TAIWAN TECH
NATIONAL TAIWAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

MRI
HW1-Spin Echo

Presenter：

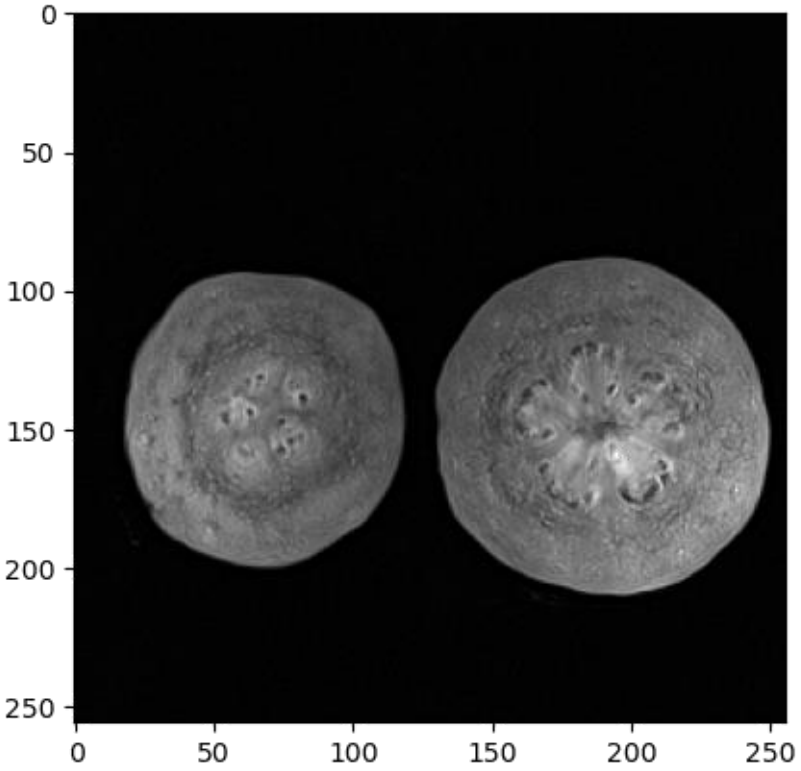
M11107309 何柏昇

OUTLINE

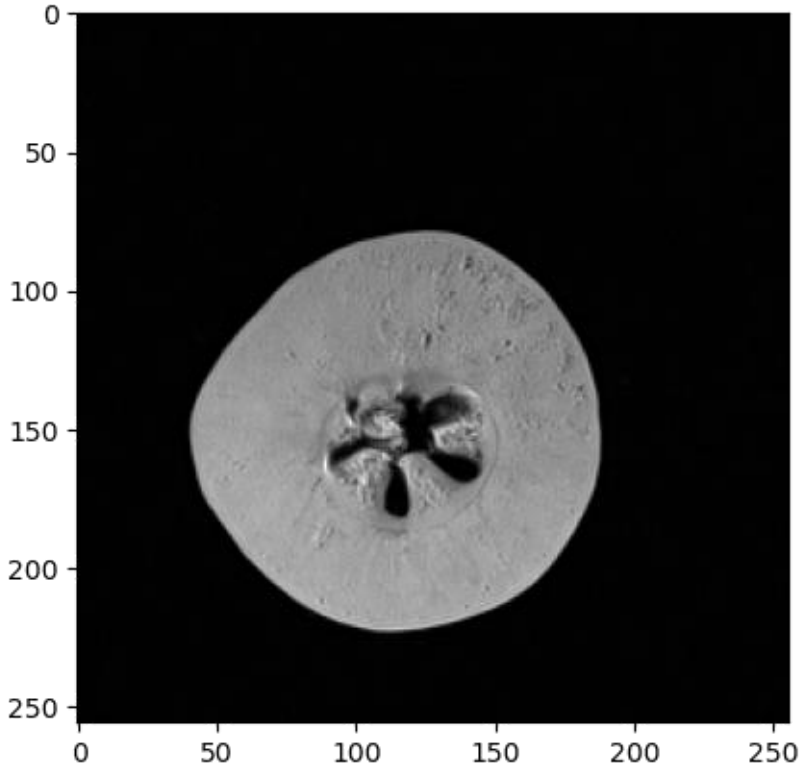
- Introduction
- Method
  - DCM
  - Curve Fitting
- Experimental Results

