# L4 Erosion, Dilation, Label Fields: 30 January, 2012 to begin

# Moodle: download Week3/Pgm4\_erosion\_dilation\_label.nb Moodle: download Week3/MAS\_rotor\_slice.h5

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In[17]:= Colorize[imageComponents]



# MAS\_rotor.h5

This is an X-ray tomography (APS) of a solid-state magic angle spinning sample holder (rotor). In real life, the diameter is 2.5 mm. The rotor is made of zirconium oxide (zirconia) and the cap is Kel-F (a plastic similar to Teflon). This sample holder is about \$1,000. My postdoc and I were using this rotor and two others rotors at the National High Magnetic Field Laboratory on their 760 MHz NMR. The sample was a pyrophoric methyl aluminum oxide (MAO). The samples were loaded in a glove box (very difficult with 2.5 mm rotors and caps. De-loading was done on the lab bench (tiny fires). One sample had a stuck cap; I broke the rotor. The next week, I was at APS for tomography experiments, so I imaged the broken rotor (damaged area is out of the field of view).



# Example of a movie made with VisIt and a Python script.

## Pgm3\_HW3\_prepare.nb 30 Jan 2012 Les Butler

MAS\_rotor.h5 {400x400x400 x Real32}

Clear[volume]

- Step 1: Filenames and files sizes
- Step 2: Import the HDF5 file
- Step 3: Scale to integer16
- Step 3: Make the key of {name,rows,columns,slices,endian,format} based on a : random number generator.
- Step 4: Crop and write binary files Note: BinaryWrite exports in the order {slices,columns,rows}
- Step 5: Plot a slice. Export MAS\_rotor \_slice.h5
- Step 6: Plot a line
- Step 7: Plot two isosurfaces
- Step 8: Import MAS\_Rotor\_slice.h5 and plot

HW3. Determine the file format by trial-and-error of a binary file using ImageJ import.

1) download your file from tezpur.hpc.lsu.edu 2) the filename has the # of rows, columns, slices, but probably out of order (#s are sorted).

3) This is an evil assignment. Practice your evil laugh. 4) Takes me about 2-5 minutes to solve.

Name	rows	columns	slices	endian	format
Ashby	335	345	345	little	int16
Galatas	280	250	280	big	uint16
Jeansonne	305	310	275	little	int16
Joshi	275	320	315	little	int16
Kadam	255	260	255	little	uint16
Kiruri	320	305	340	big	int16
Kurtz	•				
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Sartalamacchia	300	335	285	little	uint16
Schneider	285	270	265	little	uint16
Shrestha	315	350	330	little	int16
Skapura	340	315	290	little	uint16
Valles	295	265	350	little	int16
extra1	310	340	335	big	uint16
extra2	330	280	310	little	int16
extra3	265	300	250	little	int16
extra4	290	295	305	little	uint16

# Here is a screenshot of Filezilla caught in the act of transferring rotor\_Ashby\_300\_315\_320.bin from tezpur.hpc.lsu.edu/project/lbutler/ hw3 to my laptop at /Users/les/Documents/Class/4581\_Spr12/wk4/

