



Asan J & Image J 실무연수강좌

Basics of Image Processing #1

박 범 우
Biomedical Imaging Infrastructure

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신약개발 융합 바이오이미징 센터
Center for Bio-imaging of New Drug Development

- Introduction of Digital Imaging Processing
- Sampling and Quantization
- Concept of Image Properties



CHAPTER

신약개발 융합 바이오이미징 센터
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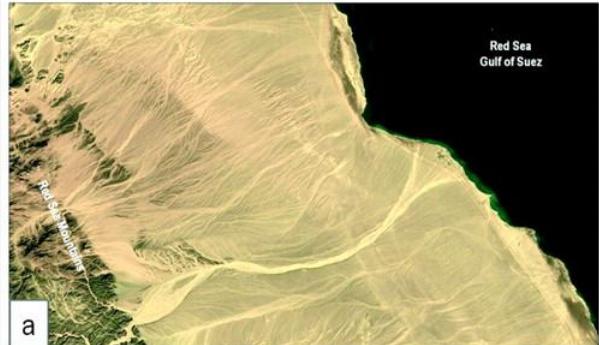


Introduction of Digital Imaging Processing

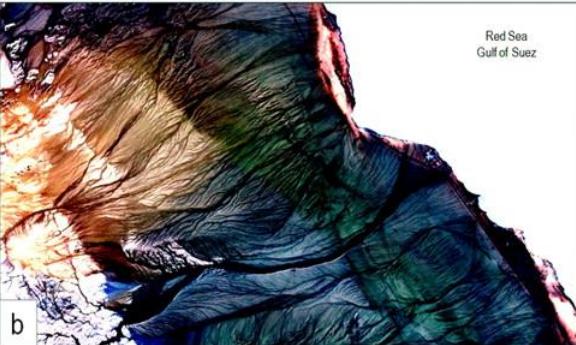
Advantage of Digital Imaging Processing (DIP)

- Accurate
- Reproducible
- Fast
- New helpful information

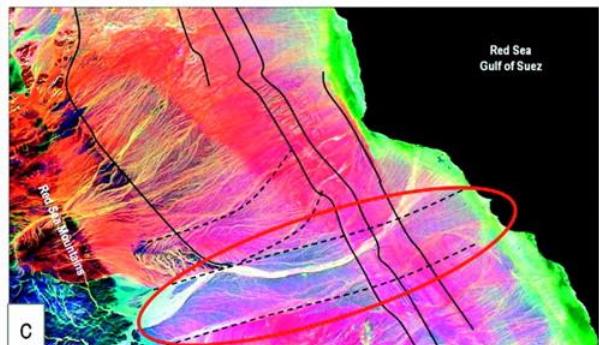
Application of DIP -Satellite-



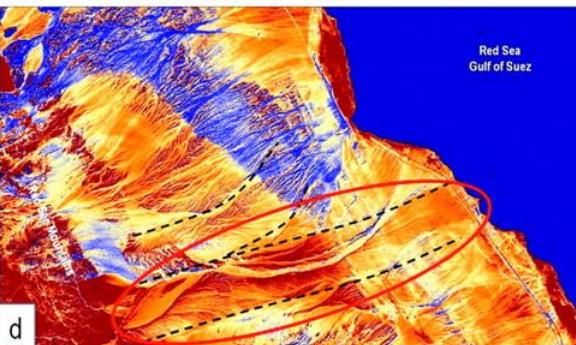
Gravel Wadi sediments Crystalline rocks Water



Gravel Wadi sediments Crystalline rocks Water



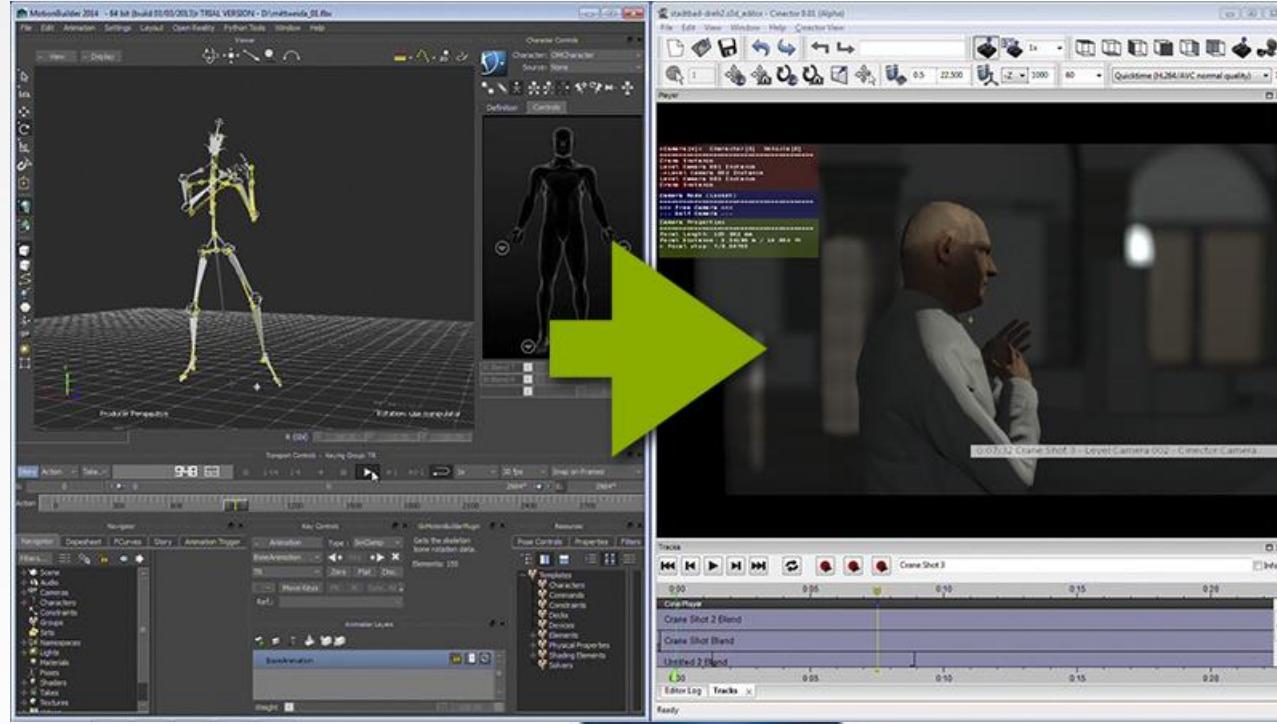
Gravel Wadi sediments Crystalline rocks Sabkha Water



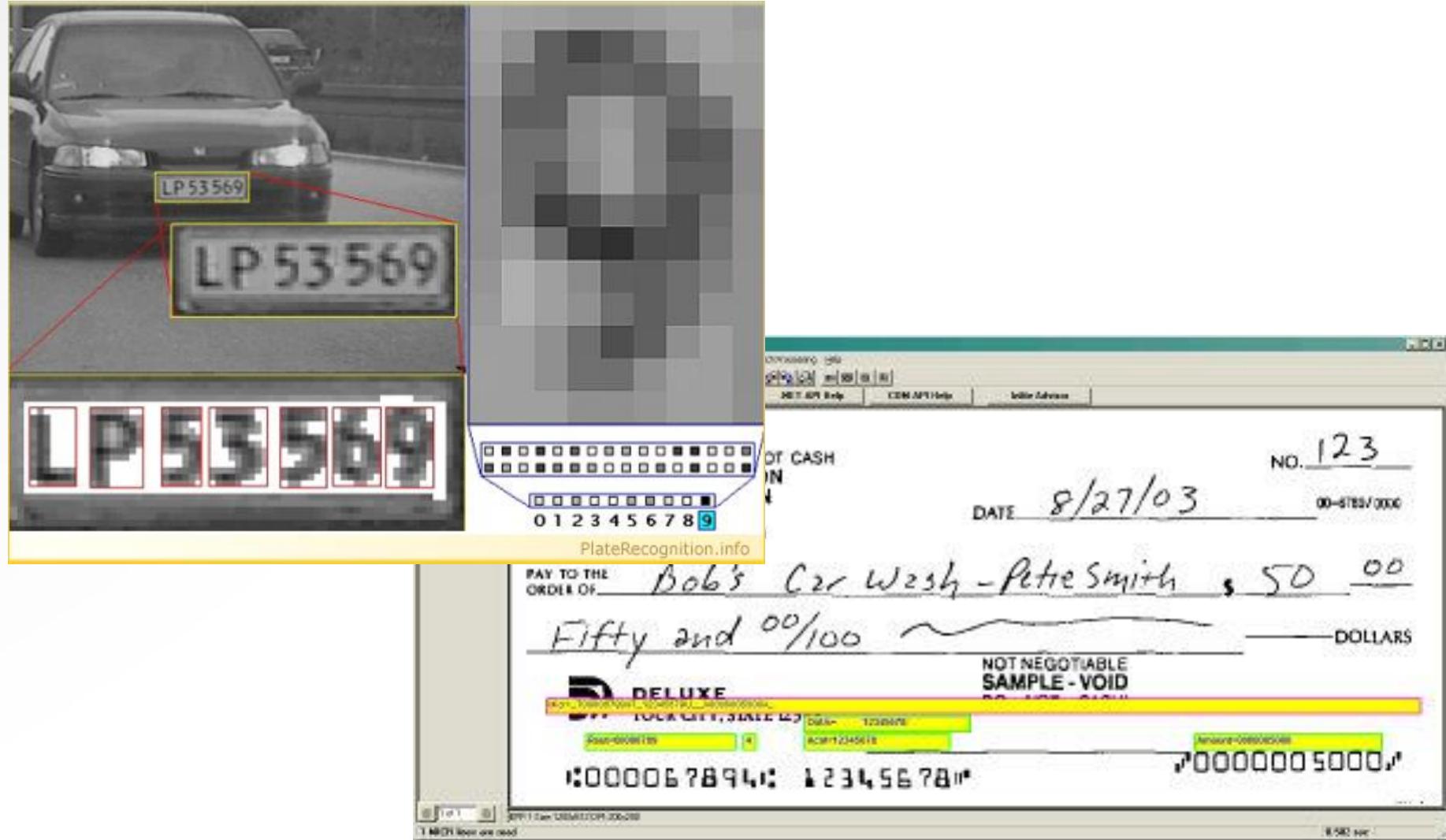
Gravel Wadi sediments Crystalline rocks, sabkha Water



