MIRA: Final Project 2024

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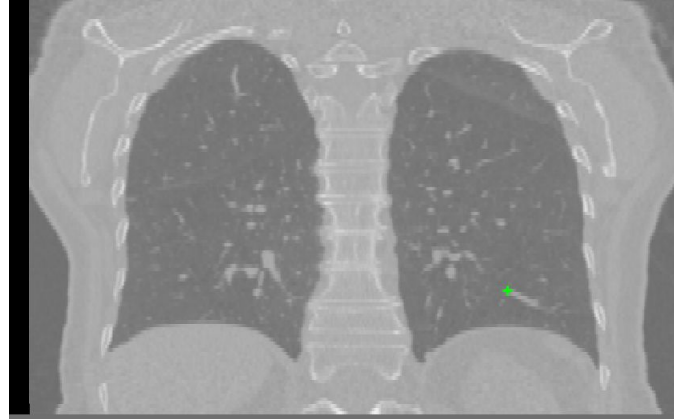
Universitat de Girona

Final Project Challenge!

- Image registration of chest CT volumes
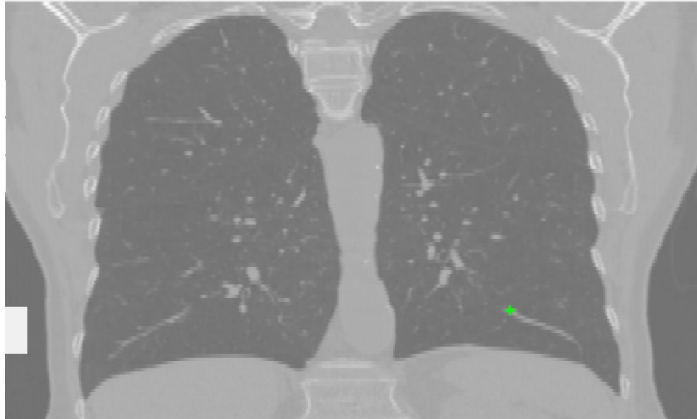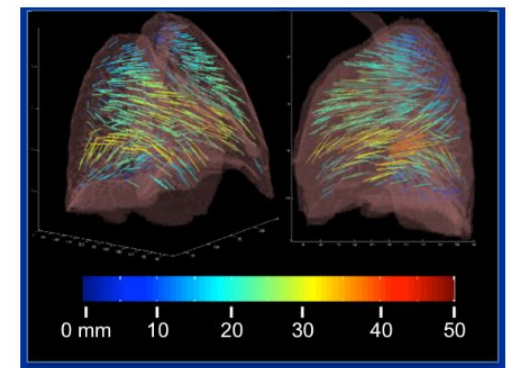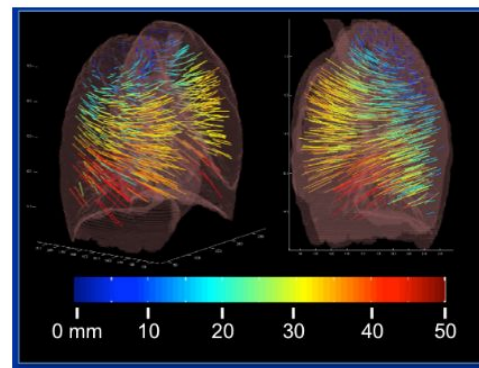

Inspiratory   *Expiratory*

- 4DCT DIR-Lab Challenge ([Website](#))
  - COPD (Chronic obstructive pulmonary disease)
    - "Inflammation that limits airflow into and out of the lungs"

