程式設計實驗計算成果分析

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一、作業名稱

灰值重心法求定框標影像中心點的像元座標

二、作業目的

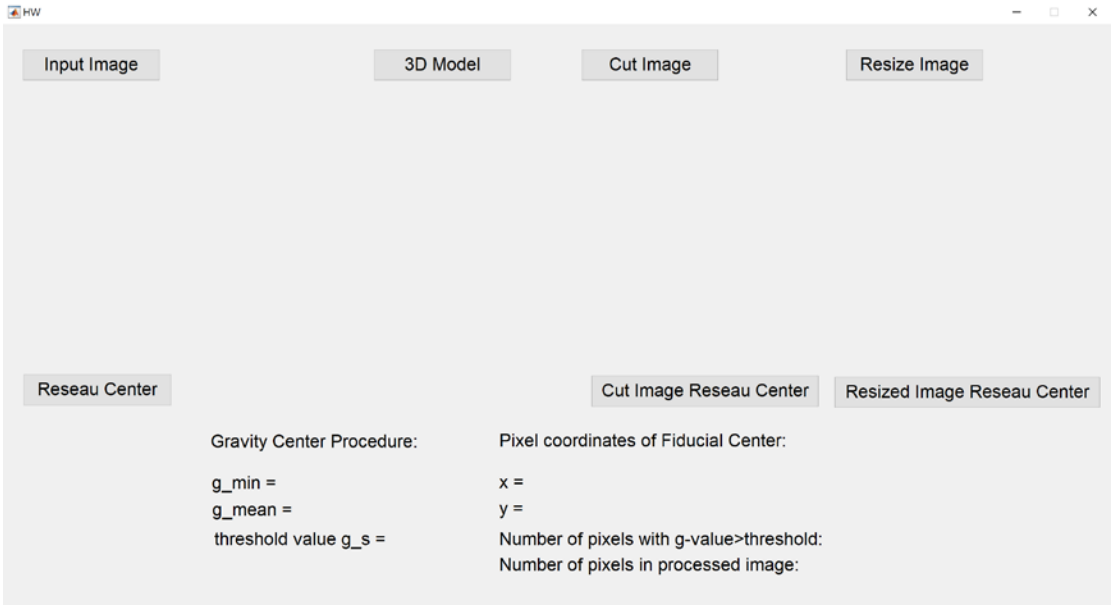
透過程式得到影像中每個像元的灰度值，利用灰質重心法計算得到框標影像中心點的像元座標，並在影像上標示出來。

