The Realization of 3D Deformation Data Augmentation

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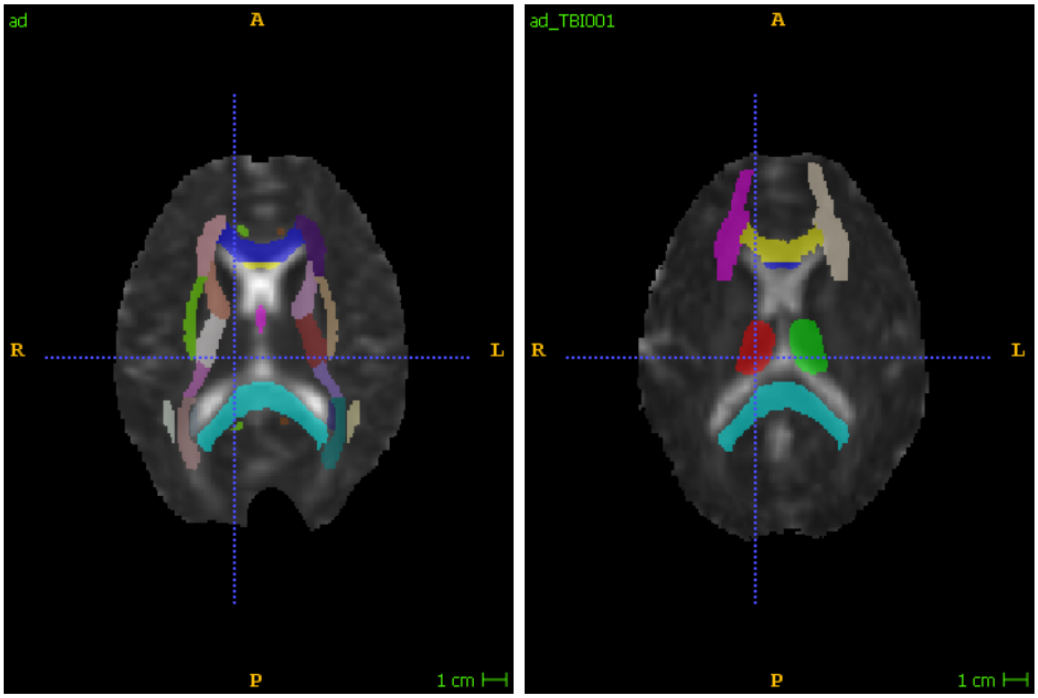
I. INTRODUCTION

As was introduced in the proposal, we realized a data augmentation method by using 3D Deformation to offset the potential noise when MRI image is registered from subject space to template space.

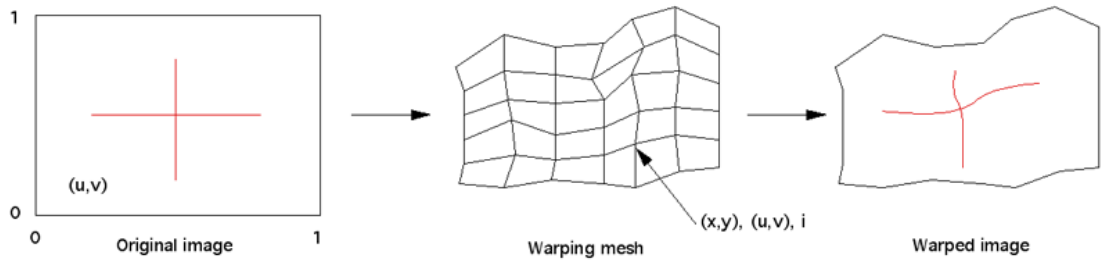


(a) A slice of MRI image in FA channel with 36 Region of interest mask

(b) A slice of MRI image in FA channel with 7 Region of interest mask

II. MESH-BASED WARPING

The standard approach is to create the image in a format that contains all the required visual information and distort it (from now on referred to as "warping") to compensate for the nonplanar nature of the projection device or surface. The original image is considered to be a texture that is applied to a mesh defined by node positions and corresponding texture coordinates. The warping can be performed in either the x, y coordinates or in the u, v coordinates or in both. This flexibility allows the method used to be chosen that best matches the way the mesh is derived, sometimes it is easier to derive the u,v coordinates given the x,y coordinates, other times the reverse is so.

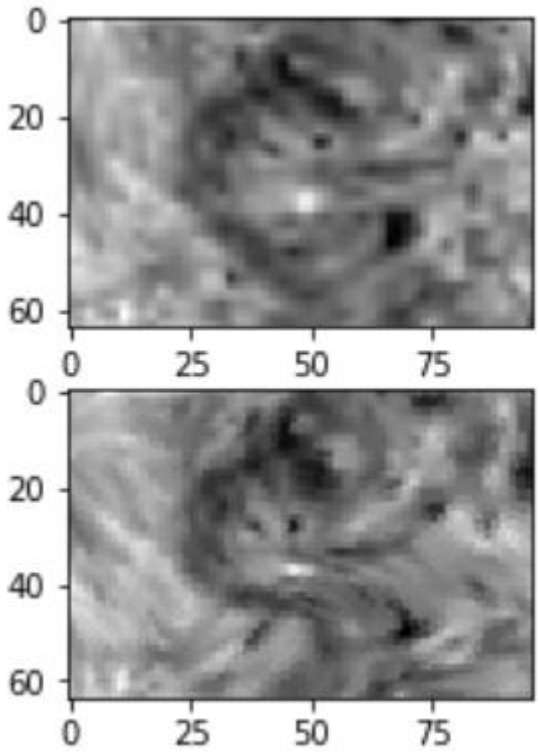


III. Realization

To realize a 3D mesh-based warping, we first warp the graph in 2-dimensional plane, and then warp it in the other dimension.

1) 2D dimensional warping

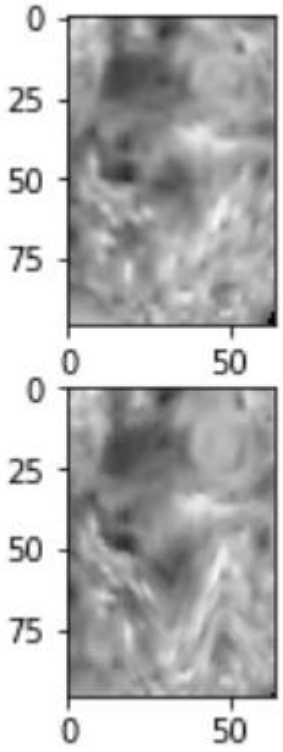
We utilized the tools in the PIL.Image package, which includes the function *Image.fromarray* to transform a numpy array to an image. We realized the function to griddify the image by extracting the coordinate (x,y) of several points in the graph. Then we add some random number to the coordinate of those points. We call the new coordinate set as source grid and the original one as the destination grid. Now we could write a function to return a mesh based on the source grid and the destination grid. Finally, we utilized the function *Image.transform(img.size, Image.MESH, mesh)* to get a new image warped based on the mesh we got above.



The result of 2D-warping on the MRI slice

2) 1D-warping

The 2D warping and 1D warping are approximately similar except 1D warping just requires one coordinate (z).



The result of 1D-warping on the MRI slice

IV. Conclusion

We have realized the learning task of classification for mTBI identification without data augmentation and the 3D deformation method to augment the data. We have not yet proven the effect of the method due to the time limit. But the whole project is still a great exercise for us to test our machine learning skills.