- Evaluation Criteria
  - TRE
  - Methodology
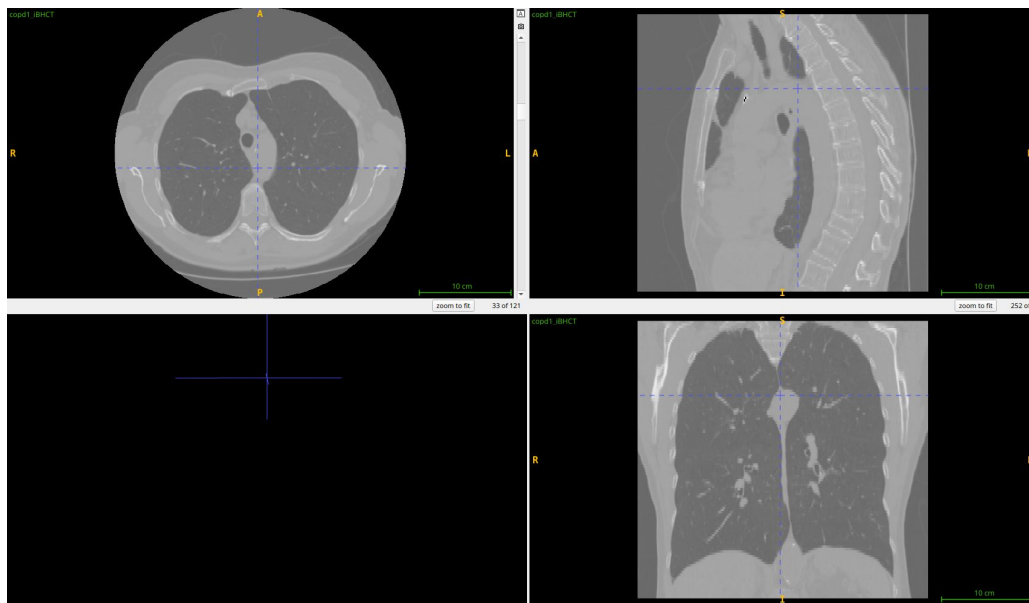 - Computational time

Final Project: description

- Data with landmark annotations (300 landmarks per case)
  - Training set
    - 4 cases, each containing: intensity images + landmark points
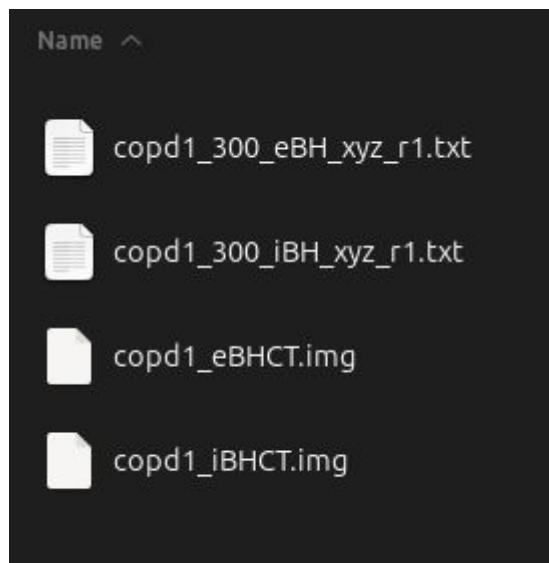
Final Project: description

- Raw image format. Load using ITK Snap or other software

- Be careful with the orientation (especially with Z axis!)
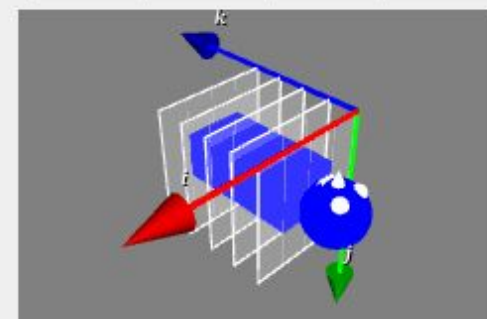
Final Project: challenge day

