

# MRI

## HW1-Spin Echo

Presenter :

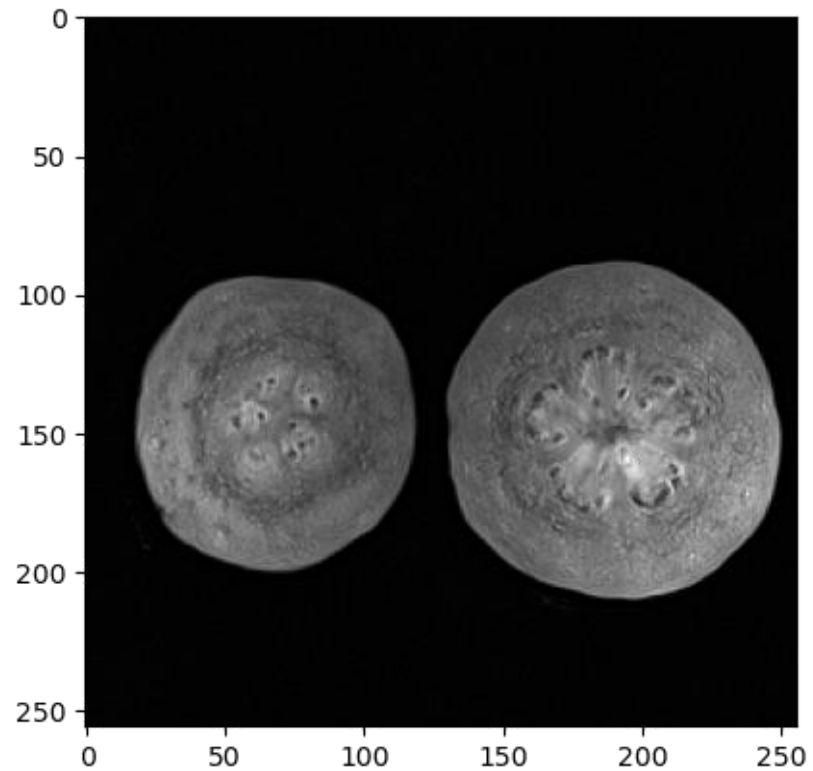
M11107309 何柏昇

# OUTLINE

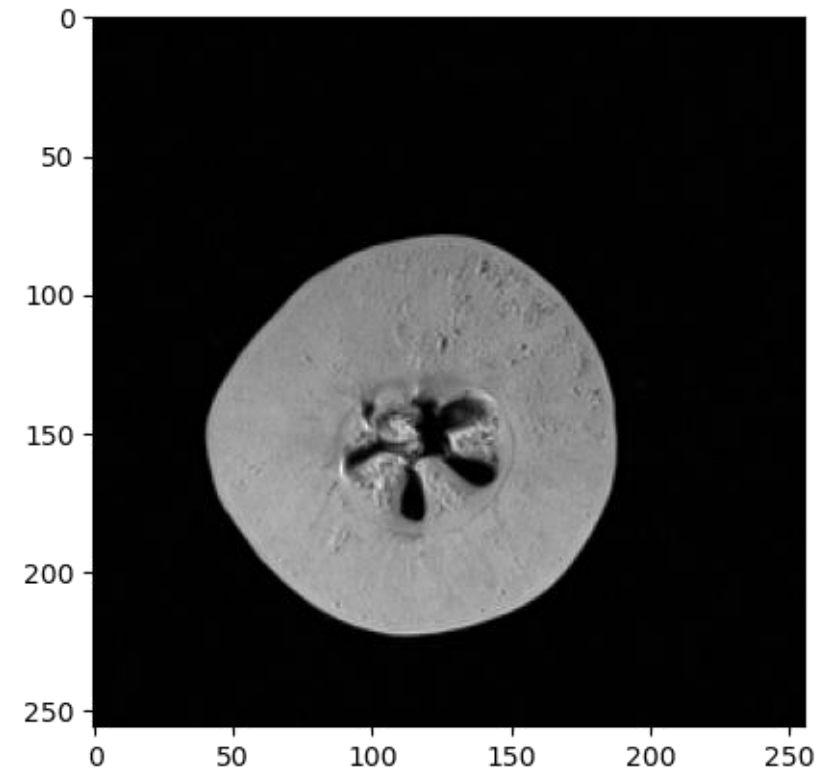
- Introduction
- Method
  - DCM
  - Curve Fitting
- Experimental Results

