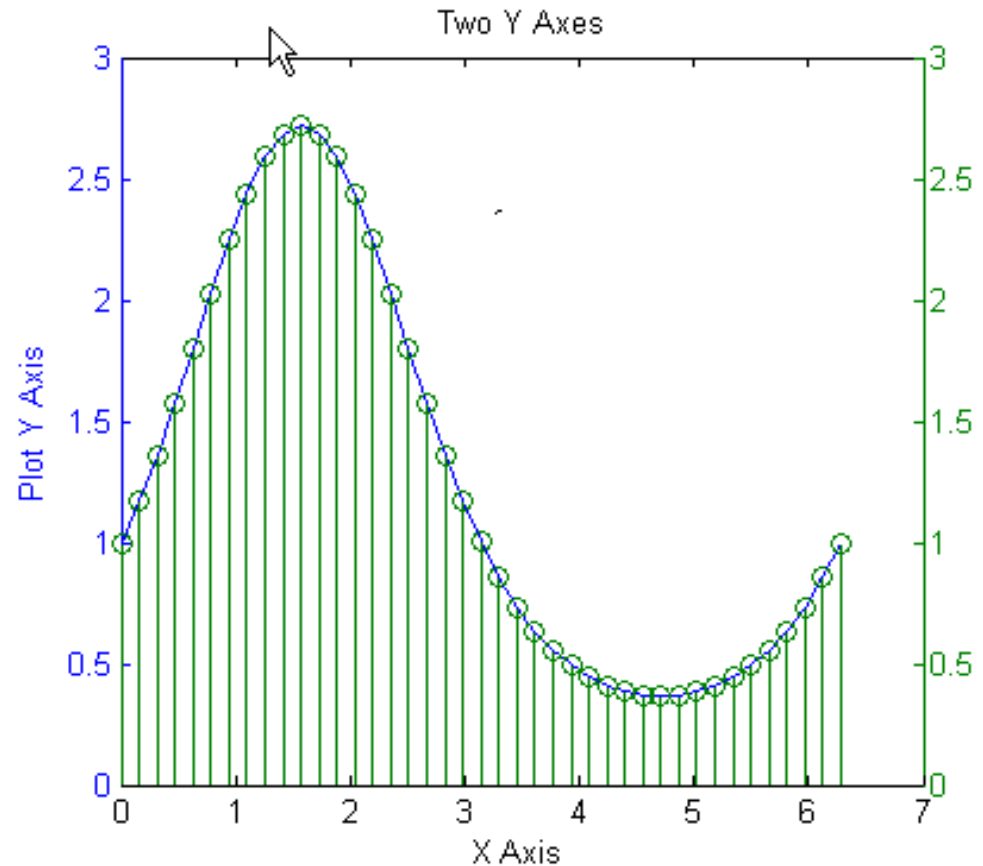
Axes define a coordinate system for the graph.

Line plot represents data.