- The day of the challenge you will be given
  - 3 new 4DCT cases, intensity volumes **with only INHALE** landmarks
- You will register the images and transform the **landmark points of INHALE** (csv file, mm)
- We will evaluate online and give the results the same day
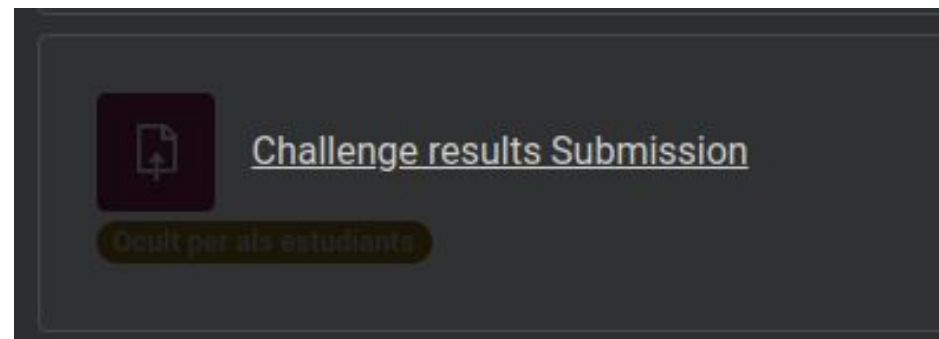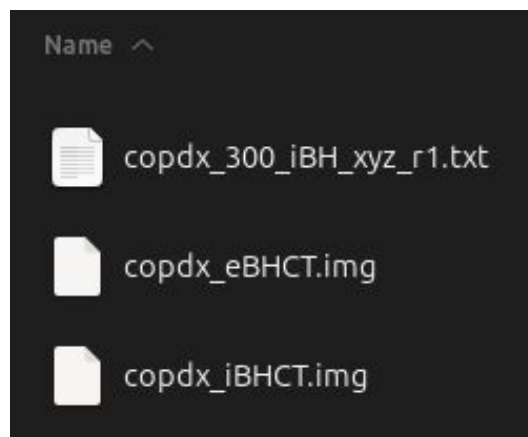
Final Project: description

- Aim
  - Register the 3D CT lung images
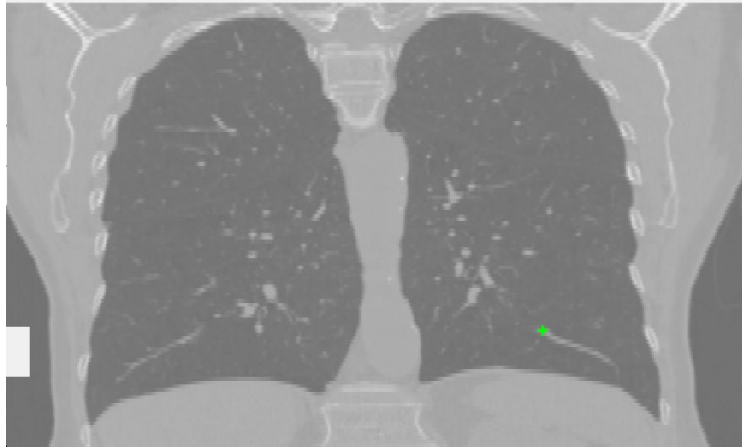
Inspiratory
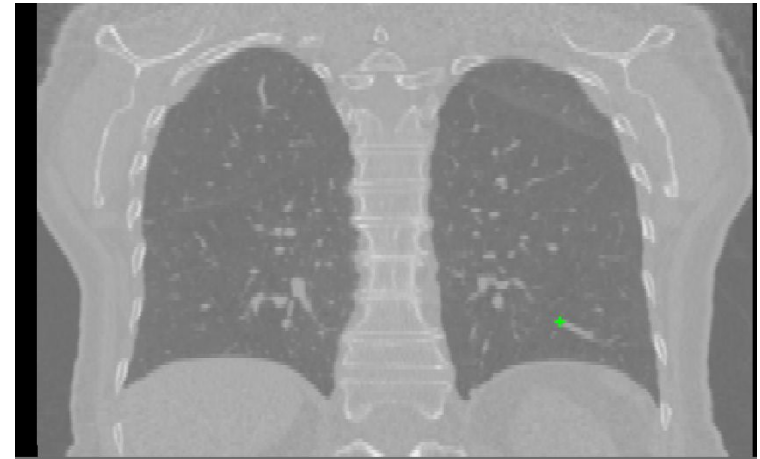
Expiratory

Final Project: description

– Evaluate using TRE (3D Euclidean distance between transformed landmarks)