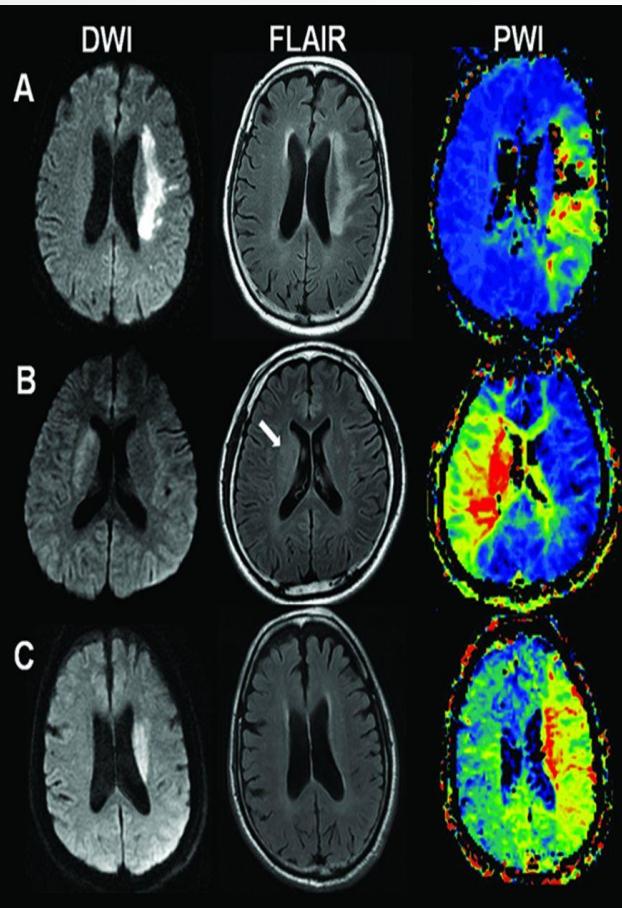
Application of DIP -Motion Rendering-



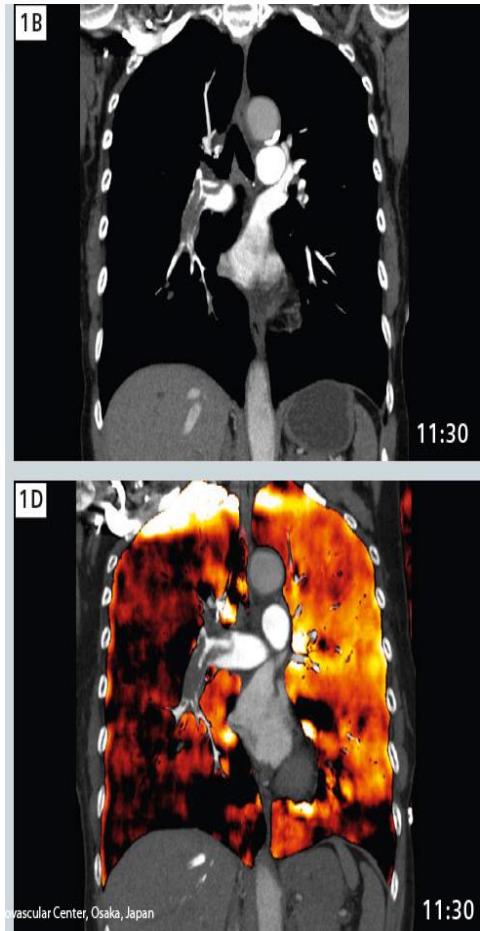
Application of DIP -Optical Character Recognition-



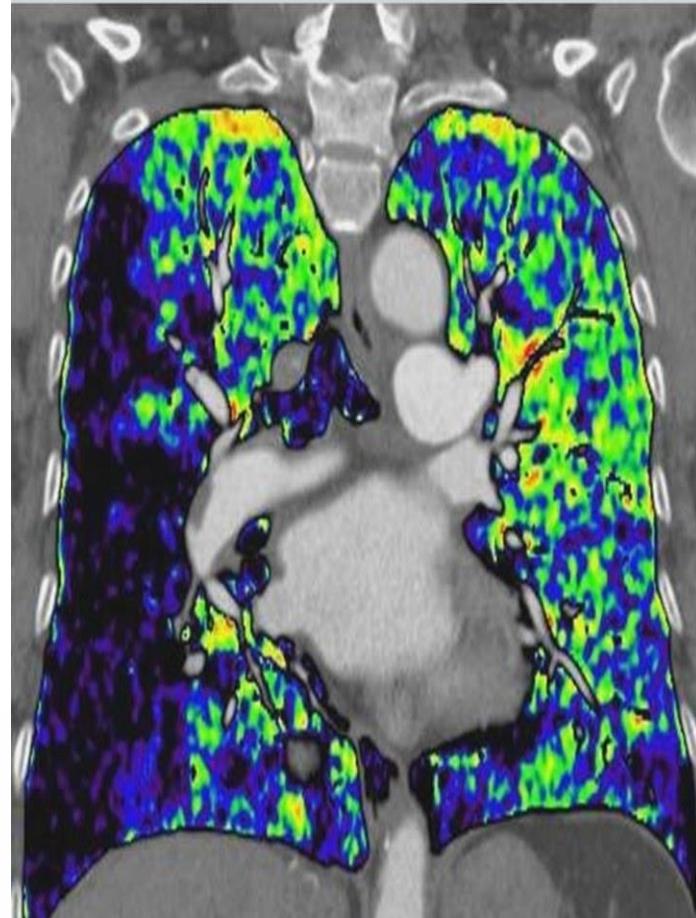
Application of DIP -Medical Imaging #1-



Brain Perfusion
(MRI)

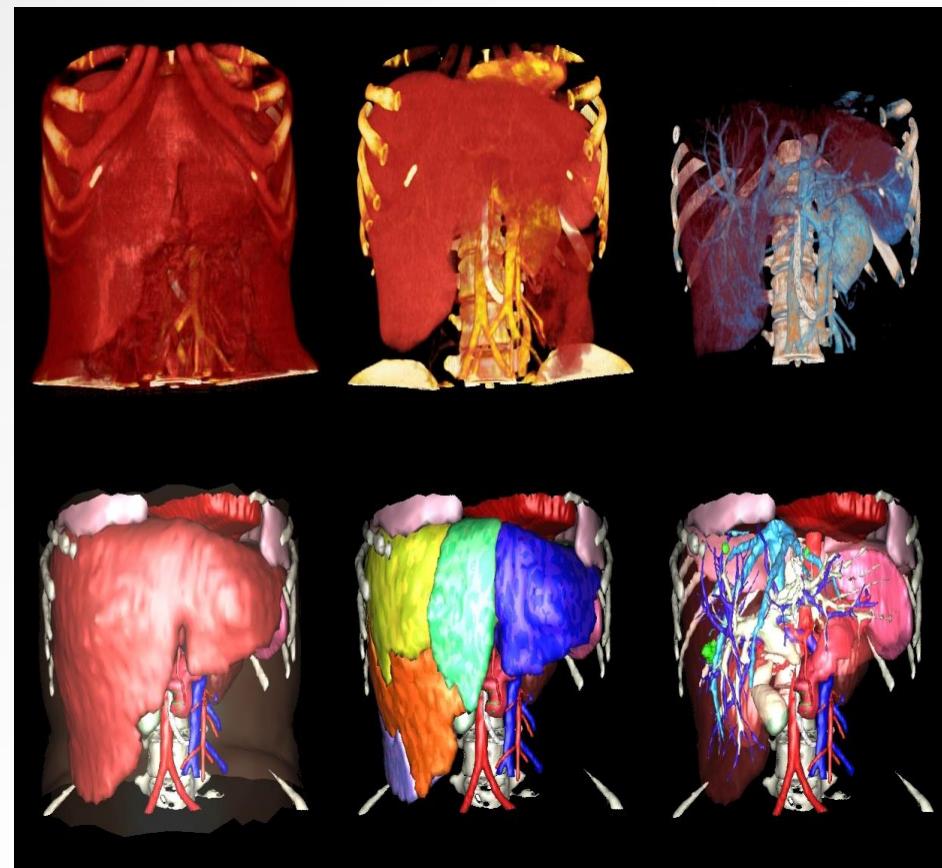


Lung Ventilation
(DECT)



