# 3D Volumetric Grayscale Image Slicing

Teng-Jui Lin

BIOEN 217

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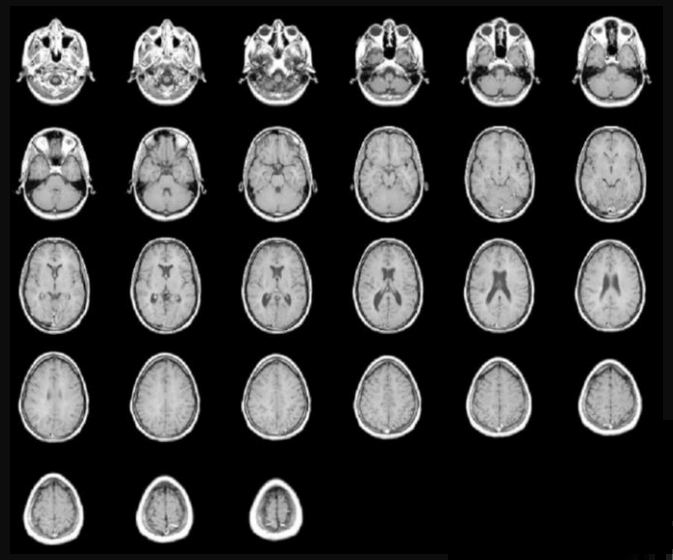
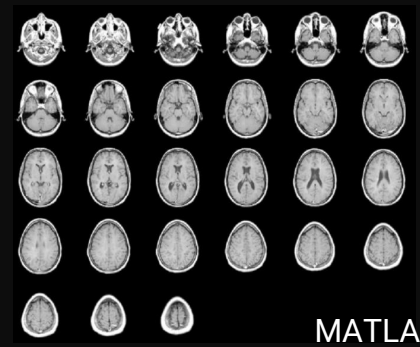
`montage(MRI)`



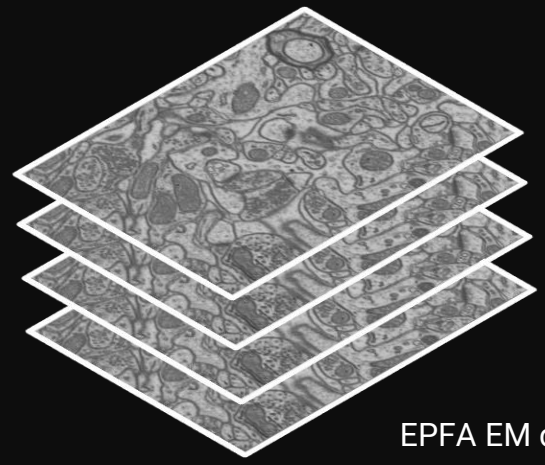
`obliqueslice3d(MRI, point, n)`

# Background

- 3D volumetric image data is widely used in science and medicine
  - Medical imaging (CT, MRI)
  - Microscopy
- Volumetric data are layers of 2D images
  - Slices about coordinate plane – easy
  - Slices about arbitrary plane – need math!



