

MRI

HW1-Spin Echo

Presenter :

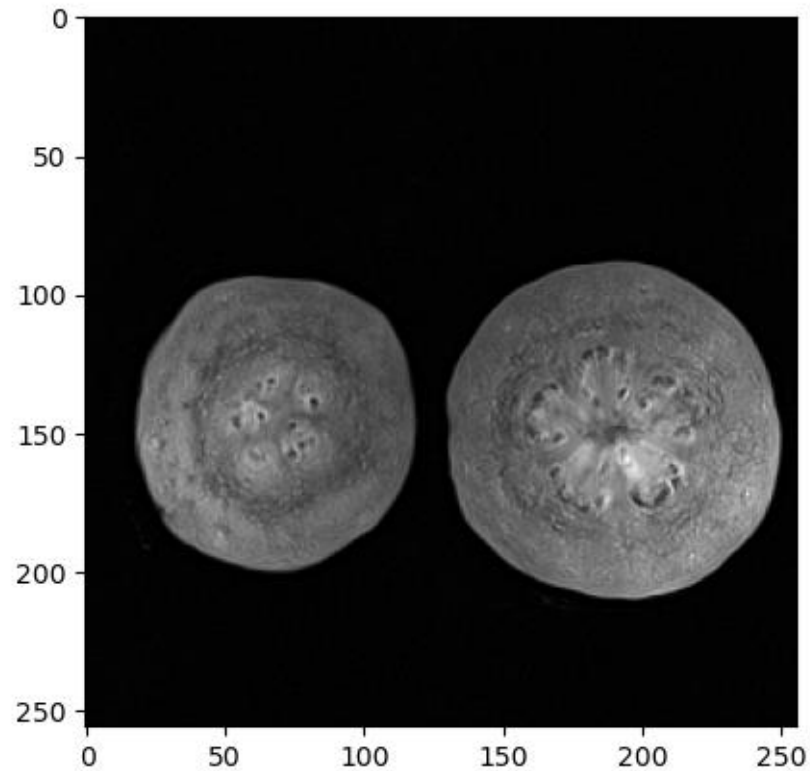
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OUTLINE

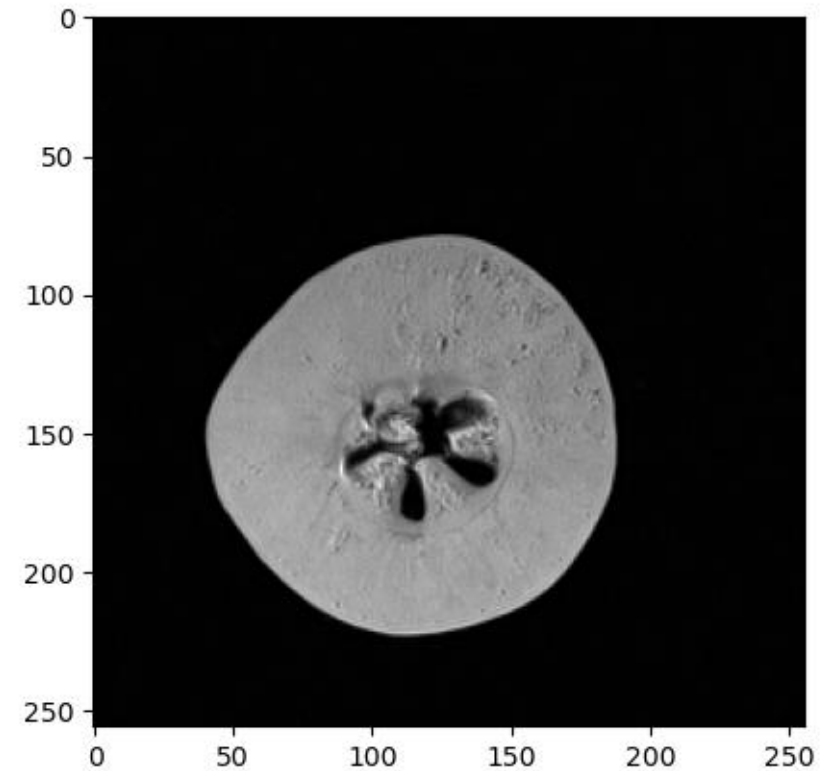
- Introduction
- Method
 - DCM
 - Curve Fitting
- Experimental Results