Dataset description

4D CT	COPDgene

Table 1b. Reference Datasets - COPDgene. Each case is identified according to the given label. The image dimensions are given in voxel units, and the voxel dimensions are given in millimeters. The "# Features" column designates the total quantity of unique landmark features identified for each case. For the 4DCT images, the full point set is identified between the maximum inhalation and exhalation component phase images. Additionally, a subset of 75 features has been propagated onto each of the expi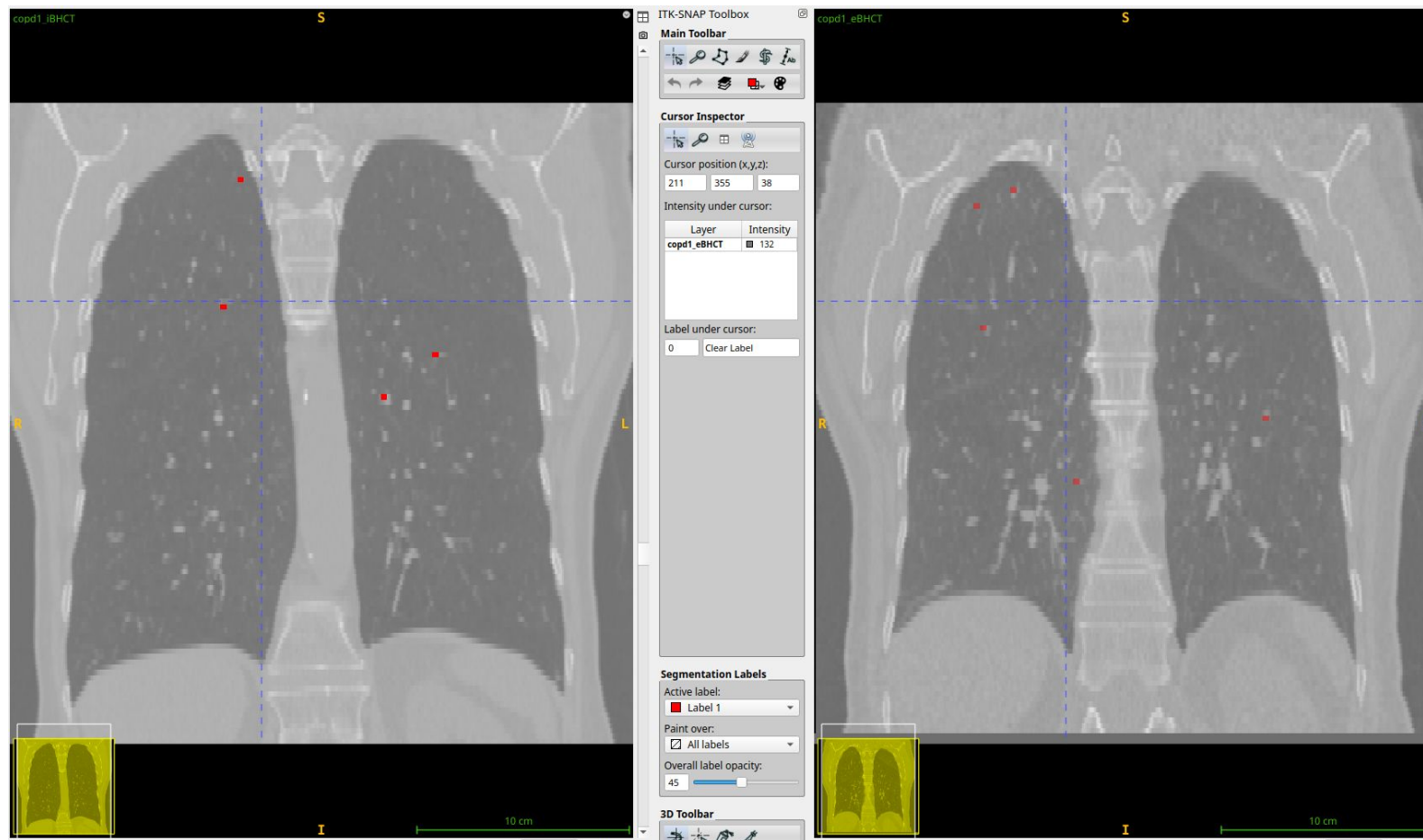ratory phase images (i.e., T00, T10, T20, T30, T40, and T50). The "Displacement" column shows the mean (and standard deviation) displacement of the complete primary feature set. The entries in the "# Repeats" column are formatted as (N_m / N_{obs}), where N_m is the number of repeat registration measurements performed by each of N_{obs} independent observers. The "Observers" column shows the combined mean (and standard deviation) repeat registration error for the set of N_{obs} data sets. Please see the references cited below for more information.

