# Key

Scripts that need to be run outside of the terminal are denoted in red

Terminal commands that need to be run are denoted in green

Variables are denoted in blue

# Storage Management

The BayouthLab folder has a maximum storage capacity of 1 TB. Once a subject has been fully processed it’s important to transfer all subject data off the exacloud system in order to allow space for further processing of other subjects. For all file transfers, the scp command can be used. Further documentation on this can be found [HERE](https://phoenixnap.com/kb/linux-scp-command#:~:text=SCP%20(Secure%20Copy%20Protocol)%20is,the%20cp%20(copy)%20command.).

**Any REFERENCE scans should be stored on the system until all follow up scans are complete and processed. The reference scan’s scan, mask, and sorted DICOM will all be needed for processing follow up scans on the same subject. For any follow up scans being processed, use the following guidelines to manage space available on the Exacloud system.**

**First transfer the following on a local machine or lab disk**

* Nifti CT images of each phase – DataToProcess/SUBJECT/SCAN/ folder
* Masks for each phase - /home/exacloud/gscratch/BayouthLab/ProcessedResults/SUBJECT/SCAN folder
* LERN warped image - /home/exacloud/gscratch/BayouthLab/ProcessedResults/SUBJECT/LERN/SUBJECT\_LERN\_SCANB\_warped\_to\_SCANA\_0EX.nii.gz
* LERN DICOM - /home/exacloud/gscratch/BayouthLab/ProcessedResults/SUBJECT/LERN/ DICOM/SCANB/
* Deformation Matrix - /home/exacloud/gscratch/BayouthLab/ProcessedResults/SUBJECT/RegistrationWithVessel/SCANB\_0EX\_to\_SCANA\_0EX/SUBJECT\_ SCANB\_0EX\_to\_SCANA\_0EX\_displacementField.mha
* Avoidance DICOMs (if applicable) - /home/exacloud/gscratch/BayouthLab/ProcessedResults/SUBJECT/SCAN/Avoidance/DICOM/

**Items to delete – verify everything has transferred successfully BEFORE proceding**

* DataToProcess/SUBJECT/SCAN/ folder
* /home/exacloud/gscratch/BayouthLab/ProcessedResults/SUBJECT/LERN/ folder
* /home/exacloud/gscratch/BayouthLab/ProcessedResults/SUBJECT/SCAN folder
* /home/exacloud/gscratch/BayouthLab/ProcessedResults/SUBJECT/RegistrationWithVessel/SCANB\_0EX\_to\_SCANA\_0EX folder
* /home/exacloud/gscratch/BayouthLab/ProcessedResults/SUBJECT/RegistrationWithVessel\_Low\_Epsilon\_005
* /home/exacloud/gscratch/BayouthLab/ProcessedResults/SUBJECT/SCAN/Avoidance/ Folder

# Subject Instructions:

New subject scans come from the clinic in DICOM format and need to be sorted into the individual phases. However all processing is run in NIFTI format.

1. **Sort list of DICOM files into folders by phase (if needed)**

If the files from the clinic are not in folders (it is just one folder of many DICOM folders). You will need to first sort the dicoms into folders such that they can be processed in step 2. If they are already in folders you may procede to step 2.

Note: this has ONLY been developed for the GE system. Any other scanner manufacturers will need to be developed separately. Any SIEMENS scans should be pre-sorted and able to proceed to step 2.

Navigate to the scripts directory

*cd /home/exacloud/gscratch/BayouthLab/ScriptsToProcessIPF/*

Open a MATLAB session by running:

/home/exacloud/software/matlab/R2022b/bin/matlab - nodisplay

It will take between 30 seconds and a minute for matlab to load. Once the MATLAB interpreter opens run – make sure you use single quotes like written below

SortCTToFolders(‘/home/exacloud/gscratch/BayouthLab/DataToProcess/DICOM/NAME/’, SUBJECT)

NAME is the name of the folder containing the DICOMs (usually it’s a string of numbers or in Date format)

SUBJECT is the name of the subject you are processing (example IPF001). You must enter this in single quotes.