Lung Perfusion
(DECT)

Application of DIP -Medical Imaging #2-



Organ Segmentation & 3D Rendering

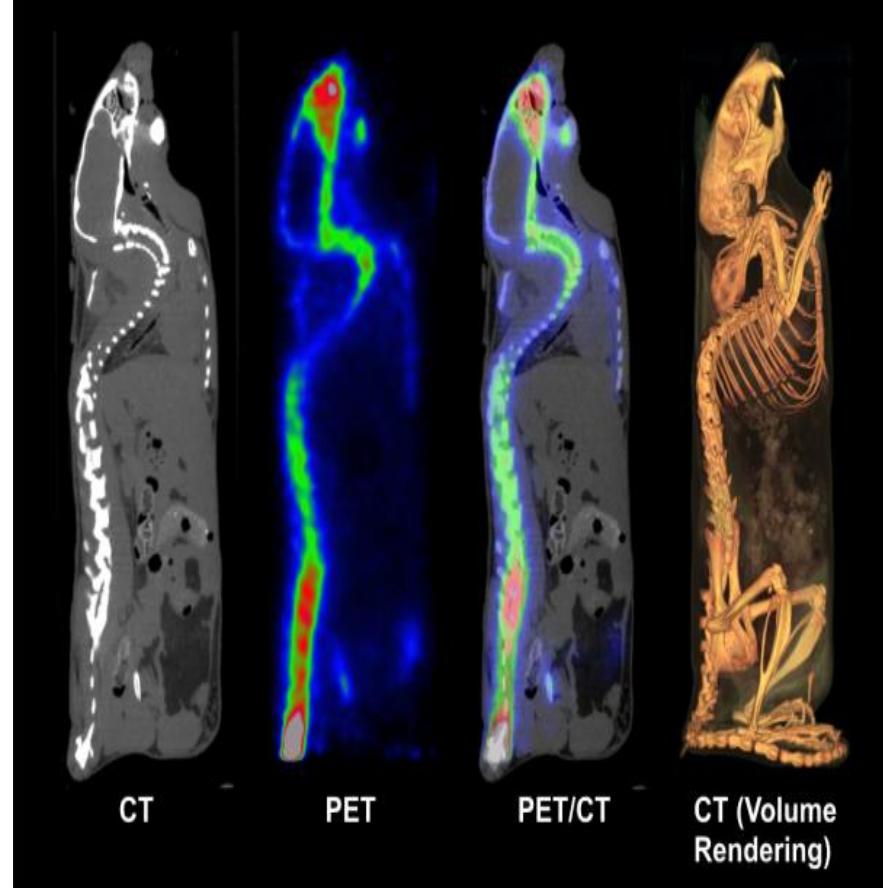
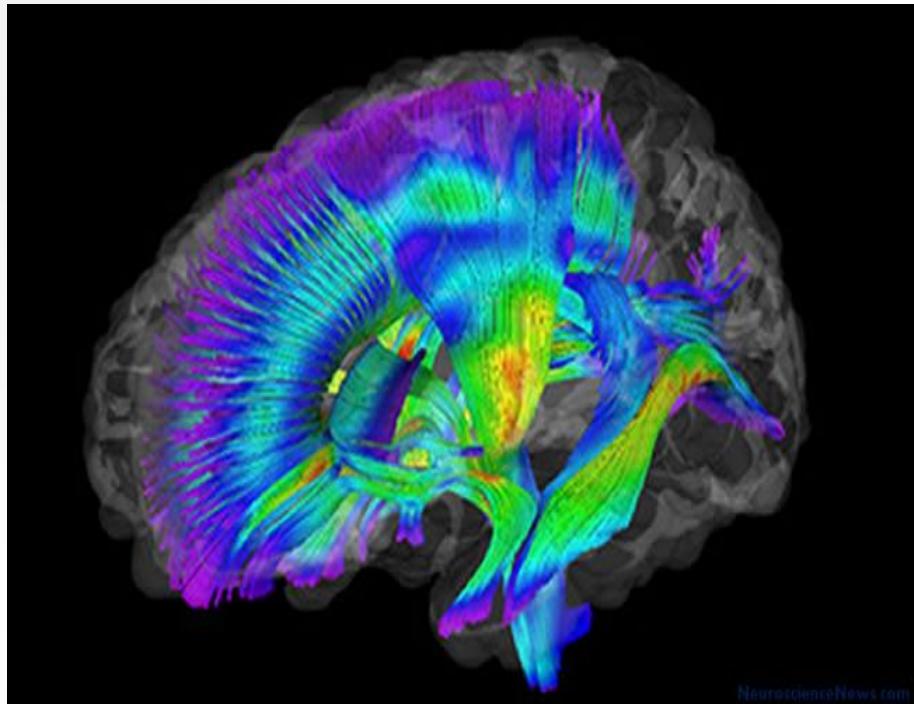
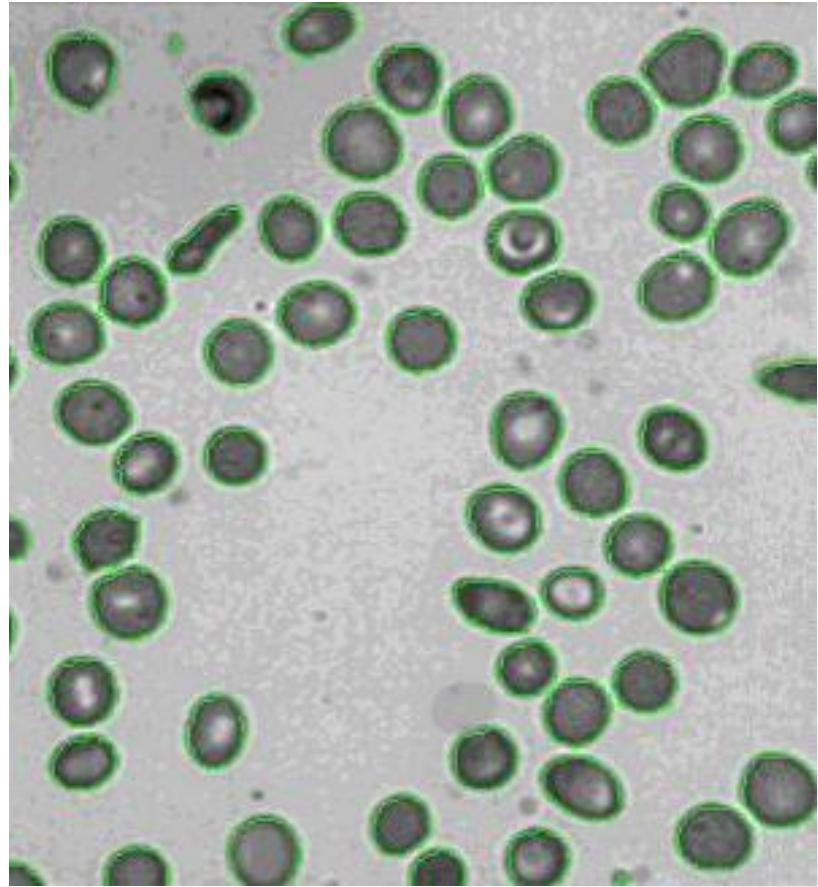


Image Fusion & Registration

Application of DIP -Medical Imaging #3-



Diffusion Tensor Imaging
(MRI)



