1、设计目的 ：综合运用 MATLAB工具箱实现图像处理的 GUI 程序设计， 利用 MATLAB图像处理工具箱，设计和实现自己的 Photoshop 。

2、题目分析

利用 matlab 的 GUI 程序设计一个简单实用的图像处理程序。该程序应具备图像处理的常用功能，以满足用户的使用。现设计程序有以下基本功能：

1）图像的读取和保存。

2）设计图形用户界面，让用户能够对图像进行任意的亮度和对比度变化调整，显示和对比变换前后的图像。

3）设计图形用户界面，让用户能够用鼠标选取图像感兴趣区域，显示和保存该选择区域。

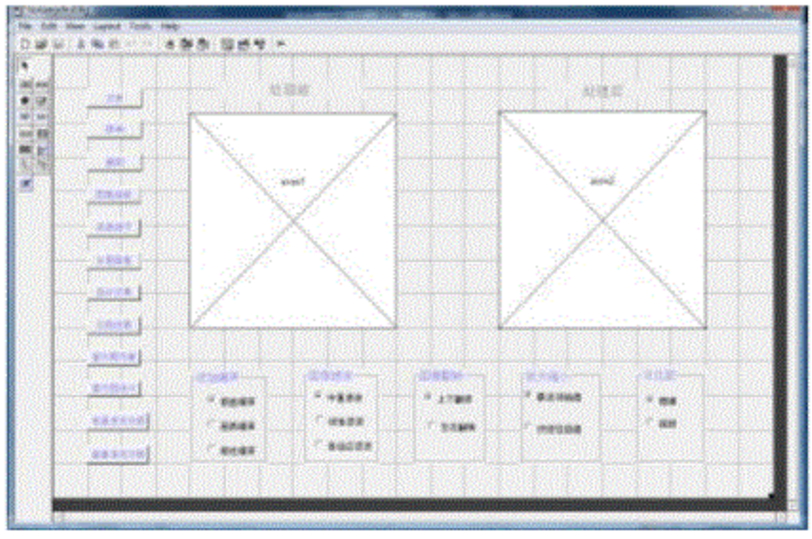
4）编写程序通过最近邻插值和双线性插值等算法将用户 所选取的图像区域进行放大和缩小整数倍的操作，并保存，比 较几种 插值的 效果 。

5）图像 直方图统计和直方 图均衡 ， 要求 显示 直方图统 计，比 较直方 图均衡 后的效果 。

6）能对图像 加入各种噪声 ， 并通过 几种滤波 算法实现 去噪并 显示 结果 。

7）额外 功能。

3、总体设计



图一

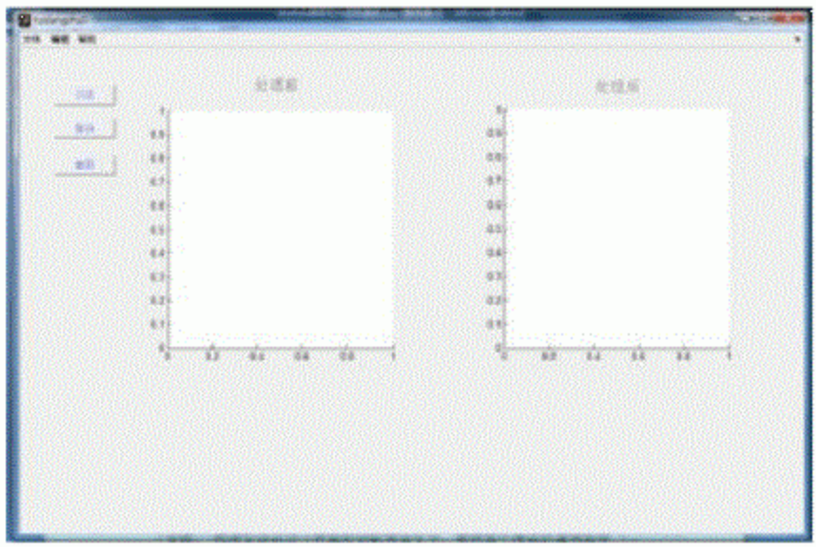
软件的总体设计界面布局如上图所示，主要分为 2 个部分：显示区域与操作区域。

显示区域：显示载入原图，以及通过处理后的图像。

操作区域：通过功能键实现对图像的各种处理。

在截图中可见，左部为一系列功能按键如“还原”、“撤销”、“截图”等等；界面正中部分为图片显示部分，界面中下方为系列功能切换选择组。

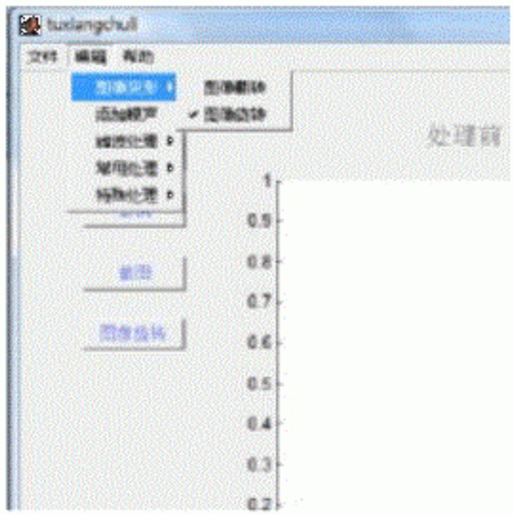
设计完成后运行的软件界面如下：

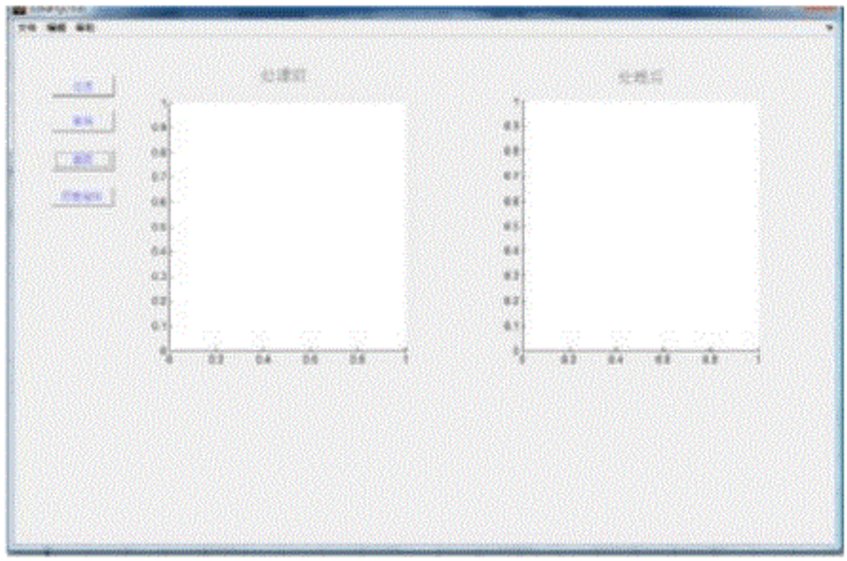


图二

与图一先比，运行后的界面更为简洁。

利用“编辑”菜单可调出相应的功能键。例如：



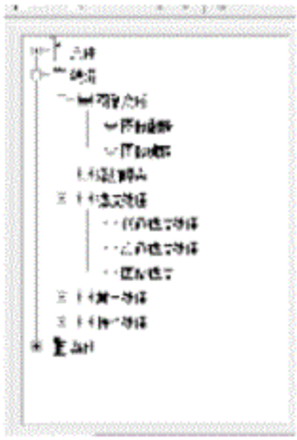


4、具体设计

现介绍各 个功能 模块 的功能 与实现。

4.1 菜单栏的设计 。

通过 Menu Editor 创建如 下菜单，通过以下 菜单来控制 显示 或隐藏 功能 按键



以“编辑”菜 单中“ 图像变形 ”中 的“ 图像 翻转”为例说 明实现用户界面功能 键 “ 图像 翻转” 的显示 与隐藏 。

实现该功能的程序 段 如下：

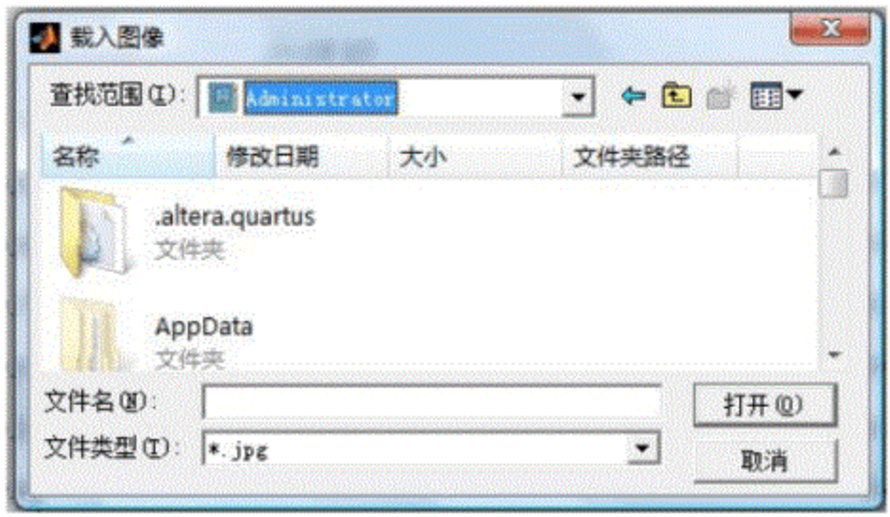
```
function    tuxiangfanzhuan_Callback(hObject, eventdata, handles)
% hObject    handle to tuxiangfanzhuan (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
```

```
set(handles.uipanel7,        'Visible'      , 'on'   );
if   strcmp(get(gcbo,        'Checked'   ),  'on'   )
   set(handles.uipanel7,             'Visible'      , 'on'   );
   set(gcbo,        'Checked'   ,   'off'     );
   set(handles.uipanel7,             'Visible'      , 'off'     );
else
   set(gcbo,        'Checked'   ,   'on'   );
end
```

该段程序通过设 置“ 图像翻转” 功能 键对应的 句柄 uipanel7 中的“ Visible ”属性的 开关 来实现该功能 键的显示 隐藏 。 其他同 理。

4.2 图像的读取和保存。

（1）利用 “ 文件”菜 单中的“ 打开 ”、“ 保存为 … ”分 别实现图 片的读取与 保存。



利用 matlab 中 “ uigetfile ”、“ imread ” “imshow”实现图像 文件的读取 与显示：

```
function    openfile_Callback(hObject, eventdata, handles)
```