# Introduction

T2 image-A



T2 image-B

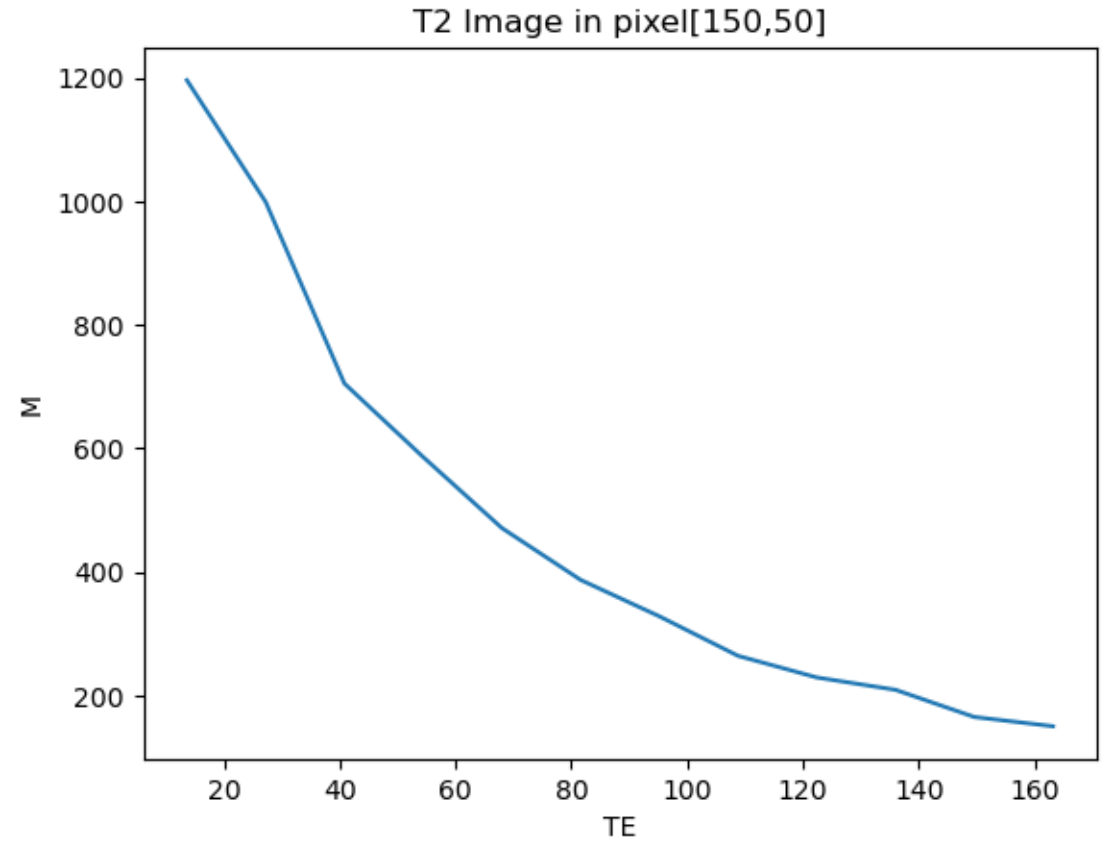


# Introduction

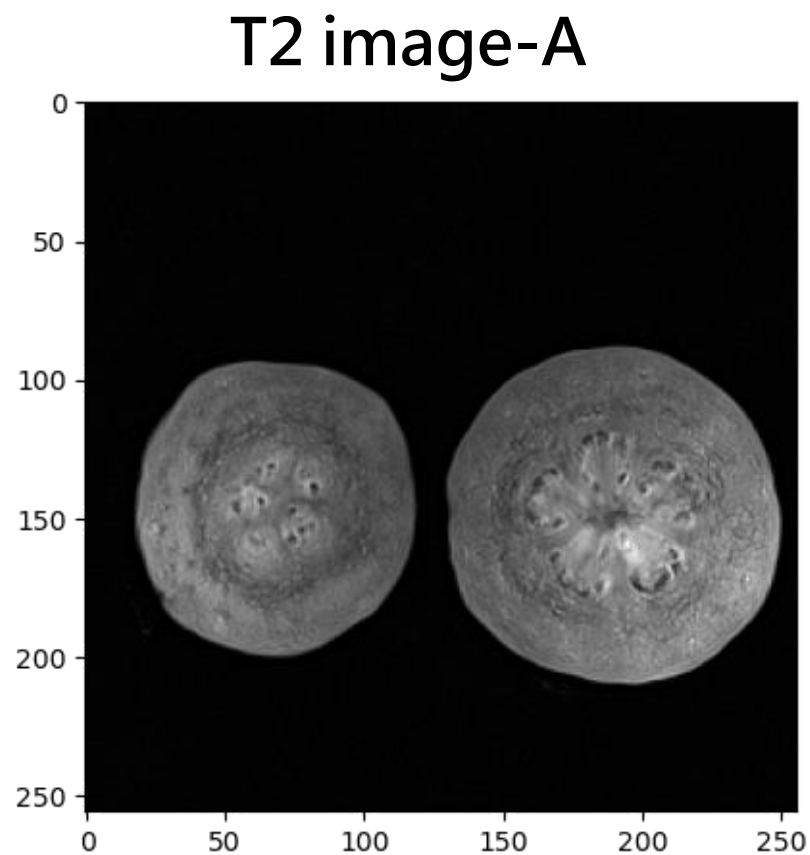
T2 equation:

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

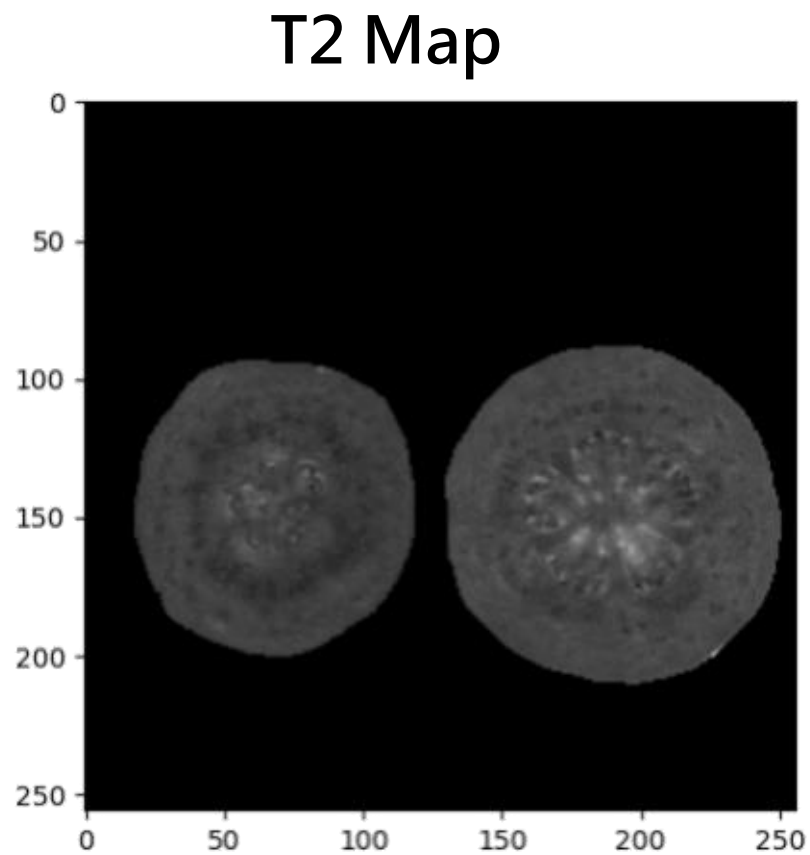
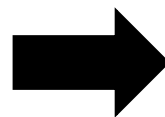
$\Rightarrow M_0$  & TE