| Label	Image Dims	Voxels (mm)	# Features	Displacement (mm)	# Repeats	Observers (mm)
COPD1	512 x 512 x 121	0.625 x 0.625 x 2.5	773	25.90 (11.57)	150/3	0.65 (0.73)
COPD2	512 x 512 x 102	0.645 x 0.645 x 2.5	612	21.77 (6.46)	150/3	1.06 (1.51)
COPD3	512 x 512 x 126	0.652 x 0.652 x 2.5	1172	12.29 (6.39)	150/3	0.58 (0.87)
COPD4	512 x 512 x 126	0.590 x 0.590 x 2.5	786	30.90 (13.49)	150/3	0.71 (0.96)
COPD5	512 x 512 x 131	0.647 x 0.647 x 2.5	1029	30.90 (14.05)	150/3	0.65 (0.87)
COPD6	512 x 512 x 119	0.633 x 0.633 x 2.5	633	28.32 (9.20)	150/3	1.06 (2.38)
COPD7	512 x 512 x 112	0.625 x 0.625 x 2.5	575	21.66 (7.66)	150/3	0.65 (0.78)
COPD8	512 x 512 x 115	0.586 x 0.586 x 2.5	791	25.57 (13.61)	150/3	0.96 (3.07)
COPD9	512 x 512 x 116	0.664 x 0.664 x 2.5	447	14.84 (10.01)	150/3	1.01 (2.54)
COPD10	512 x 512 x 135	0.742 x 0.742 x 2.5	480	22.48 (10.64)	150/3	0.87 (1.65)