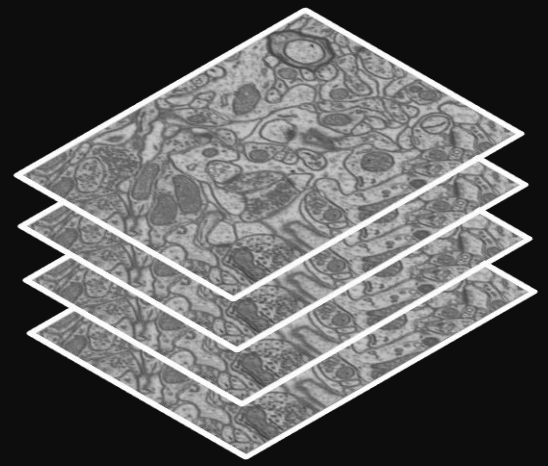
MATLAB MRI dataset



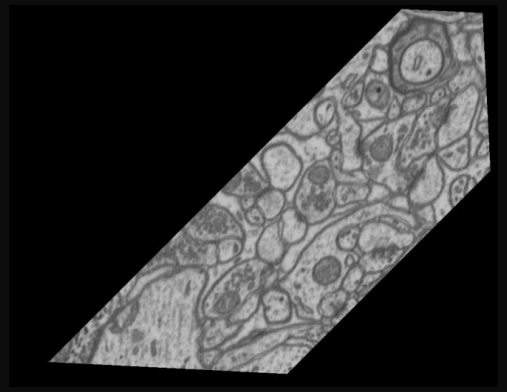
EPFA EM dataset

# Objective

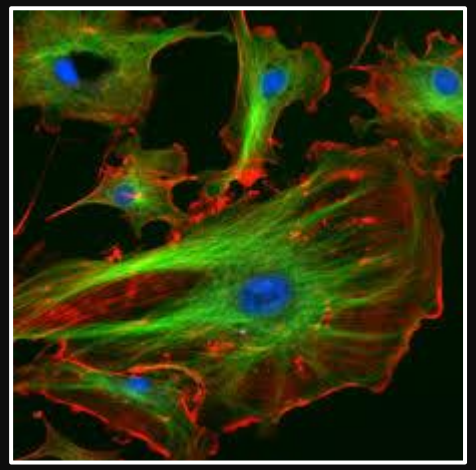
- Explore 3D volumetric image data
- Develop oblique slicing function for 3D volumetric grayscale image
  - Start from 2D



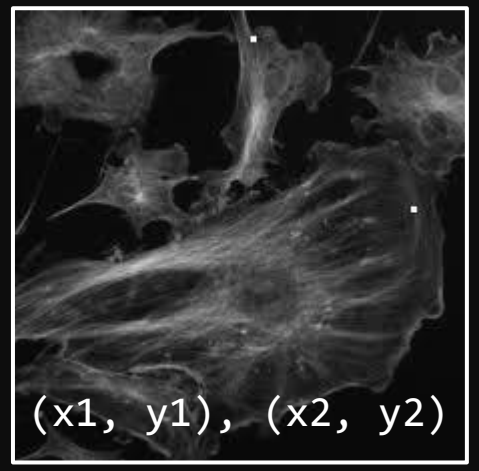
```
obliqueslice3d(img, point, normal)
```



# obliqueslice2d(img, point1, point2)



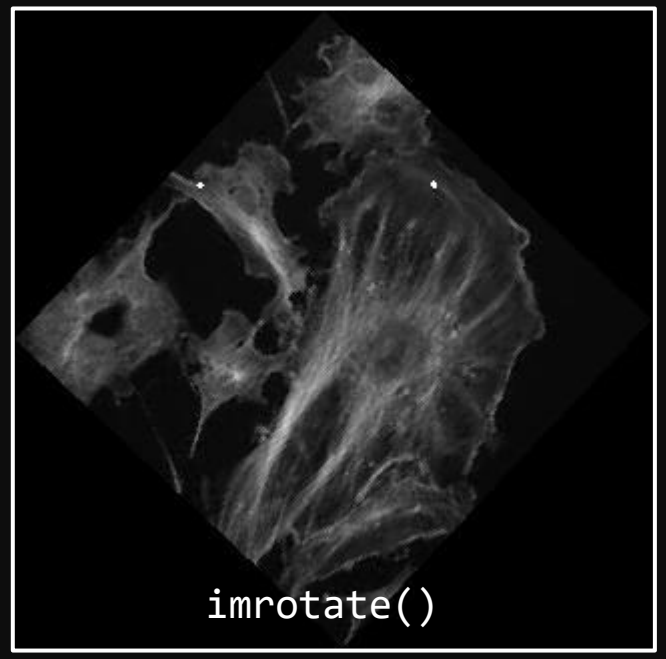

https://imagej.nih.gov/ij/images/

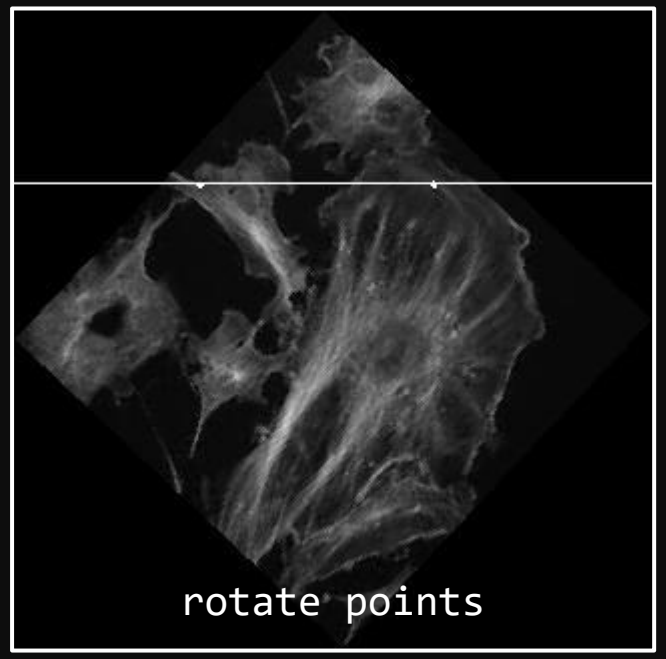



angle = atan(slope)