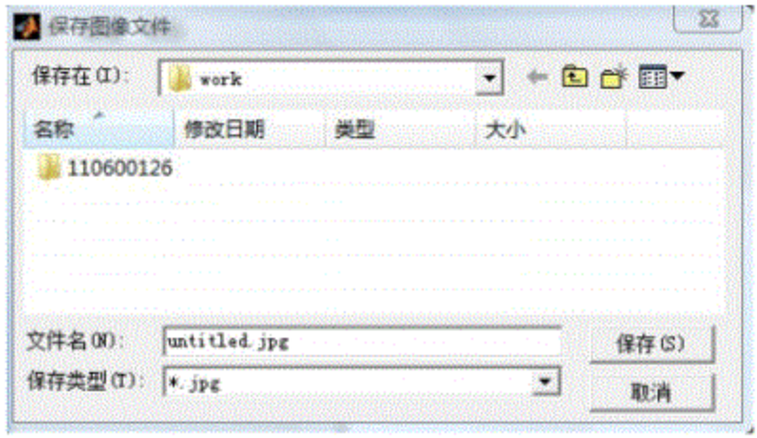
```
% hObject    handle to openfile (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

[filename,pathname]=uigetfile({          '*.jpg'    ; '*.bmp'   ; '*.tif'      ; '*.*'    }, ' 载入 图
像 ' );
if   isequal(filename,0)|isequal(pathname,0)
   errordlg(       ' 没有选 中文件 ', ' 出错 ' );
      return   ;
else
  file=[pathname,filename];
    global   S   % 设置一个 全局变量S，保存 初始 图像 路径，以便之 后的 还原操作
  S=file;
  x=imread(file);
  set(handles.axes1,        'HandleVisibility'          , 'ON' );
  axes(handles.axes1);
  imshow(x);
  set(handles.axes1,        'HandleVisibility'          , 'OFF' );
  axes(handles.axes2);
  imshow(x);
  handles.img=x;
  guidata(hObject,handles);
end
```


程序 关键部分 ：

通过 [filename,pathname]=uigetfile({   '*.jpg'   ; '*.bmp'   ; '*.tif'   ; '*.*'   }, ' 载
入图像 ') 选择 相应路径打开 的图像 ； 通过 file=[pathname,filename];
x=imread(file);   读取选 中的图像 ； 最后，通过 imshow(x) 在显示区域 上显示图
像。

（2）图像保存。

利用“ uiputfile ”、“ imwrite ”函数实现图像 文件的保存。




```
function    save_Callback(hObject, eventdata, handles)
% hObject    handle to save (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
 [sfilename ,sfilepath]=uiputfile({                '*.jpg'    ; '*.bmp'   ; '*.tif'      ; '*.*'    }, ' 保
存图像 文件' , 'untitled.jpg'         );
    if   ~isequal([sfilename,sfilepath],[0,0])
     sfilefullname=[sfilepath ,sfilename];
    imwrite(handles.img,sfilefullname);
    else
     msgbox(     ' 你按了取消键' , ' 保存 失败' );
    end
```

程序关键部分：

通[sfilename ,sfilepath]=uiputfile({ '*.jpg' ; '*.bmp' ; '*.tif' ; '*.*' }, ' 保存图像 文件' , 'untitled.jpg')选择图像 文件保存的 路径与格式；然后，通过 sfilefullname=[sfilepath ,sfilename];

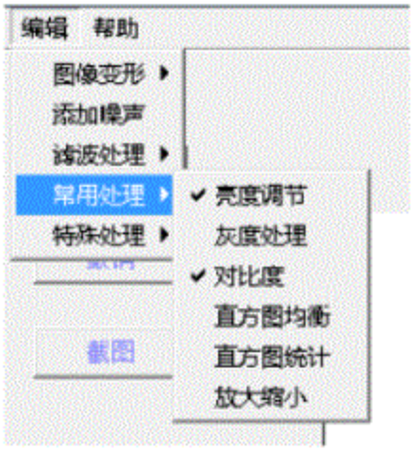
imwrite(handles.img,sfilefullname); 实现对图像的保存。

（3）程序的 退出。

```
function    exit_Callback(hObject, eventdata, handles)
% hObject    handle to exit (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
clc;
close   all  ;
close(gcf);
clear;
```

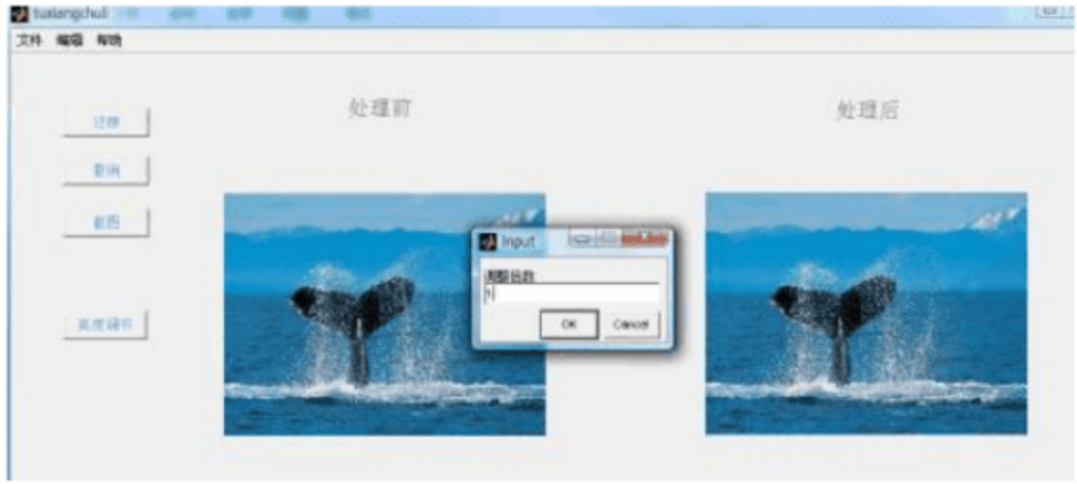
4.3 对图像进行任意的亮度和对比度变化调整，显示和对比变换前后的图像。

运行程序后，通过 “编辑”菜单中的“常用处理 ”选中“ 亮度调节”



在显示出相应的功能键后，通过 载入读取图像，比 并进行处理， 效果如下：

亮度处理前：



亮度处理后：

实现程序 段如下：

```
% --- Executes on button press in radiobutton12.
function    radiobutton12_Callback(hObject, eventdata, handles)
% hObject    handle to radiobutton12 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

% Hint: get(hObject,'Value') returns toggle state of radiobutton12
global   T
axes(handles.axes2);
T=getimage;
 prompt={  ' 调整 倍数 ' };
 defans={  '1'  };
 p=inputdlg(prompt,      'input'    ,1,defans);
```

```
p1=str2num(p{1});
 y=imadjust(handles.img,[ ], [ ],p1);                    %亮度调 节
imshow(y);
handles.img=y;
guidata(hObject,handles);
```

对比度处理前：

对比度处理后 （增强 3 倍）：

对比度 减弱 1.5 倍后：

实现程序 段如下：

```
function    uipanel10_SelectionChangeFcn(hObject, eventdata, handles)
% hObject    handle to uipanel10 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global   T
str=get(hObject,      'string'      );
axes(handles.axes2);


switch   str
   case ' 增强 '
      T=getimage;
       prompt={          ' 输入参数 :'  };
       defans={          '1'   };
        p=inputdlg(prompt,                'input'     ,1,defans);
        p1=str2num(p{1});
        f=immultiply(handles.img,p1);
        imshow(f);
        handles.img=f;
        guidata(hObject,handles);
    case ' 减弱 '
     T=getimage;
       prompt={          ' 输入参数 :'  };
       defans={          '1'   };
```

```
    p=inputdlg(prompt,              'input'     ,1,defans);
    p1=str2num(p{1});
    f=imdivide(handles.img,p1);
    imshow(f);
    handles.img=f;
    guidata(hObject,handles);
end
```

该程序 段主要通过 f=immultiply(handles.img,p1);

p=inputdlg(prompt, 'input' ,1,defans);

分别实现图像对比度的 增强与减弱。

4．4 用鼠标选取图像感兴趣区域，显示和保存该选择区域 。

通过 imcrop(x) 函数来实现对图片某一区域的 截取，截取的图片在右框中显示。结合“保存为…”，可把截图处理后的图 片保存在指定路径 。

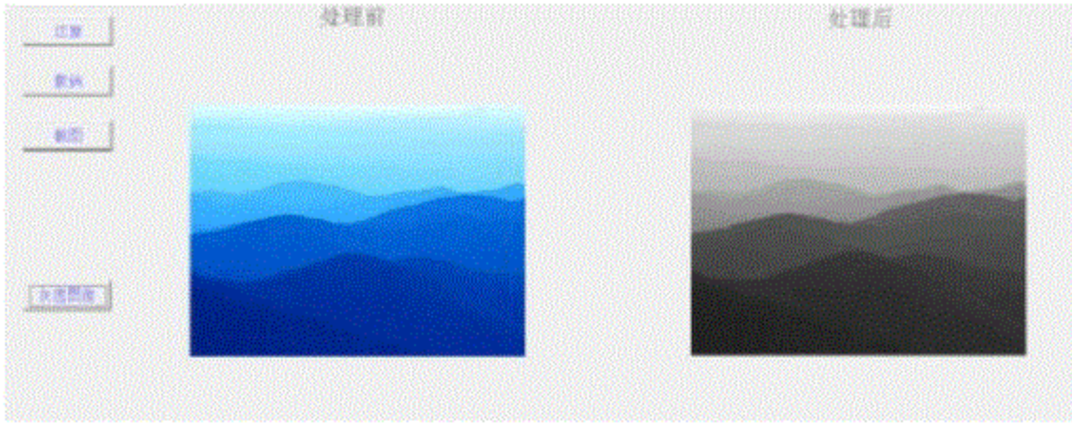
实现程序 段如下：

```
% --- 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)
```

```
global  T
axes(handles.axes2);
T=getimage;
x=imcrop(handles.img);                          %截图
imshow(x);
handles.img=x;
guidata(hObject,handles);
```