Introduction

T2 image-A



T2 image-B

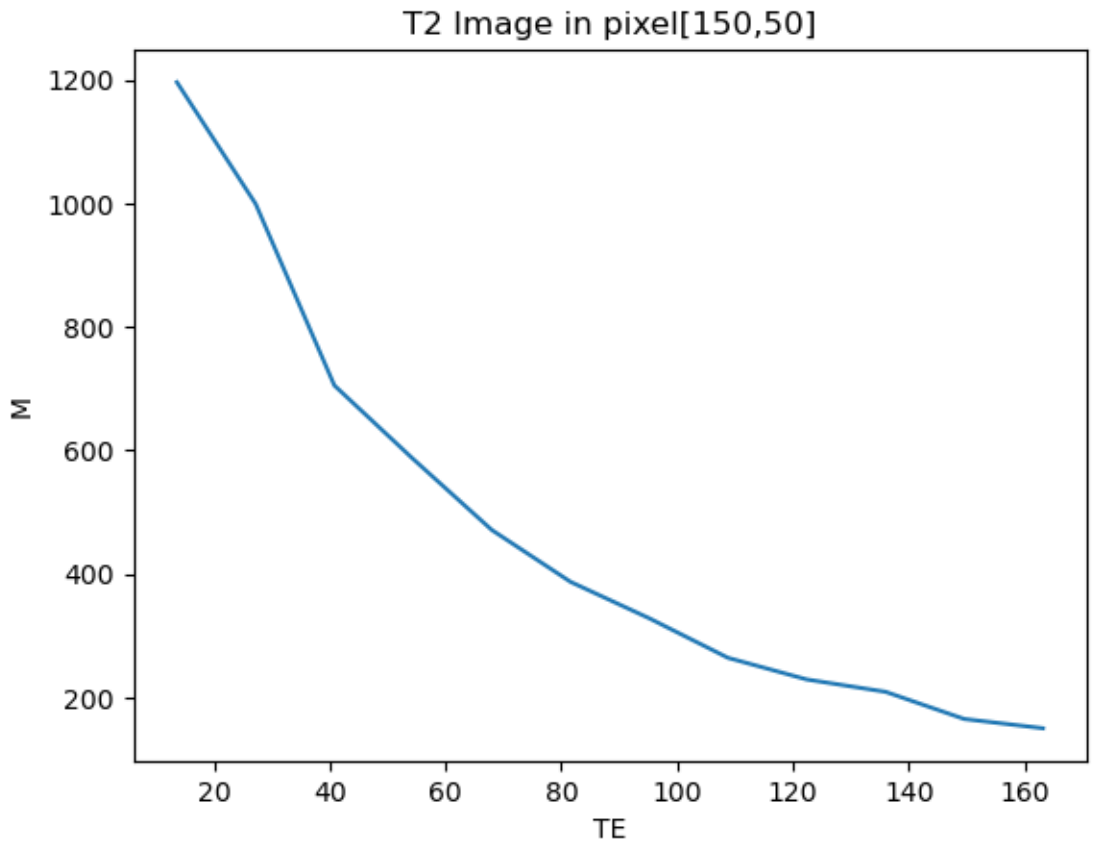


Introduction

T2 equation:

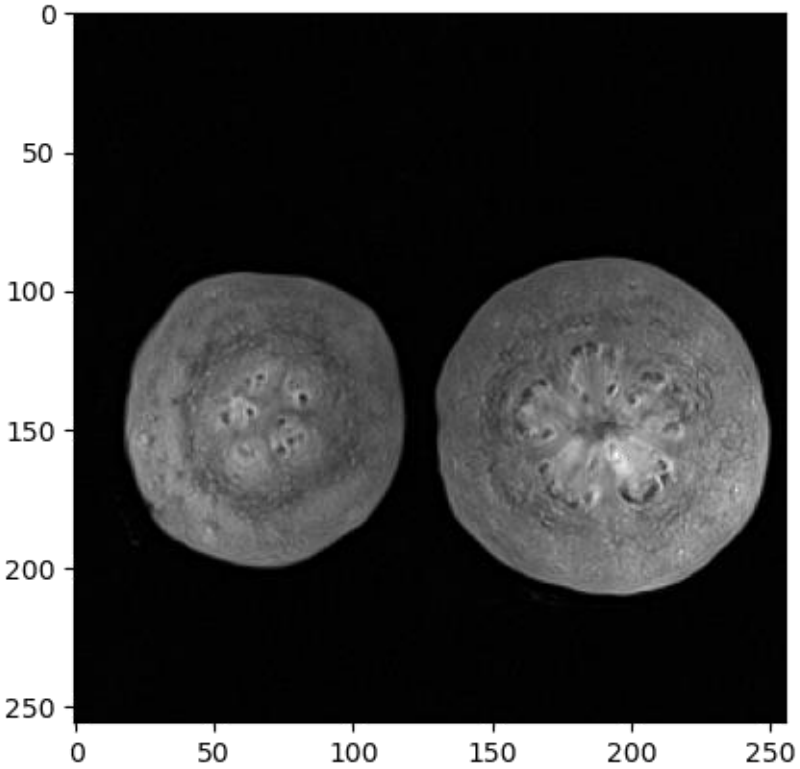
$$M = M_0 * e^{-T2/TE}$$

$$\Rightarrow M_0 \ \& \ \mathrm{TE}$$



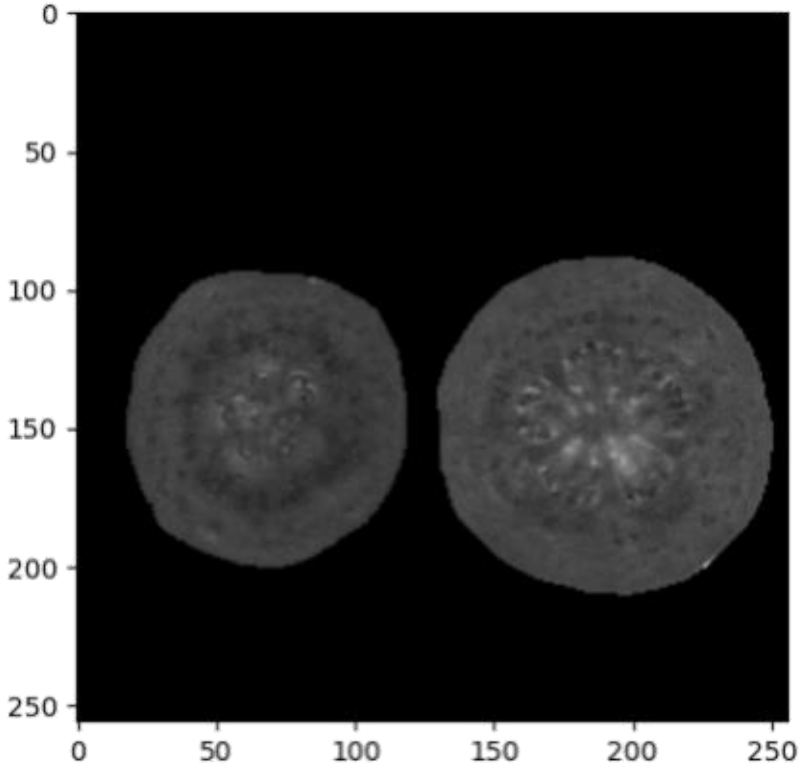
Introduction

T2 image-A



Mapping

T2 Map



OUTLINE

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

Method

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: '212130
(0008, 0016) SOP Class UID                       UI: MR Imag
```

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()
```

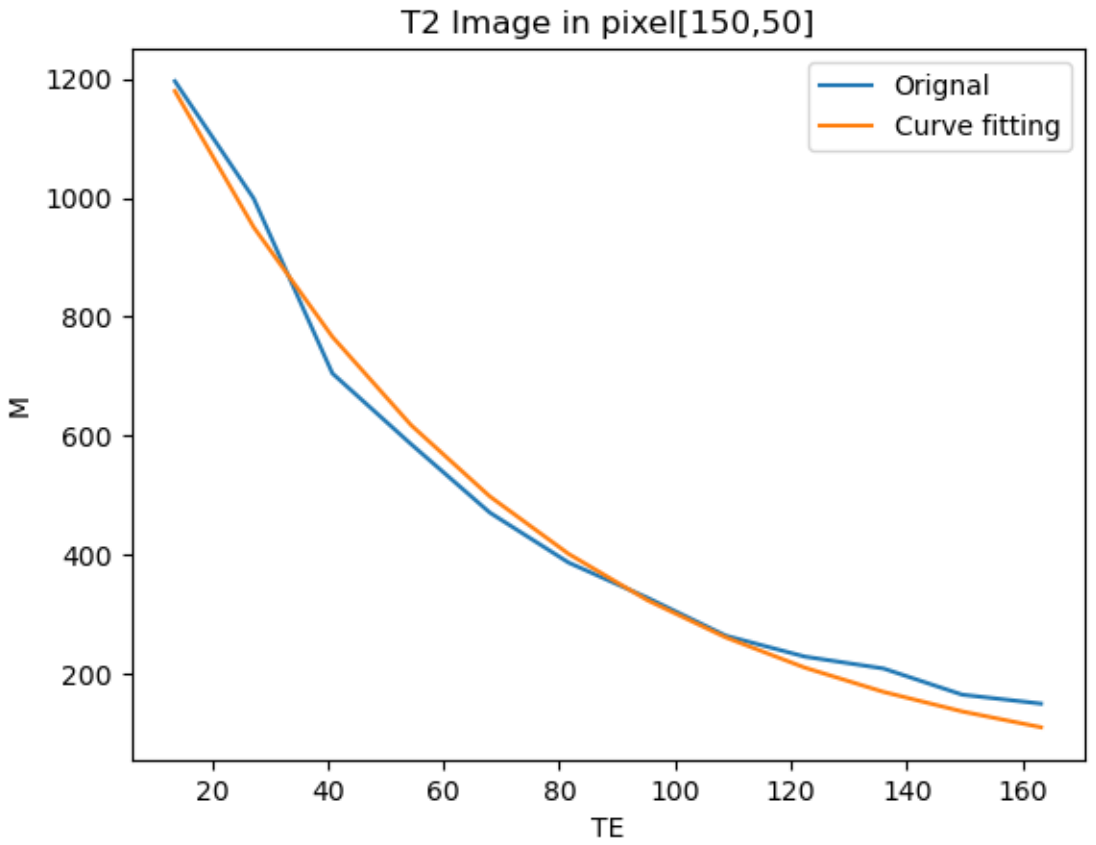
```
Echo time: 13.6
shape:     (256, 256)
data type: uint16
```