# Introduction



Mapping



# OUTLINE

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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()
```

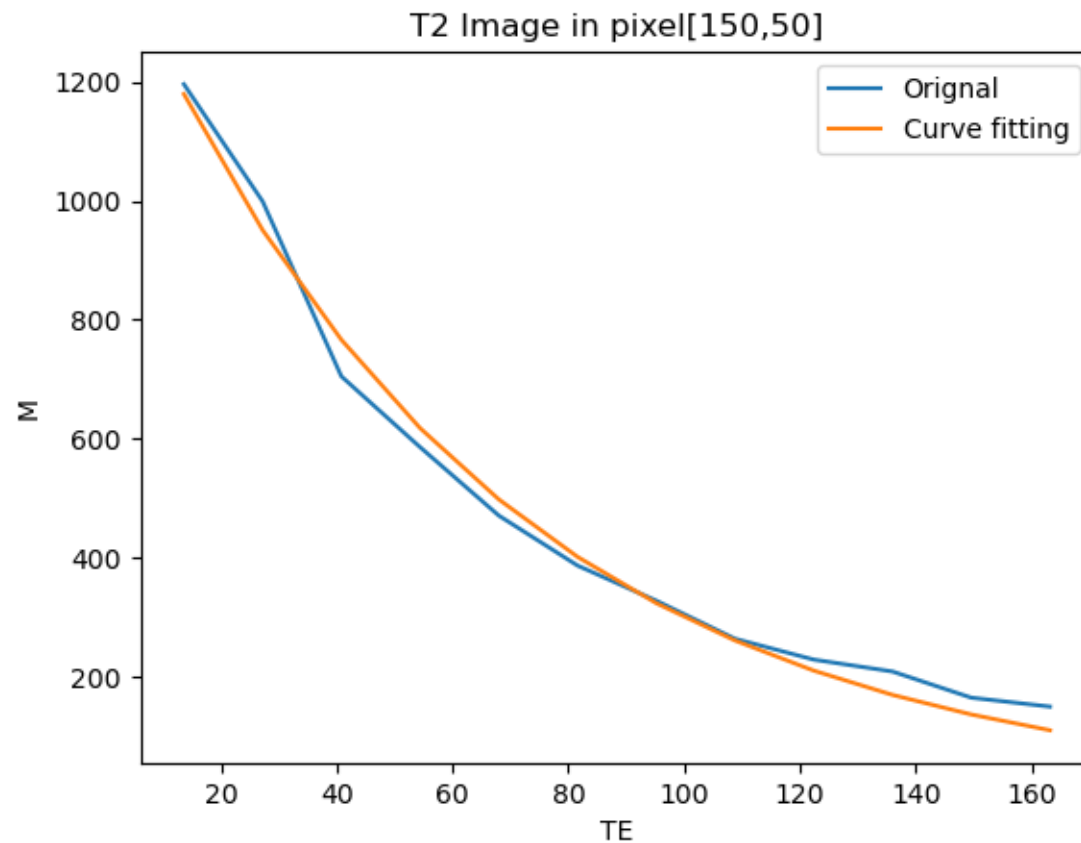
Echo time: 13.6  
shape: (256, 256)  
data type: uint16

# Method - Curve Fitting

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

⇒  $M_0$  & TE