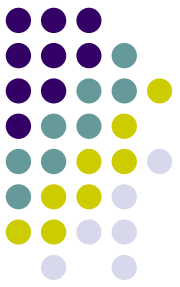
Matlab - graphics



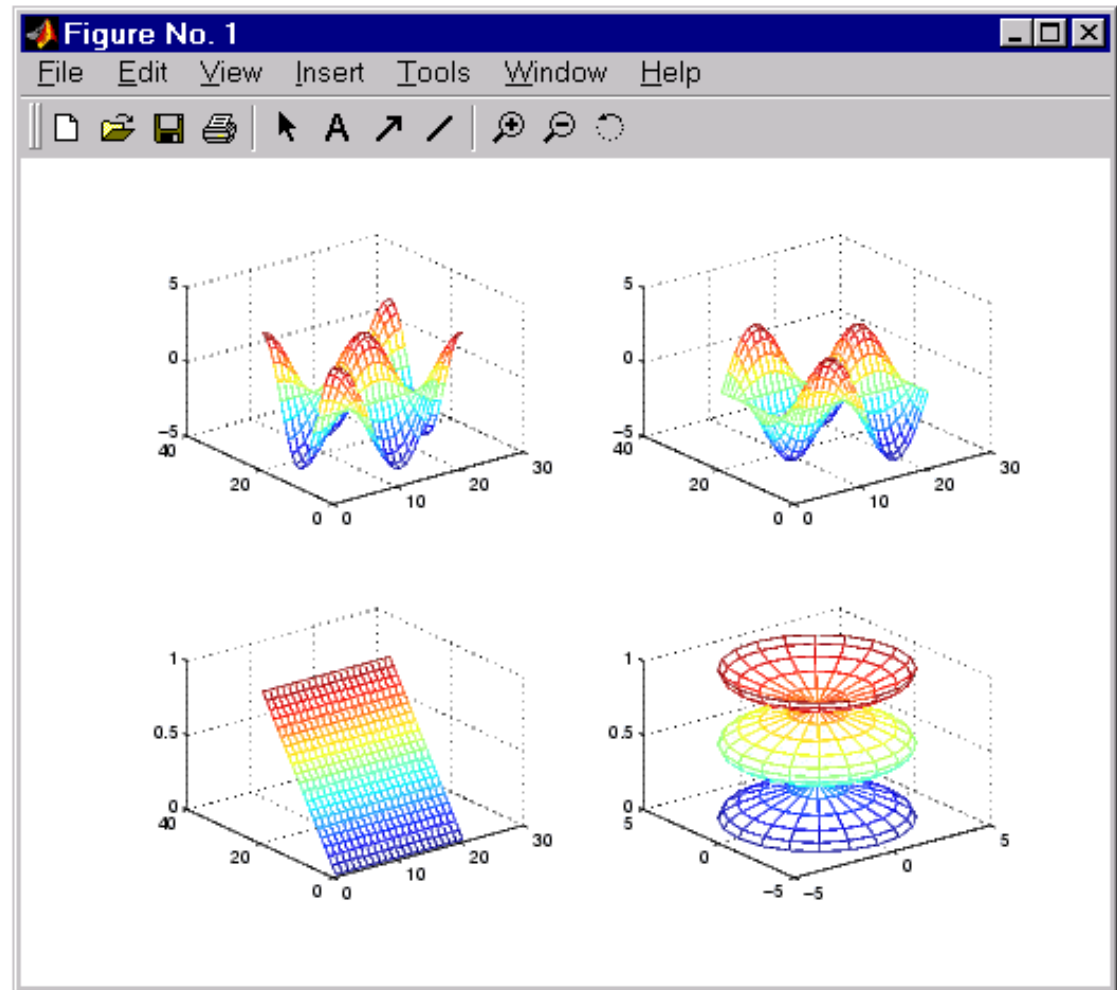
```
t = 0:pi/20:2*pi;  
y = exp(sin(t));  
ploty(t,y,t,y,'plot','stem')  
xlabel('X Axis')  
ylabel('Plot Y Axis')  
title('Two Y Axes')
```



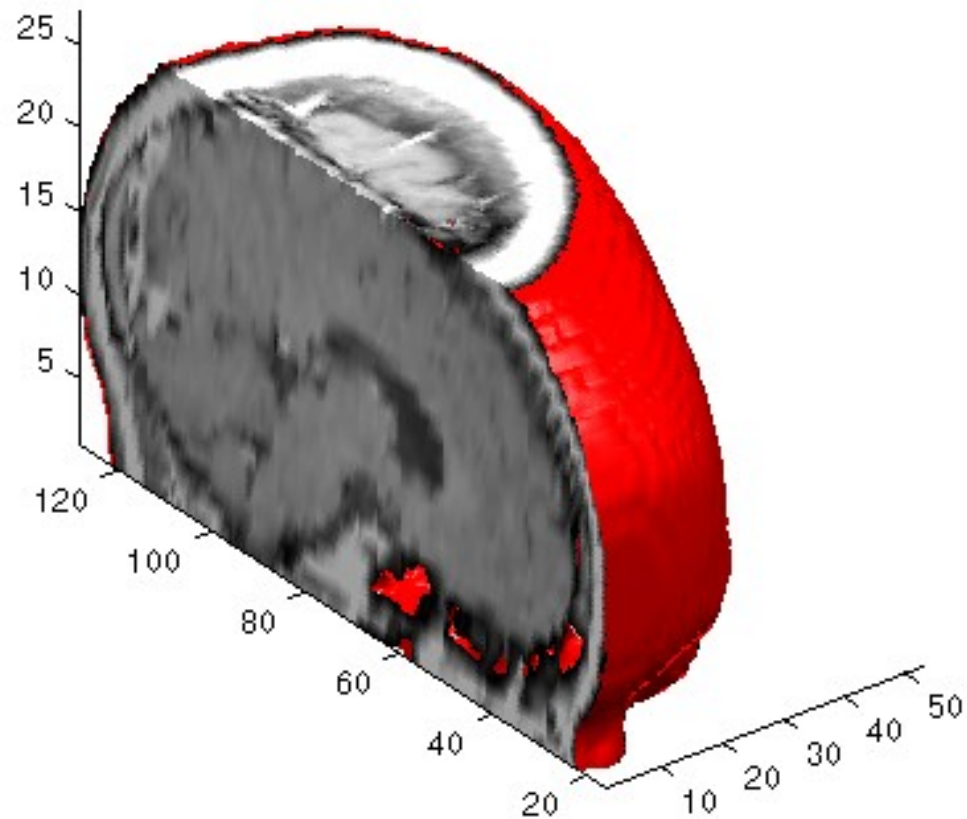
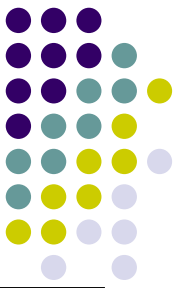
Matlab - graphics