1. **Sort the DICOM files in MATLAB**

Navigate to the scripts directory

*cd /home/exacloud/gscratch/BayouthLab/ScriptsToProcessIPF/*

Open a MATLAB session by running:

/home/exacloud/software/matlab/R2022b/bin/matlab - nodisplay

It will take between 30 seconds and a minute for matlab to load. Once the MATLAB interpreter opens run – make sure you use single quotes like written below

parseDicomNewStructure(‘/home/exacloud/gscratch/BayouthLab/DataToProcess/DICOM/NAME’, ‘SCAN’)

NAME is the name of the folder containing the DICOMs (usually it’s a string of numbers or in Date format). You must enter the path in single quotes.

SCAN is the name of the scan you are processing (example SCAN1). You must enter this in single quotes.

1. **Convert from DICOM to NIFTI**

*cd /home/exacloud/gscratch/BayouthLab/ScriptsToProcessIPF/*

*sh convertAllCT.sh SUBJECT SCANTEXTFILE KERNELTEXTFILE*

SUBJECT is IPF\*\*\*

SCANTEXTFILE is a text file that contains a list of scans you want to convert. Pre-written in the ScriptsToProcessIPF folder are scan1.txt, scan12.txt, scan34.txt, scan56.txt, scan78.txt for the different combinations of time points. A custom text file can be created and used if different scans or only 1 scan is needed using these as examples.

KERNELTEXTFILE is convert\_kernels.txt. This is a text file that specifies the reconstruction kernels. The dependence on kernel has mainly been removed in this installation so you should not need to edit this file.

1. **Make Output directory for lungmasks**

mkdir -p -m777 /home/exacloud/gscratch/BayouthLab/ProcessedResults/SUBJECT/SCAN/lung/alpha

SUBJECT is IPF\*\*\*

SCAN is the name of the scan you are processing (example SCAN1)

1. **Install anaconda if it is not already installed**

cd /home/exacloud/gscratch/BayouthLab

bash Anaconda3-2023.03-1-Linux-x86\_64.sh

This will prompt you to go through the terms and conditions and type yes that you acknowledge them all. Do this.

**When you get to the point where it says “Anaconda will be installed into this location” type /home/exacloud/gscratch/BayouthLab/anaconda3XY/ where XY are your initials – this will create a user installation in the BayouthLab folder which has the space to accommodate this installation – your user directory does not.**

Once this completes successfully you will need to log out and log back in

1. **Install masking code – only needs to be done the first time you run it**

cd /home/exacloud/gscratch/BayouthLab/src/DeepLung

conda create --name deeplung python=3.9

conda activate deeplung

pip3 install .

conda deactivate

You will need to log out and log back in

1. **Create lung masks (needs to be done for all scans– reference and scan you are processing)**

conda activate deeplung

cd /home/exacloud/gscratch/BayouthLab/ScriptsToProcessIPF/

sh CreateCNNMask.sh SUBJECT SCAN

*This will create lung masks for all 10 phases of the 4DCT for the subject and scan input. If for some reason you need to do less than the 10 phases open the CreateCNNMasks.sh file and change the for loop to only include the phases you want.*

conda deactivate

1. **Run Registrations**

This will submit a job to the exacloud cluster to perform each task. They are independent so you can submit the job in part a and in part b and have them both run on the cluster at the same time. To check the status of the jobs at any point. Type the command squeue -u USER where USER is your OHSU login username.

* 1. **For ALL Scans regardless of timepoint (this will take 4-8 hours to complete)**
     + 1. sbatch ProcessLERNRegs.sh SUBJECT KERNEL SCAN

SUBJECT should be selected as the subject you are running

SCAN should be selected as the scan you are running.

KERNEL is the kernel the data was reconstructed with (usually B50f\_1mm or Br51f\_1mm)

* 1. **For any scans that are NOT the reference scan you will also need to calculate the deformation matrix between the scan you are running and the reference scan** 
     1. **If the scan you are running is from the same timepoint as the reference scan (example you are running SCAN2 and the reference is SCAN1) – this will take 1-3 hours to complete.**
        1. sbatch ProcessSameTimepoint.sh SUBJECT SCANA SCANA\_MOVE SCANA\_FIXED SCANB SCANB\_MOVING SCANB\_FIXED
     2. **If the scan you are running is a follow up scan – this will take 4-6 hours to complete**
        1. sbatch ProcessDifferentTimepoint.sh SUBJECT SCANA SCANA\_FIXED SCANB SCANB\_MOVING SCANB\_FIXED

SUBJECT should be selected as the subject you are running

SCANA should be selected as the frame of reference of the treatment.