Orientation
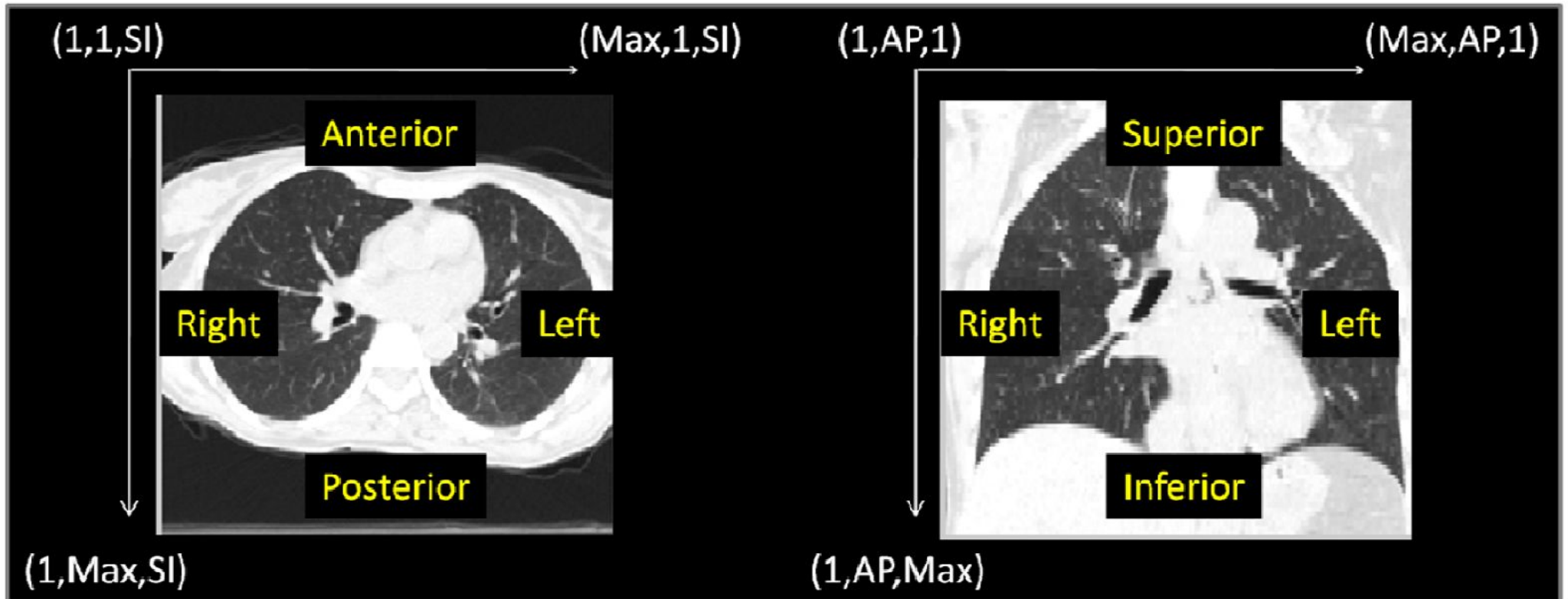
RAS orientation

Important dates

- Dates:
    - **22/11/24: Introduction to the Final Project**
    - 13/12/24: 1st Follow-up
    - 20/12/24: 2nd Follow up (Checkpoint of <u>baseline</u>)
    - 10/01/25: Final Project Challenge day (right after exam)
        - Final project submission: same day

FRI
13   ×

- 8am CAD (P.Lab-3)
- 8am CASMR (P.Lab-1)
- 12pm CASMR (P.Lab-2)
- 12pm MIRA (P.Lab-1)
- 2:30pm MIRA (P.Lab-3)
- 4:30pm CASMR (P.Lab-3)
- 4:30pm MIRA (P.Lab-2)

Relevant information

- Attendance is compulsory

- Submission
  - Code and executable
  - Report in paper format (LaTeX) (5-10 pages)

- Evaluation Criteria
  - TRE
  - Accuracy, Robustness, Methodology, Computational time
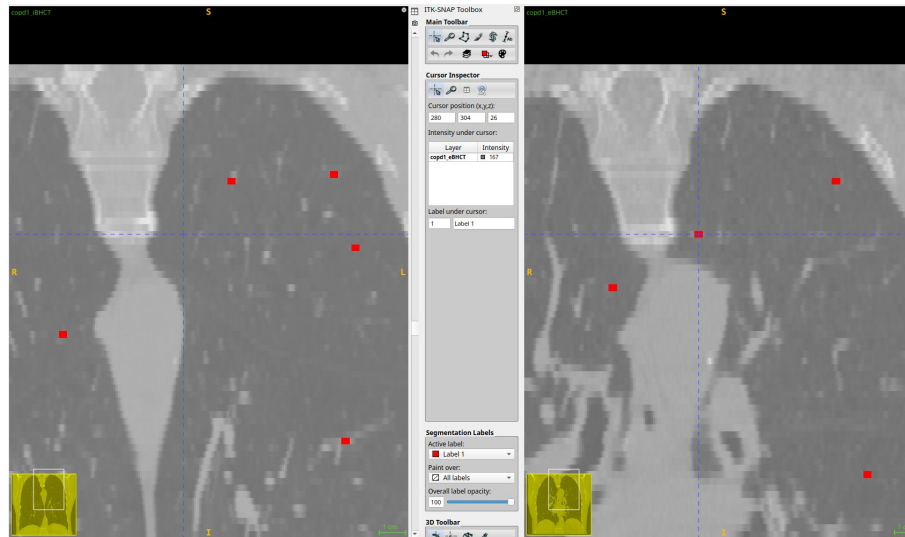
Suggestions

- KISS

- Make sure you understand image format (dimensions), landmarks and reference systems
- Compute landmark errors without registration and make sure matches the ones in the table