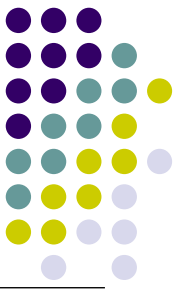


```
t = 0:pi/10:2*pi;  
[X,Y,Z] = cylinder(4*cos(t));  
subplot(2,2,1);  
mesh(X)subplot(2,2,2);  
mesh(Y)subplot(2,2,3);  
mesh(Z)subplot(2,2,4);  
mesh(X,Y,Z)
```



Matlab - graphics

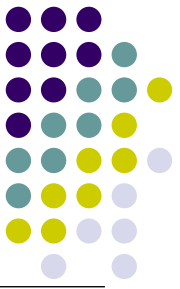




Matlab – Image Processing

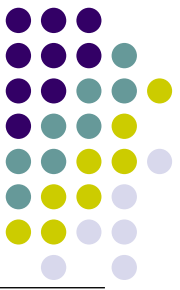
- Spatial image transformation
- Morphological operations
- Neighborhood and block operations
- Linear filtering and filter design
- Transforms Image analysis and enhancement
- Image registration
- Deblurring
- Region of interest operations

Matlab – Image Processing



1. `clear all; clc;`
2. `I = imread('rice.png');`
3. `imshow(I);`
4. `background = imopen(I, strel('disk', 15));`
5. `I2 = imsubtract(I, background);`
6. `imshow(I2);`
7. `I3 = imadjust(I2);`
8. `imshow(I3);`
9. `level = graythresh(I3);`
10. `bw = im2bw(I3, level);`
11. `imshow(bw);`

1. `[labeled, numObjects] = bwlabel(bw, 4);`
2. `graindata = regionprops(labeled, 'Area');`
3. `RGB_label = label2rgb(labeled, @spring, 'c', 'shuffle');`
4. `imshow(RGB_label)`
5. `graindata = regionprops(labeled, 'basic')`
6. `graindata(50).Area`
7. `allgrains = [graindata.Area];`
8. `max_area = max(allgrains)`
9. `biggrain = find(allgrains == max_area)`
10. `nbins = 20;`
11. `figure, hist(allgrains, nbins)`