三、實作日期

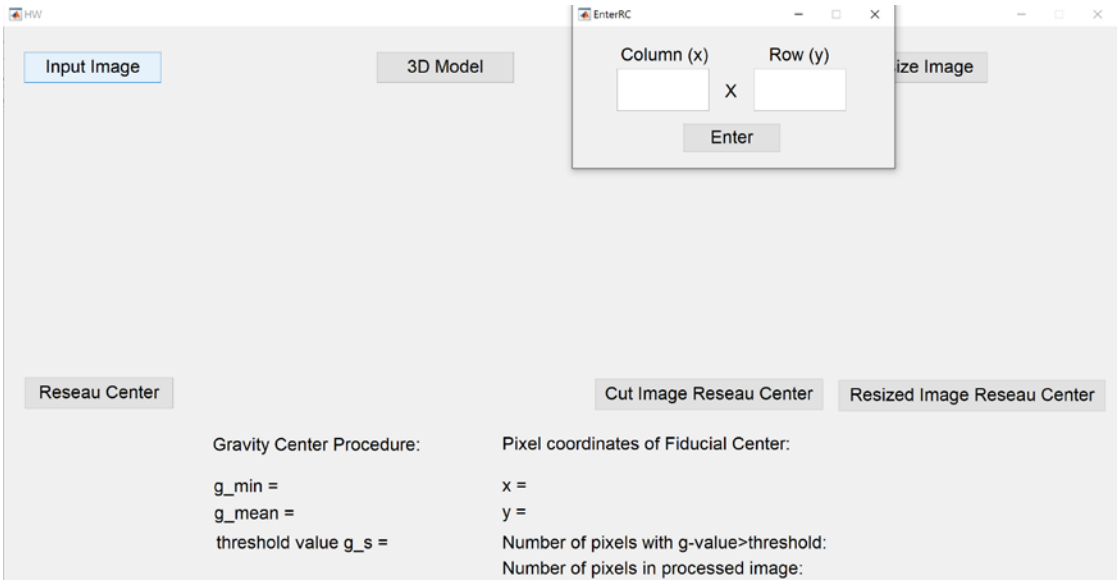
2020 年 10 月 30 日至 2020 年 11 月 9 日

四、實作步驟

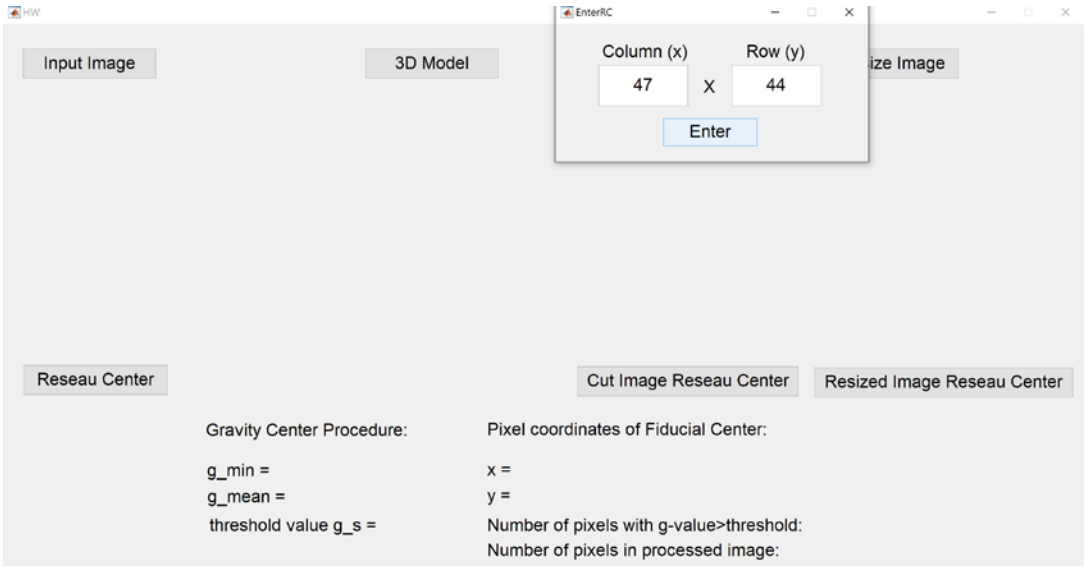
1. 執行 HW.m。

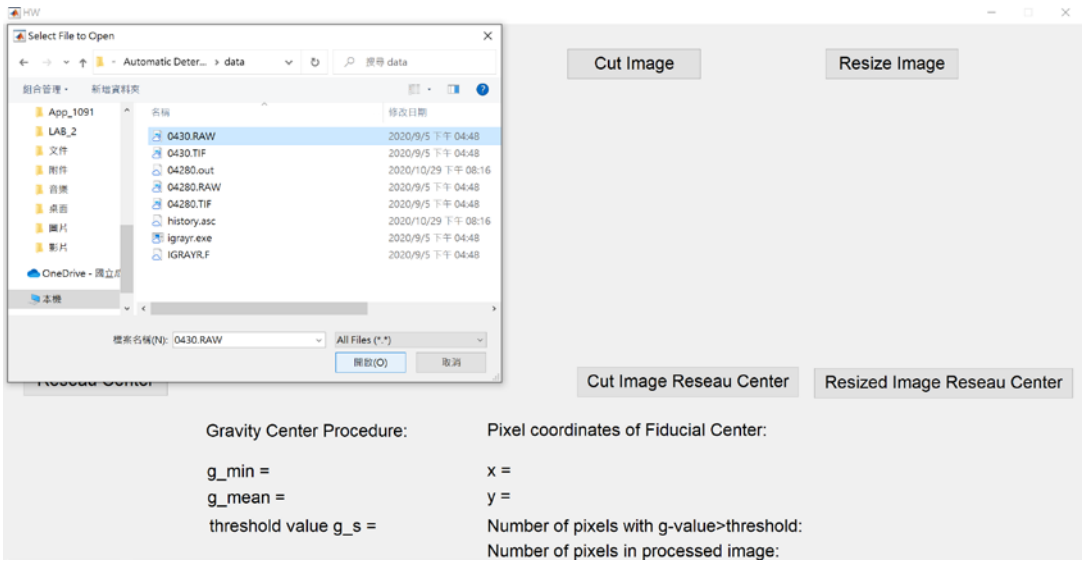


2. 點選 Input Image，跳出 EnterRC 的顯示窗。

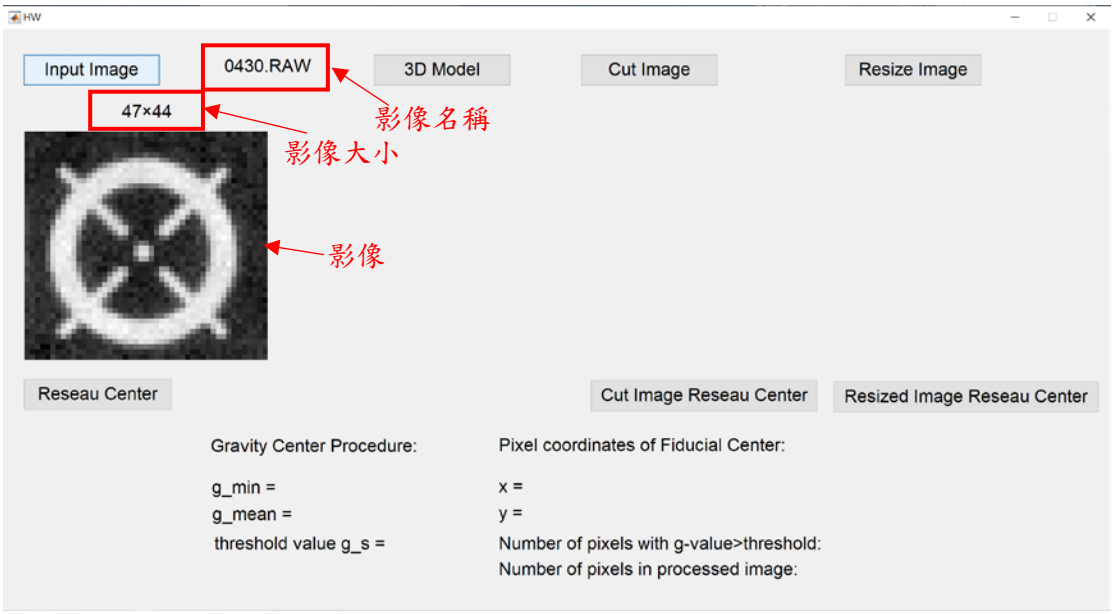


3. 輸入 Column 值和 Row 值，按下 Enter，會跳出 Select File to Open 的視窗，選擇欲開啟的 raw 格式檔案。