Cell Analysis

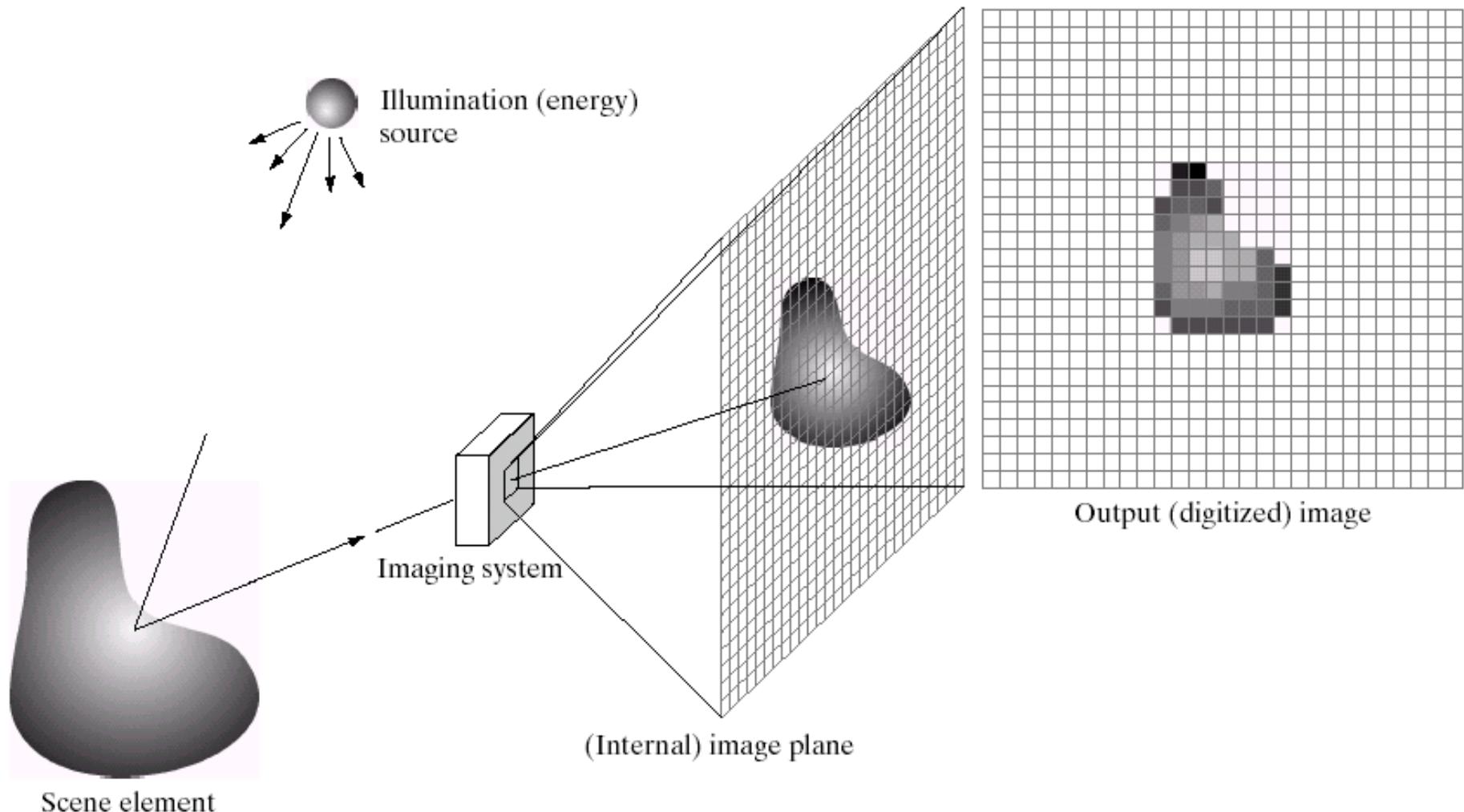
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Center for Bio-imaging of New Drug Development

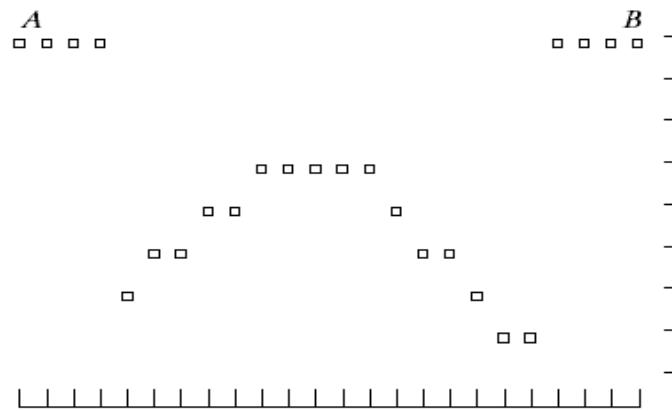
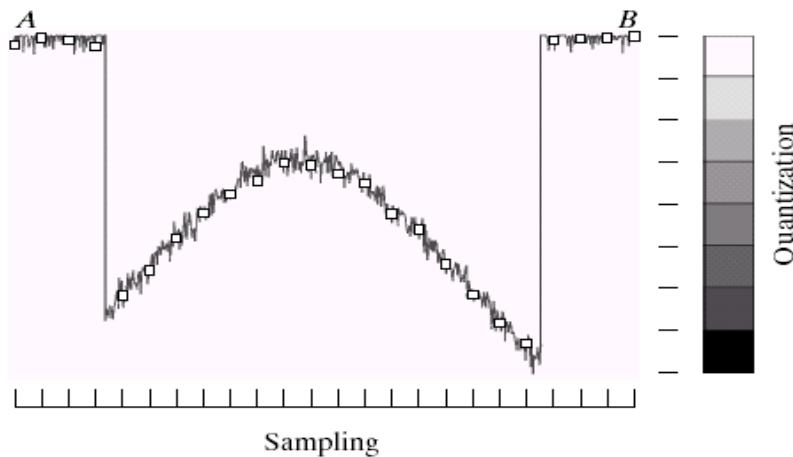
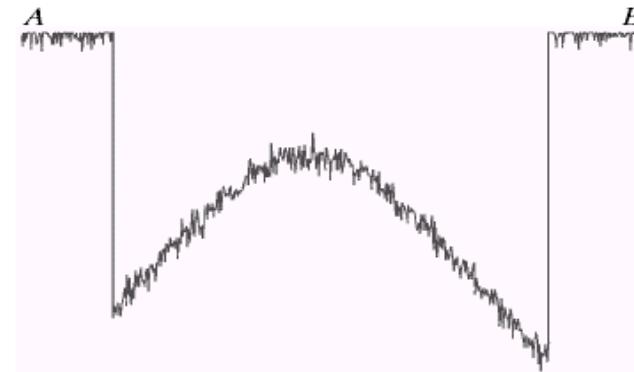
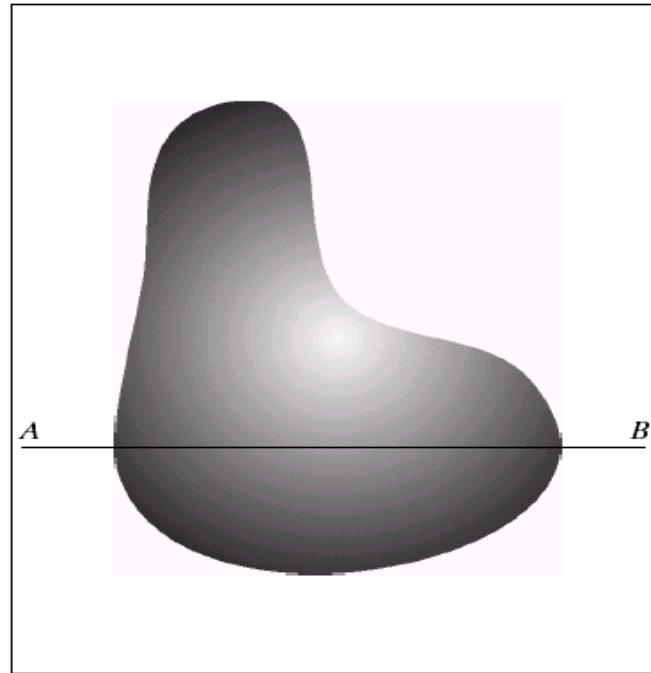