⇒ *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

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

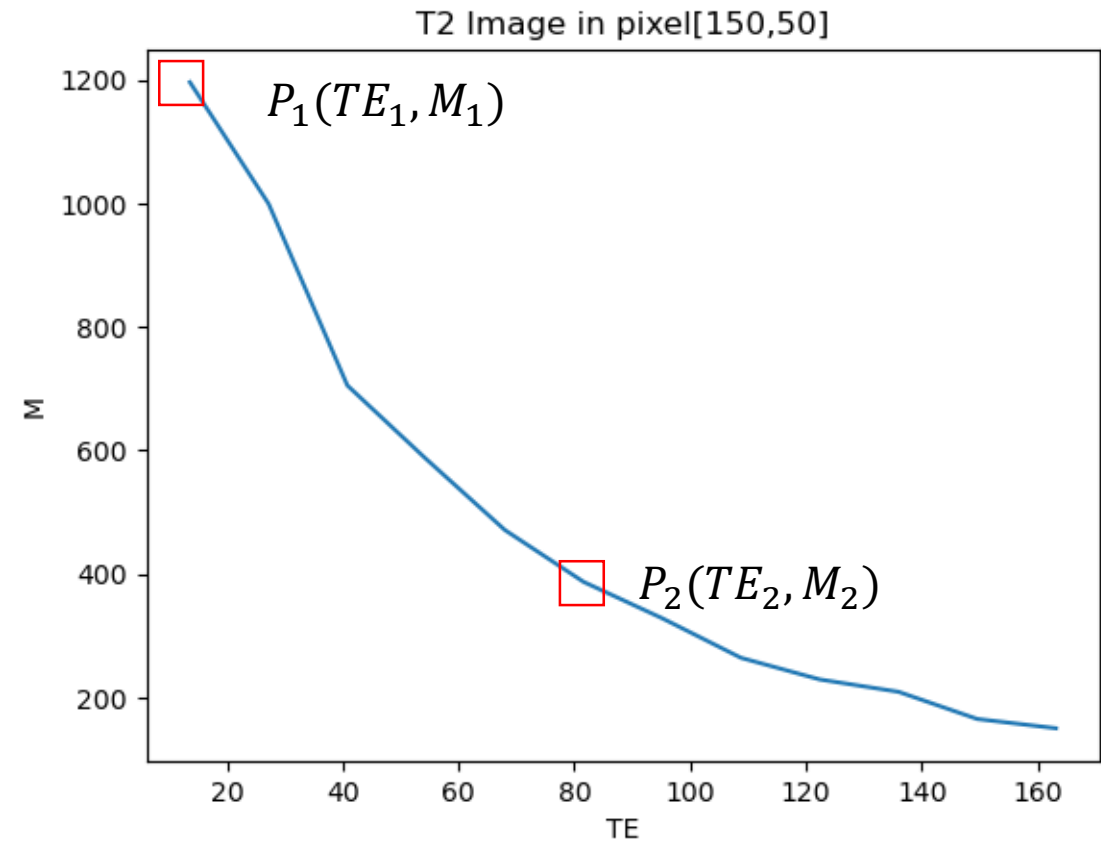
When  $T2 = TE$

$$M = M_0 * 0.37$$

Assume  $M_1 \approx M_0$

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

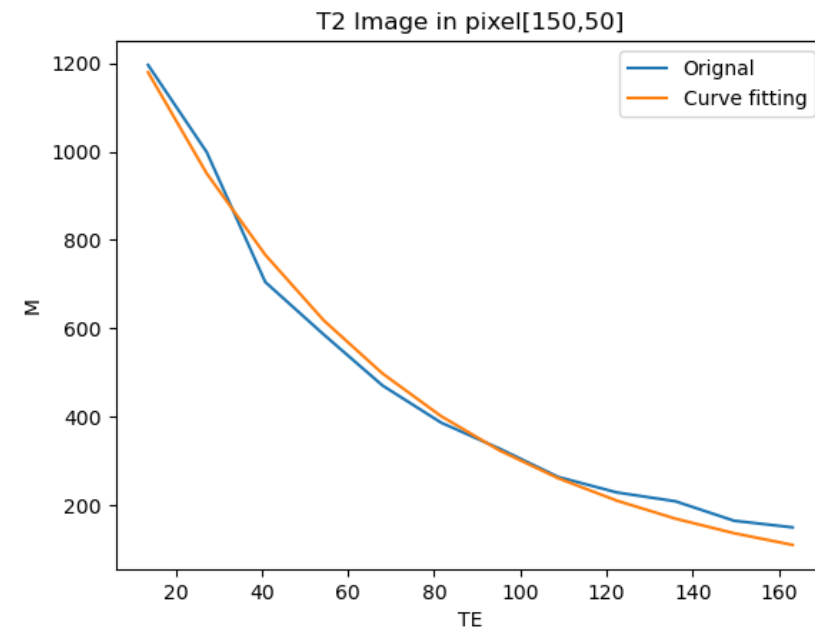
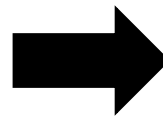
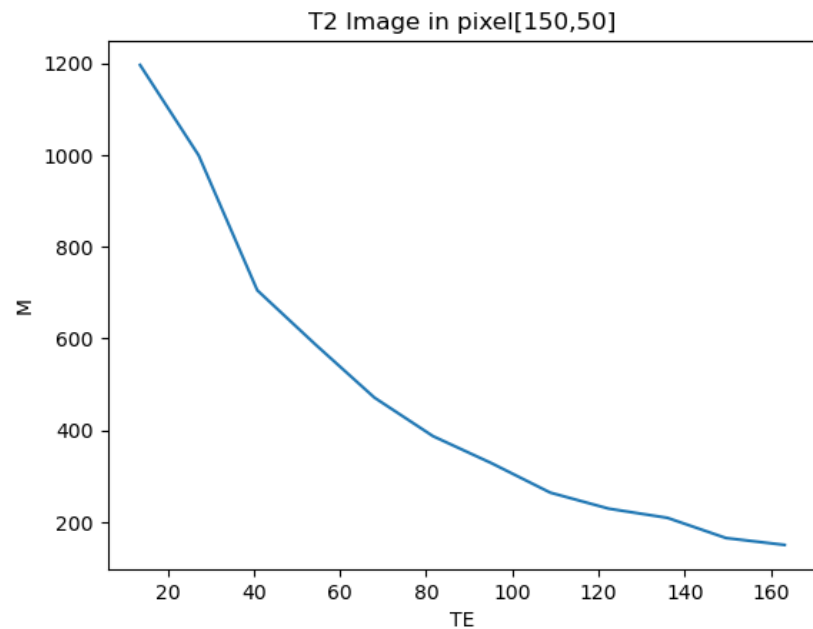