Introduction

T2 image-A



T2 image-B

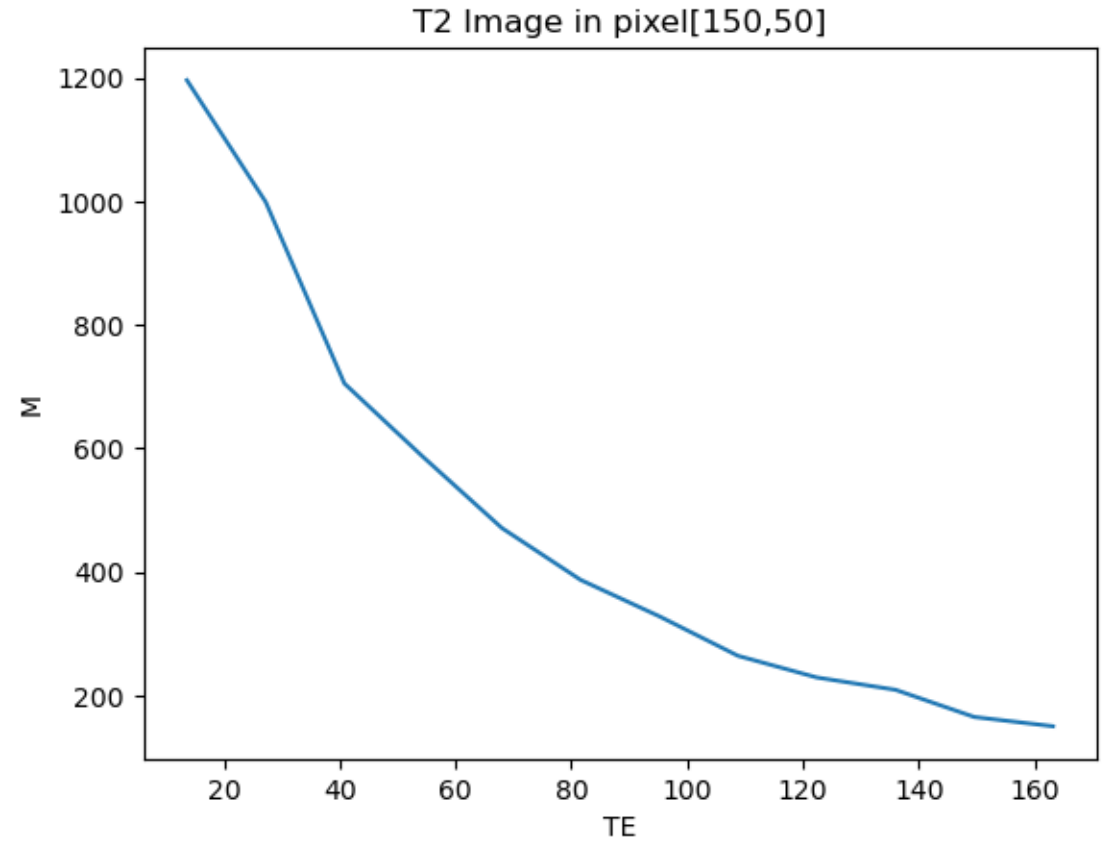


Introduction

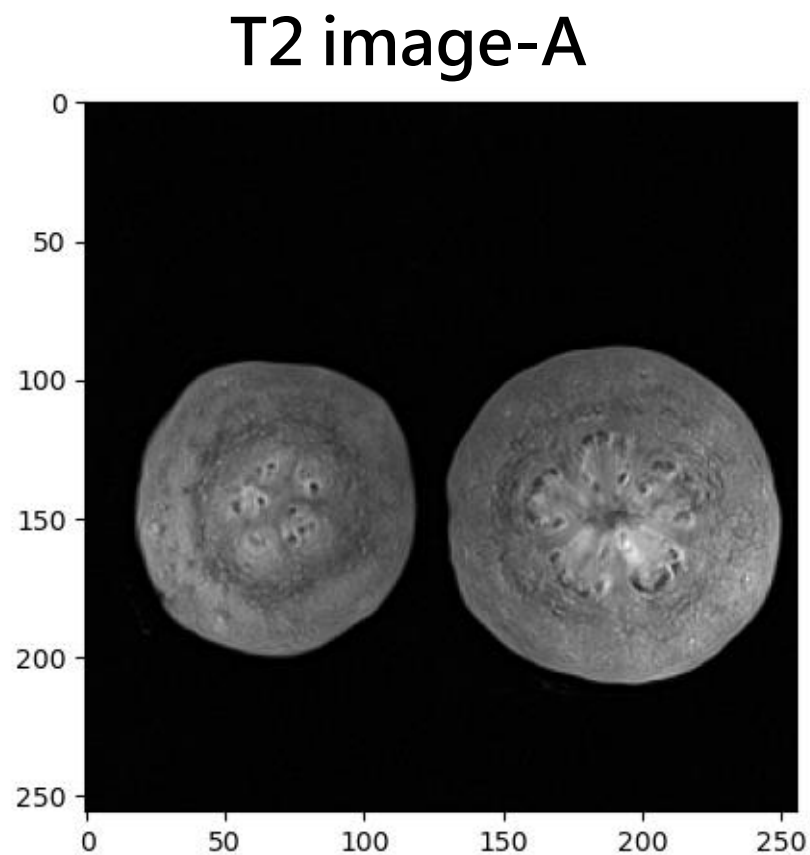
T2 equation:

$$M = M_0 * e^{-T2/TE}$$

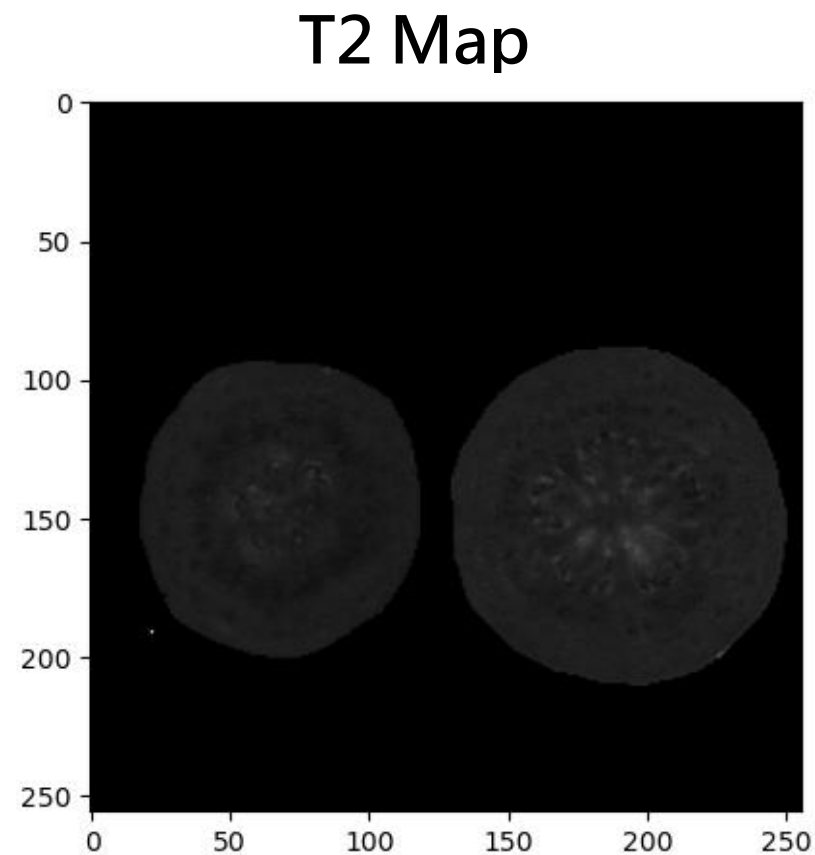
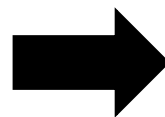
$\Rightarrow M_0$ & TE



Introduction



Mapping



OUTLINE

- Introduction
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Python

- `pydicom`: To read DCM file
- `numpy` and `scipy`: To calculate
- `matplotlib`: To `plot` the image

Method - DCM

DCM file Read

- pydicom

```
#讀取 DCM
filename = '012 se mc/012-001.dcm'
ds = dcmread(filename)

print(ds)
```

```
Dataset.file_meta -----
(0002, 0000) File Meta Information Group Length  UL: 178
(0002, 0001) File Meta Information Version       OB: b'\x00\
(0002, 0002) Media Storage SOP Class UID        UI: MR Imag
(0002, 0003) Media Storage SOP Instance UID     UI: 1.3.12.
(0002, 0010) Transfer Syntax UID                UI: Explici
(0002, 0012) Implementation Class UID          UI: 1.3.12.
(0002, 0013) Implementation Version Name       SH: 'MR_VB1
-----
(0008, 0005) Specific Character Set             CS: 'ISO_IR
(0008, 0008) Image Type                         CS: ['ORIGI
(0008, 0012) Instance Creation Date             DA: '201410
(0008, 0013) Instance Creation Time            TM: '212136
(0008, 0016) SOP Class UID                     UI: MR Imag
(0008, 0018) SOP Instance UID                  UI: 1.3.12.
```