Sampling and Quantization for Image

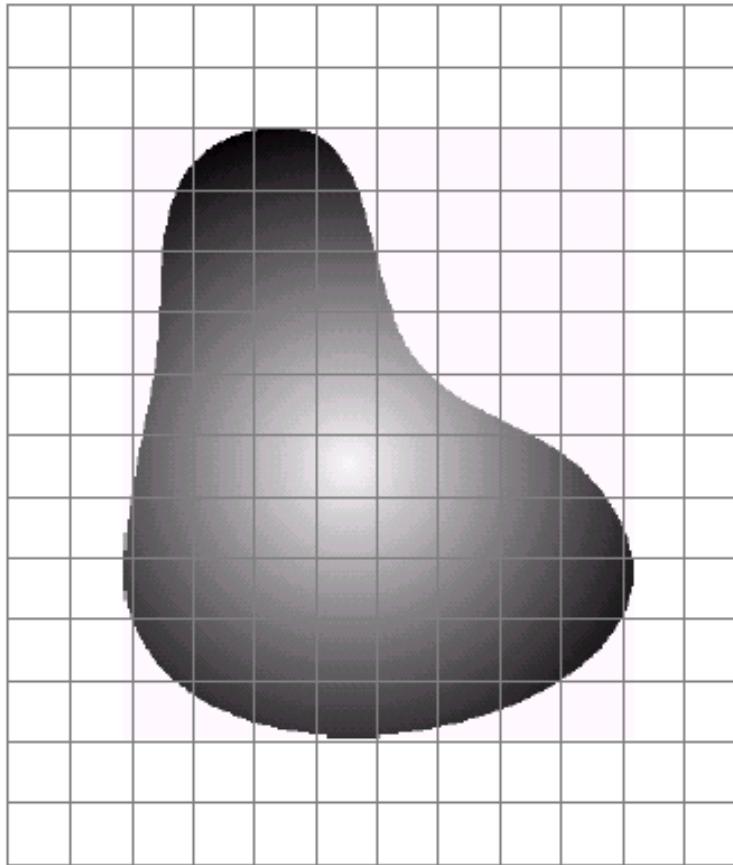
Image Acquisition



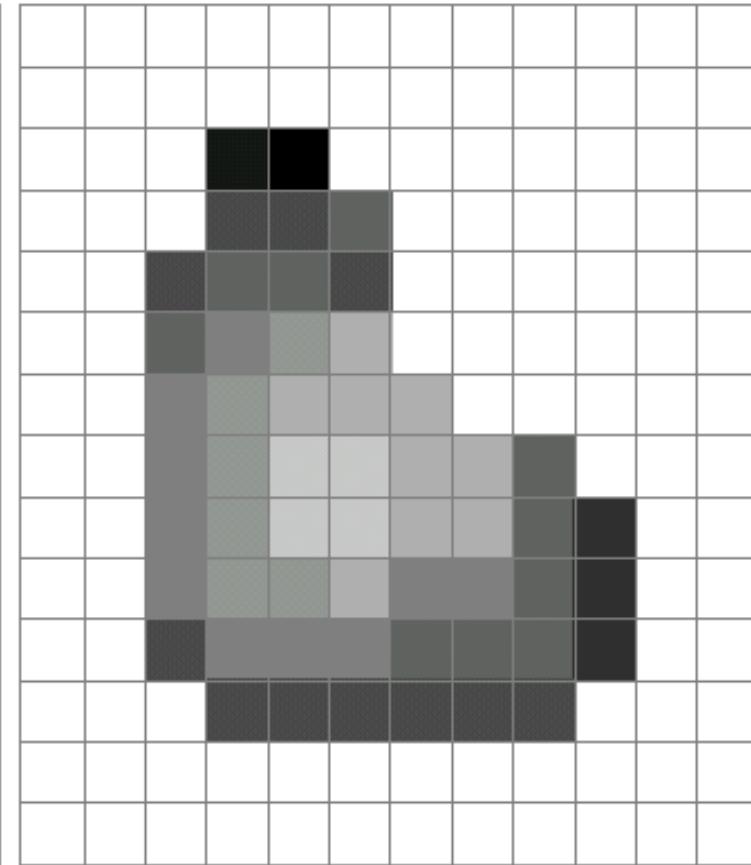
Sampling & Quantization



Sampling & Quantization

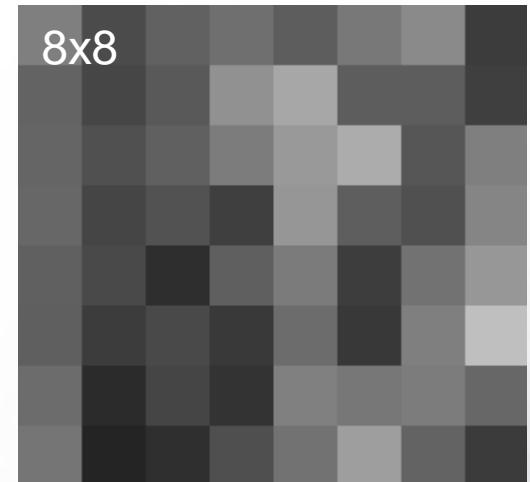
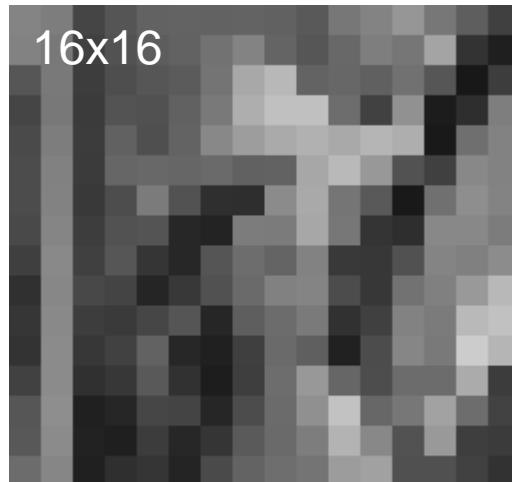
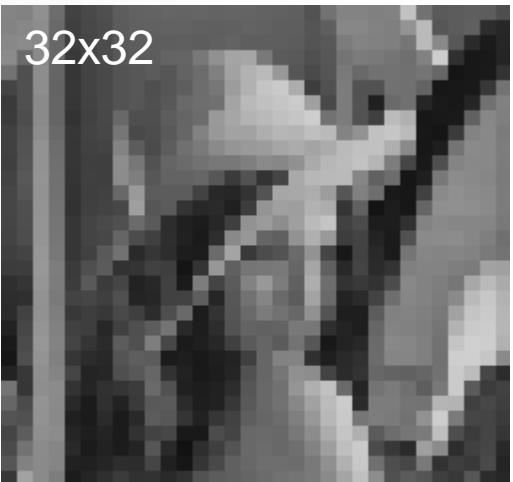


Original
(Continuous)

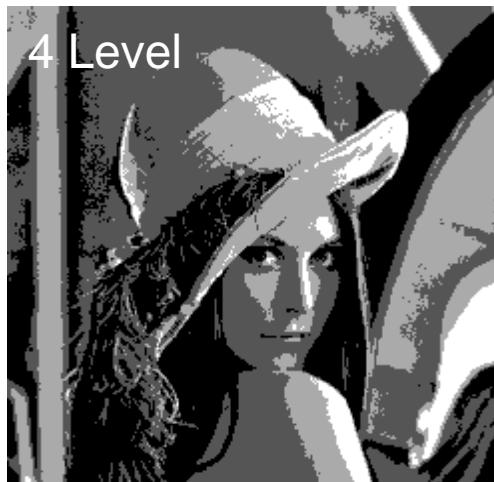
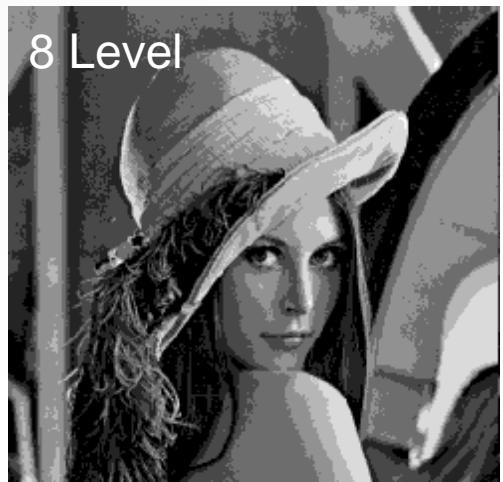
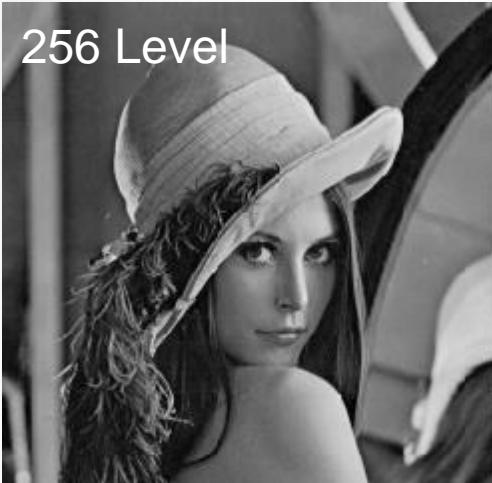


Digitized
(Discrete)