$$\Rightarrow P_0 = (TE_2, M_1)$$



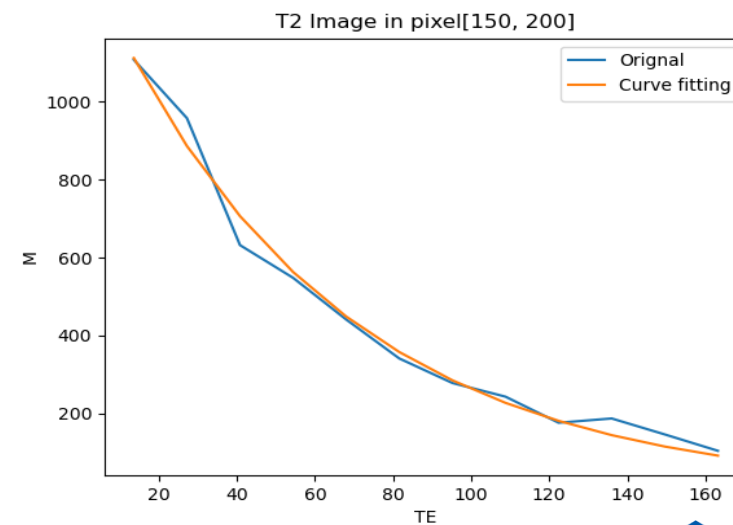
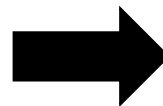
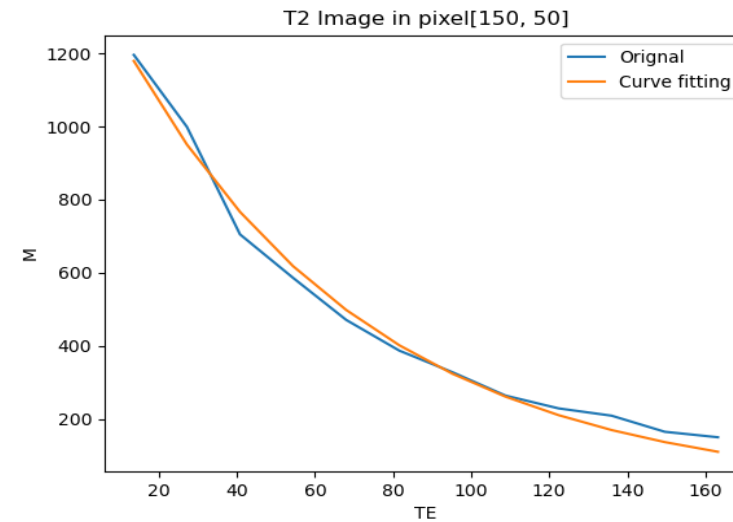
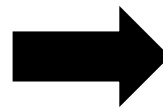
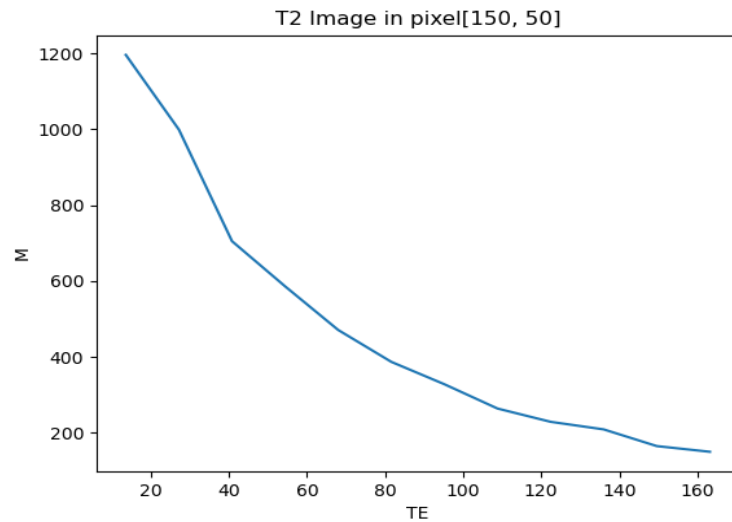
# OUTLINE

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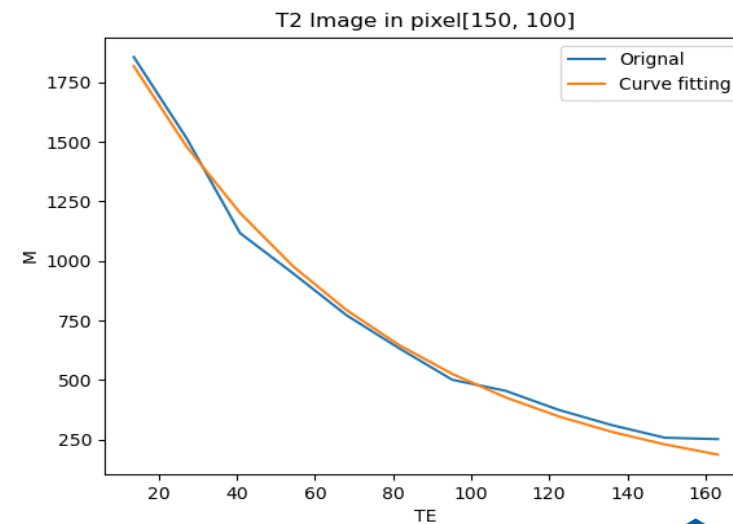