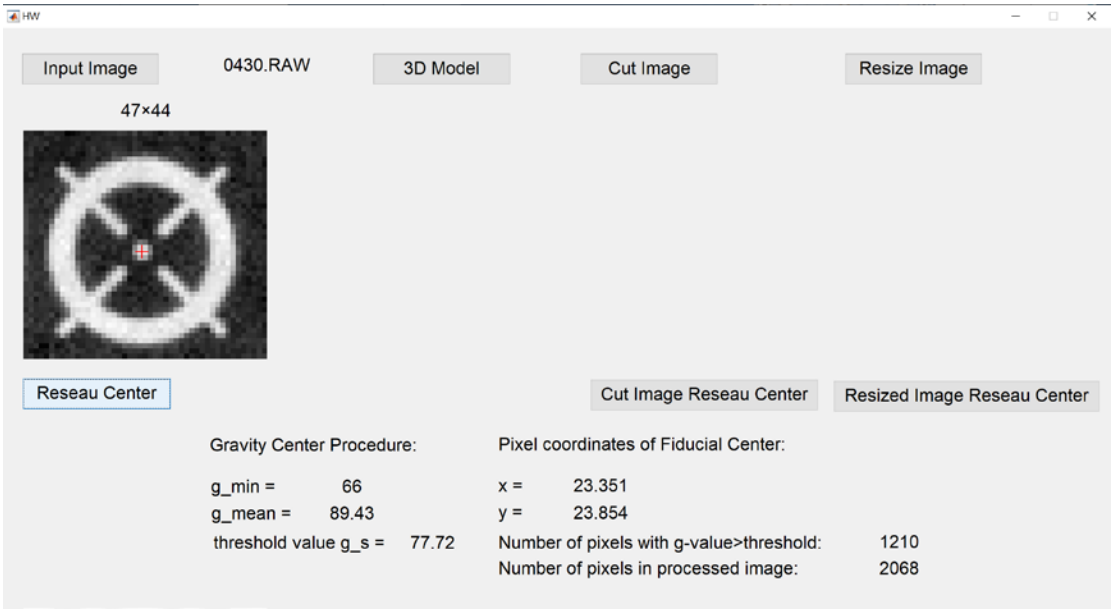




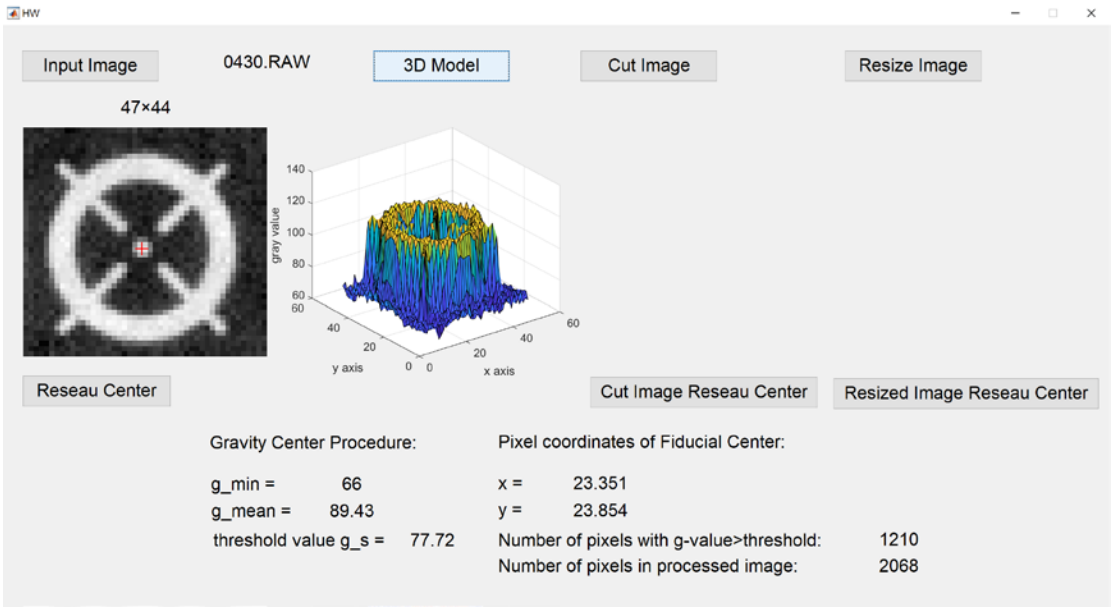
4. 開啟後會顯示影像名稱、影像大小及影像。



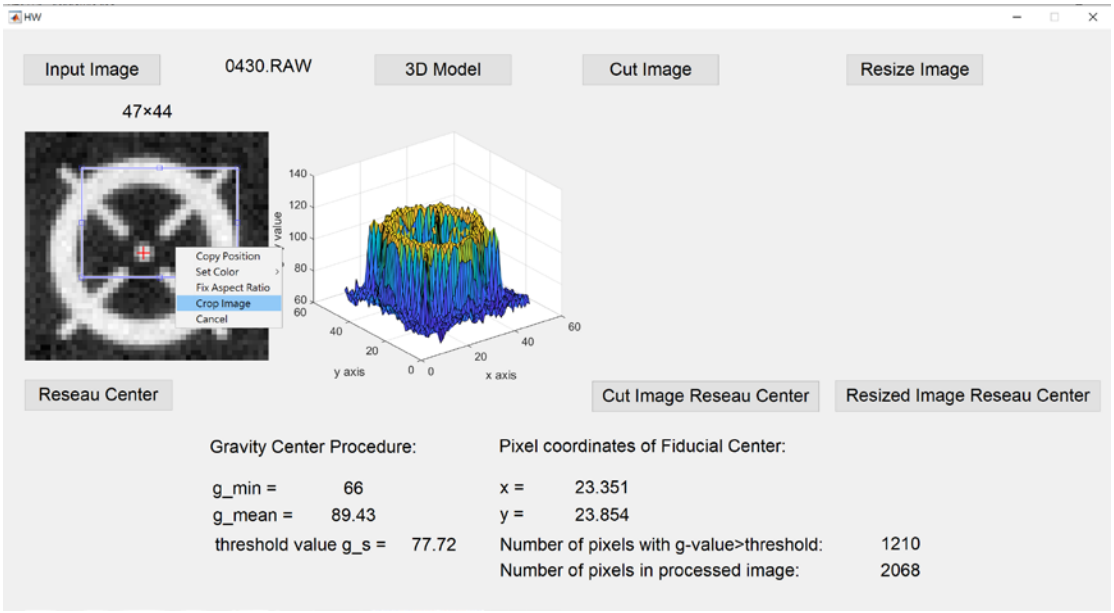
5. 點選 Reseau Center 會計算得到灰度值最小值(g_min)、灰度值平均值(g_mean)、灰度值臨界值(g_s)、框標影像中心點的像元座標(x, y)、灰度值大於臨界值的像元數及總像元數，並在影像上標示框標影像中心點的像元座標(紅色十字)。