DCM Table

DICOM Library
Anonymize, Share, View DICOM files ONLINE

(0018,0061)	DS	
(0018,0070)	IS	Counts Accumulated
(0018,0071)	CS	Acquisition Termination Condition
(0018,0072)	DS	Effective Duration
(0018,0073)	CS	Acquisition Start Condition
(0018,0074)	IS	Acquisition Start Condition Data
(0018,0075)	IS	Acquisition Termination Condition Data
(0018,0080)	DS	Repetition Time
(0018,0081)	DS	Echo Time
(0018,0082)	DS	Inversion Time
(0018,0083)	DS	Number of Averages
(0018,0084)	DS	Imaging Frequency
(0018,0085)	SH	Imaged Nucleus
(0018,0086)	IS	Echo Number(s)

Method - DCM

DCM file Read

- pydicom

```
# Echo time
print('Echo time: ', ds[0x18,0x81].value)

# Information of image
print('shape: ', ds.pixel_array.shape)
print('data type: ', ds.pixel_array.dtype)

# matplotlib to plot the DCM
plt.imshow(ds.pixel_array, cmap='gray')
plt.show()
```

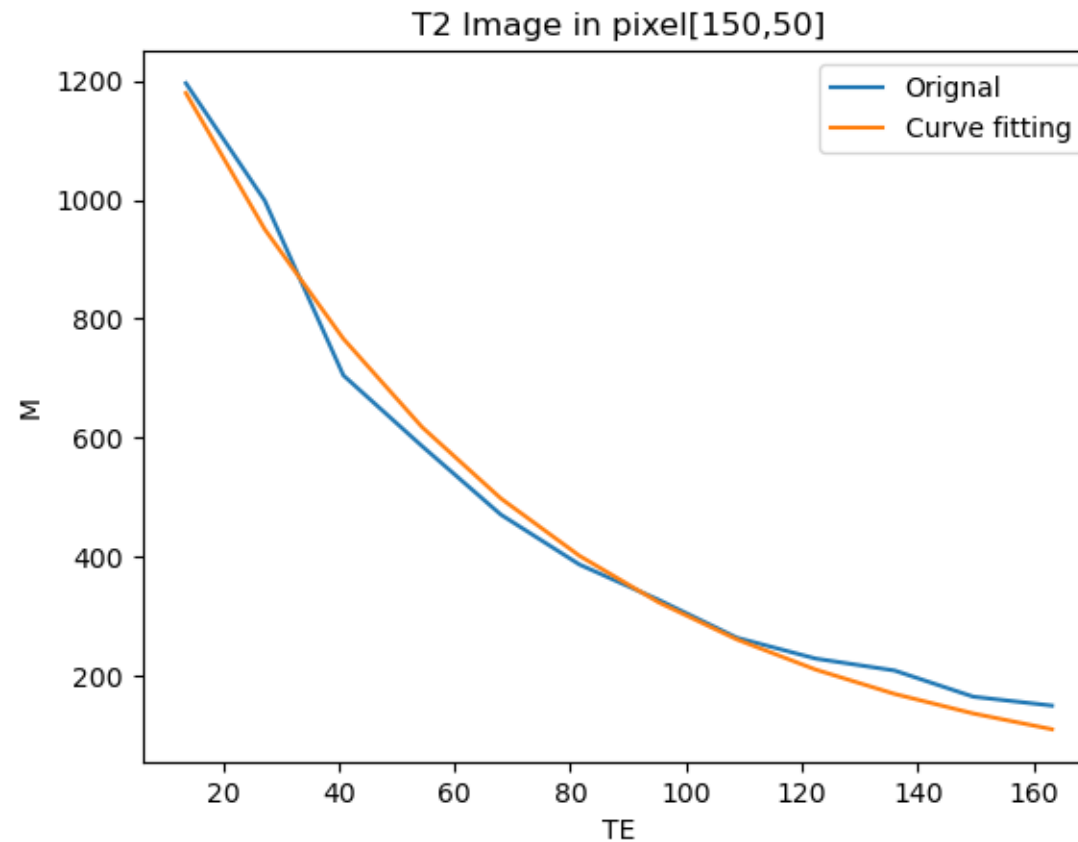
Echo time: 13.6
shape: (256, 256)
data type: uint16