Suggestions

- Be careful on image formats / orientations!
- Use Matlab? help functions (to see landmark errors)
- Use existing known software ITK-Snap, Elastix, etc for visualization and deforming points
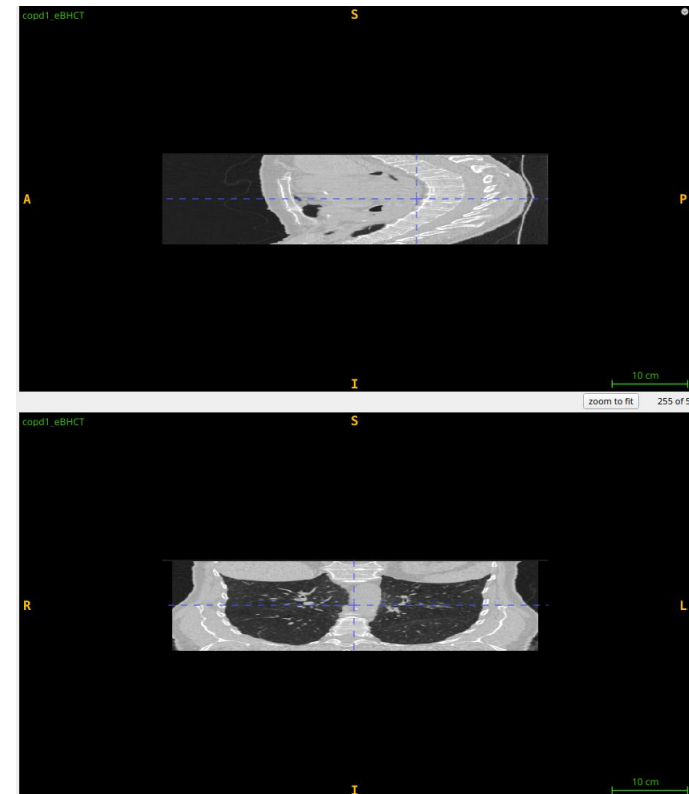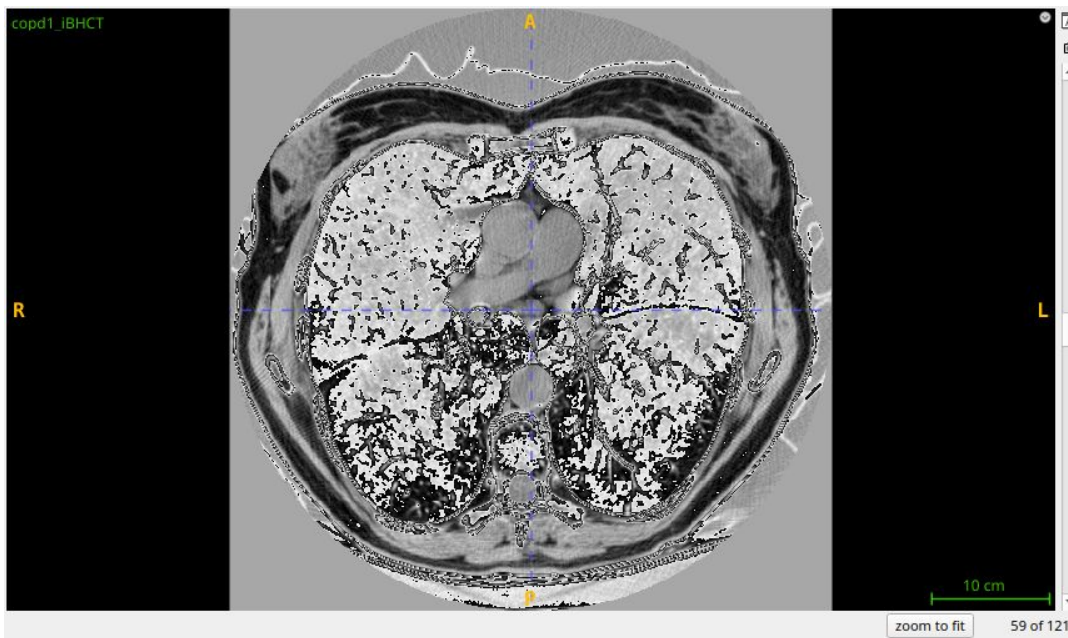
Final Mark

- Final Project Mark:
  - Baseline is compulsory
  - 20 % Challenge day results
    - TRE Error in **mm**
  - 80 % Report and source code
    - Submitting Baseline only. Max mark 8
    - Use of additional methods /libraries. Max mark 10

Final Project: Evaluation

- Good coding practice   10%
  - Correct and clear programming, use of functions/objects, templates, etc. and consistent code and comments.
- Methodology   25%
  - Methods used are well justified, sound and clear
  - Know the limitations (when does it fail)
- Evaluation and results   20%
  - Accuracy. Registration metrics. Dice Similarity coefficient
  - Computational time
- Report   45%

And most importantly…