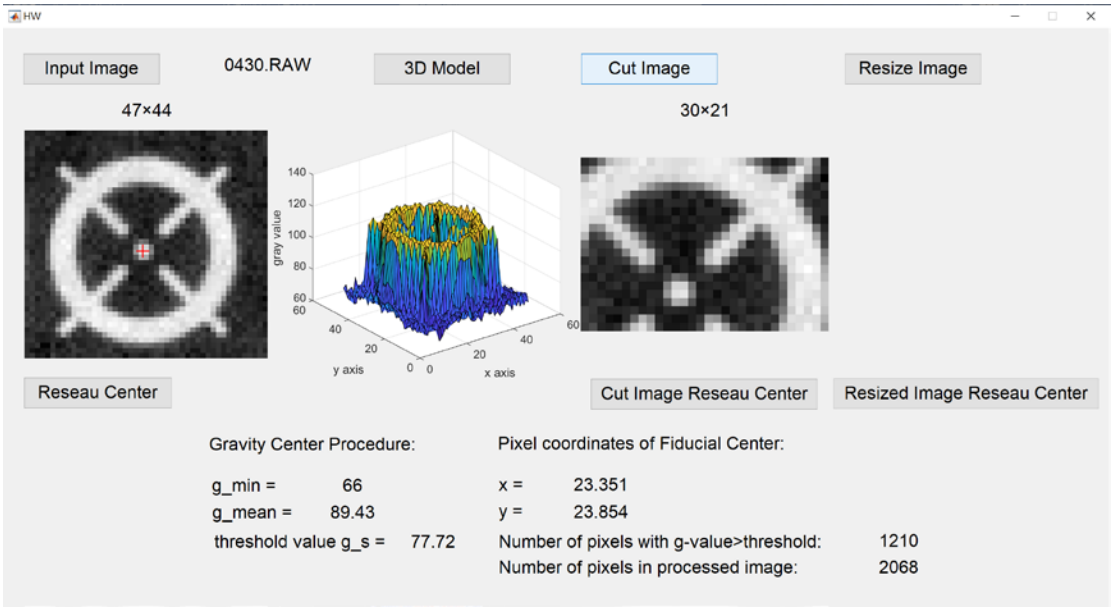
6. 點選 3D Model 會將灰度值在三維座標中顯示。



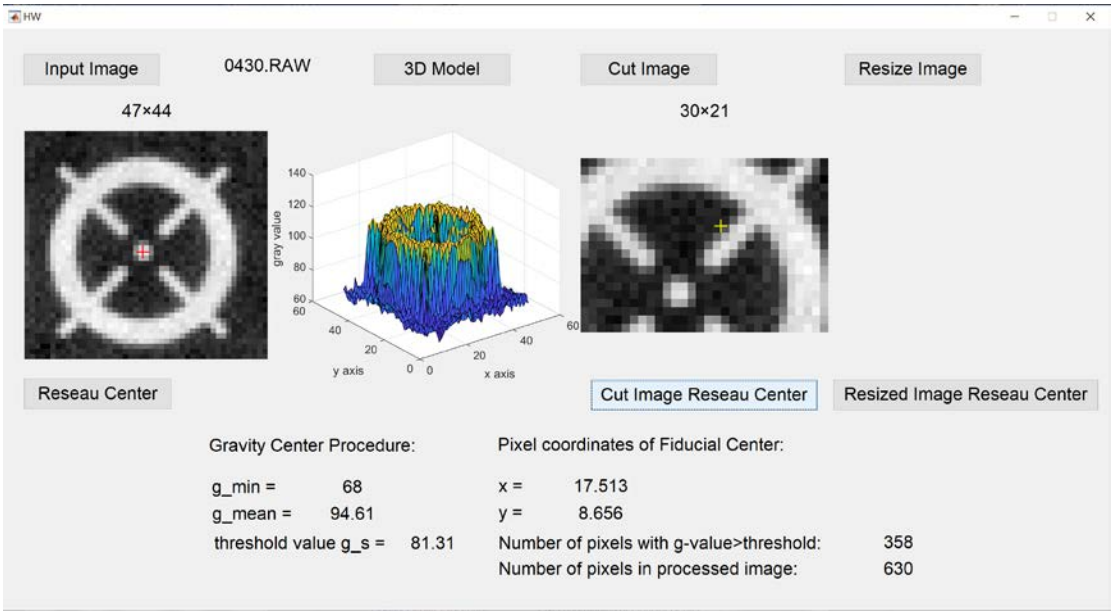
7. 點選 Cut Image 則可以在原影像上進行擷取，選擇範圍後按右鍵選擇 Crop Image。



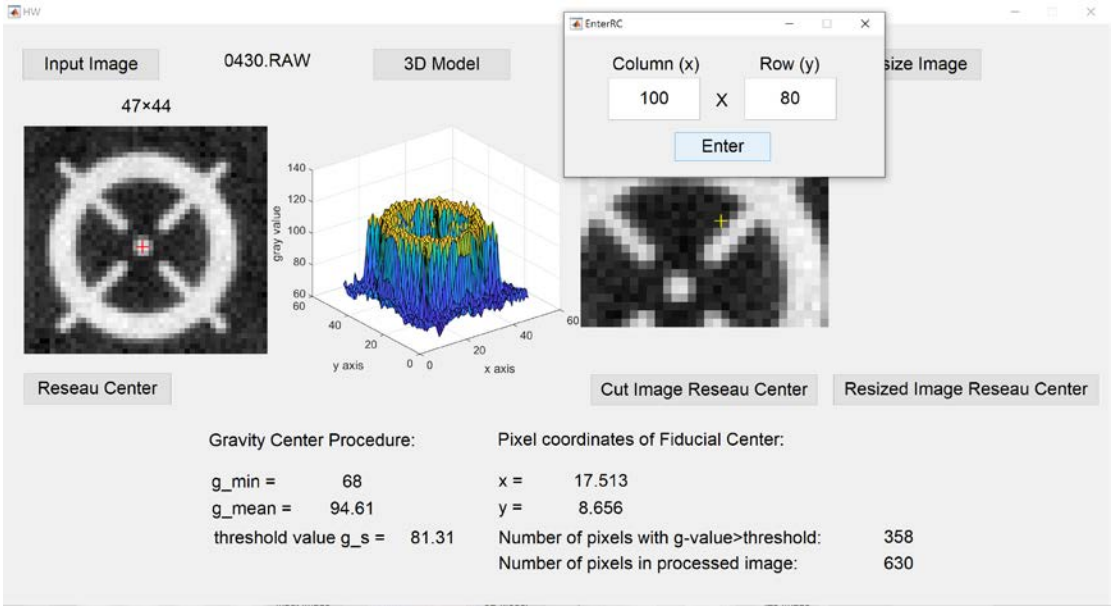
8. 顯示擷取的影像範圍。



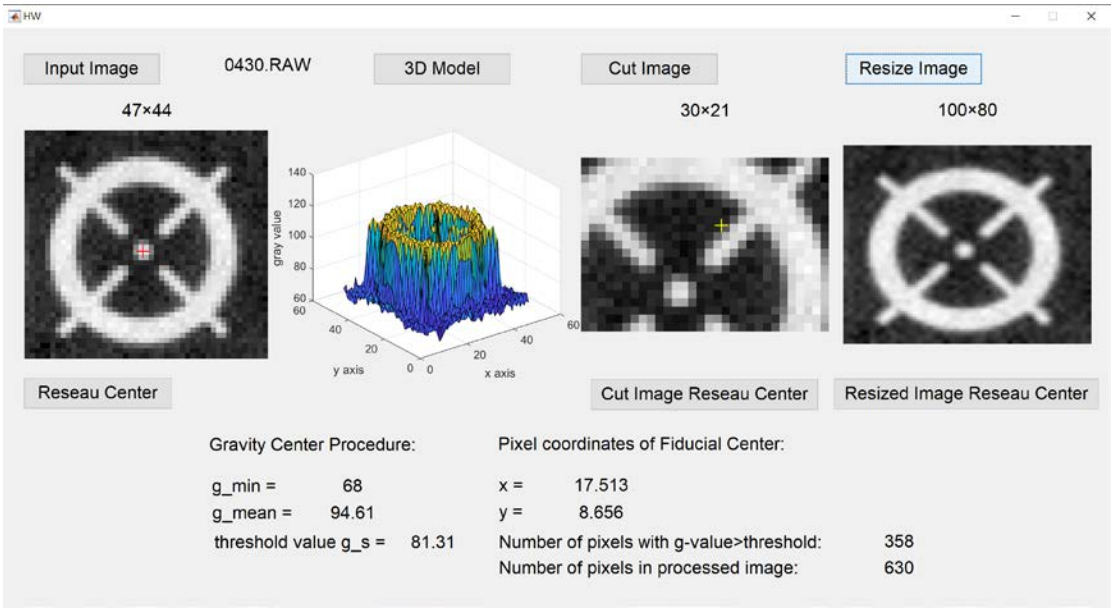
9. 點選 Cut Image Reseau Center，會計算得到擷取後影像的灰度值最小值(g_min)、灰度值平均值(g_mean)、灰度值臨界值(g_s)、框標影像中心點的像元座標(x, y)、灰度值大於臨界值的像元數及總像元數，並在影像上標示框標影像中心點的像元座標(黃色十字)。