$$R = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$$

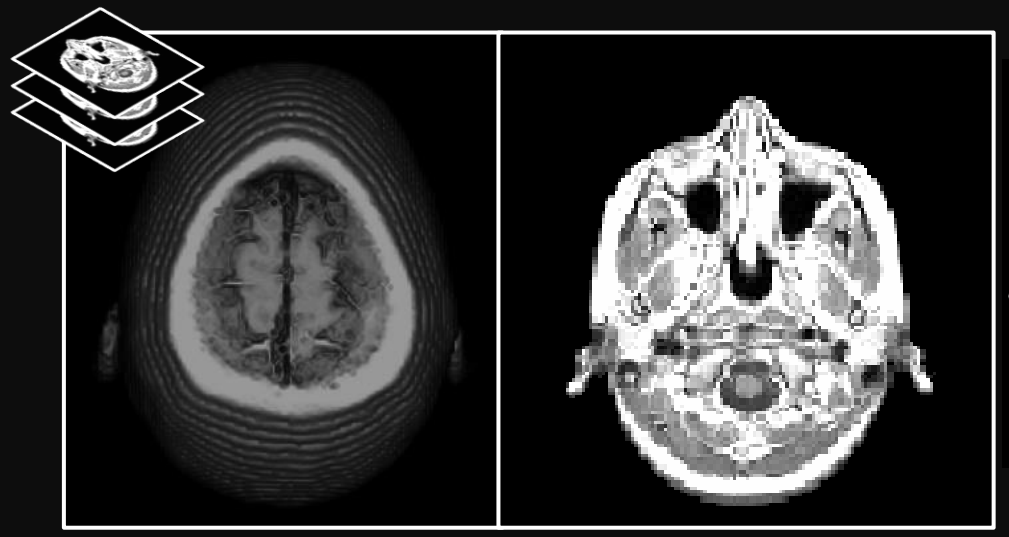
Rotation Matrix, Wikipedia




obliqueslice2d()

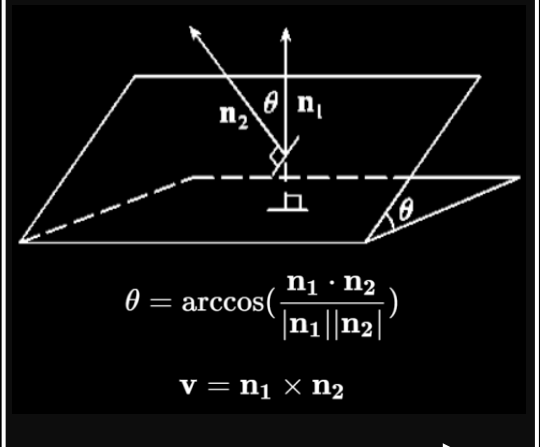
# obliqueslice3d(img, point, normal)

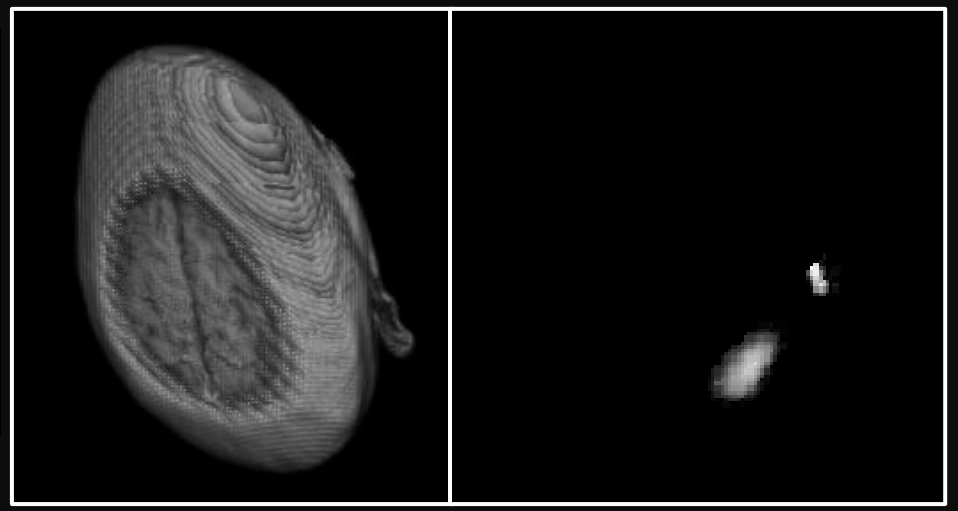


volshow()



sliceViewer()



imrotate3()