4.5 图像转化为灰度图像。

由于在matlab 中较多的图像处理 函数支持对灰度图像进行处理， 故对图像进行 灰度转化十分必要。可利用rgb2gray （X）函数对其他图像进行 灰度图像的 转化。转化实例如下：



实现程序 段如下：

```
% --- Executes on button press in radiobutton16.
function    radiobutton16_Callback(hObject, eventdata, handles)
% hObject    handle to radiobutton16 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

% Hint: get(hObject,'Value') returns toggle state of radiobutton16
 global  T
axes(handles.axes2);
```

```
T=getimage;
x=rgb2gray(handles.img);                    %RGB ???×a???a?ò ?è í ???
imshow(x);
handles.img=x;
guidata(hObject,handles);
```

4.6 对图像进行放大和缩小整数倍的操作。

通过 imresize(X ，n，mode)函数对图像 X进行 放大或 者缩小。N放大缩小倍数 ，mode 为采用的 方式。

通过处理后 可发现保存的图 片的比原图放大了（ 缩小了）。

实现的程序 段如下：

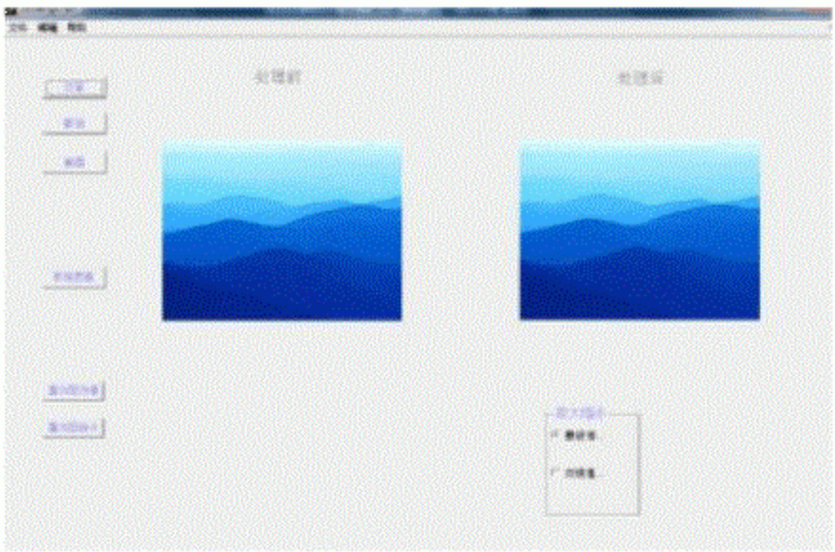
```
function    uipanel9_SelectionChangeFcn(hObject, eventdata, handles)
% hObject    handle to uipanel9 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global   T
str=get(hObject,      'string'      );
axes(handles.axes2);
switch   str
   case ' 最近邻插值 '
     T=getimage;
       prompt={          ' 输入参数 :' };
       defans={          '2'  };
       p=inputdlg(prompt,              'input'     ,1,defans);
       p1=str2num(p{1});
       f=imresize(handles.img,p1,                'nearest'     );
       imshow(f);
       handles.img=f;
      guidata(hObject,handles);
```

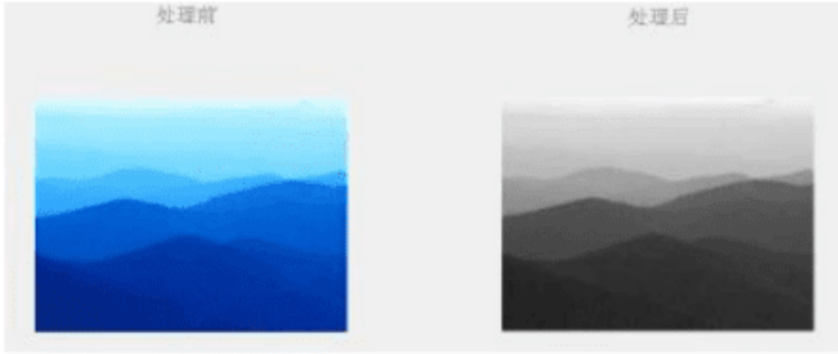
```
    case '双线性插值'
     I=getimage;
      prompt={          '输入参数:' };
      defans={          '1' };
      p=inputdlg(prompt,              'input'     ,1,defans);
      p1=str2num(p{1});
      f=imresize(handles.img,p1,                'bilinear'       );
      imshow(f);
      handles.img=f;
      guidata(hObject,handles);
end
```

4.7 图像直方图统计和直方图均衡。

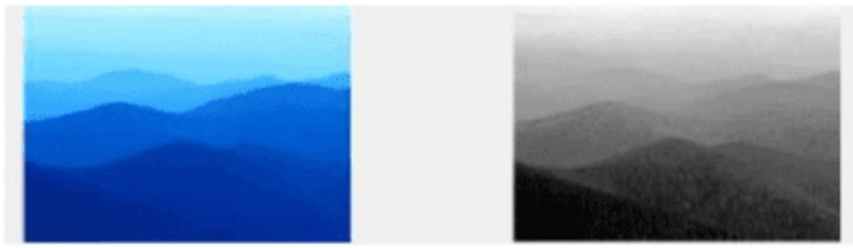
（1）通过 histeq （X）函数实现直方图均衡。

因为此函数只能对灰度图像进行直方图均衡。故应先将彩图转为灰度图像。





在上一步的基础上对第二幅图进行 直方 图均衡：

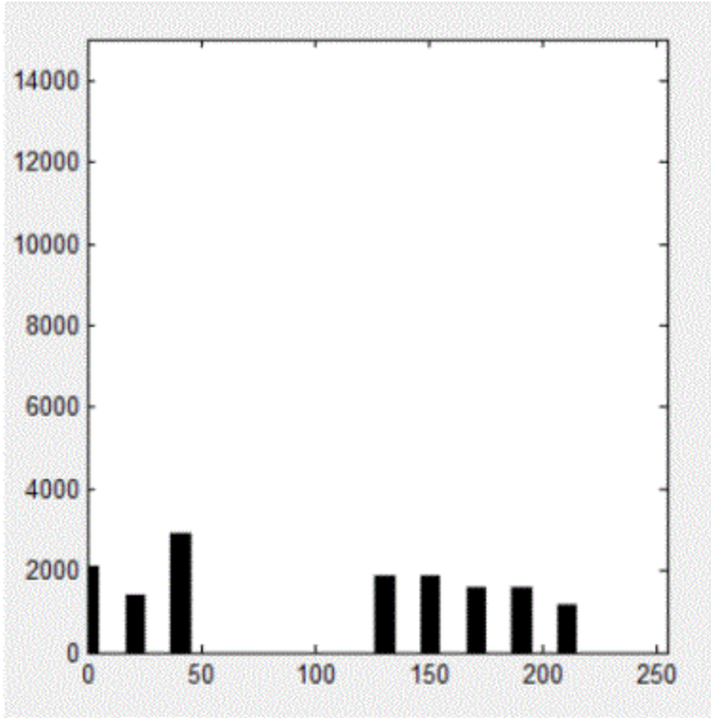


直方 图均衡 实现程序 段如下：

```
% --- Executes on button press in pushbutton7.
function    pushbutton7_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton7 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global   T
axes(handles.axes2);
T=getimage;
h=histeq(handles.img);
imshow(h);
handles.img=h;
guidata(hObject,handles);
```

关键部分 ：通过 h=histeq(handles.img)　　进行 直方 图均衡

（2） 直方 图统 计。通过利用 imhist(X) 函数来 实现 直方 图统 计。



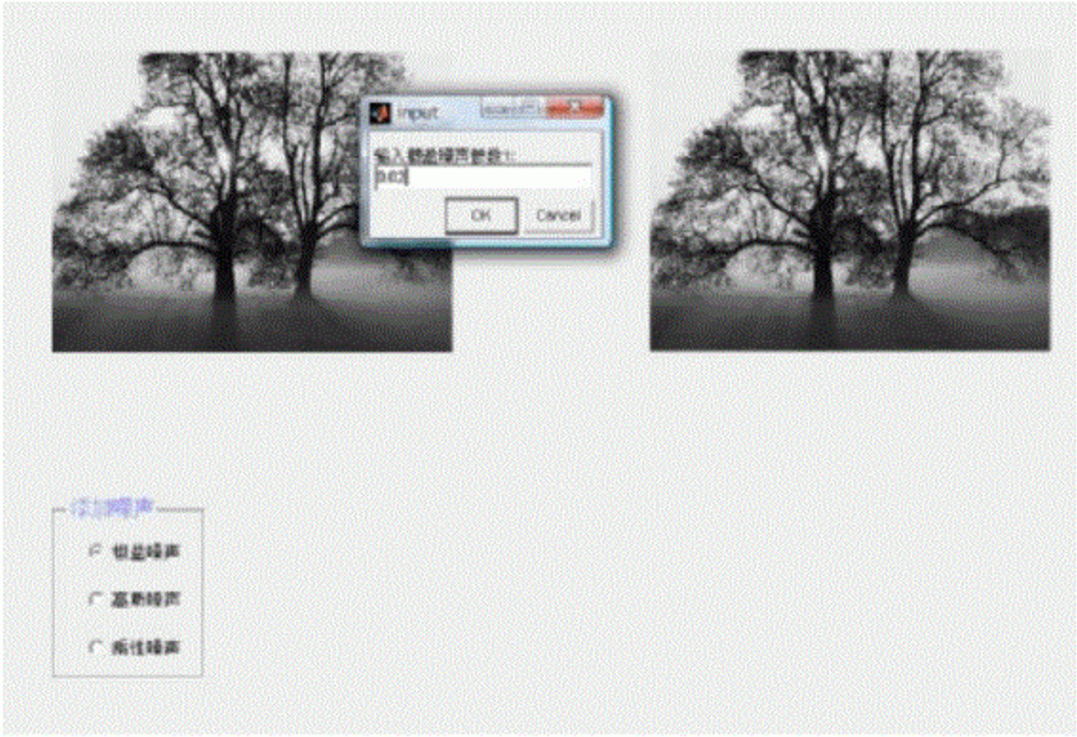

```
% --- Executes on button press in pushbutton8.
function    pushbutton8_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton8 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
axes(handles.axes2);
x=imhist(handles.img);          %直方图统计
x1=x(1:10:256);
horz=1:10:256;
bar(horz,x1);
axis([0 255 0 15000]);
set(handles.axes2,    'xtick'    ,0:50:255);
set(handles.axes2,    'ytick'    ,0:2000:15000);
```