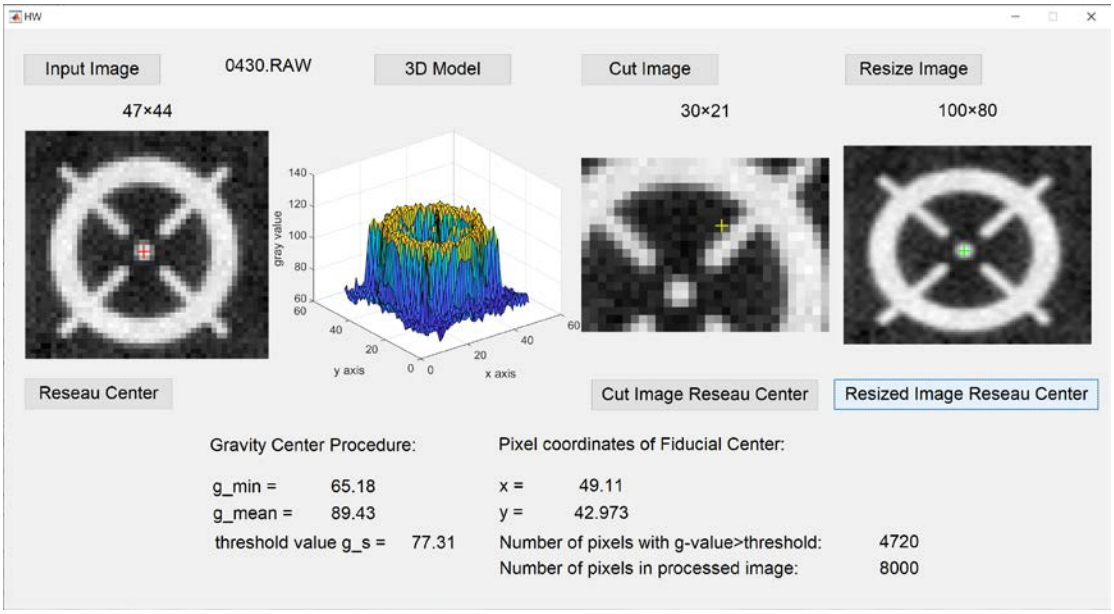
10. 點選 Resize Image 則跳出 EnterRC 的顯示窗。



11. 輸入再取樣的 Column 值和 Row 值，按下 Enter，則顯示再取樣的影像。



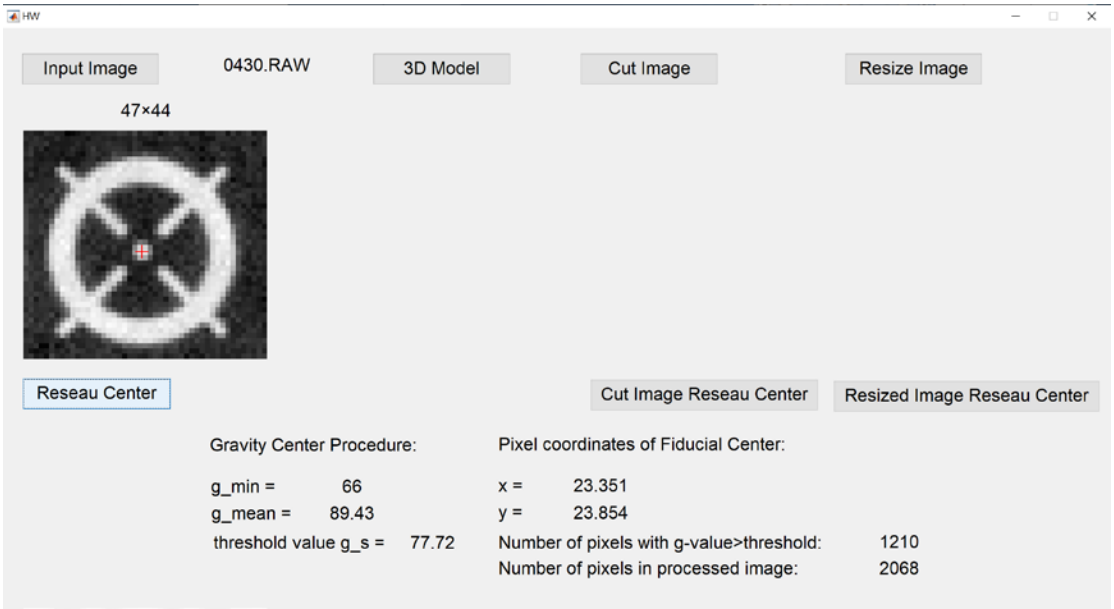
12. 點選 Resized Image Reseau Center，會計算得到再取樣後影像的灰度值最小值(g_min)、灰度值平均值(g_mean)、灰度值臨界值(g_s)、框標影像中心點的像元座標(x, y)、灰度值大於臨界值的像元數及總像元數，並在影像上標示框標影像中心點的像元座標(綠色十字)。