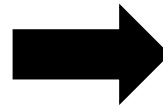
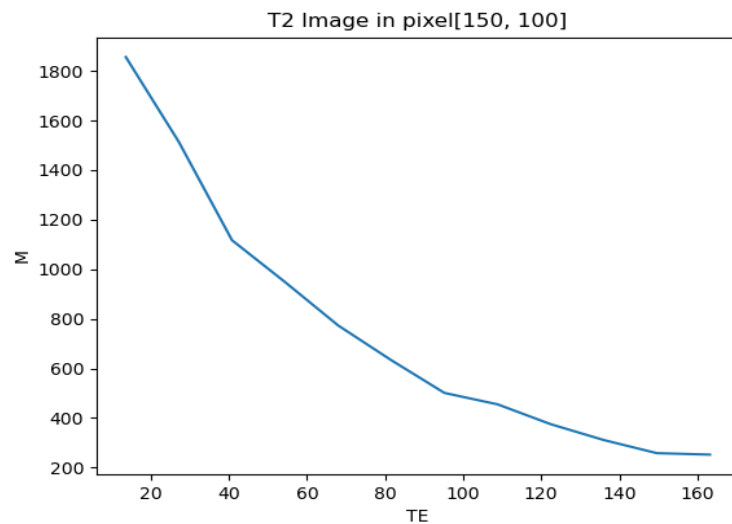
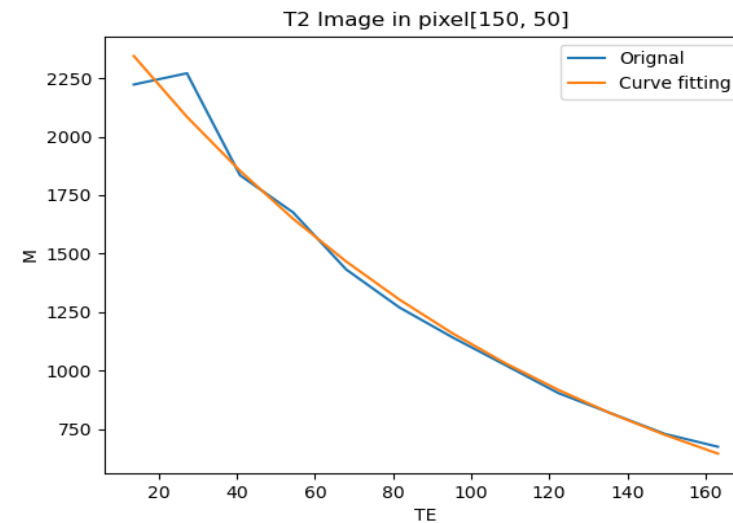
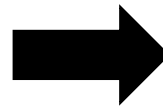
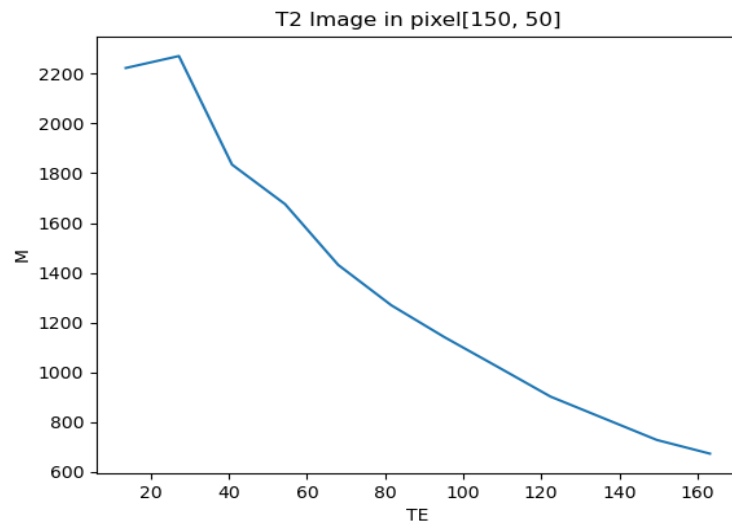
# ● Experimental Results - Curve Fitting



# ● Experimental Results - Curve Fitting - Image A

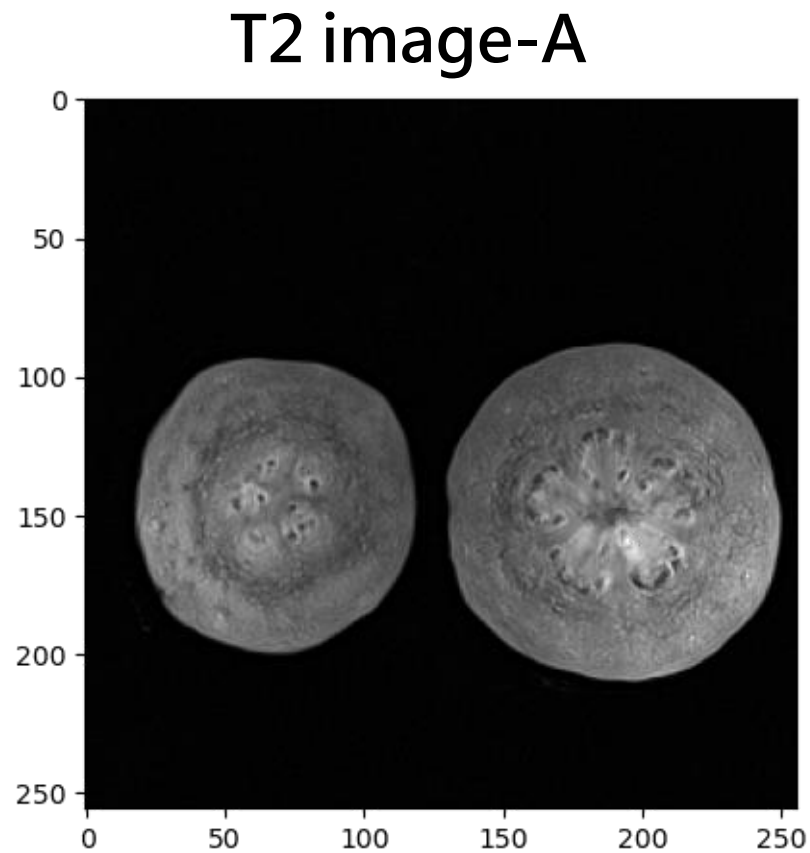