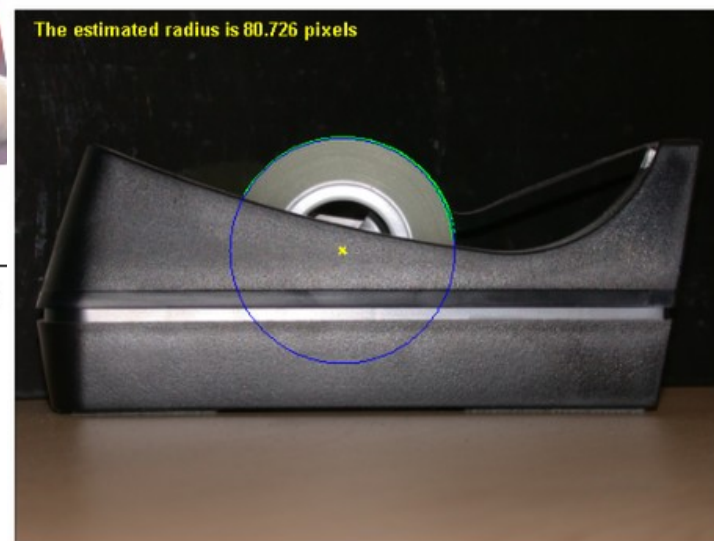
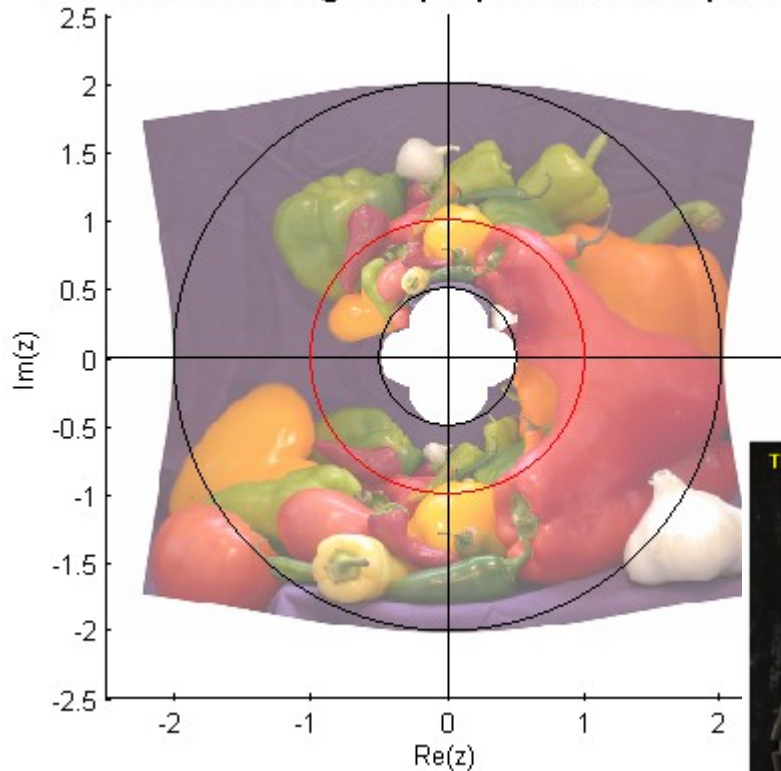