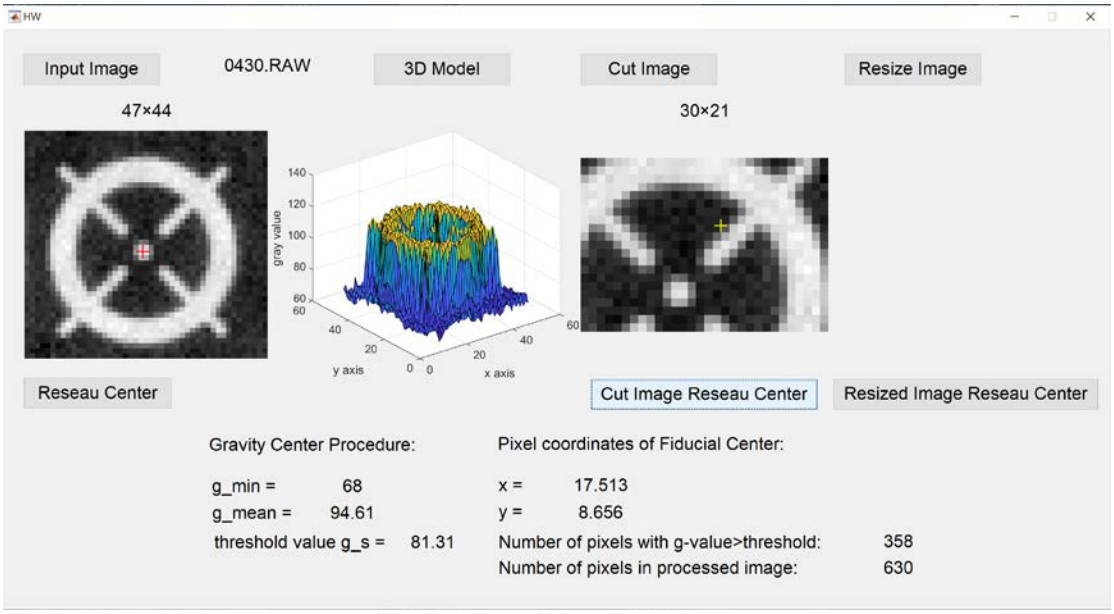
五、計算成果與分析

1. 0430.RAW

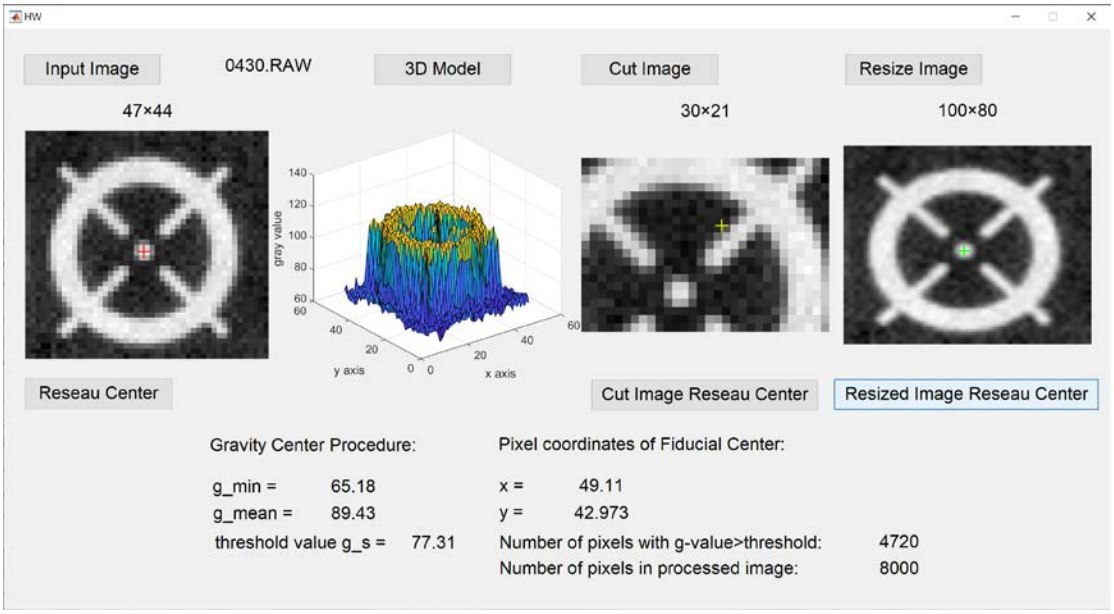
(1) 原影像：從下圖可以看到原影像為近乎黑白對稱的影像，因此由灰值重心法計算得到的坐標(紅色十字)會接近影像中心的位置。



(2) 擷取後影像：擷取後的影像為不對稱的黑白影像，因此透過灰值重心法計算得到的坐標(黃色十字)會偏離影像中心。

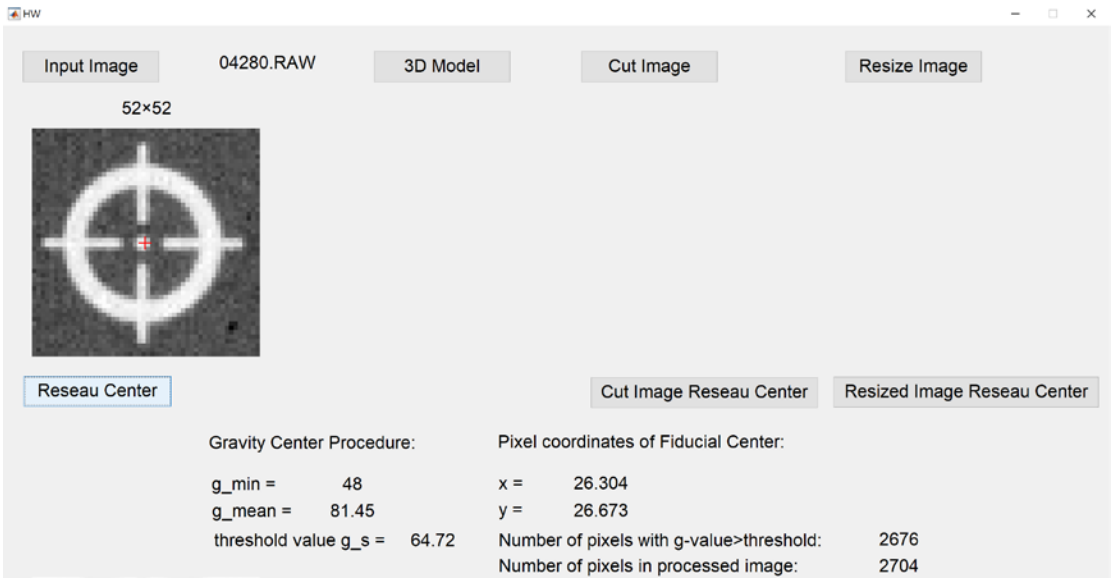


(3) 再取樣後影像：將影像進行仔取樣以後依然會是對稱的黑白影像，且灰度最小值與灰度平均值與原影像接近，因此透過灰值重心法計算得到的坐標(綠色十字)會與原影像的坐標(紅色十字)一樣位於接近影像中心的位置。