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,outputFile):
    for row in range(256):
        for colum in range(256):
            # if value of image < 270, to skip
            if img[row,colum,0] < 270: continue
            coef=curve_fit(lambda t,a,b: a*np.exp(-t/b),  echoTime,  (img[row,colum,:]), p0=(img[row,colum,0],echoTime[5]))
            #coef = [M0, TE]
            T2map[row,colum,:] = coef[0]
            #print(TE)

    plt.imshow(T2map[:,:,1],cmap='gray')
    plt.savefig("images/"+outputFile)
    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

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

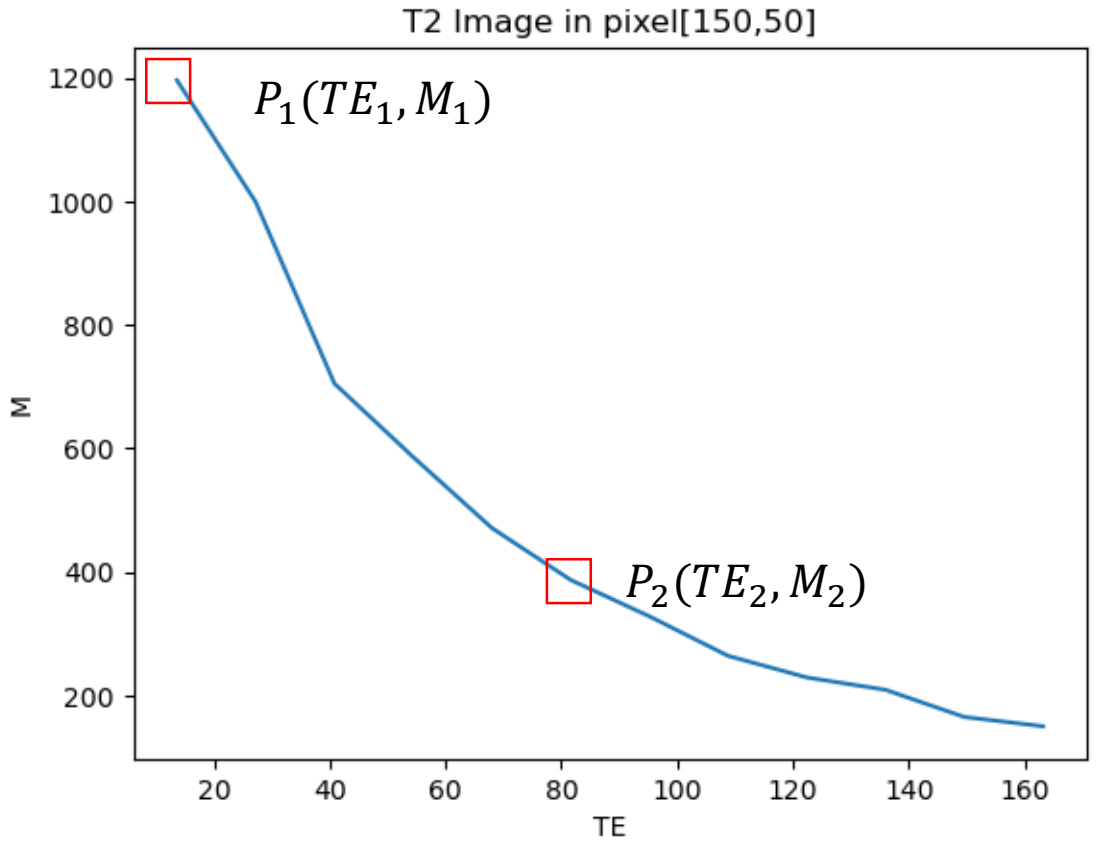
When $T2 = TE$

$$M = M_0 * 0.37$$

Assume $M_1 \approx M_0$

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

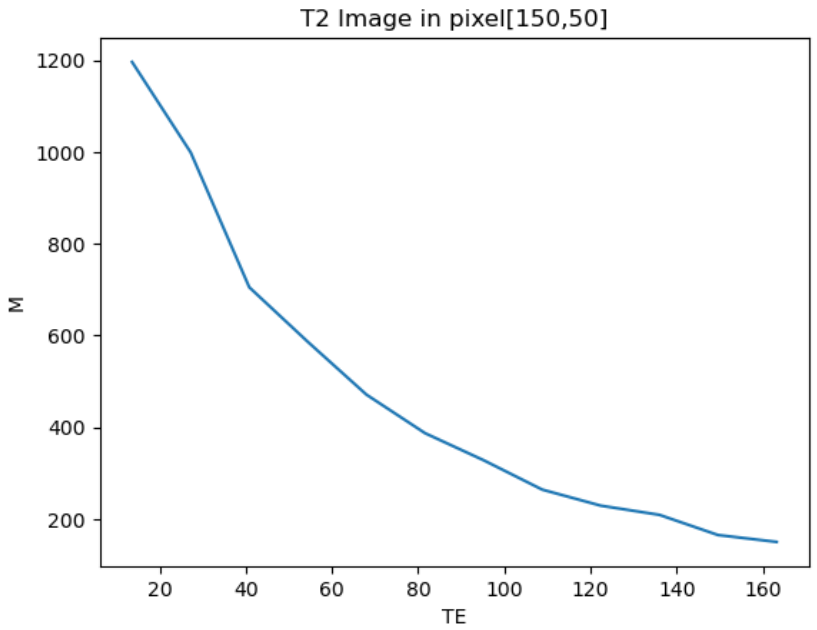
$$\Rightarrow P_0 = (TE_2, M_1)$$

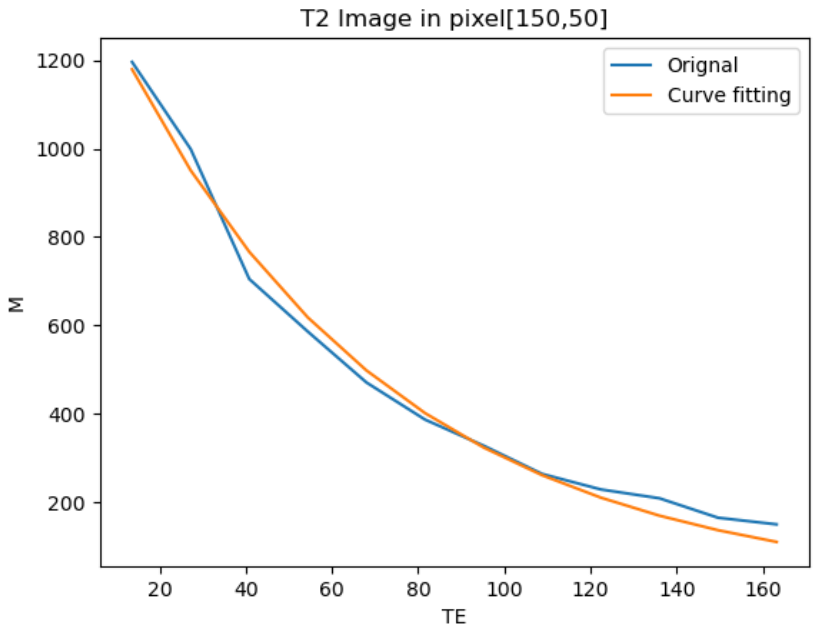


OUTLINE

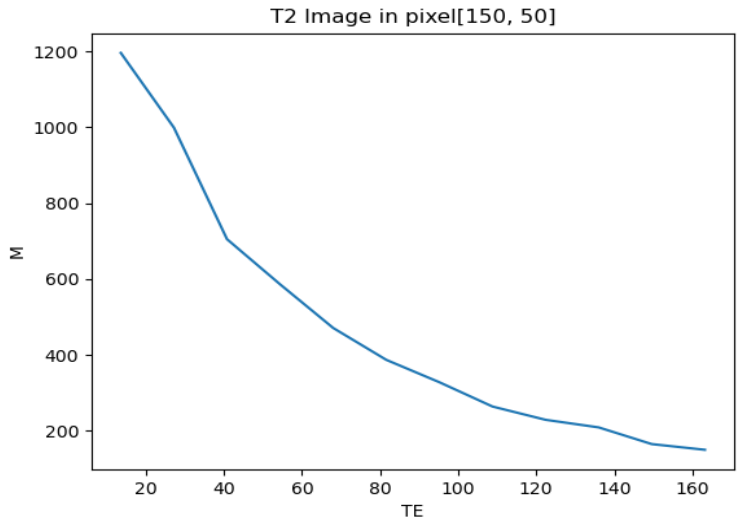
- Introduction
- Method
  - DCM
  - Curve Fitting
- Experimental Results