Effect of Sampling



Effect of Quantization



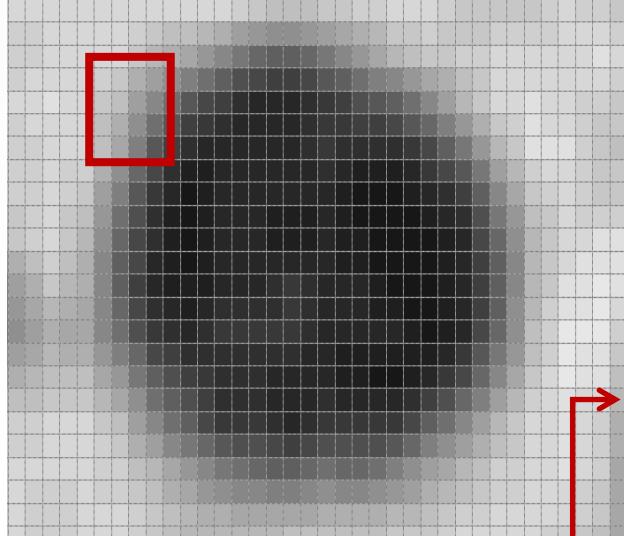
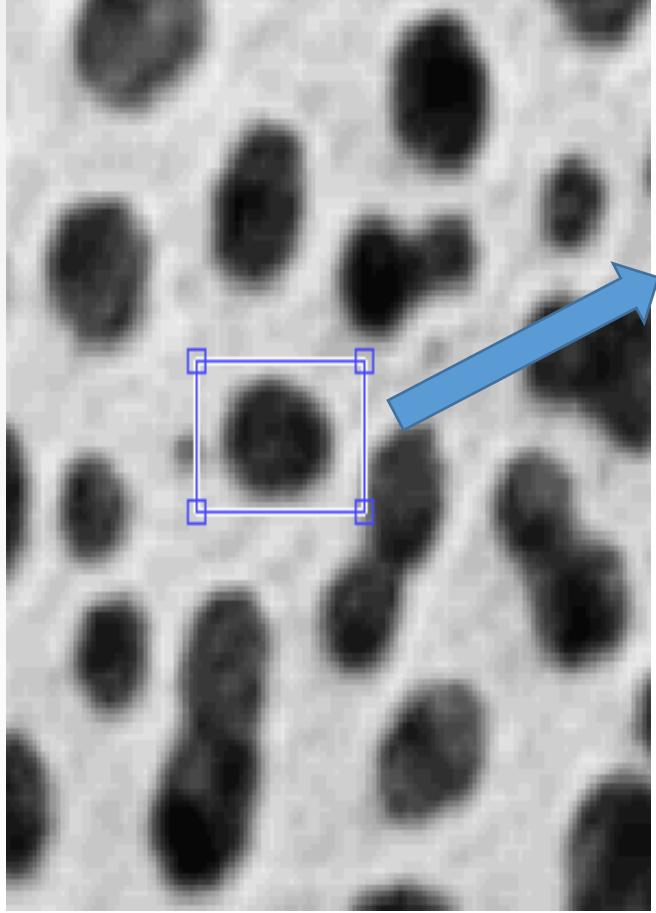
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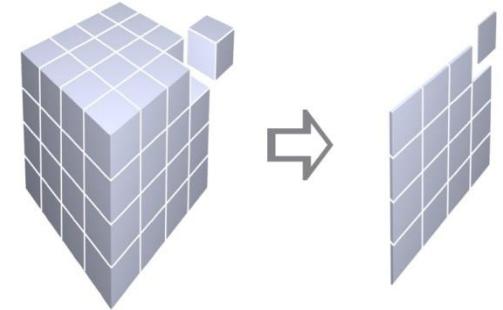


Concept of Image Properties

Image and Matrix



Voxel Pixel

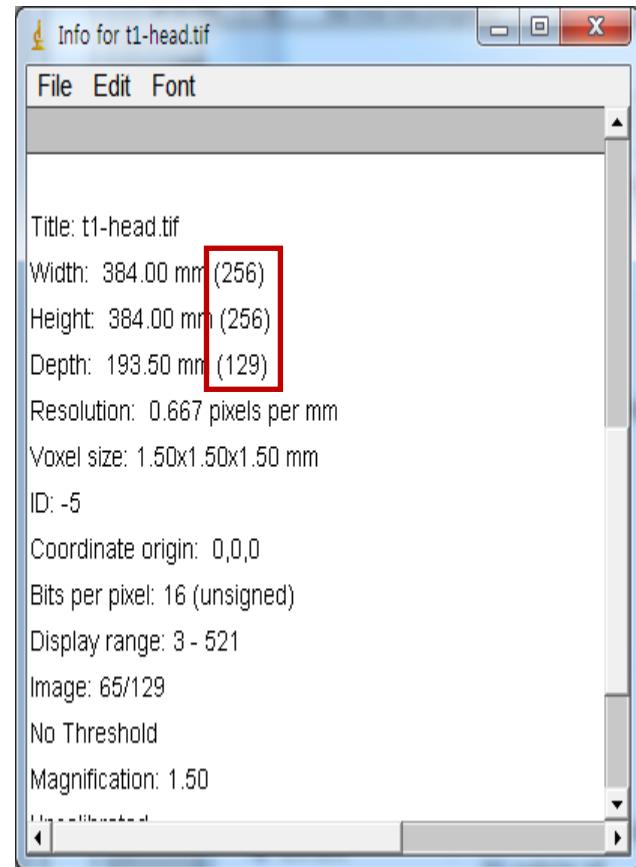
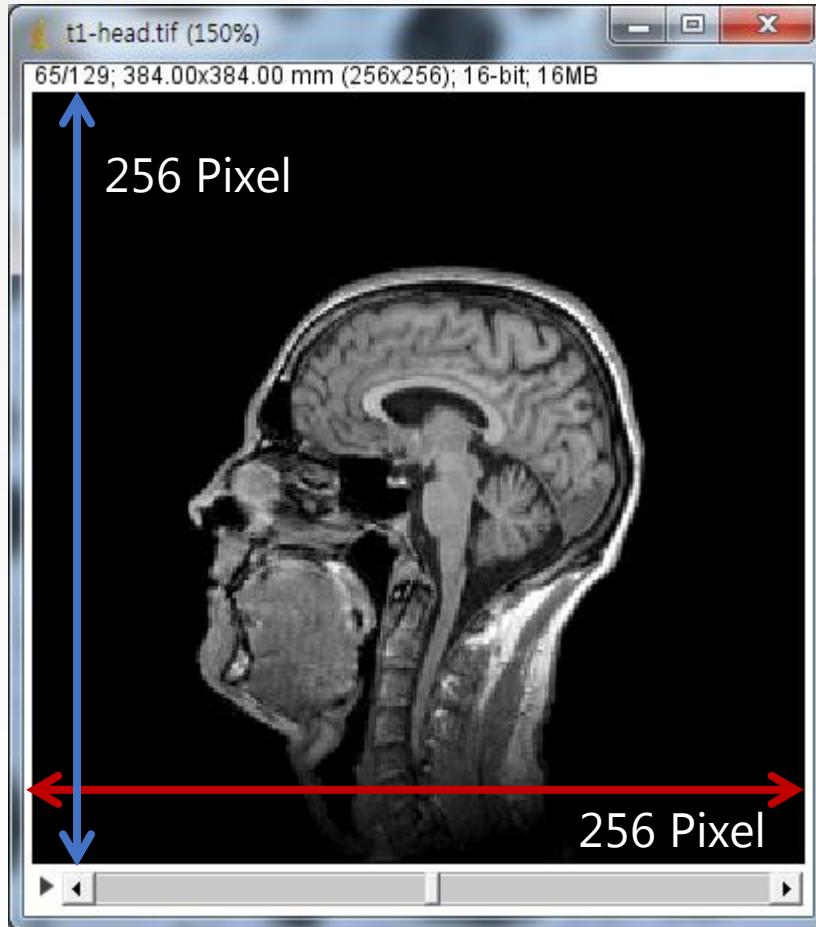


Pixel: picture element (2D)
Voxel: volume element (3D)



<40> R:0.84 G:0.84 B:0.84	<56> R:0.78 G:0.78 B:0.78	<72> R:0.72 G:0.72 B:0.72	<80> R:0.69 G:0.69 B:0.69	<88> R:0.65 G:0.65 B:0.65	<104> R:0.59 G:0.59 B:0.59
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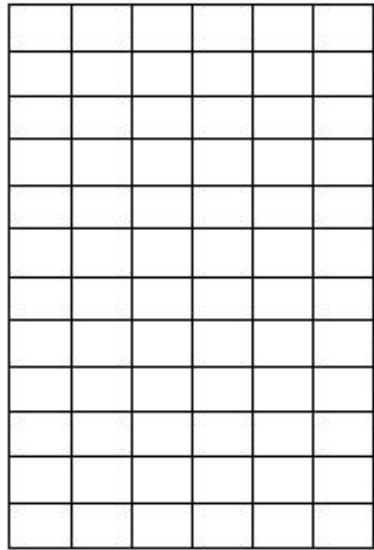
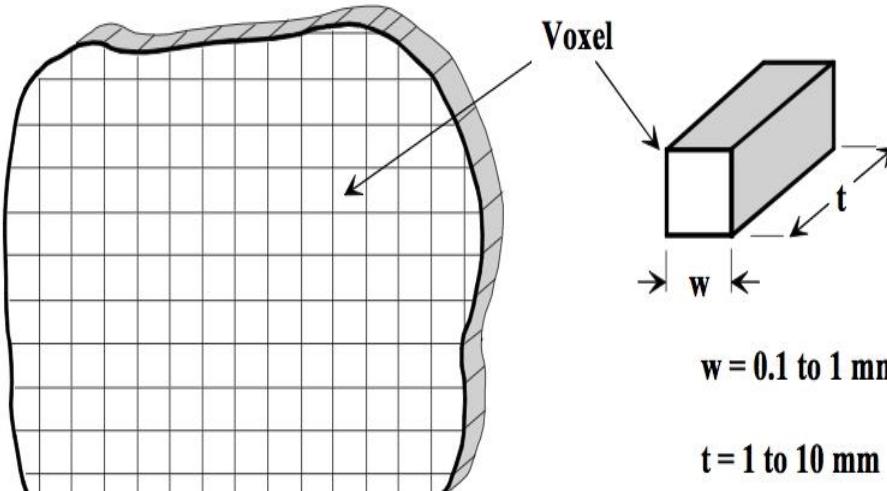
Matrix Size