# Host = tezpur.hpc.lsu.edu, port = 20, path=/project/lbutler

<ul> <li>O O O</li> <li>sftp://lbutler@tezpur.hpc.lsu.edu - FileZilla</li> <li>Image: Image: I</li></ul>								
Host: sftp://tezpur.hpv Username: Ibutler Pa	assword: ••••••	•••• Port: Quic	kconnect 💌					
Command: Pass: ***********************************	nby_300_315_320.bin :uments/Class/4581_Spi _320.bin => local:/Users	r12/wk3/rotor_Ashby_300_315 s/les/Documents/Class/4581_S	_320.bin" pr12/wk3/rotor_Ashby_300_315_	_320.bin				
Local site: /Users/les/Documents/Class/4581_Spr12/v	wk3/	Remote site: /project/lbu	tler/hw3					
<ul> <li>3035_Spr08</li> <li>3035_Spr11</li> <li>4581_Spr12</li> <li>tutorial_video</li> <li>wk1</li> <li>wk2</li> <li>wk3</li> </ul>	0	<ul> <li>camd</li> <li>caroline</li> <li>clint</li> <li>data_material</li> <li>dominique</li> <li>elise</li> <li>hw3</li> </ul>	S					
Env Clace		2 kameron						
Filename       Filesize       Filetype       Last modil          .DS_Store       6,148       File       01/28/20         L4_30Jan_Ero       4,138,074       key-file       01/30/20         MAS_rotor.h5       256,001,4       h5-file       01/28/20         MAS_rotor_sli       642,048       h5-file       01/28/20         MAS_rotor_sli       642,048       h5-file       01/28/20         MASrotor_19       577,655       QuickTime M       04/19/20         MASrotor_19       1,707,487       QuickTime M       04/19/20         Pgm3_HW3_p       47,821       nb-file       01/30/20         Pgm4_erosio       15,162       nb-file       01/30/20         9       files. Total size: 422,723,795       bytes	012 16: 012 12: 012 07: 012 07: 012 03: 007 09: 007 09: 012 04: 012 10:	<ul> <li>MAS_rotor.h5</li> <li>rotor_Ashby_300_315</li> <li>rotor_Galatas_275_285</li> <li>rotor_Jeansonne_250</li> <li>rotor_Joshi_255_270_2</li> <li>rotor_Kadam_265_325</li> <li>rotor_Kiruri_250_280</li> <li>rotor_Kurtz_280_335</li> <li>Selected 1 file. Total size: 60,4</li> </ul>	Prilesize       Filetype       Last model         256,       h5-file       01/28/2         60,4       MacBinary       01/28/2         46,2       MacBinary       01/28/2         45,9       MacBinary       01/28/2         39,9       MacBinary       01/28/2         60,2       MacBinary       01/28/2         60,2       MacBinary       01/28/2         63,7       MacBinary       01/28/2         80,000       bytes       01/28/2	2012       -rw-rr       Ibutler h3         2012       -rw-rr       Ibutler h3				
Server/Local file       Direction       Remote file         sftp://lbutler@tezpur.h       //Users/les/Documents       <<	Si 3/rotor 60,480,00 6% 16,744,44	ize Priority Status 00 Normal Transferring 48 bytes (1.8 MB/s)						





In ImageJ, import the data from MAS\_rotor\_slice.h5 1) Plugins/HDF5 to get /slice with format "float" 2) To save some time (and this is a small file), make a duplicate with Image/Duplicate and give the result some simple name.





## In ImageJ 3) Let's look at the values across the zirconia rotor with the line tool and Analyze/Plot Profile



Select Analyze / Plot Profile

# In ImageJ 4) Binarize (using an automatic threshold) with Process/Binary/Make Binary





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## In ImageJ 5) We can (not required) make objects bigger with

This time, I did not dilate because I wanted a lot of small objects in the label field.

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5) We can (not required) make objects bigger with Process/Binary/Dilate about 5 times.

# In ImageJNext, a connected component (label) analysis. Do Analyze/Analyze Particles...(Use some auto brightness/contrast with Image/Adjust/Brightness/Contrast

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	77	1	255	255	255		
	78	2	255	255	255		
	79	1	255	255	255		

Step 1: Import MAS\_Rotor\_slice.h5 and plot

```
In[1]:= Import[NotebookDirectory[] <> "MAS_rotor_slice.h5"]
```

Out[1]= {/slice}

In[2]:= aSlice = Import[NotebookDirectory[] <> "MAS\_rotor\_slice.h5", {"Datasets", "/slice"}]; Dimensions[aSlice]

```
Out[3]= {400, 400}
```



### In[4]:= gSlice = ListDensityPlot[aSlice, ColorFunction → "GrayTones", PlotRange → {All, All, All}]



[12]:= imageBinary = Binarize  $\left[ \text{imageSlice}, \frac{1}{65535} \right]$ 





Step 4: Erode

### Step 5: Hole Closing



n[14]:= imageClose = Closing[imageErode, 4]



Step 6: Dilate

```
In[15]:= imageDilate = Dilation[imageClose, 1]
```



## Step 6: Connected Componente (label field) analysis

### n[16]:= imageComponents = MorphologicalComponents[imageDilate]



## In[18]:= Dimensions[imageComponents]

```
Out[18]= \{400, 400\}
```

### In[17]:= Colorize[imageComponents]