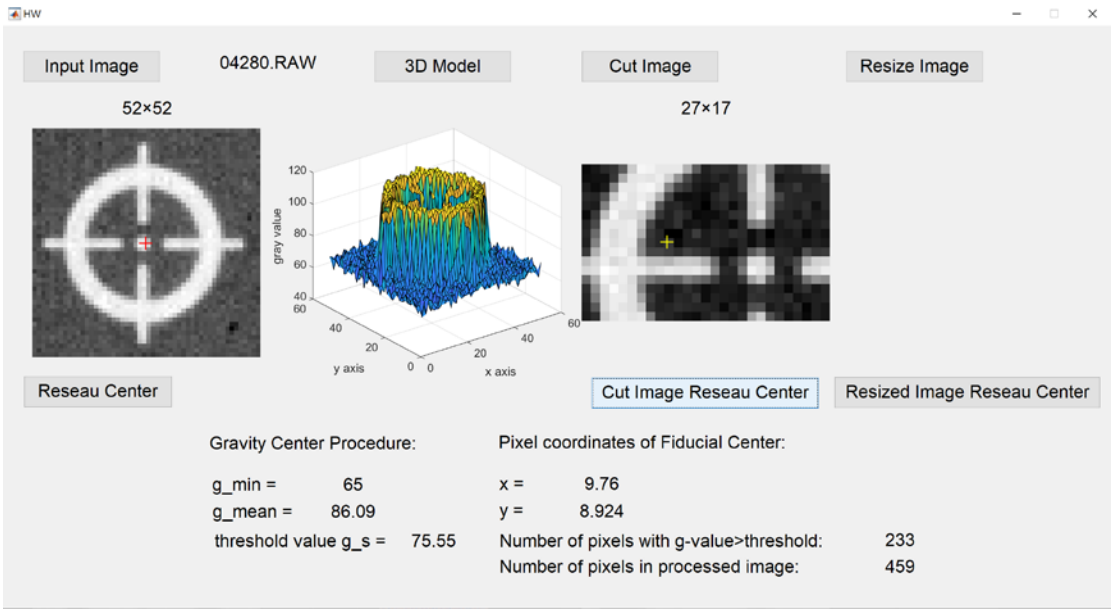


2. 04280.RAW

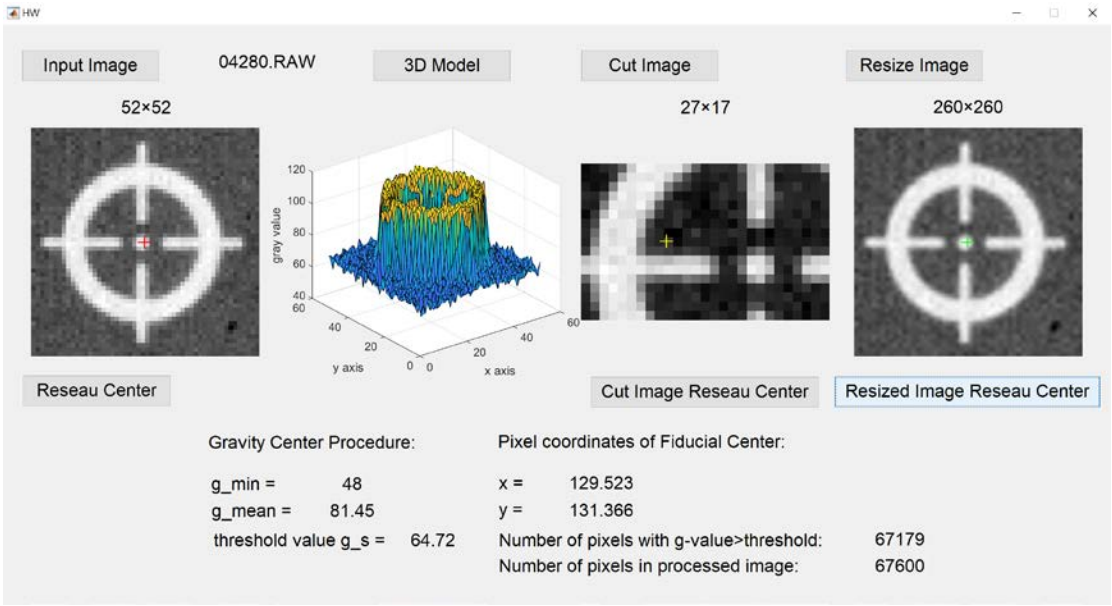
(1) 原影像：從下圖可以看到原影像為近乎黑白對稱的影像，因此由灰值重心法計算得到的坐標(紅色十字)會接近影像中心的位置。



(2) 擷取後影像：擷取後的影像為不對稱的黑白影像，因此透過灰值重心法計算得到的坐標(黃色十字)會偏離影像中心，且較偏向白色區塊的位置。



(3) 再取樣後影像：將影像進行仔取樣以後依然會是對稱的黑白影像，且依然是正方形影像，所以灰度最小值與灰度平均值與原影像一樣，因此透過灰值重心法計算得到的坐標(綠色十字)會與原影像的坐標(紅色十字)一樣位於接近影像中心的位置。



六、心得與討論

在程式撰寫的過程中，因為使用的是 MATLAB 的 GUI 功能來構成一個視窗，因此許多程式也要根據 GUI 的寫法來調整。為了方便匯入不同像元的影像，除了主要視窗 HW 以外，多寫了一個 EnterRC 的視窗，在輸入影像前可以先輸入像元尺寸。

而在進行灰值重心法的計算時，因為 MATLAB 內的行列坐標並非我們常用的(c, r)而是(r, c)，因此在計算過程中常常要記得將 column 和 row 兩者對調才能順利計算。

七、結論

當影像為對稱黑白圖形時，其進行灰值重心法計算得到的坐標會接近影像中心，而影像為不對稱的黑白圖形時，利用灰值重心法計算得到的坐標會偏離影像中心，且接近白色區塊較多的區域。而影像經過再取樣以後，因為灰度值的比例還是與原影像相差無幾，因此利用灰值重心法計算得到的坐標位置還是會與原影像一樣接近影像中心。

主程式碼：

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

% Last Modified by GUIDE v2.5 09-Nov-2020 09:46:12

% Begin initialization code - DO NOT EDIT
gui_Singleton = 1;
gui_State = struct('gui_Name',       mfilename, ...
                   'gui_Singleton',  gui_Singleton, ...
                   'gui_OpeningFcn', @HW_OpeningFcn, ...
                   'gui_OutputFcn',  @HW_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 HW is made visible.
function HW_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 HW (see VARARGIN)

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

% Update handles structure
guidata(hObject, handles);

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


% --- Outputs from this function are returned to the command line.
function varargout = HW_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 button press in inputImage.
function inputImage_Callback(hObject, eventdata, handles)
% hObject    handle to inputImage (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global img col row;
%呼叫EnterRC.m
EnterRC;
waitfor(EnterRC);
%取得EnterRC.m設定的行列值
mainGui = findobj('Name','HW');
col=getappdata(mainGui,'col');
row=getappdata(mainGui,'row');
%匯入raw影像
[imagefile,imagepath]=uigetfile('*.*');
fid=fopen([imagepath,imagefile],'rb');
imgOrigin=fread(fid,[col,row]);
img=imgOrigin';
fclose(fid);
imshow(img,[],'Parent',handles.axes1);
set(handles.text1,'string',imagefile);
set(handles.textOrigin,'string',col+"¡Ñ"+row);

% --- Executes on button press in model.
function model_Callback(hObject, eventdata, handles)
% hObject    handle to model (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global img col row;
%繪製3D模型
Z=img;
[X,Y]=meshgrid(1:col,1:row);
axes(handles.axes2);
surf(X,Y,Z);
xlabel("x axis");
ylabel("y axis");
zlabel("gray value");
```

```
% --- Executes on button press in calculateCenter.
function calculateCenter_Callback(hObject, eventdata, handles)
% hObject    handle to calculateCenter (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global img x y;
%計算灰度值的最小值、平均值、臨界值
gmin=roundn(min(min(img)),-2);
set(handles.txt_g_min,'string',gmin);
gmean=roundn(mean(mean(img)),-2);
set(handles.txt_g_mean,'string',gmean);
gS=roundn((gmin+gmean)/2,-2);
set(handles.txt_g_s,'string',gS);
%取得影像大小
[img1r,img1c]=size(img);
%灰度值大於臨界值時為1，小於則為0
img1(img<=gS)=0;
img1(img>gS)=1;
%計算灰度值大於臨界值得像元數
num1=sum(img1==1);
set(handles.txt_num_thre,'string',num1);
%計算總像元數
sumPixels1=numel(img1);
set(handles.txt_pixels,'string',sumPixels1);
%計算灰度重心x、y座標
img1=reshape(img1,[img1r,img1c]);
sub1=img-gS;
M1=sum(sum(img1.*sub1));
x=roundn((1/M1)*sum(sum([1:img1c].*img1.*sub1)),-3);
set(handles.txt_x,'string',x);
y=roundn((1/M1)*sum(sum([1:img1r]'.*img1.*sub1)),-3);
set(handles.txt_y,'string',y);
%在圖上繪製紅色十字
axes(handles.axes1);
hold on;
plot(x,y,'r+','LineWidth',1,'MarkerSize',12);
hold off;
```