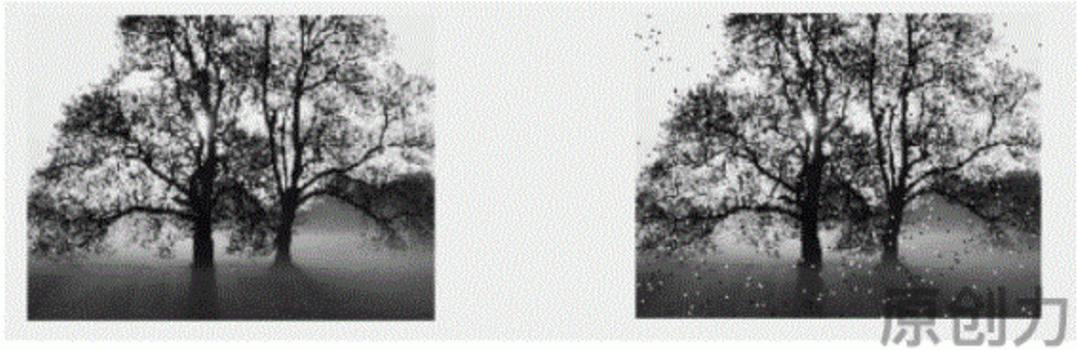
注意：横纵坐标的范围应选取适当，否则，统计图表有可能超出范围。

4.8 加入各种噪声，并通过几种滤波算法实现去噪。

（1）加入噪声 。通过 imnoise(I,type,parameters) 来加入各种噪声 。

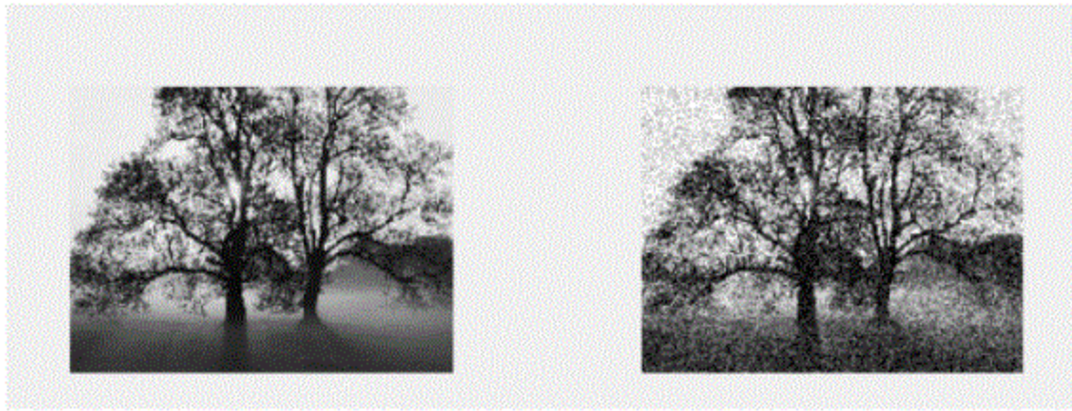
加入 椒盐 噪声



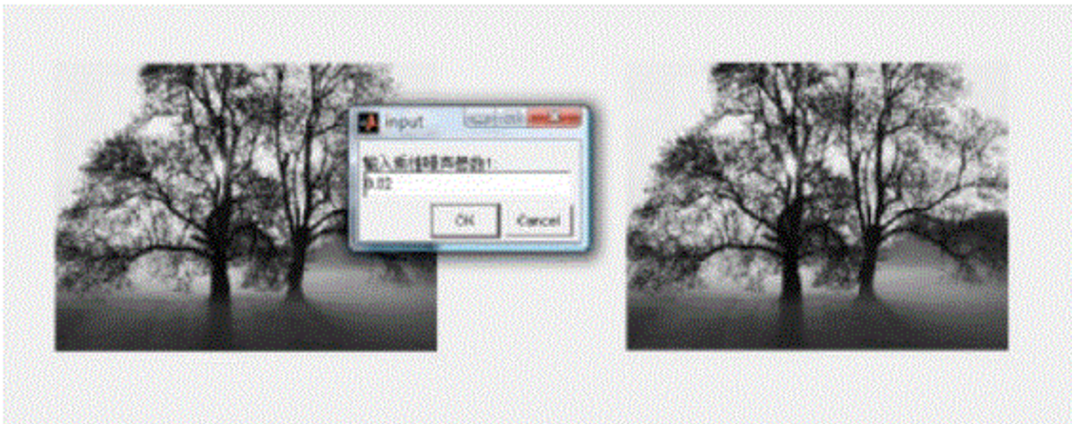


加入 高斯 噪声：


处理前
处理后
input
输入高斯噪声参数1:
输入高斯噪声参数2:
0.02
OK
Cancel
椒盐噪声
高斯噪声
乘性噪声



加入乘性噪声：


input
输入乘性噪声参数1:
0.02
OK
Cancel

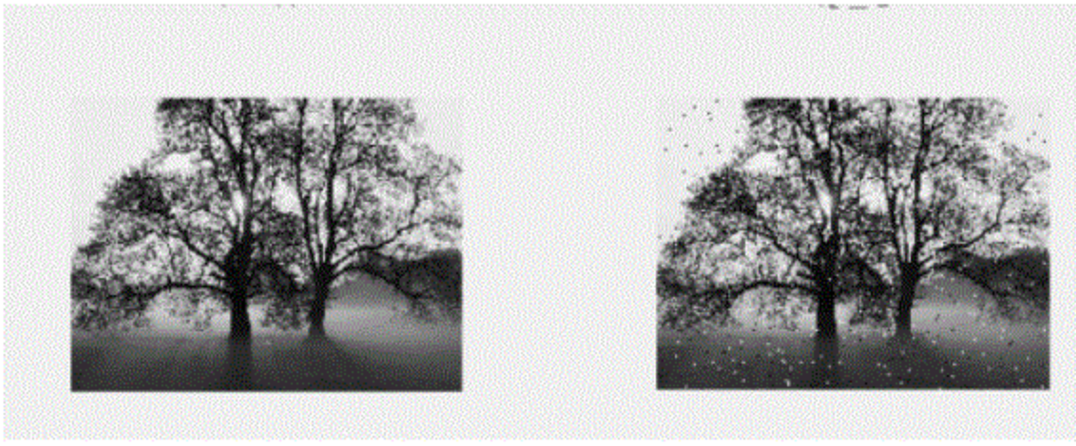
实现程序 段如下：

```
function    uipanel4_SelectionChangeFcn(hObject, eventdata, handles)
% hObject    handle to uipanel4 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global   T
str=get(hObject,      'string'      );
axes(handles.axes2);
switch   str
      case  ' 椒盐噪声 '
    T=getimage;
    prompt={      ' 数日椒盐 噪声 参数 1:'  };
    defans={      '0.02'   };
    p=inputdlg(prompt,            'input'     ,1,defans);
    p1=str2num(p{1});
    f=imnoise(handles.img,            'salt & pepper'       ,p1);
    imshow(f);
    handles.img=f;
    guidata(hObject,handles);
     case  ' ?高斯 噪声 '
     T=getimage;
    prompt={      ' 输入高斯 噪声 1:'  , ' 输入高斯 噪声 2' };
    defans={      '0'   , '0.02'   };
```

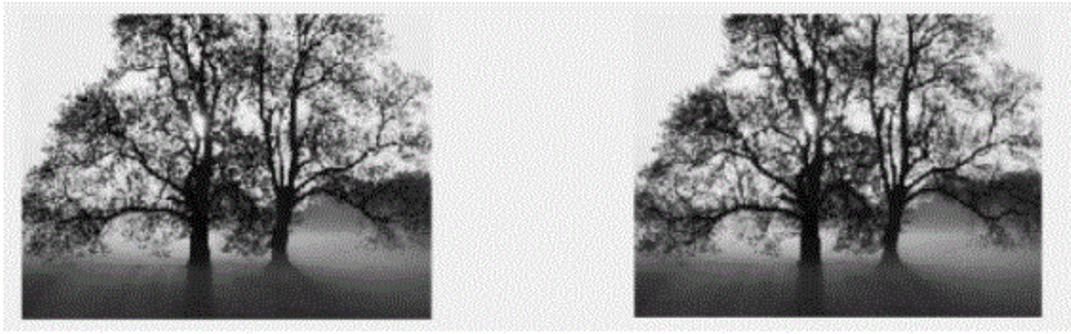
```
    p=inputdlg(prompt,          'input'    ,1,defans);
    p1=str2num(p{1});
    p2=str2num(p{2});
    f=imnoise(handles.img,          'gaussian'    ,p1,p2);
    imshow(f);
    handles.img=f;
    guidata(hObject,handles);
     case '乘性噪声'
     T=getimage;
    prompt={      '输入乘性噪声 1:'  };
    defans={      '0.02'   };
    p=inputdlg(prompt,          'input'    ,1,defans);
    p1=str2num(p{1});
    f=imnoise(handles.img,          'speckle'    ,p1);
    imshow(f);
    handles.img=f;
    guidata(hObject,handles);
end
```