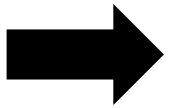
Experimental Results - Curve Fitting

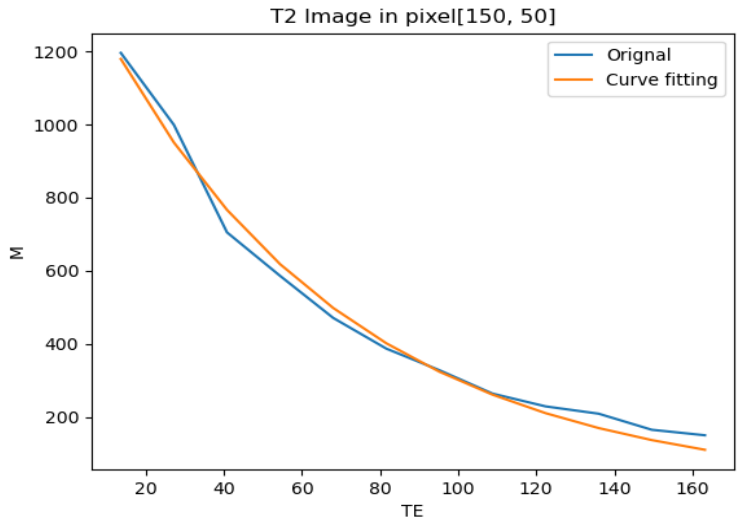


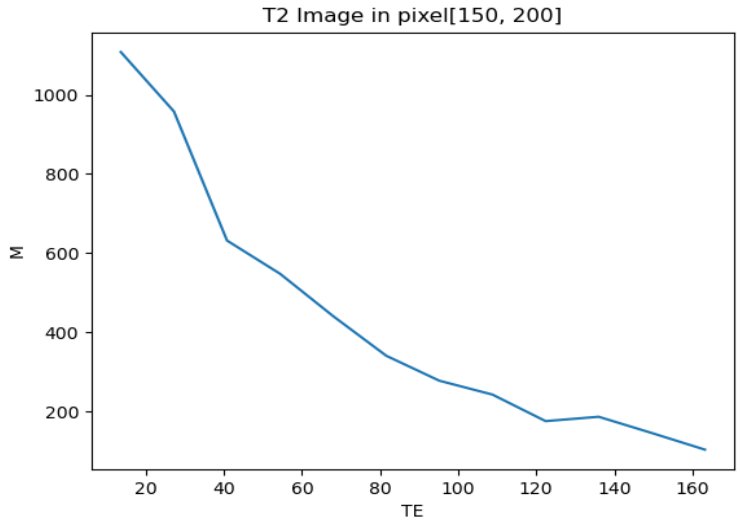


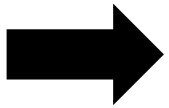
Experimental Results - Curve Fitting - Image A



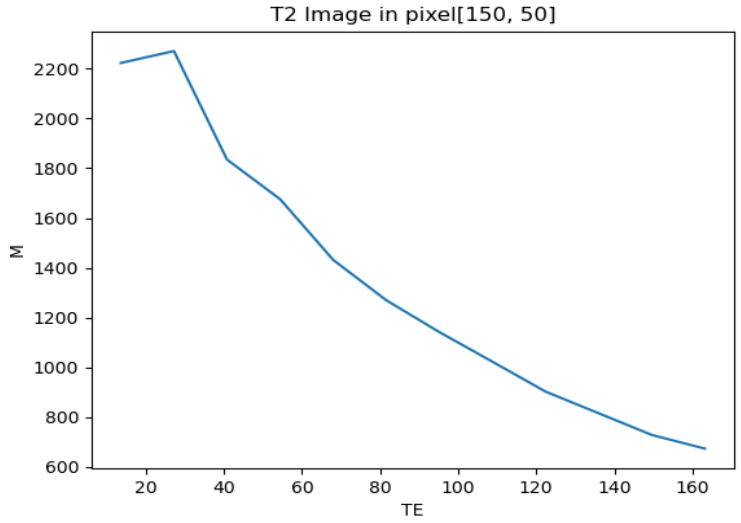


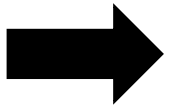


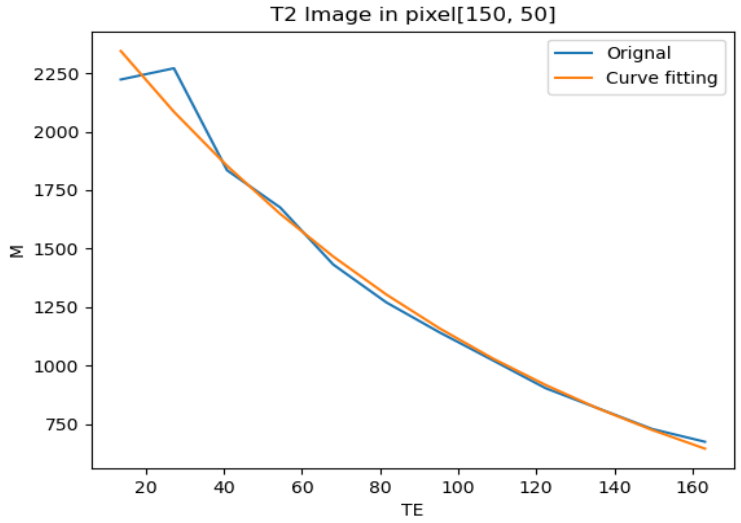


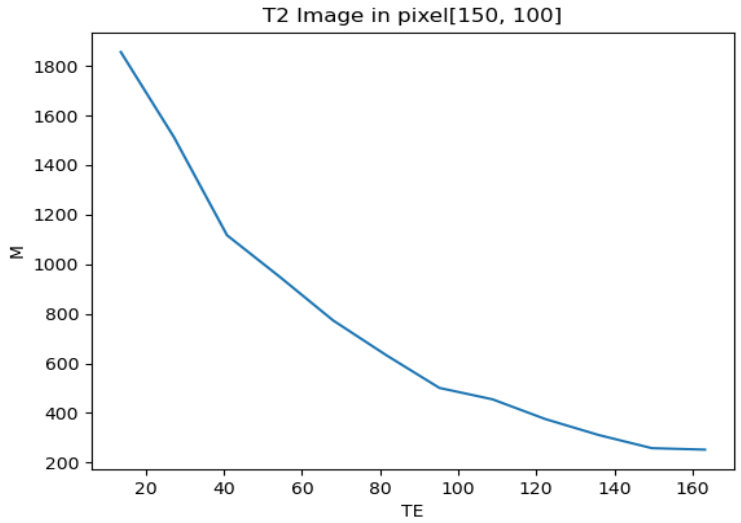


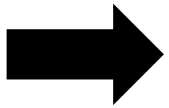
Experimental Results - Curve Fitting - Image B