Method - Curve Fitting

$$M = M_0 * e^{-T2/TE}$$

$\Rightarrow M_0$ & TE

\Rightarrow *Curve fitting*



Method - Curve Fitting

Curve fitting

- `scipy.optimize.curve_fit`

```
def Mapping(img, echoTime, T2map):  
    for row in range(256):  
        for column in range(256):  
            # if value of image < 250, to skip  
            if img[row,column,0] < 250: continue  
            coef=curve_fit(lambda t,a,b: a*np.exp(-t/b), echoTime, (img[row,column,:]), p0=(img[row,column,0],echoTime[5]))  
            #coef = [M0, TE]  
            T2map[row,column,:] = coef[0]  
            #print(TE)  
  
plt.imshow(T2map[:,:,:1],cmap='gray')  
plt.show()
```

- Setting threshold: To skip noise of background
- Curve fitting : To find M_0 & TE
- Setting P_0 : To find correct solution faster

Method - Curve Fitting

Curve fitting

- Setting P_0 : To find correct solution faster

$$M = M_0 * e^{-T2/TE}$$

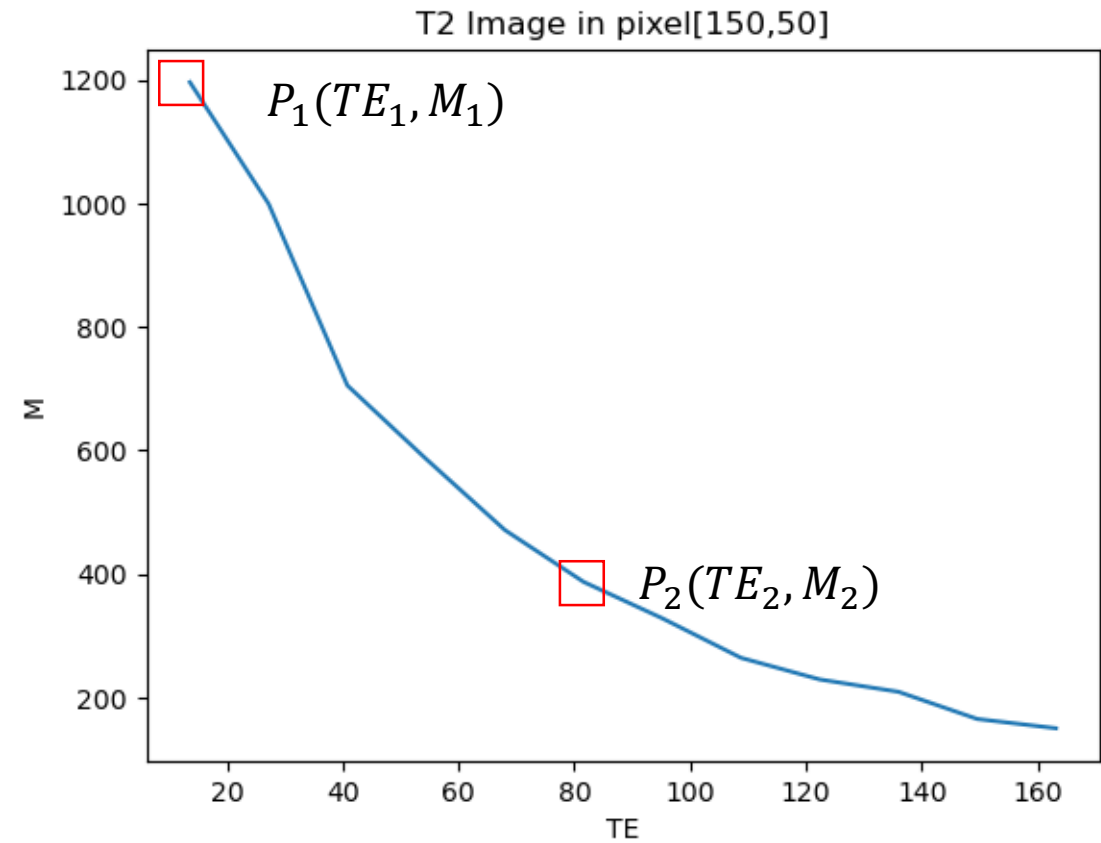
When $T2 = TE$

$$M = M_0 * 0.37$$

Assume $M_1 \approx M_0$

$$\Rightarrow M_2 \approx M_1 * 0.37$$

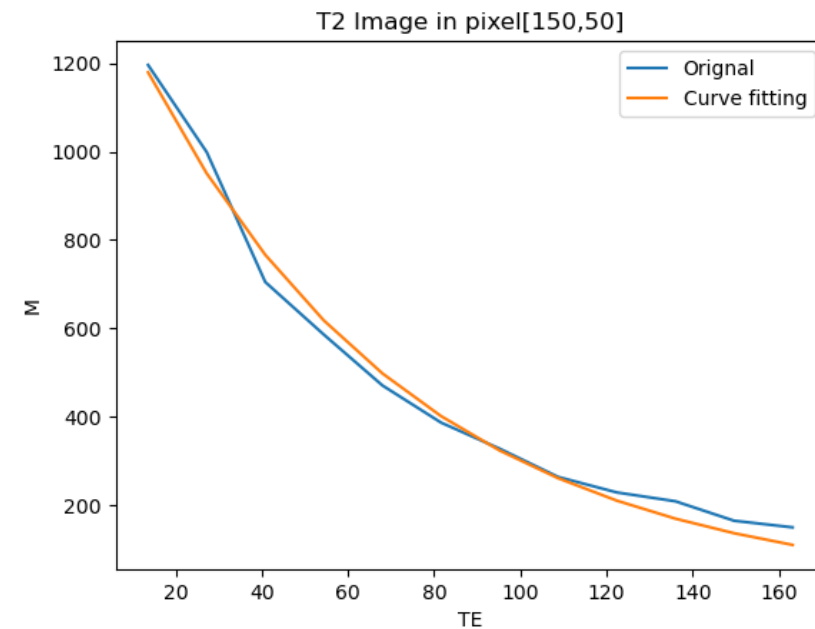
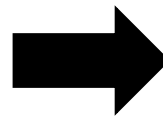
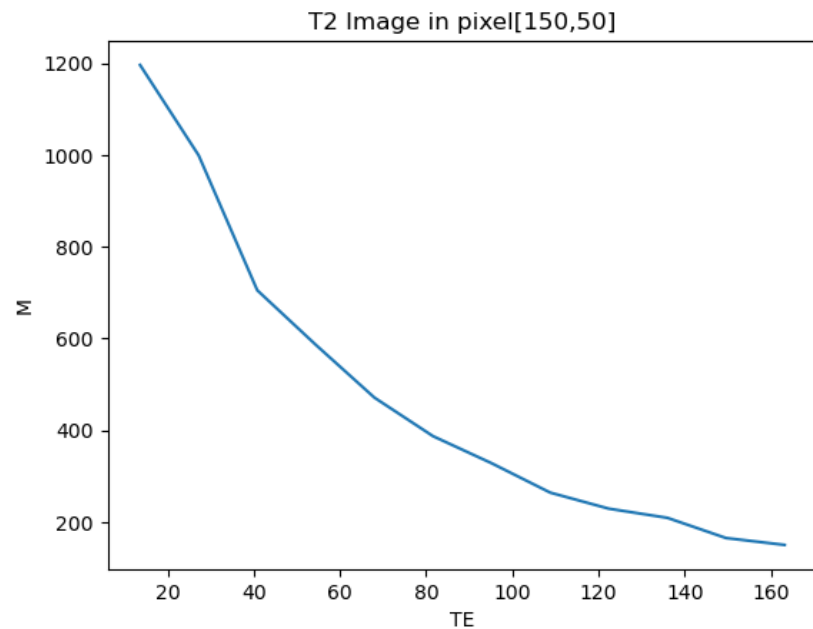
$$\Rightarrow P_0 = (TE_2, M_1)$$