```
% --- Executes on button press in cutImage.
function cutImage_Callback(hObject, eventdata, handles)
% hObject    handle to cutImage (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global imgCut colCut rowCut ;
%切取原影像
axes(handles.axes1);
imgCut=imcrop;
%輸出切取後影像
imshow(imgCut,[],'Parent',handles.axes3);
[rowCut,colCut]=size(imgCut);
set(handles.textCut,'string',colCut+"¡Ñ"+rowCut);


% --- Executes on button press in calculateCutCenter.
function calculateCutCenter_Callback(hObject, eventdata, handles)
% hObject    handle to calculateCutCenter (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global imgCut colCut rowCut;
%計算切取後影像灰度值的最小值、平均值、臨界值
gminCut=roundn(min(min(imgCut)),-2);
set(handles.txt_g_min,'string',gminCut);
gmeanCut=roundn(mean(mean(imgCut)),-2);
set(handles.txt_g_mean,'string',gmeanCut);
gSCut=roundn((gminCut+gmeanCut)/2,-2);
set(handles.txt_g_s,'string',gSCut);
%灰度值大於臨界值時為1，小於則為0
img2(imgCut<=gSCut)=0;
img2(imgCut>gSCut)=1;
%計算切取後灰度值大於臨界值得像元數
num2=sum(img2==1);
set(handles.txt_num_thre,'string',num2);
%計算切取後總像元數
sumPixels2=numel(img2);
set(handles.txt_pixels,'string',sumPixels2);
%計算切取後影像灰度重心x、y座標
```

```
img2=reshape(img2,[rowCut,colCut]);
sub2=imgCut-gSCut;
M2=sum(sum(img2.*sub2));
xCut=roundn((1/M2)*sum(sum([1:colCut].*img2.*sub2)),-3);
set(handles.txt_x,'string',xCut);
yCut=roundn((1/M2)*sum(sum([1:rowCut]'.*img2.*sub2)),-3);
set(handles.txt_y,'string',yCut);
%在圖上繪製黃色十字
axes(handles.axes3);
hold on;
plot(xCut,yCut,'y+','LineWidth',1,'MarkerSize',12);
hold off;


% --- Executes on button press in resizeImage.
function resizeImage_Callback(hObject, eventdata, handles)
% hObject    handle to resizeImage (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global img imgResized colResized rowResized;
%呼叫EnterRC.m
EnterRC;
waitfor(EnterRC);
%取得EnterRC.m設定的在取樣的行列值
mainGui = findobj('Name','HW');
colResized=getappdata(mainGui,'col');
rowResized=getappdata(mainGui,'row');
%輸出再取樣影像
imgResized=imresize(img,[rowResized colResized]);
imshow(imgResized,[],'Parent',handles.axes4);
set(handles.textResized,'string',colResized+"¡Ñ"+rowResized);


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

```
global imgResized colResized rowResized;
%計算再取樣後影像灰度值的最小值、平均值、臨界值
gminResized=roundn(min(min(imgResized)),-2);
set(handles.txt_g_min,'string',gminResized);
gmeanResized=roundn(mean(mean(imgResized)),-2);
set(handles.txt_g_mean,'string',gmeanResized);
gSResized=roundn((gminResized+gmeanResized)/2,-2);
set(handles.txt_g_s,'string',gSResized);
%灰度值大於臨界值時為1，小於則為0
img3(imgResized<=gSResized)=0;
img3(imgResized>gSResized)=1;
%計算再取樣後灰度值大於臨界值得像元數
num3=sum(img3==1);
set(handles.txt_num_thre,'string',num3);
%計算再取樣後總像元數
sumPixels3=numel(img3);
set(handles.txt_pixels,'string',sumPixels3);
%計算再取樣後影像灰度重心x、y座標
img3=reshape(img3,[rowResized,colResized]);
sub3=imgResized-gSResized;
M3=sum(sum(img3.*sub3));
xResized=roundn((1/M3)*sum(sum([1:colResized].*img3.*sub3)),-3);
set(handles.txt_x,'string',xResized);
yResized=roundn((1/M3)*sum(sum([1:rowResized]'.*img3.*sub3)),-3);
set(handles.txt_y,'string',yResized);
%在圖上繪製綠色十字
axes(handles.axes4);
hold on;
plot(xResized,yResized,'g+','LineWidth',1,'MarkerSize',12);
hold off;


% --- Executes when user attempts to close figure1.
function figure1_CloseRequestFcn(hObject, eventdata, handles)
% hObject    handle to figure1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
```

```
% Hint: delete(hObject) closes the figure
delete(hObject);
clear global;
```

輸入 Column、Row 值程式碼：

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

% Last Modified by GUIDE v2.5 07-Nov-2020 20:53:35

% Begin initialization code - DO NOT EDIT
gui_Singleton = 1;
gui_State = struct('gui_Name',       mfilename, ...
                   'gui_Singleton',  gui_Singleton, ...
                   'gui_OpeningFcn', @EnterRC_OpeningFcn, ...
                   'gui_OutputFcn',  @EnterRC_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 EnterRC is made visible.
function EnterRC_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 EnterRC (see VARARGIN)

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

% Update handles structure
guidata(hObject, handles);

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


% --- Outputs from this function are returned to the command line.
function varargout = EnterRC_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 col_Callback(hObject, eventdata, handles)
% hObject    handle to col (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 col as text
%        str2double(get(hObject,'String')) returns contents of col as a double


% --- Executes during object creation, after setting all properties.
function col_CreateFcn(hObject, eventdata, handles)
% hObject    handle to col (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 row_Callback(hObject, eventdata, handles)
% hObject    handle to row (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 row as text
%        str2double(get(hObject,'String')) returns contents of row as a double
```

```
% --- Executes during object creation, after setting all properties.
function row_CreateFcn(hObject, eventdata, handles)
% hObject    handle to row (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 pushbuttonEnter.
function pushbuttonEnter_Callback(hObject, eventdata, handles)
% hObject    handle to pushbuttonEnter (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
%輸入行列值
colValue=str2double(get(handles.col,'String'));
rowValue=str2double(get(handles.row,'String'));
%將行列值設定回HW.m
mainGui = findobj('Name','HW');
setappdata(mainGui,'col',colValue);
setappdata(mainGui,'row',rowValue);
closereq() %關閉視窗
```