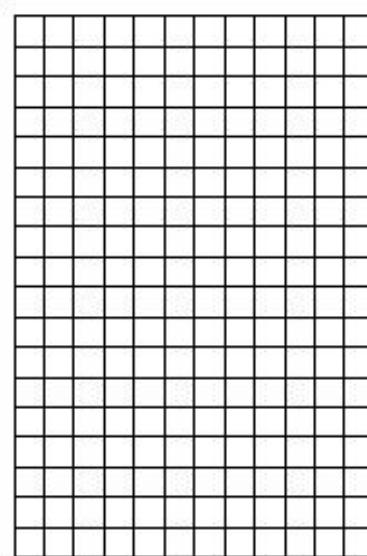
Matrix Size: Number of sampling for each dimension

Image → show info (Ctrl + I)

Pixel Size

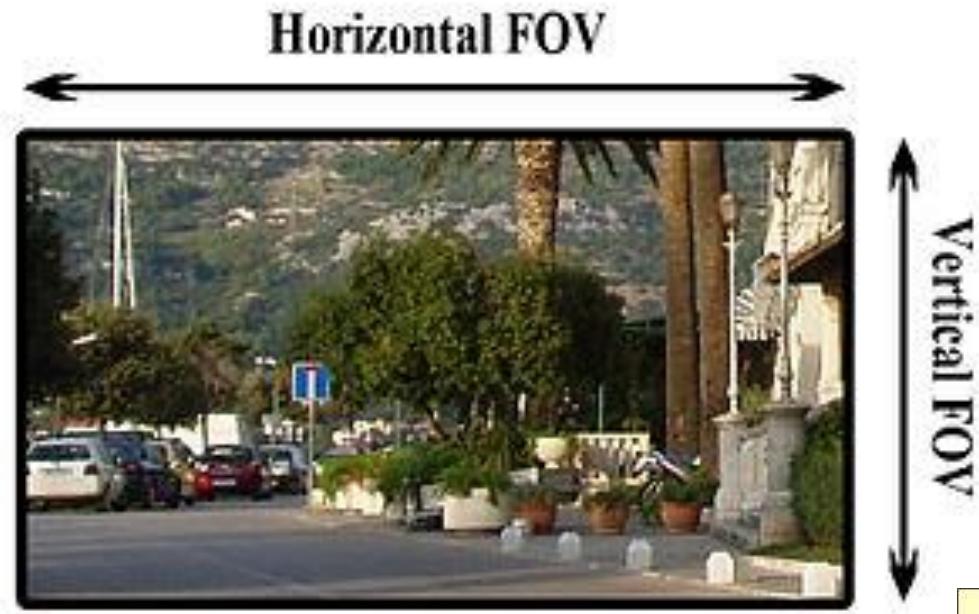


Large pixel size low resolution image



Small pixel size high resolution image

Field of View (FOV)



FOV = Pixel size * Matrix size

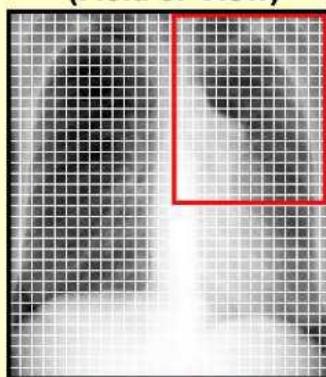
(mm) = (mm) * (pixels)

300mm * 400mm

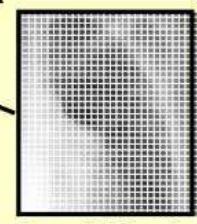
$$= (1\text{mm} * 1\text{mm}) * (300 * 400)$$

Digital Image Detail Effect of Image Size

Large Image
(Field of View)



Small Image
(Field of View)



Relation between Pixel size and Matrix size on Fixed FOV

FOV = 50mm

1024mtx, 0.048mm



512mtx, 0.097mm



256mtx, 0.195mm



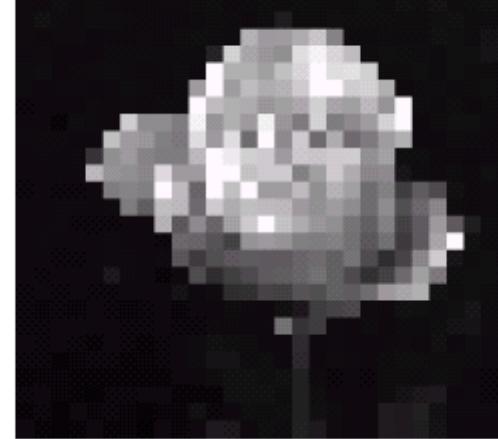
128mtx, 0.390mm



64mtx, 0.781mm



32mtx, 1.562mm

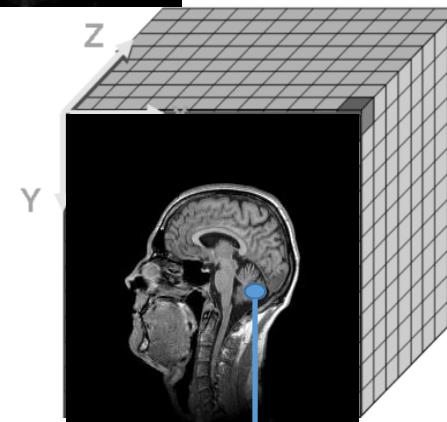


Dimension of image

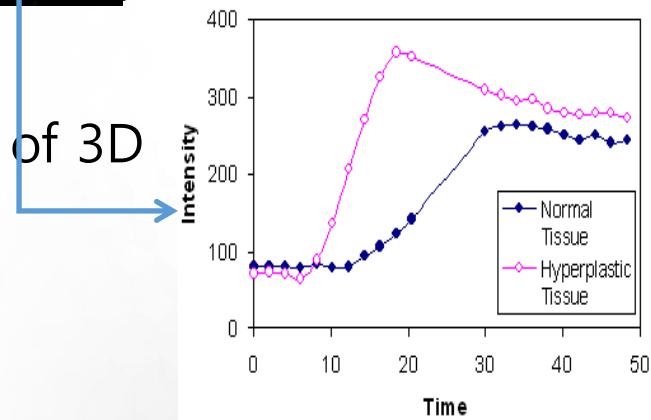
- 2D: *Slice(ImageJ)*
 - $f(x, y)$: Conventional picture



- 3D: *Stack(ImageJ)*
 - $f(x, y, z)$: Volume Image
 - $f(x, y, t)$: Video sequence



- 4D: *Hyperstack(ImageJ)*
 - $f(x, y, z, t)$: Moving 3D object or time series of 3D



x, y, z : Spatial coordinate

t : Temporal coordinate

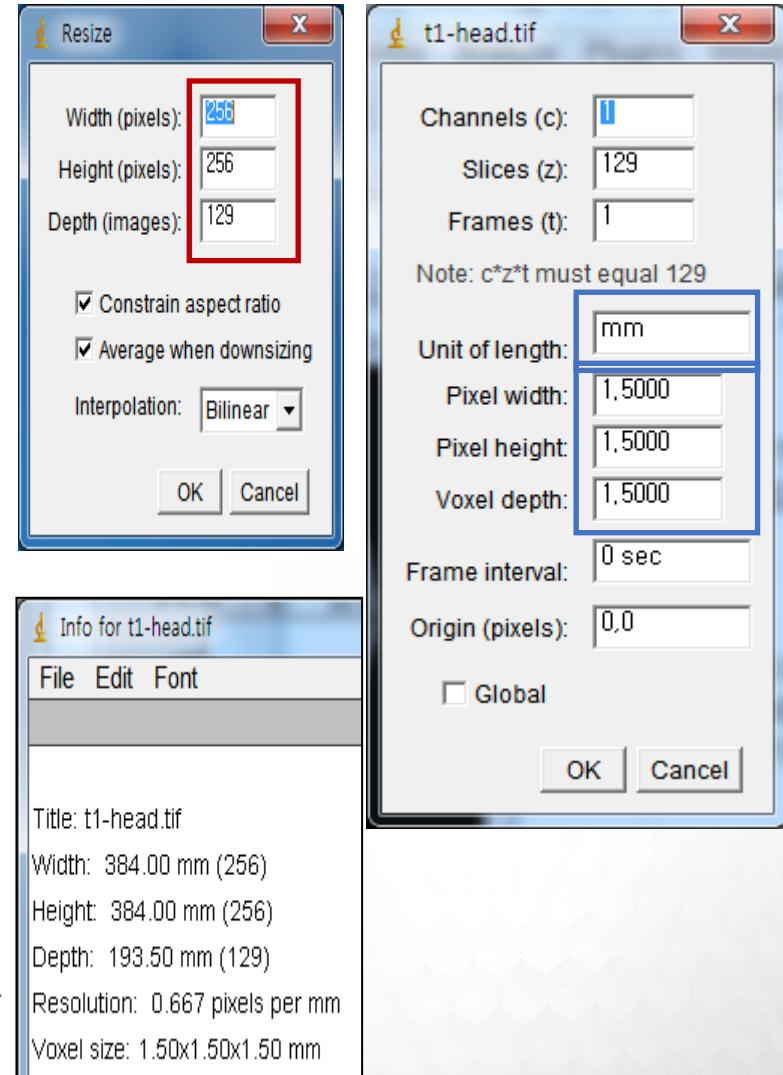
Open Example on ImageJ

- “File” → “Open Samples” → T1 Head
 - Internet connection is needed
- Fine file on USB
 - Drag file on ImageJ
 - “File” → “Open” → Select file