（2）滤除噪声 （椒盐 噪声）。

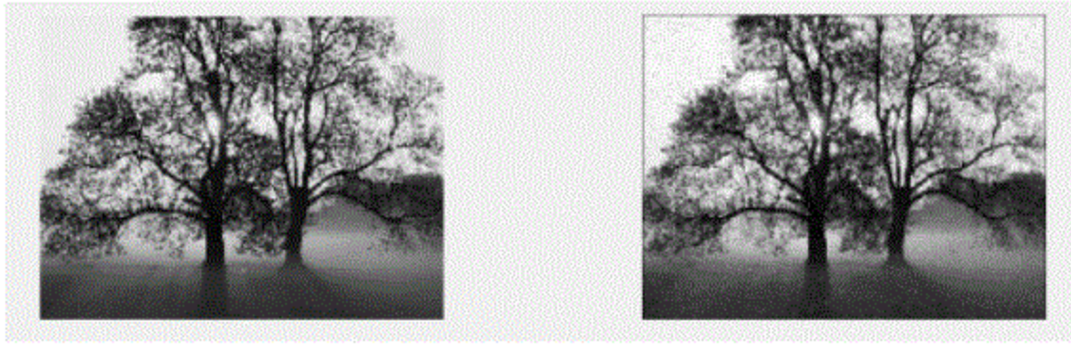
滤波 前



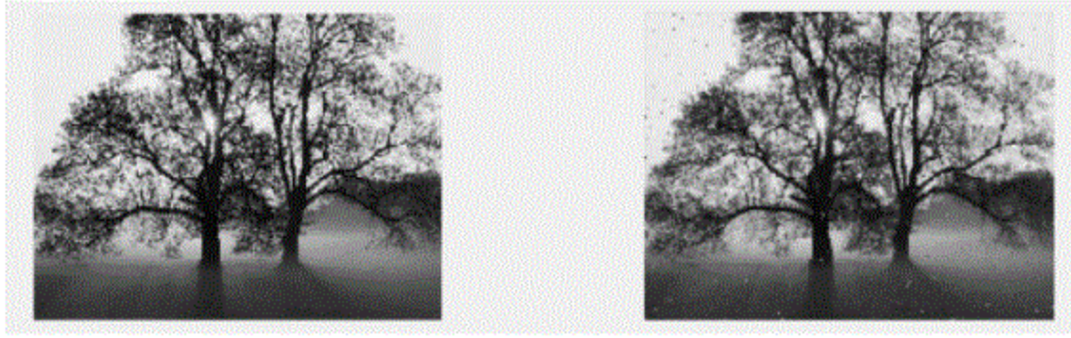
中值滤波 后



线性 滤波 后



自适应 滤波 后

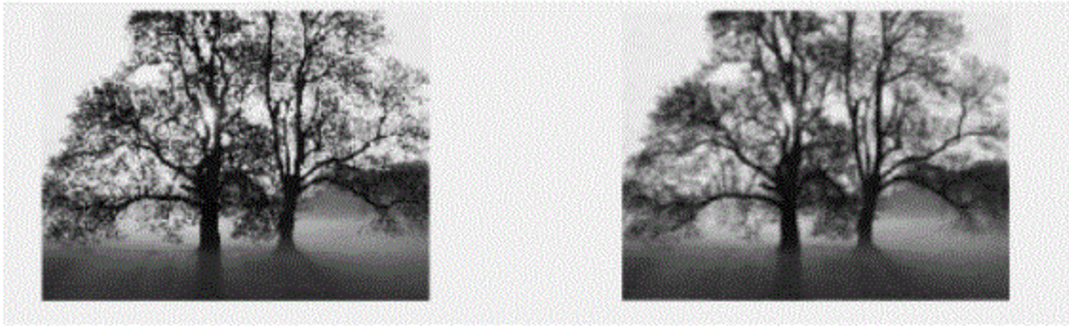


实现程序 段如下：

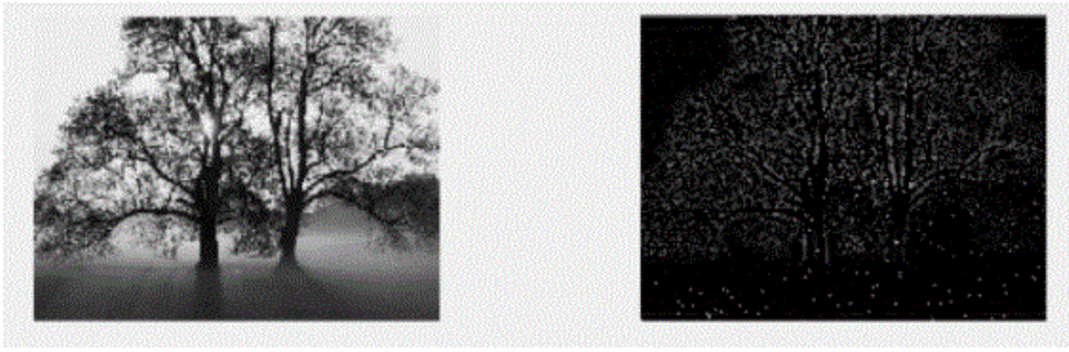
```
function uipanel5_SelectionChangeFcn(hObject, eventdata, handles) %
图像 滤波
% hObject    handle to uipanel5 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global T
str=get(hObject, 'string' );
axes(handles.axes2);
```

```
switch   str
        case  '中值滤波'
        T=getimage;
        k=medfilt2(handles.img);
        imshow(k);
        handles.img=k;
        guidata(hObject,handles);
        case  '线性 滤波'
        T=getimage;
        h=[1 1 1;1 1 1;1 1 1];
        H=h/9;
        i=double(handles.img);
        k=convn(i,h);
        imshow(k,[]);
        handles.img=k;
        guidata(hObject,handles);
        case  '自适应滤波'
        T=getimage;
        k=wiener2(handles.img,[5,5]);
        imshow(k);
        handles.img=k;
        guidata(hObject,handles);
end
```

低通滤波 器滤波 后



高通滤波 器滤波 后



实现程序 如下：

```
% --- Executes on button press in pushbutton14.
function    pushbutton14_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton14 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)


axes(handles.axes2);
y1=handles.img;
f=double(y1);              % 数据类型 转 换， matlab 不支持 图像的 无符号 整 型的计算
g=fft2(f);               % 傅里叶 变换
g=fftshift(g);                % 转 换 数据矩阵
[M,N]=size(g);
nn=2;            %二阶巴特沃 斯低 通 滤波 器
d0=50;                  %截 止频率 50
m=fix(M/2); n=fix(N/2);
for  i=1:M
          for  j=1:N
        d=sqrt((i-m)^2+(j-n)^2);
        h=1/(1+0.414*(d/d0)^(2*nn));                    % 计算 低 通 滤波 器传递 函 数
        result(i,j)=h*g(i,j);
          end
```

```
end
result=ifftshift(result);
y2=ifft2(result);
y3=uint8(real(y2));
imshow(y3);                                          % 显示处理后的图像



% --- Executes on button press in pushbutton15.
function     pushbutton15_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton15 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

axes(handles.axes2);
x=(handles.img);

f=double(x);                                         % 数据类型 转换
k=fft2(f);                                           % 傅里叶 变换
g=fftshift(k);                                       % 转换数据矩阵
[M,N]=size(g);
nn=2;
d0=25;                                               %截止频率 25
m=fix(M/2); n=fix(N/2);
for  i=1:M
            for  j=1:N
        d=sqrt((i-m)^2+(j-n)^2);                     % 计算高通滤波器传递函数
                if   d<=d0
```

```
            h=0;
                else  h=1;
                end
          result(i,j)=h*g(i,j);
            end
end
result=ifftshift(result);
y2=ifft2(result);
y3=uint8(real(y2));
imshow(y3);                                          % 显示 滤波 处理后的图像
```

4.9 还原

通过一个 全局变量保存 原始图像 路径，在需要还原 至原始图像时，重新 读取该全局变量即可。

实现程序 段如下：

```
% --- Executes on button press in pushbutton9.
function    pushbutton9_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton9 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
     global   S                                          %还原
   axes(handles.axes2);
   y=imread(S);
   f=imshow(y);
   handles.img=y;
    guidata(hObject,handles);
```


4.10 撤销。

撤销上 一步 的操作 。通过 另设一个 全局变量 T 保存 是上一次操作 后的图像。

实现程序 段如下：

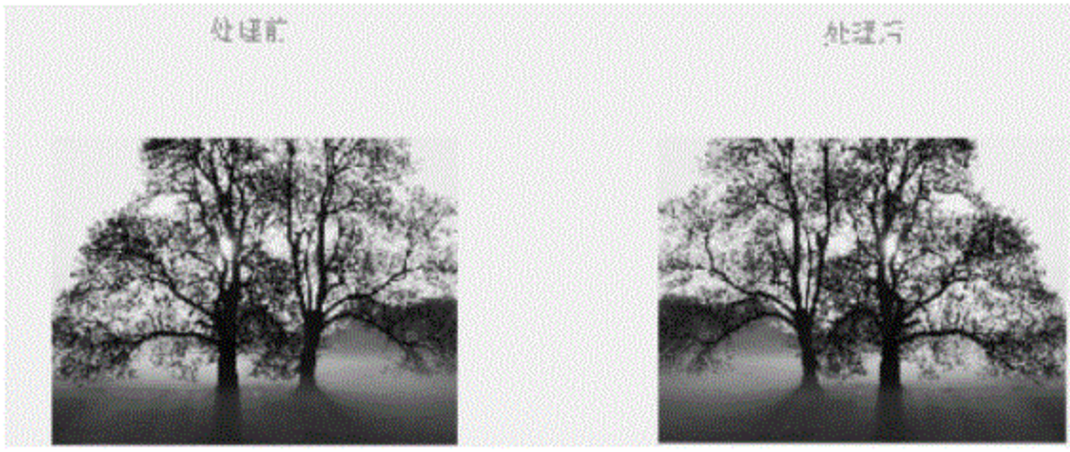
```
--- Executes on button press in pushbutton11.
function    pushbutton11_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton11 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
axes(handles.axes2);              %撤销
global   T
imshow(T);
handles.img=T;
guidata(hObject,handles);
```

该程序 段只 是简单的显示图像的功能， 其中全局变量T中储存的 是上一步操作处理后的图像 信息 。在以上的各段功能程序 段中可见均 有 “T=getimage; ”，此句把当 前操作 前的图像， 即上一次操作 后的图像 信息赋予 全局变量T。