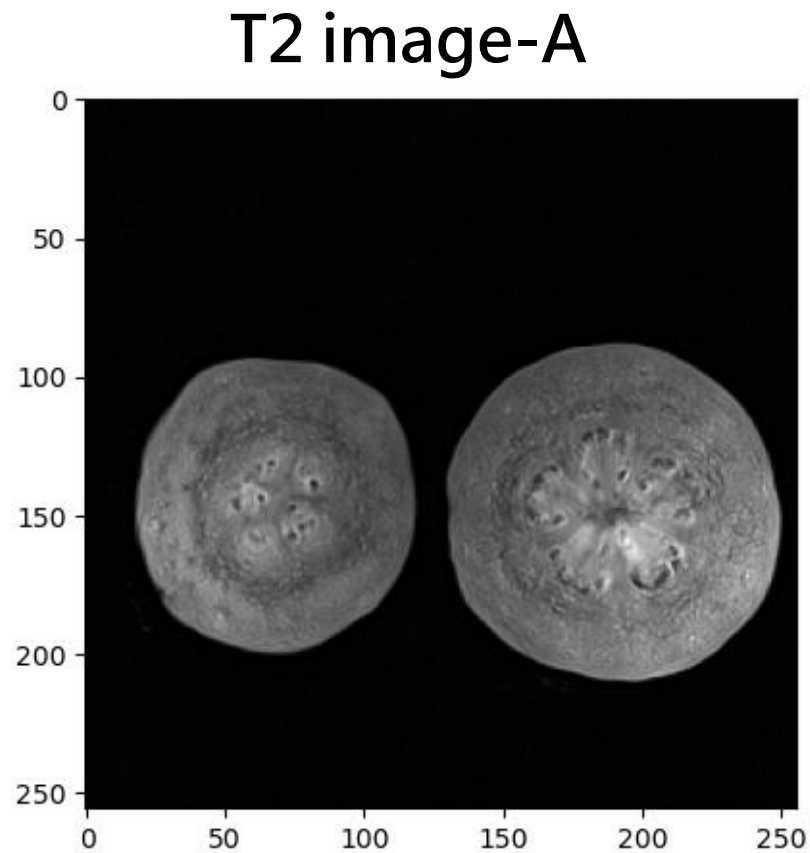
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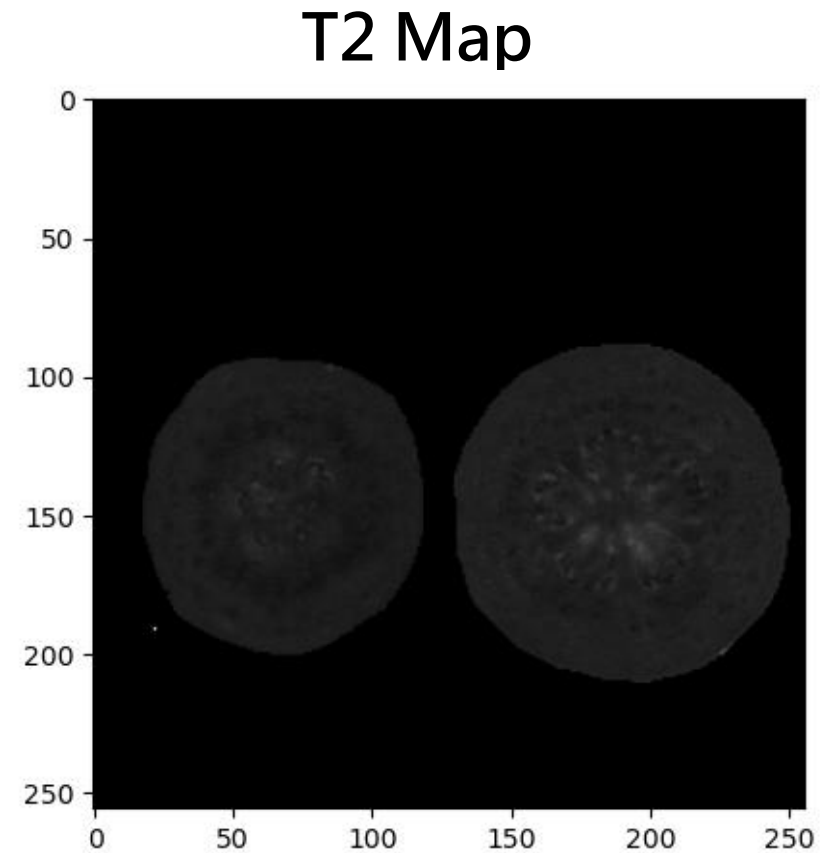
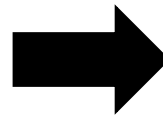
● Experimental Results - Curve Fitting