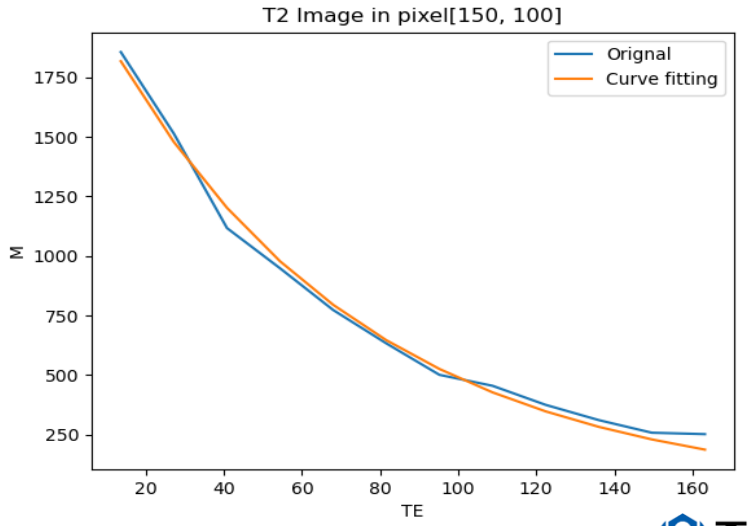






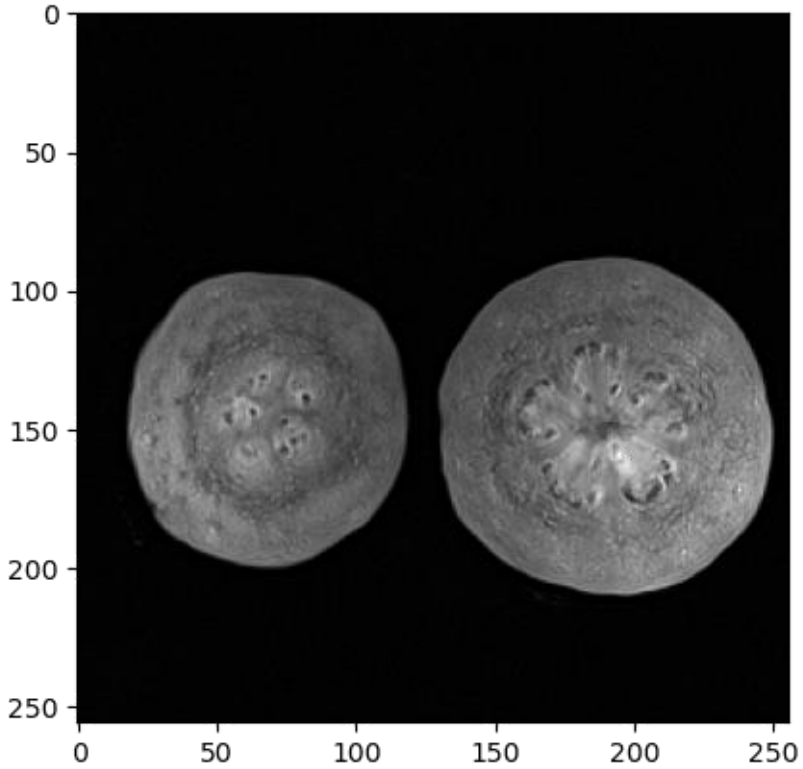






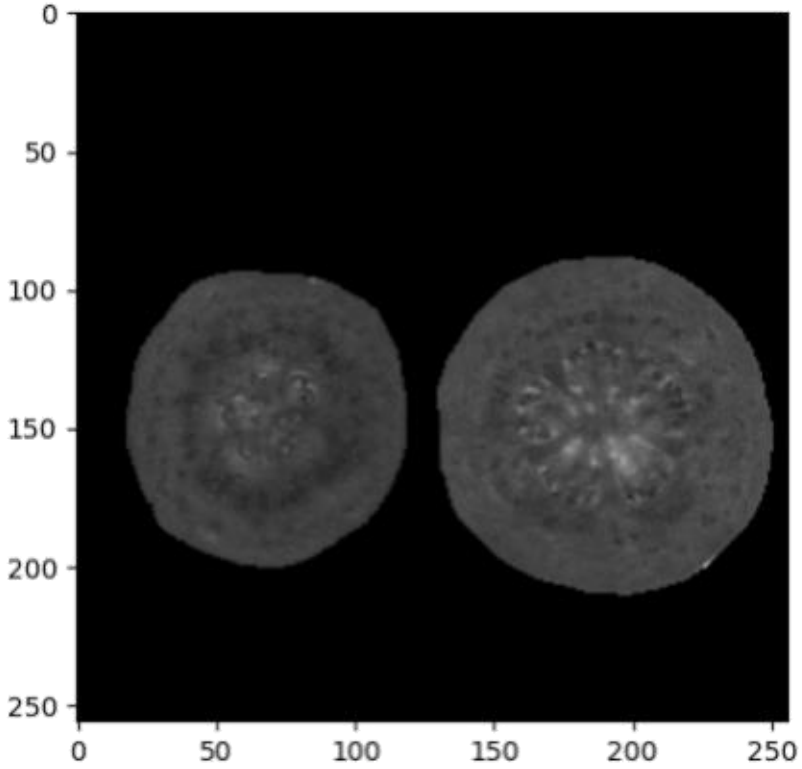
Experimental Results - Mapping

T2 image-A