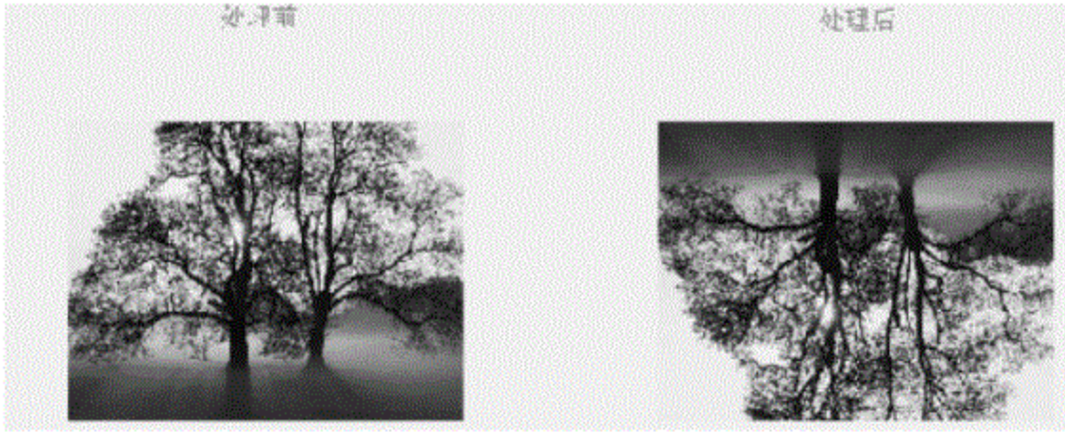
4.11 图像变形。

（1）图像 翻转 。实现图像的 镜像翻转 。

左右翻转 ：



上下翻转



实现程序 如下：

```
function    uipanel7_SelectionChangeFcn(hObject, eventdata, handles)                %
图像 翻转
% hObject    handle to uipanel7 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
str=get(hObject,      'string'      );
axes(handles.axes2);
global   T
switch   str
      case  ' 左右翻转 '
      T=handles.img;
     f=fliplr(handles.img);
     imshow(f);
     handles.img=f;
     guidata(hObject,handles);
      case  ' 上下翻转 '
      T=handles.img;
       f=flipud(handles.img);
       imshow(f);
       handles.img=f;
       guidata(hObject,handles);
```

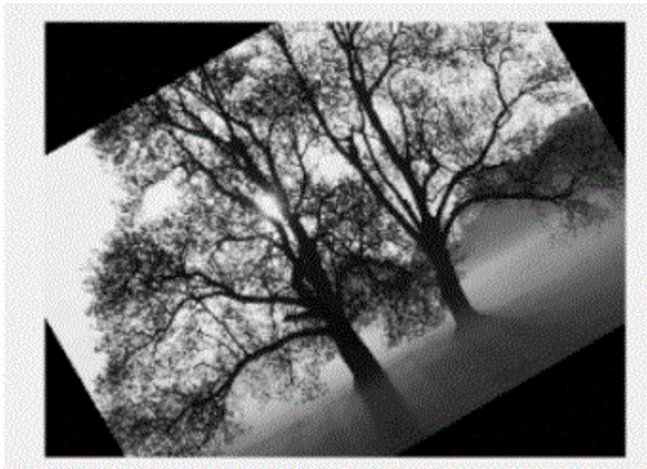
end

程序 关键部分 ：通过 f=fliplr(handles.img); f=flipud(handles.img);

分别实现 左右镜像翻转与上 下镜像翻转 。

（2）图像 旋转。

实现图像的 逆时针旋 转任意 角度。



实现程序 段如下：

```
function    pushbutton3_Callback(hObject, eventdata, handles)                %图像
爱那 个旋 转
% hObject    handle to pushbutton3 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global   T
axes(handles.axes2);
T=getimage;
prompt={ ' 旋转 角度:' };
```

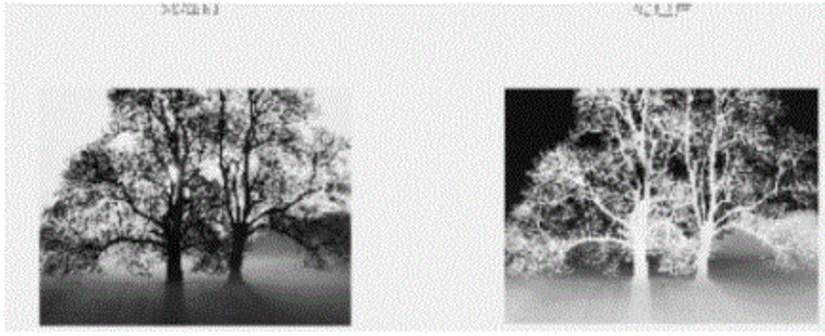
```
defans={  '0'  };
 p=inputdlg(prompt,       'input'     ,1,defans);
p1=str2num(p{1});
f=imrotate(handles.img,p1,          'bilinear'       , 'crop'    );
imshow(f);
handles.img=f;
guidata(hObject,handles);
```

关键部分：通过 p=inputdlg(prompt, 'input' ,1,defans);p1=str2num(p{1}); 来输入旋转参数。

通过函数 f=imrotate(handles.img,p1, 'bilinear' , 'crop'); 实现翻转。

4.12 特殊处理

（1）底片效果。将图像变为底片，并显示。



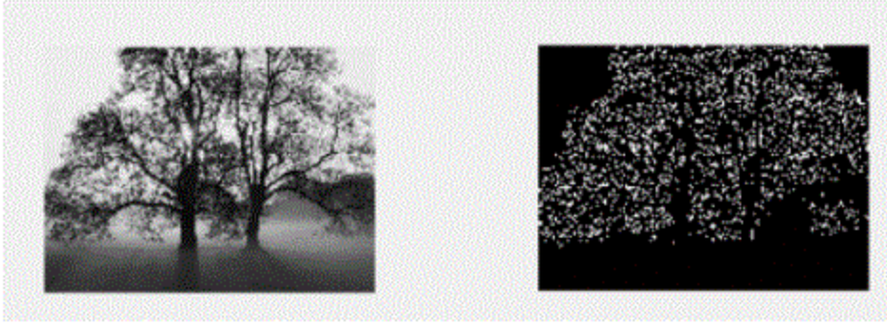
实现程序如下：

```
% --- Executes on button press in pushbutton12.
function    pushbutton12_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton12 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global   T
axes (handles.axes2);
T=getimage;
f=imcomplement(handles.img);          %图像取反'
```

```
imshow(f);
handles.img=f;
guidata(hObject,handles);
```

程序段关键部分：通过 f=imcomplement(handles.img); 实现图像取反，形成底片效果。

（2）边缘信息。采取图像的边缘信息。



实现程序段如下：

```
% --- Executes on button press in pushbutton16.
function pushbutton16_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton16 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global T
axes(handles.axes2);
 T=getimage;
f=edge(handles.img, 'canny' );
imshow(f);
handles.img=f;
guidata(hObject,handles);
```

程序关键部分：通过 f=edge(handles.img, 'canny'); 是实现边缘信息的获取。

5、结果分析

软件测试基本成功，课题所要求的功能均能较好实现。但一些功能只支持灰度图像的处理。

其中值得一提的是在滤波处理中的低通滤波与高通滤波的效果。由于一般图像中含有较多的低频信息成分高频成分较少，通过低通滤波后，噪声以及高频成分被滤除，图像虽有少量失真，略显模糊，但尚可辨识。但若是通过高通滤波后，大量的有效低频信息被滤除，图像严重失真，不可辨识。

6、心得体会

通过为期两周的 matlab 课程设计实践，使我对 matlab 的使用有了进一步的了解和熟悉。

当我第一次拿到此次的课题时，感到有些无所适从。虽然，曾经学习过 matlab 的课程，在课程的考核中也取得了较好的成绩，但由于对 matlab 的学习更多的只是停留在理论上的学习，在课时内的试验也只是简单的基础性试验，所以对 matlab 实际运用不是很熟练。

虽然对课题感到很懵懂，但在郑老师的简单提示与指导后，我开始找到了解决问题的路径。我选择的是“利用 matlab 的 GUI 程序设计一个简单实用的图像处理程序”这一课题。本课题的重点是句柄的使用、GUI 的使用以及 matlab 中相关图像处理函数使用。

为此，在实践正式开始前，我利用课余时间，重新复习了 matlab 教材，专门借阅了利用 matlab 进行图像处理的相关教程，通过索引网络上的相关资料，为课设做了较为充分的准备。在参考了相关材料及源程序，我对自己要做的课设内容有了进一步的了解，并对 matlab 的使用有了更深的体会。

当然，在课设的进行过程中，我还是遇到了不少问题。例如，起初由于我对句柄使用以及一些函数使用的不恰当，使得在对图像文件的保存上就遇到了问题，不过最后还是在老师的提示下解决了。随着课设的进行，对 matlab 的的熟悉度逐步加深。在基本功不断扎实的基础上，我开始进行一些扩张功能的尝试，比如还原操作、对功能键实现显示和隐藏的功能、实现撤销多次前操作等。其

中前两个较为成功的完成，但在第三个功能上出现了些问题，由于对 matlab 中数组结构体与循环套用使用的不当，到实践结束之际也未实现所犯的错误，只能退而求次，实现执行撤销功能（恢复到上次操作），不能不说不是一个遗憾……

但是，总体来说，此次的课程设计，还是较为满意的。它不但鞭策着我去巩固 matlab 的基础理论知识，还提高了我对 matlab 的实际操作运用，使得理论与实践相结合，为进一步学习 matlab 打下坚实的基础；同时，在实践的工程中，也让我体会到一种努力付出并得到回报的满足感觉。

参考书目：(五号，宋体加粗)