SCANB is the scan you are running that needs to be registered to the reference

SCANA\_MOVING and SCANB\_MOVING are the max inspiration phases (set at 100IN)

SCANA\_FIXED and SCANB\_FIXED are the reference phases (usually we choose this to be max expiration phase which is 0EX)

1. **Create LERN Map – run the LER4D\_100.R script from the LERN subfolder**

**The first time you run this you will need to edit your Bash file to export the R library paths such that R can find the installed packages. After you do this once you should not have to do this again for future subjects you process. To do so:**

vi ~/.bash\_profile

click SHIFT-I to edit

hit enter after the last line and paste export R\_LIBS=/home/exacloud/gscratch/BayouthLab/ into the file

click ESC to exit editing mode then type :w ENTER followed by :q ENTER to save and quit

exit out of command prompt and log back in for changes to take place

Check installed packages includes oro.nifti:

R

installed.packages()

q()

n (In response to saving the workspace)

**After the above has been done once, all future times you can start here:**

Note: The LER4D\_100.R script uses all 10 phases of the 4DCT to create the LERN map. If you wish to use fewer phases. This can be done by editing line 52 to another number and commenting out the respective phases you do not wish to use in lines 53-62.

cd /home/exacloud/gscratch/BayouthLab/ScriptsToProcessIPF/LERN/

Rscript LER4D\_100.R SUBJECT SCAN

SUBJECT should be selected as the subject you are running

SCAN should be selected as the scan you are running.

1. **Warp LERN Map to reference**

This will create a file named SUBJECT\_LERN\_SCANB\_warped\_to\_ SCANA\_0EX.nii.gz in the folder /home/exacloud/gscratch/BayouthLab/ProcessedResults/SUBJECT/LERN/

cd /home/exacloud/gscratch/BayouthLab/ScriptsToProcessIPF/

sh WarpLERN.sh SUBJECT SCANA SCANB

**SUBJECT** is the subject you are running

**SCANA** is the reference scan you want to warp to

**SCANB** is the scan you are running

1. **Convert Jacobians to DICOM**

sh jacobiansToDICOM.sh SUBJECT SCANA SCANA\_FIX SCANB

**SUBJECT** is the subject you are running

**SCANA** is the reference scan the LERN was warped to

**SCANA\_FIX** is the reference phase (usually 0EX)

**SCANB** is the scan you are running

1. **Qualitative analysis of Jacobians in Slicer**

Transfer the warped LERN file to your home machine and open in slicer – make sure there are no horizontal streaks.

**IF THE SUBJECT IS RANDOMIZED TO THE EXPERIMENTAL ARM AND THIS IS THEIR PRE\_RT SCAN**

Note this is based on our old processes and will likely be changing as we get Eric’s code running on the cluster for his cGAN model and treatment planning scripts.

1. **Create Avoidance Maps - \*\*cannot currently run because the trained model is not on OHSU’s system.**

Open a MATLAB session by running:

/home/exacloud/software/matlab/R2022b/bin/matlab - nodisplay

It will take between 30 seconds and a minute for matlab to load. Once the MATLAB interpreter opens run

CalculateAvoidanceMapsAuto(SUBJECT, SCANA, SCANA\_FIX, SCANB) – Note you must enter variables in single quotations ex. ‘IPF002’.

**SUBJECT** is the subject you are running

**SCANA** is the reference scan the LERN was warped to

**SCANA\_FIX** is the reference phase (usually 0EX)

**SCANB** is the scan you are running

This script will create several avoidance structures named in the format SUBJECT\_DOSEGyAvoidance.nii.gz

These generated avoidance structures will be placed in /home/exacloud/gscratch/BayouthLab/ProcessedResults/SUBJECT/SCAN/Avoidance/

1. **Convert Avoidance Maps to DICOM**

sh avoidanceToDICOM.sh SUBJECT SCANA SCANB PHASE for all phases you want the DICOMs for (usually just the planning phase is needed)

**SUBJECT** is the subject you are running

**SCANA** is the reference scan the LERN was warped to

**SCANB** is the scan you are running