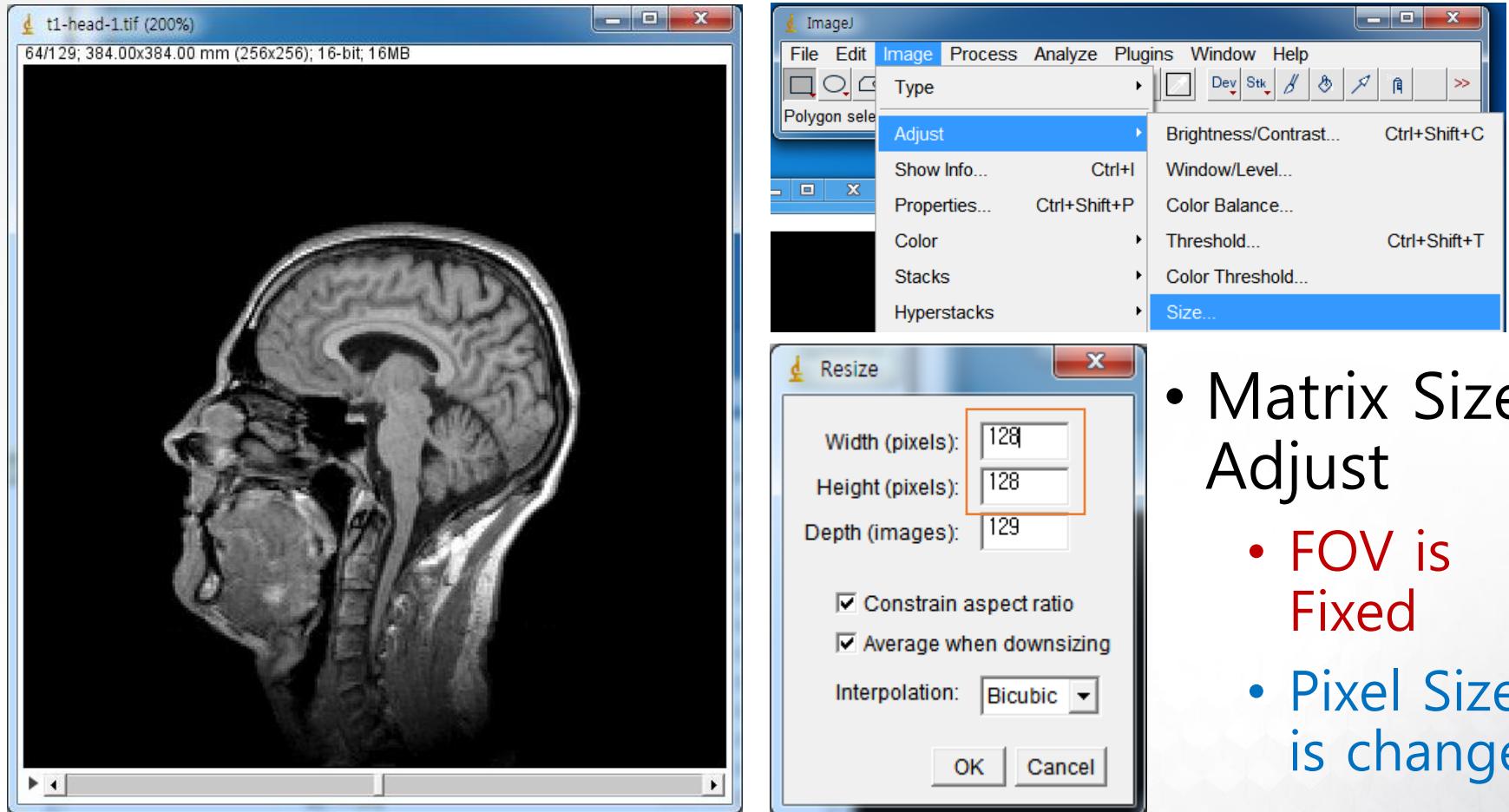


Check Image Properties

- Matrix Size
 - $256 \times 256 \times 129$
 - Image → Adjust → Size
- Pixel(voxel) size
 - 1.5mm^3
 - Image → Properties
 - (Ctrl + Shift + P)
- FOV
 - $384 \times 384 \times 193.5\text{mm}$
- *Image → Show info* 

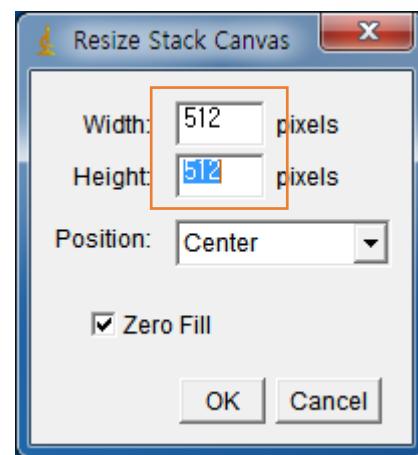
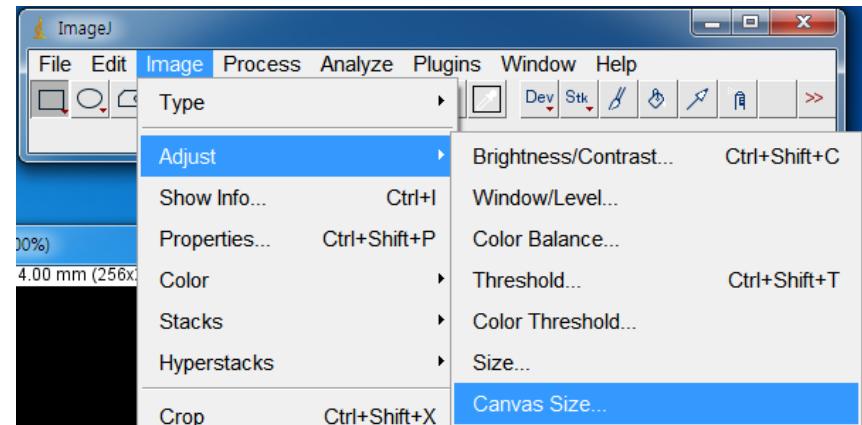


Example #1 -Resize-



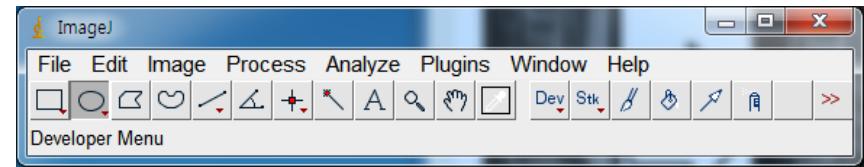
- Matrix Size Adjust
 - FOV is Fixed
 - Pixel Size is changed

Example #2 -Canvas Size-



- Matrix Size adjust
 - Pixel Size is Fixed
 - FOV is changed

Why image properties is important?

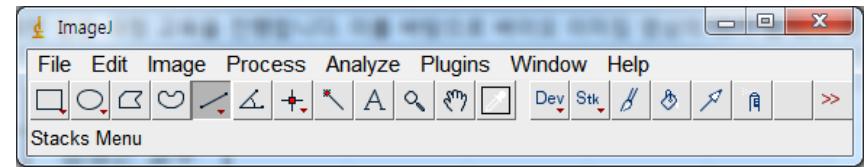


Analyze → Measure
Ctrl + M



Label	Area	Mean	StdDev	Mode	Min	Max
t1-head.tif.62	481.501	308	20.546	314	240	359

Why image properties is important?

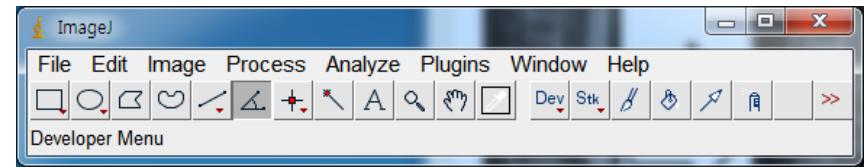


Analyze → Measure
Ctrl + M



Label	Area	Mean	StdDev	Mode	Min	Max	Angle	Length
1 t1-head.tif.62	288.001	230.269	107.225	366.142	36.298	520.195	-30.809	189.981

Why image properties is important?



Analyze → Measure
Ctrl + M



Label	Area	Mean	StdDev	Mode	Min	Max	Angle
1 t1-head.tif:62	0	0	0	0	0	0	25.890



Thank you