[1] 《MATLAB实用教程》 郑阿奇 电子工业出版社

[2] 《MATLAB仿真在信号处理中的应用》 徐明远 刘增力 西安电子科技大学出版社

附录：(五号，宋体加粗)

```
function     varargout = tuxiangchuli(varargin)
% TUXIANGCHULI M-file for tuxiangchuli.fig
%      TUXIANGCHULI, by itself, creates a new TUXIANGCHULI or raises the existing
%      singleton*.
%
%      H = TUXIANGCHULI returns the handle to a new TUXIANGCHULI or the handle to
%      the existing singleton*.
%
%      TUXIANGCHULI('CALLBACK',hObject,eventData,handles,...) calls the local
%      function named CALLBACK in TUXIANGCHULI.M with the given input arguments.
%
%      TUXIANGCHULI('Property','Value',...) creates a new TUXIANGCHULI or raises the
%      existing singleton*.  Starting from the left, property value pairs are
%      applied to the GUI before tuxiangchuli_OpeningFunction gets called.  An
%      unrecognized property name or invalid value makes property application
%      stop.  All inputs are passed to tuxiangchuli_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 tuxiangchuli

% Last Modified by GUIDE v2.5 14-Mar-2009 21:34:50

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

if   nargout
   [varargout{1:nargout}] = gui_mainfcn(gui_State, varargin{:});
else
   gui_mainfcn(gui_State, varargin{:});
end
% End initialization code - DO NOT EDIT
```

```
% --- Executes just before tuxiangchuli is made visible.
function     tuxiangchuli_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 tuxiangchuli (see VARARGIN)

% Choose default command line output for tuxiangchuli
handles.output = hObject;

% Update handles structure
guidata(hObject, handles);

% UIWAIT makes tuxiangchuli wait for user response (see UIRESUME)
% uiwait(handles.figure1);



% --- Outputs from this function are returned to the command line.
function     varargout = tuxiangchuli_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;



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



% --------------------------------------------------------------------
function     exit_Callback(hObject, eventdata, handles)
% hObject    handle to exit (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
clc;
close    all  ;
close(gcf);
clear;
```

```
% --------------------------------------------------------------------
function openfile_Callback(hObject, eventdata, handles)
% hObject    handle to openfile (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
[filename,pathname]=uigetfile({'*.jpg';'*.bmp';'*.tif';'*.*'},' ??è ?í ???');
if isequal(filename,0)|isequal(pathname,0)
  errordlg(' ??ó D???D???t ',' 3?í ');
    return ;
else
  file=[pathname,filename];
   global S %é è??ò ???è ??? ±?á ?S£?± £′ ?3?ê ?í ?????£?ò ?± ???o ó µ ??1?-2ù×÷
  S=file;
  x=imread(file);

  set(handles.axes1,'HandleVisibility','ON');
  axes(handles.axes1);
  imshow(x);

  set(handles.axes1,'HandleVisibility','OFF');
  axes(handles.axes2);
  imshow(x);
  handles.img=x;
  guidata(hObject,handles);
end

% --------------------------------------------------------------------
function about_Callback(hObject, eventdata, handles)
% hObject    handle to about (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
msgbox(' ?aê ?ò ???GUIµ ?í ???′ |3ì Ð',' 1?ó ú ');

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



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

[sfilename ,sfilepath]=uiputfile({'*.jpg';'*.bmp';'*.tif';'*.*'},' ± £′ ?í ??????t','unt
itled.jpg');
```

```
     if   ~isequal([sfilename,sfilepath],[0,0])
     sfilefullname=[sfilepath ,sfilename];
    imwrite(handles.img,sfilefullname);
     else
     msgbox(      ' ?? °  ′ á  ?è  ??07£?, ' ± £ ′  ?§ °  ü ' );
     end
```

```
% --- Executes on button press in radiobutton12.
function     radiobutton12_Callback(hObject, eventdata, handles)
% hObject    handle to radiobutton12 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

% Hint: get(hObject,'Value') returns toggle state of radiobutton12
global    T
axes(handles.axes2);
T=getimage;
 prompt={   '  µ÷ ??  ± ?ê  y' };
 defans={   '1'   };
 p=inputdlg(prompt,        'input'      ,1,defans);
 p1=str2num(p{1});
  y=imadjust(handles.img,[ ], [ ],p1);                               %??á  á  í   ???
 imshow(y);
 handles.img=y;
 guidata(hObject,handles);
```

```
% --------------------------------------------------------------------
function     uipanel4_SelectionChangeFcn(hObject, eventdata, handles)
% hObject    handle to uipanel4 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global    T
str=get(hObject,       'string'       );
axes(handles.axes2);
switch    str
       case  ' ?  • ????é  ù'
     T=getimage;
     prompt={        ' ê  ?è  ??• ????é  ù2?ê  ý:'  };
     defans={        '0.02'    };
     p=inputdlg(prompt,             'input'     ,1,defans);
```

```
    p1=str2num(p{1});
    f=imnoise(handles.img,              'salt & pepper'        ,p1);
    imshow(f);
    handles.img=f;
    guidata(hObject,handles);
      case  ' ???1??é ù'
     T=getimage;
    prompt={        ' ê ?è ????1??é2?ê ¶:'  , ' ê ?è ????1??é2?ê ¶:' };
    defans={        '0'   , '0.02'    };
    p=inputdlg(prompt,              'input'     ,1,defans);
    p1=str2num(p{1});
    p2=str2num(p{2});
    f=imnoise(handles.img,              'gaussian'     ,p1,p2);
    imshow(f);
    handles.img=f;
    guidata(hObject,handles);
      case  ' 3?D???è   ù'
     T=getimage;
    prompt={        ' ê ?è ?3?D???è ù2?ê ¶:'  };
    defans={        '0.02'    };
    p=inputdlg(prompt,              'input'     ,1,defans);
    p1=str2num(p{1});
    f=imnoise(handles.img,              'speckle'     ,p1);
    imshow(f);
    handles.img=f;
    guidata(hObject,handles);
end




% --- Executes on button press in radiobutton16.
function     radiobutton16_Callback(hObject, eventdata, handles)
% hObject    handle to radiobutton16 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

% Hint: get(hObject,'Value') returns toggle state of radiobutton16
  global   T
axes(handles.axes2);
T=getimage;
x=rgb2gray(handles.img);                          %RGB ???× a???a?ò  ?è í  ???
imshow(x);
handles.img=x;
guidata(hObject,handles);
```

```
% --- 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)
global    T
axes(handles.axes2);
T=getimage;
x=imcrop(handles.img);                          %??í ?
imshow(x);
handles.img=x;
guidata(hObject,handles);
```

```
% --- Executes on button press in pushbutton3.
function    pushbutton3_Callback(hObject, eventdata, handles)                    %i  ???Dy × a
% hObject    handle to pushbutton3 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global    T
axes(handles.axes2);
T=getimage;
prompt={  ' Dy × a???è :'  };
defans={   '0'  };
 p=inputdlg(prompt,       'input'     ,1,defans);
p1=str2num(p{1});
f=imrotate(handles.img,p1,          'bilinear'       , 'crop'    );
imshow(f);
handles.img=f;
guidata(hObject,handles);
```

```
% 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
```

```
% --------------------------------------------------------------------
function     uipanel5_SelectionChangeFcn(hObject, eventdata, handles)                %¼  ?????2¨
% hObject    handle to uipanel5 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global    T
str=get(hObject,       'string'      );
axes(handles.axes2);
switch    str
       case  ' ?D?µ ??2   ¨ '
       T=getimage;
       k=medfilt2(handles.img);
       imshow(k);
       handles.img=k;
       guidata(hObject,handles);
       case  ' ??D???2  ¨ '
       T=getimage;
       h=[1 1 1;1 1 1;1 1 1];
       H=h/9;
       i=double(handles.img);
       k=convn(i,h);
       imshow(k,[]);
       handles.img=k;
       guidata(hObject,handles);
       case  ' ×?ê  ê  ó  |??2¨ '
       T=getimage;
       k=wiener2(handles.img,[5,5]);
       imshow(k);
       handles.img=k;
       guidata(hObject,handles);
end
```

```
% --------------------------------------------------------------------
function     uipanel7_SelectionChangeFcn(hObject, eventdata, handles)                %¾µ ??• -× a
% hObject    handle to uipanel7 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
str=get(hObject,       'string'      );
```

```
axes(handles.axes2);
global    T
switch    str
       case  ' ×óó ò • -× á
       T=handles.img;
      f=fliplr(handles.img);
      imshow(f);
      handles.img=f;
      guidata(hObject,handles);
       case  ' é  ???• -× á
       T=handles.img;
        f=flipud(handles.img);
        imshow(f);
        handles.img=f;
        guidata(hObject,handles);
end



% --- Executes on button press in pushbutton7.
function     pushbutton7_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton7 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global    T
axes(handles.axes2);
T=getimage;
h=histeq(handles.img);                                    %? ± • ?í  ?? ùoa
imshow(h);
handles.img=h;
guidata(hObject,handles);



% --- Executes on button press in pushbutton8.
function     pushbutton8_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton8 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
axes(handles.axes2);
x=imhist(handles.img);            %? ± • ?í  ?í  3??
x1=x(1:10:256);
horz=1:10:256;
bar(horz,x1);
axis([0 255 0 15000]);
set(handles.axes2,       'xtick'      ,0:50:255);
set(handles.axes2,       'ytick'      ,0:2000:15000);
```

```
% --------------------------------------------------------------------
function    uipanel9_SelectionChangeFcn(hObject, eventdata, handles)
% hObject    handle to uipanel9 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global   T
str=get(hObject,      'string'     );
axes(handles.axes2);
switch   str
   case ' × ??üá  ú  2??µ
    T=getimage;
      prompt={          ' ê  ?è  ?2?ë' ý};
      defans={          '2'  };
      p=inputdlg(prompt,              'input'     ,1,defans);
      p1=str2num(p{1});
      f=imresize(handles.img,p1,                'nearest'     );
      imshow(f);
      handles.img=f;
     guidata(hObject,handles);

    case ' ????D?2??µ  '
     T=getimage;
      prompt={          ' ê  ?è  ?2?ë' ý};
      defans={          '1'  };
      p=inputdlg(prompt,              'input'     ,1,defans);
      p1=str2num(p{1});
      f=imresize(handles.img,p1,                'bilinear'       );
      imshow(f);
      handles.img=f;
      guidata(hObject,handles);
end



% --- Executes on button press in pushbutton9.
function    pushbutton9_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton9 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
      global   S                                                %?1?-1|? ü
   axes(handles.axes2);
   y=imread(S);
   f=imshow(y);
   handles.img=y;
   guidata(hObject,handles);
```

```
% --- Executes on button press in pushbutton11.
function    pushbutton11_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton11 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
axes(handles.axes2);              %3• ?ù1|? ü
global   T
imshow(T);
handles.img=T;
guidata(hObject,handles);

% ------------------------------------------------------------------
function    uipanel10_SelectionChangeFcn(hObject, eventdata, handles)
% hObject    handle to uipanel10 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global   T
str=get(hObject,      'string'      );
axes(handles.axes2);

switch   str
   case ' ???? '
      T=getimage;
       prompt={          ' ê  ?è  ?2?ë' ý};
       defans={          '1'  };
        p=inputdlg(prompt,              'input'    ,1,defans);
        p1=str2num(p{1});
        f=immultiply(handles.img,p1);
        imshow(f);
        handles.img=f;
        guidata(hObject,handles);
     case ' ??è  ?'
      T=getimage;
       prompt={          ' ê  ?è  ?2?ë' ý};
       defans={          '1'  };
       p=inputdlg(prompt,              'input'    ,1,defans);
       p1=str2num(p{1});
       f=imdivide(handles.img,p1);
       imshow(f);
       handles.img=f;
       guidata(hObject,handles);
end
```

```
% --- Executes on button press in pushbutton12.
function    pushbutton12_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton12 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global   T
axes (handles.axes2);
T=getimage;
f=imcomplement(handles.img);            %tí  ???è ?• ′
imshow(f);
handles.img=f;
guidata(hObject,handles);
```

```
% --- Executes on button press in pushbutton14.
function    pushbutton14_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton14 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

axes(handles.axes2);
y1=handles.img;
f=double(y1);                          % ê  y?Yà  àDí  × a??£¨MATLAB?? § 3?í  ???µ??T• ?o???Dí   µ?????
g=fft2(f);                              % ?µá  ¢à±????
g=fftshift(g);                           % × a??ê  y?Y???   ó
[M,N]=size(g);
nn=2;                                  % ?t?  ×°  í ì  ???(Butterworth)      µí ¨ì ??2 ¨ ? ÷
d0=50;                                 %??1?µ?ê  ?a 50
m=fix(M/2); n=fix(N/2);
for   i=1:M
         for   j=1:N
       d=sqrt((i-m)^2+(j-n)^2);
       h=1/(1+0.414*(d/d0)^(2*nn));                  % ????µí  í¨ ??2 ¨ ? ÷ ′  ?µ Yo¯ ê  y
       result(i,j)=h*g(i,j);
         end
end
result=ifftshift(result);
y2=ifft2(result);
y3=uint8(real(y2));
imshow(y3);                                      % ??ê  ???2 ¨ ′  |ào ó µ ?í   ???
```

```
% --- Executes on button press in pushbutton15.
function     pushbutton15_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton15 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

axes(handles.axes2);
x=(handles.img);

f=double(x);                                    % ê  y?Yà  àDì  × a??
k=fft2(f);                                        % ? µ á  ¢ à±????
g=fftshift(k);                                      % × a??ê  y?Y???   ó
[M,N]=size(g);
nn=2;
d0=25;                                          %??1?µ ?ê  ?a 25
m=fix(M/2); n=fix(N/2);
for   i=1:M
              for   j=1:N
          d=sqrt((i-m)^2+(j-n)^2);                        % ?????í   ¨ ??2 ¨ ?  ÷ ′  ? µ Yo¯ ê  y
                     if   d<=d0
             h=0;
                     else   h=1;
                     end
          result(i,j)=h*g(i,j);
              end
end
result=ifftshift(result);
y2=ifft2(result);
y3=uint8(real(y2));
imshow(y3);                                       % ??ê  ???2 ¨ ′  |ào µ ?í   ???



% --- Executes on button press in pushbutton16.
function     pushbutton16_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton16 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global    T
axes(handles.axes2);
 T=getimage;
f=edge(handles.img,       'canny'    );
imshow(f);
handles.img=f;
guidata(hObject,handles);
```