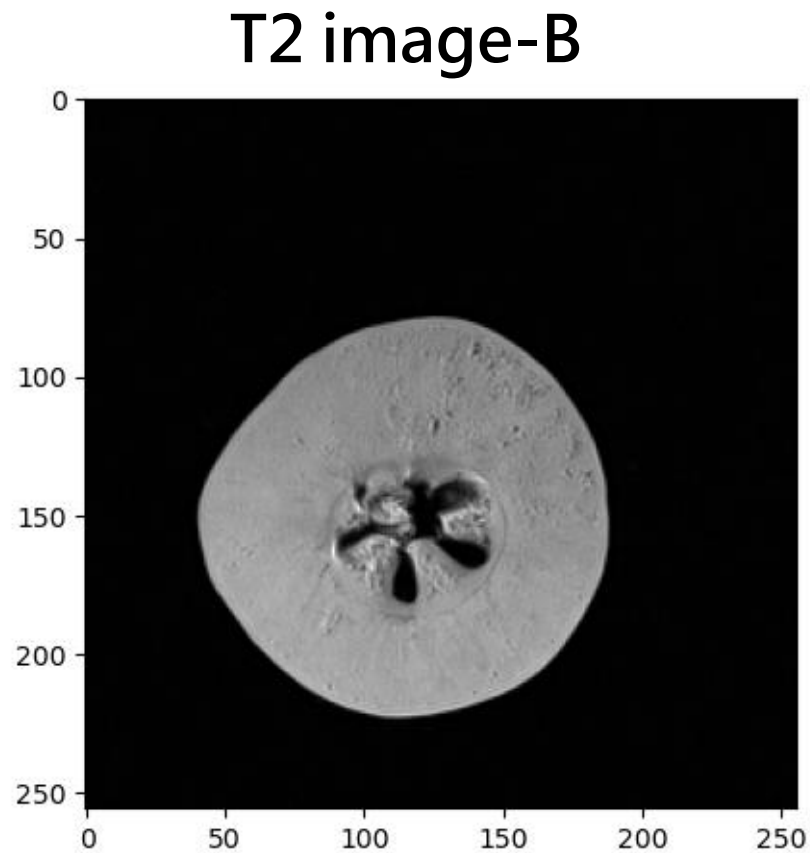
● Experimental Results - Mapping



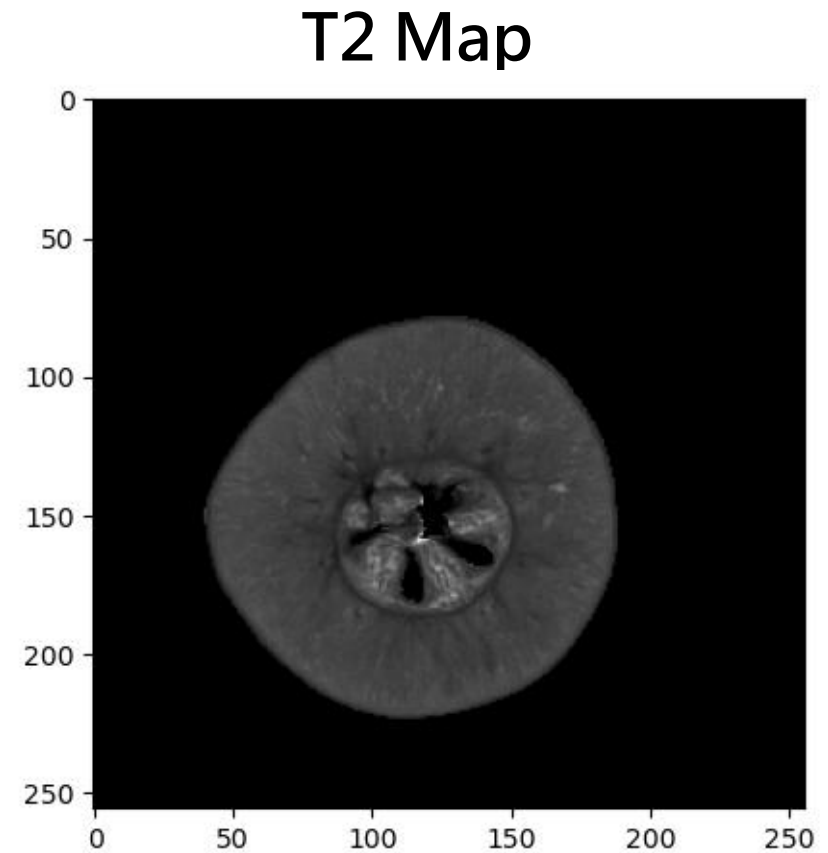
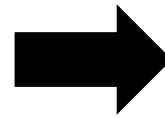
Mapping



● Experimental Results - Mapping



Mapping



Q&A

Thanks

GitHub