Matlab – Image Processing

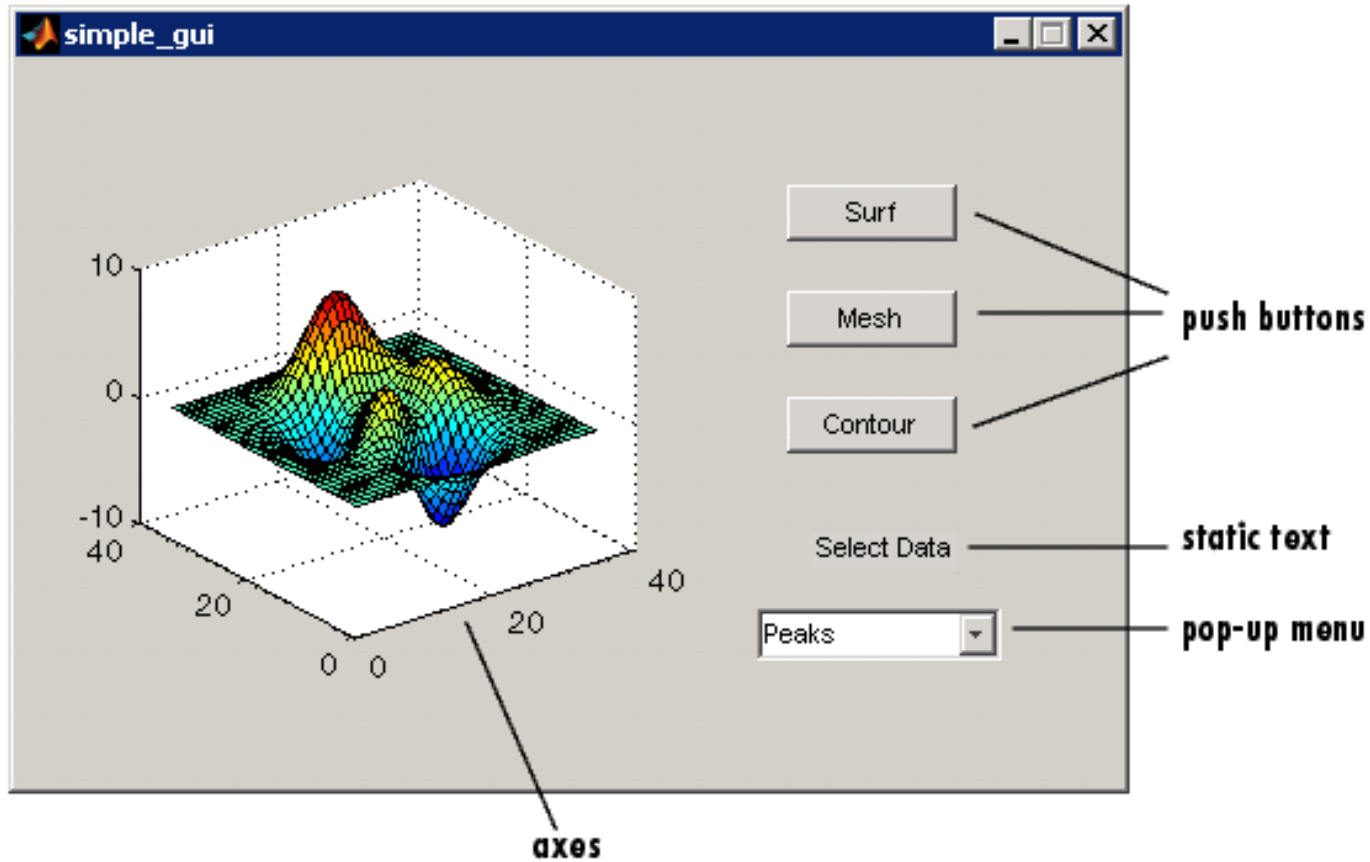
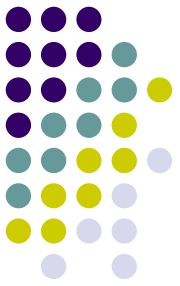
Deblurring with Oversized PSF



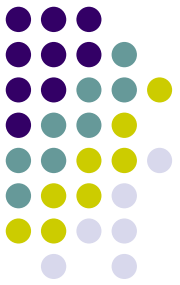
Transformed Image Superposed on Output Plane



Matlab – GUI



Matlab – GUI



The image shows the Matlab GUIDE (GUIDE User Interface) environment. On the left is the "GUIDE Quick Start" dialog box, and on the right is the main GUIDE window titled "untitled.fig".

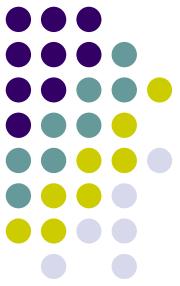
GUIDE Quick Start Dialog:

- Buttons: "Create New GUI" (selected), "Open Existing GUI"
- Section: "GUIDE templates"
- List of templates:
 - Blank GUI (Default)
 - GUI with Uicontrols
 - GUI with Axes and Menu
 - Modal Question Dialog
- Checkbox: "Save on startup as:" with a text field containing "D:\Work\K"

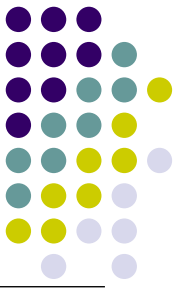
Main GUIDE Window (untitled.fig):

- Menu: File, Edit, View, Layout, Tools, Help
- Toolbar: Includes icons for file operations (New, Open, Save, Print), editing (Cut, Copy, Paste), and GUI design (Grid, Undo, Redo, Zoom, Run).
- Toolbox (left side):
 - Select
 - Push Button
 - Slider
 - Radio Button
 - Checkbox
 - Edit Text
 - Static Text
 - Popup Menu
 - Listbox
 - Toggle Button
 - Axes
 - Panel
 - Button Group
 - ActiveX Control
- Canvas: A large grid area for designing the GUI.