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


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


% --------------------------------------------------------------------
function tianjiazaosheng_Callback(hObject, eventdata, handles)
% hObject    handle to tianjiazaosheng (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
set(handles.uipanel4,        'Visible'      , 'on'   );
if   strcmp(get(gcbo,        'Checked'   ),  'on'   )
   set(handles.uipanel4,            'Visible'      , 'on'   );
   set(gcbo,         'Checked'   ,   'off'     );
   set(handles.uipanel4,            'Visible'      , 'off'     );
else
   set(gcbo,         'Checked'   ,   'on'   );
end

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


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

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


% --------------------------------------------------------------------
function     tuxiangfanzhuan_Callback(hObject, eventdata, handles)
% hObject    handle to tuxiangfanzhuan (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
set(handles.uipanel7,         'Visible'       , 'on'   );
if   strcmp(get(gcbo,         'Checked'   ),  'on'   )
   set(handles.uipanel7,              'Visible'       , 'on'   );
   set(gcbo,          'Checked'   ,   'off'     );
   set(handles.uipanel7,              'Visible'       , 'off'     );
else
   set(gcbo,          'Checked'   ,   'on'   );
end



% --------------------------------------------------------------------
function     tuxiangxuanzhuan_Callback(hObject, eventdata, handles)
% hObject    handle to tuxiangxuanzhuan (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
set(handles.pushbutton3,         'Visible'       , 'on'   );
if   strcmp(get(gcbo,         'Checked'   ),  'on'   )
   set(handles.pushbutton3,              'Visible'       , 'on'   );
   set(gcbo,          'Checked'   ,   'off'     );
   set(handles.pushbutton3,              'Visible'       , 'off'     );
else
   set(gcbo,          'Checked'   ,   'on'   );
end



% --------------------------------------------------------------------
function     ditonglvbochuli_Callback(hObject, eventdata, handles)
% hObject    handle to ditonglvbochuli (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
set(handles.pushbutton14,         'Visible'       , 'on'   );
if   strcmp(get(gcbo,         'Checked'   ),  'on'   )
   set(handles.pushbutton14,              'Visible'       , 'on'   );
   set(gcbo,          'Checked'   ,   'off'     );
```

```
    set(handles.pushbutton14,              'Visible'       , 'off'     );
else
    set(gcbo,          'Checked'   ,   'on'   );
end

% --------------------------------------------------------------------
function     gaotonglvbochuli_Callback(hObject, eventdata, handles)
% hObject    handle to gaotonglvbochuli (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
set(handles.pushbutton15,         'Visible'       , 'on'   );
if   strcmp(get(gcbo,          'Checked'   ),  'on'   )
    set(handles.pushbutton15,              'Visible'       , 'on'   );
    set(gcbo,          'Checked'   ,   'off'     );
    set(handles.pushbutton15,              'Visible'       , 'off'     );
else
    set(gcbo,          'Checked'   ,   'on'   );
end

% --------------------------------------------------------------------
function     tuxianglvbo_Callback(hObject, eventdata, handles)
% hObject    handle to tuxianglvbo (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
set(handles.uipanel5,         'Visible'       , 'on'   );
if   strcmp(get(gcbo,          'Checked'   ),  'on'   )
    set(handles.uipanel5,              'Visible'       , 'on'   );
    set(gcbo,          'Checked'   ,   'off'     );
    set(handles.uipanel5,              'Visible'       , 'off'     );
else
    set(gcbo,          'Checked'   ,   'on'   );
end



% --------------------------------------------------------------------
function     liangdutiaojie_Callback(hObject, eventdata, handles)
% hObject    handle to liangdutiaojie (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
set(handles.radiobutton12,           'Visible'       , 'on'   );
if   strcmp(get(gcbo,          'Checked'   ),  'on'   )
    set(handles.radiobutton12,               'Visible'       , 'on'   );
    set(gcbo,          'Checked'   ,   'off'     );
    set(handles.radiobutton12,               'Visible'       , 'off'     );
else
    set(gcbo,          'Checked'   ,   'on'   );
end
```

```
% --------------------------------------------------------------------
function    huidutxiang_Callback(hObject, eventdata, handles)
% hObject    handle to huidutxiang (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
set(handles.radiobutton16,          'Visible'      , 'on'   );
if   strcmp(get(gcbo,        'Checked'   ),  'on'   )
   set(handles.radiobutton16,             'Visible'      , 'on'   );
   set(gcbo,          'Checked'   ,   'off'     );
   set(handles.radiobutton16,             'Visible'      , 'off'     );
else
   set(gcbo,          'Checked'   ,   'on'   );
end

% --------------------------------------------------------------------
function    duibidu_Callback(hObject, eventdata, handles)
% hObject    handle to duibidu (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
set(handles.uipanel10,         'Visible'      , 'on'   );
if   strcmp(get(gcbo,        'Checked'   ),  'on'   )
   set(handles.uipanel10,             'Visible'      , 'on'   );
   set(gcbo,          'Checked'   ,   'off'     );
   set(handles.uipanel10,             'Visible'      , 'off'     );
else
   set(gcbo,          'Checked'   ,   'on'   );
end

% --------------------------------------------------------------------
function    zhifangtujunheng_Callback(hObject, eventdata, handles)
% hObject    handle to zhifangtujunheng (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
set(handles.pushbutton7,         'Visible'      , 'on'   );
if   strcmp(get(gcbo,        'Checked'   ),  'on'   )
   set(handles.pushbutton7,            'Visible'      , 'on'   );
   set(gcbo,          'Checked'   ,   'off'     );
   set(handles.pushbutton7,            'Visible'      , 'off'     );
else
   set(gcbo,          'Checked'   ,   'on'   );
end

% --------------------------------------------------------------------
function    zhifangtutongji_Callback(hObject, eventdata, handles)
% hObject    handle to zhifangtutongji (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
set(handles.pushbutton8,         'Visible'      , 'on'   );
```

```
if   strcmp(get(gcbo,         'Checked'   ),  'on'   )
   set(handles.pushbutton8,              'Visible'      , 'on'   );
   set(gcbo,          'Checked'   ,   'off'     );
   set(handles.pushbutton8,              'Visible'      , 'off'     );
else
   set(gcbo,          'Checked'   ,   'on'   );
end

% --------------------------------------------------------------------
function     fangdasuoxiao_Callback(hObject, eventdata, handles)
% hObject    handle to fangdasuoxiao (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
set(handles.uipanel9,          'Visible'       , 'on'   );
if   strcmp(get(gcbo,         'Checked'   ),  'on'   )
   set(handles.uipanel9,              'Visible'      , 'on'   );
   set(gcbo,          'Checked'   ,   'off'     );
   set(handles.uipanel9,              'Visible'      , 'off'     );
else
   set(gcbo,          'Checked'   ,   'on'   );
end

% --------------------------------------------------------------------
function     dipianxiaoguo_Callback(hObject, eventdata, handles)
% hObject    handle to dipianxiaoguo (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
set(handles.pushbutton12,         'Visible'       , 'on'   );
if   strcmp(get(gcbo,         'Checked'   ),  'on'   )
   set(handles.pushbutton12,              'Visible'      , 'on'   );
   set(gcbo,          'Checked'   ,   'off'     );
   set(handles.pushbutton12,              'Visible'      , 'off'     );
else
   set(gcbo,          'Checked'   ,   'on'   );
end

% --------------------------------------------------------------------
function     bianyuanxinxi_Callback(hObject, eventdata, handles)
% hObject    handle to bianyuanxinxi (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
set(handles.pushbutton16,         'Visible'       , 'on'   );
if   strcmp(get(gcbo,         'Checked'   ),  'on'   )
   set(handles.pushbutton16,              'Visible'      , 'on'   );
   set(gcbo,          'Checked'   ,   'off'     );
   set(handles.pushbutton16,              'Visible'      , 'off'     );
else
   set(gcbo,          'Checked'   ,   'on'   );
end
```