Summary of Summer Internship

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Vyas Gupta’s Summer 2019 at the Medical Physics Department of MSKCC under the mentorship of Dr. George (Guang) Li. My folder is located at ‘\\imph9026\b\George\Vyas\_Gupta’.

# Project 1: Batch Tester Framework

The purpose of this project was to create a MATLAB script that will test a given function across all datasets within a folder. Using this script would increase productivity – less time would be spent trying test the code with each dataset individually; instead, one click would produce results for all datasets, which could then be viewed all at once. Furthermore, seeing the results against all datasets ensures that the programmer creates robust code rather than overfit to the one or a few datasets.

The protocol for using this Batch Tester can be found in the Word document “BatchTesterFramework.docx” at the “B:\George\Vyas\_Gupta\Protocols\” directory. It describes how to set up the original Batch Tester, as well as how to customize it. This tool can be customized for each project to cater to the developer’s needs. For instance, I modified a copy of this code for my spine segmentation project and added a component to calculate the dice coefficient based on the results of my spine segmenting code and hand-made ground truth masks. All of this is included in protocol.

# Project 2: Spine Segmentation Function

The Spine Segmentation MATLAB function generates a mask of the spine in a given chest cavity MRI. This is intended for the development of the DIR-4D algorithm; currently, TR-4DMRI has various artifacts due to the sliding of internal organs to against the chest wall and spine. Segmenting out the spine and chest wall and then performing DIR-4D on the separated image will generate more accurate results. The driving force of the algorithm is locating parallel horizontal bars that appear in the coronal view due to the gaps between vertebrae and interpolating them to reach this mask.

The protocol for this function can be found in the Word document “SpineSegmentationFunction.docx” at the “B:\George\Vyas\_Gupta\Protocols\” directory. It provides greater information on each section of code.

Dice coefficient and sensitivity were determined by comparing with a handmade ground truth that I imported into MATLAB from MIM. Dice coefficients were calculated using MATLAB’s provided function and sensitivity was calculated using the total volume of the intersection between the code’s mask and the handmade mask divided by the volume of the handmade mask. A Dice coefficient above .80 is typically recognized as reasonable segmentation. Here are the best results of running the program across 15 datasets (patients and volunteers):

|  |  |  |
| --- | --- | --- |
| **Patient/Volunteer #** | **Dice Coefficient** | **Sensitivity** |
| P12 | 0.8298 | 0.8673 |
| P13 | 0.8288 | 0.7793 |
| P14 | 0.7849 | 0.8898 |
| P18 | 0.7867 | 0.7026 |
| P3 | 0.7681 | 0.7770 |
| P6 | 0.8036 | 0.8727 |
| P9 | 0.7760 | 0.6959 |
| V10 | 0.8175 | 0.8674 |
| V11 | 0.7800 | 0.8553 |
| V12 | 0.8147 | 0.8254 |
| V13 | 0.8510 | 0.9111 |
| V15 | 0.8387 | 0.8313 |
| V2 | 0.8104 | 0.7868 |
| V8 | 0.7218 | 0.7556 |
| V9 | 0.8030 | 0.8633 |
| Average | **0.8010** | 0.8187 |

# Project 3: DeepLab Spine Segmentation Experiment

This is just a prospective project, but the idea is to use Deep Learning to segment the spine for the same reason as listed above. The reason this project was prospective/experimental was because the goal is to create a DeepLab model that will segment the body cavity from the body shell. Furthermore, there are currently technological limitations with going this route full-fledged; currently, IMPH9074 only holds a 2 GB GPU and 12+ GB would be required. Therefore, I have used a much more compact neural network (MobileNet backbone) and a batch size of 1 (leads to overfitting and lower accuracy/robustness).

# Smaller Projects