Matlab – GUI



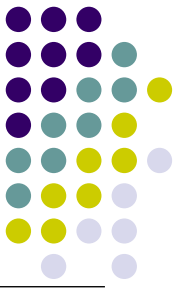
The image displays the MATLAB GUI Builder interface. The main window is titled "untitled.fig" and contains a menu bar (File, Edit, View, Layout, Tools, Help) and a toolbar. On the left is a "Select" toolbar with various GUI components like Push Button, Slider, Radio Button, Check Box, Edit Text, Static Text, Pop-up Menu, Listbox, Toggle Button, Axes, Panel, Button Group, and ActiveX Control. The central workspace shows a plot area with a white square labeled "axes1" and a grid. To the right of the plot are buttons for "Surf", "Mesh", and "Contour", and a "Select Data" dropdown menu currently set to "Peaks". A context menu is open over the "Peaks" dropdown, listing actions such as Cut, Copy, Paste, Clear, Duplicate, Bring to Front, Send to Back, Property Inspector, Object Browser, M-file Editor, View Callbacks (with a sub-menu), and Property Editor. The "View Callbacks" sub-menu is open, showing options: Callback, CreateFcn, DeleteFcn, ButtonDownFcn, and KeyPressFcn. A mouse cursor is pointing at the "Callback" option.



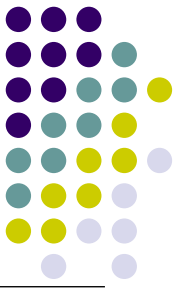
Matlab – GUI

- **function** simple_gui
- f = figure('Visible','off','Position',[360,500,450,285]);
-
- hsurf = uicontrol('Style','pushbutton','String','Surf',...
'Position',[315,220,70,25],...
'Callback',{@surfbutton_Callback});
- hmesh = uicontrol('Style','pushbutton','String','Mesh',...
'Position',[315,180,70,25],...
'Callback',{@meshbutton_Callback});
- hcontour = uicontrol('Style','pushbutton',...
'String','Countour',...
'Position',[315,135,70,25],...
'Callback',{@contourbutton_Callback});
- htext = uicontrol('Style','text','String','Select Data',...
'Position',[325,90,60,15]);
- hpopup = uicontrol('Style','popupmenu',...
'String',{'Peaks','Membrane','Sinc'},...
'Position',[300,50,100,25],...
'Callback',{@popup_menu_Callback});
- ha = axes('Units','Pixels','Position',[50,60,200,185]);
- align([hsurf,hmesh,hcontour,htext,hpopup],'Center','None');

Matlab – GUI



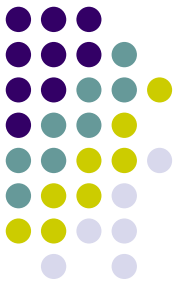
```
1. % Create the data to plot
2.     peaks_data = peaks(35);
3.     membrane_data = membrane;
4.     [x,y] = meshgrid(-8:.5:8);
5.     r = sqrt(x.^2+y.^2) + eps;
6.     sinc_data = sin(r)./r;
7.
8.     % Initialize the GUI.
9.     %Change units to normalized so components resize automatically.
10.    set([f,ha,hsurf,hmesh,hcontour,htext,hpopup],...
11.        'Units','normalized');
12.    %Create a plot in the axes.
13.    current_data = peaks_data;
14.    surf(current_data);
15.    % Assign the GUI a name to appear in the window title.
16.    set(f,'Name','Simple GUI')
17.    % Move the GUI to the center of the screen.
18.    movegui(f,'center')
19.    % Make the GUI visible.
20.    set(f,'Visible','on');
```



Matlab – GUI

- % Callbacks for simple_gui. These callbacks automatically have
- **function** popup_menu_Callback(source,eventdata)
- str = get(source, 'String'); val = get(source, 'Value');
- switch str{val};
- case 'Peaks' % User selects Peaks
- current_data = peaks_data;
- case 'Membrane' % User selects Membrane
- current_data = membrane_data;
- case 'Sinc' % User selects Sinc
- current_data = sinc_data;
- end
- end
- % Push button callbacks
- **function** surfbutton_Callback(source,eventdata)
- surf(current_data);
- end
- **function** meshbutton_Callback(source,eventdata)
- mesh(current_data);
- end
- **function** contourbutton_Callback(source,eventdata)
- contour(current_data);
- end

Matlab – More



C MEX Cycle