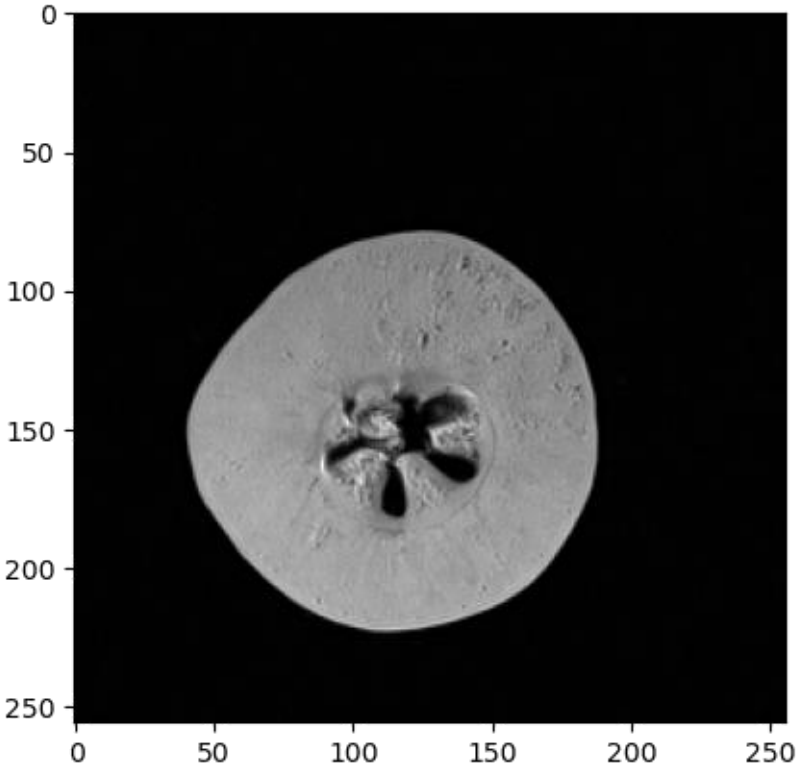
Mapping

T2 Map



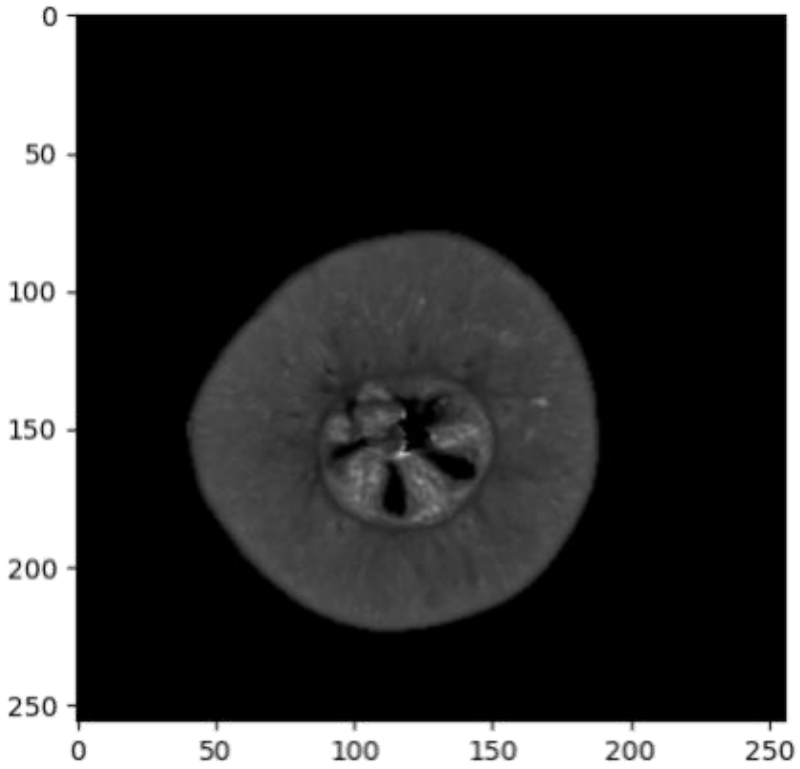
Experimental Results - Mapping

T2 image-B



Mapping

T2 Map



Q&A

Thanks

GitHub