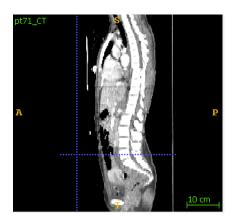# Registration as Data Augmentation for Making Different X-Cat Data
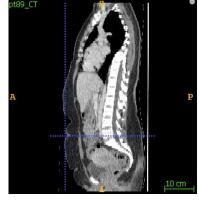
Title: Using Simple Registration as a data augmentation technique for making more XCAT CT data.
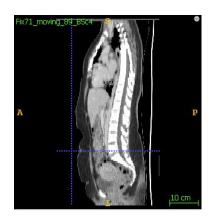
Data: In this project XCAT data is been used. XCAT has 50 Cases and their corresponding labels (31 Male and 19 Female Cases).

Method:

- **Main idea:** Main idea of this project was making some new data using simple registration technique from existing CT data. This code be a possible alternative of arbitrary augmentation such as flip, rotation, zoom etc.

- **Method used:** A simple but powerful non-rigid registration technique BSpline is been used for this. There are number of parameters that can be used to make the variation of the registration to make new data which is completely different from Moving and Fixed CT used for registration.

| a) Moving Image | b) Fixed Image | c) Registered Image |

Fig. Input and output of the Registration.

- **Labels:** From the Registration we got an Transformation matrix, which can be used to make the labels for the new CT data.

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Experiments:

There are numbers of parameter you can change to make the degree of registration for making different data. Here Below listing some perform experiments:

##Case-1
Default Prameter-- works Really Good But time Consuing
Time:19 min

###Case-2
Default Parameter Change
Learning rate=2
convergence window=20
time:11 min

###Case-3
Converge Window=50
all this cases are different.

##Case-4
learningRate=2.0, numberOfIterations=4, convergenceMinimumValue=1e-10, convergenceWindowSize=10
Not as fat as same, but fatter than other cases.
time:9.59min

##Case-5
registration_method.SetMetricAsMattesMutualInformation(numberOfHistogramBins=50)
outcomes: little fater than case 1

##Case-6
mesh_size = [int(image_size/grid_spacing + 0.9)

time:mesh_size = [int(image_size/grid_spacing + 0.9)

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##Case-7
grid_physical_spacing = [100.0, 100.0, 100.0]

time: 0:07:32 secs (Wall clock time)

##Case-8
grid_physical_spacing = [200.0, 200.0, 200.0]
Execution took: 0:06:36 secs (Wall clock time)

##Case-9
grid_physical_spacing = [400.0, 400.0, 400.0]
very bad.
time:6:17

##Case-10
grid_physical_spacing = [25.0, 25.0, 25.0]
time:35

##Case-11
Order=2
time:4:58 min

Code: Code is provided in Gitlab.

Required Libraries for this Code:
1. Numpy
2. SimpleItk
3. Matplotlib
4. Math
5. Os
6. Glob
7. Ipythondisply
8. ipywedgets

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