# ● Experimental Results - Curve Fitting - Image B

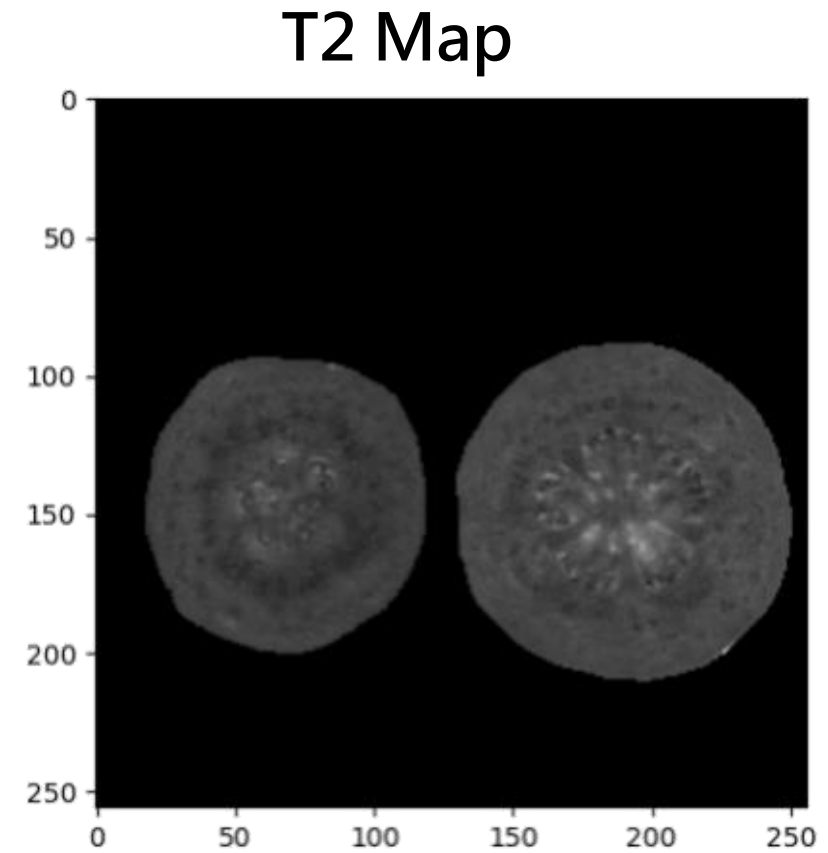
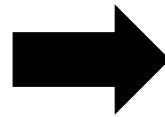




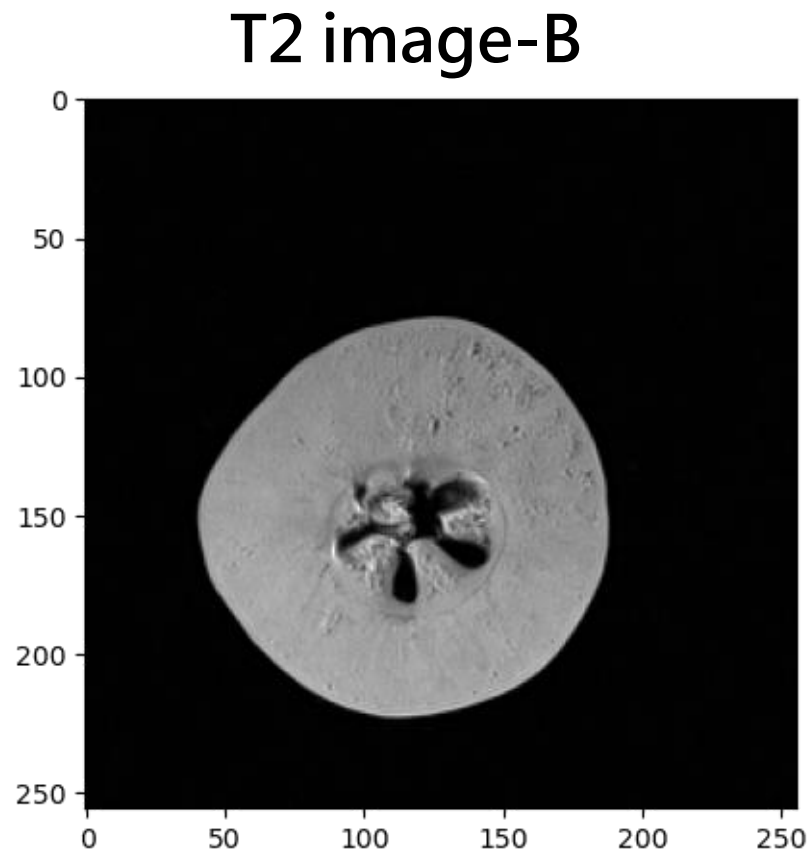
# ● Experimental Results - Mapping



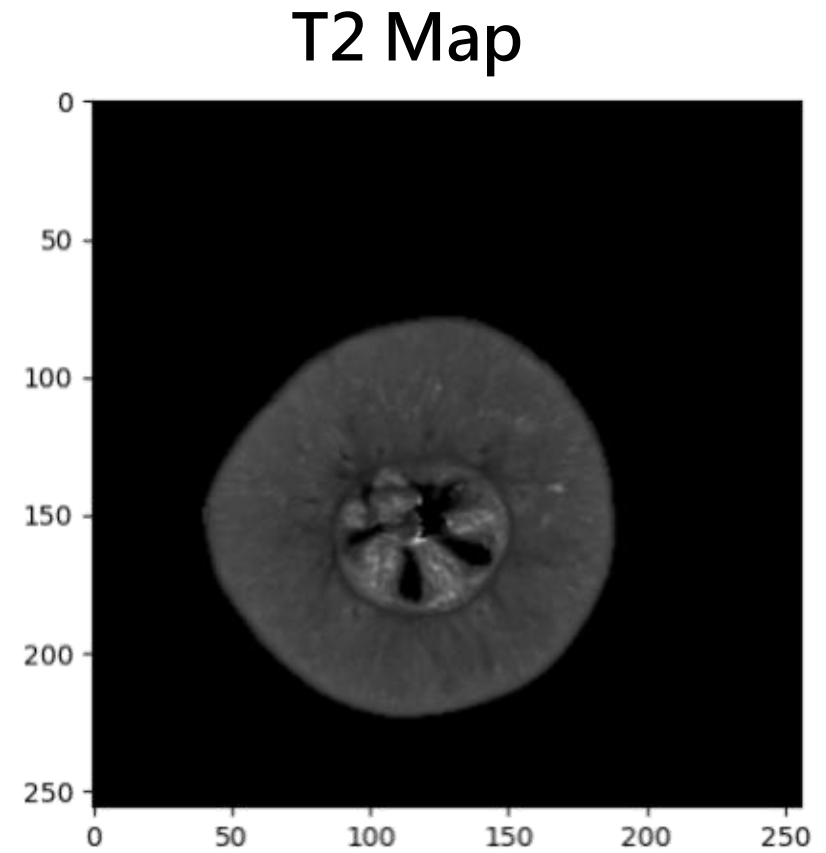
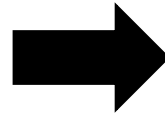
Mapping



# ● Experimental Results - Mapping



Mapping



# Q&A

# Thanks

GitHub