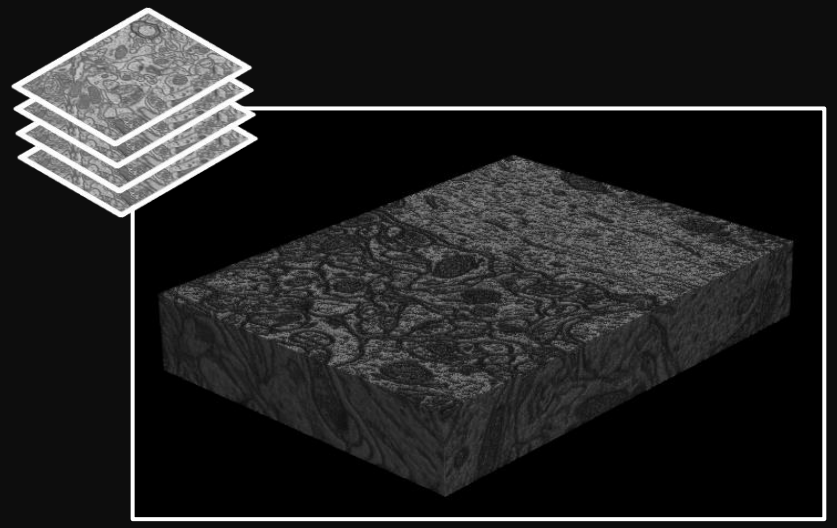
$$R = \begin{bmatrix} ll(1-\cos\theta)+\cos\theta & ml(1-\cos\theta)-n\sin\theta & nl(1-\cos\theta)+m\sin\theta \\ lm(1-\cos\theta)+n\sin\theta & mm(1-\cos\theta)+\cos\theta & nm(1-\cos\theta)-l\sin\theta \\ ln(1-\cos\theta)-m\sin\theta & mn(1-\cos\theta)+l\sin\theta & nn(1-\cos\theta)+\cos\theta \end{bmatrix}$$

Transformation Matrix, Wikipedia

rotate point; get z coordinate

```
obliqueslice3d(
        MRI,
        [50, 50, 12],
        [1; 1; 1]
)
```

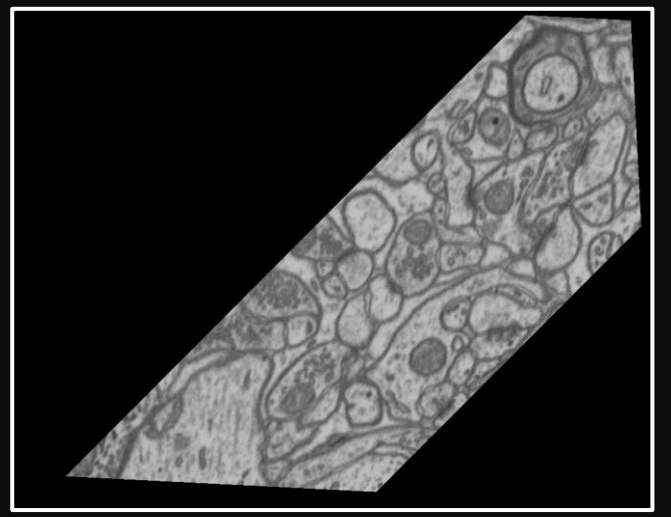
# Application: Microscopy Images



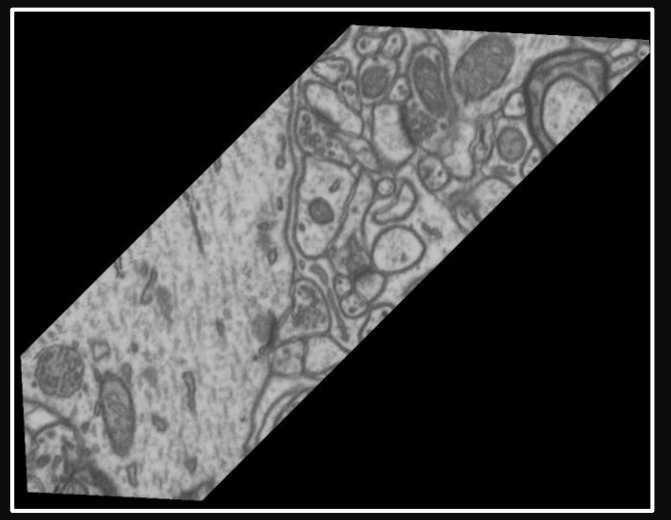
EPFA EM dataset

1024 x 768 x 165

```
obliqueslice3d(
        cells_stack,
        [250; 250; 50],
        [1; 1; 3]
)
```



```
obliqueslice3d(
        cells_stack,
        [300; 500; 50],
        [-1; -1; 3]
)
```



# Conclusion

- Packaged functions
  - `obliqueslice2d(img, point1, point2)`
  - `obliqueslice3d(img, point, normal)`
- Problem solving skills
  - Extract problem solving pattern from lower dimension
  - Reduce oblique slicing problem to slicing along axis by rotation
- Future directions
  - Inputs characterized by plane parameters make slicing difficult to visualize
  - GUI-guided slicing needed