PELVIC IMAGE ANALYSIS AND GEOMETRY RECONSTRUCTION USING ARTIFICIAL INTELLIGENCE

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Background

Medical imaging are used to view the human body to diagnose, monitor, or treat medical conditions.
The output image, i.e., MRI image, is processed to be more beneficial to medical doctors using image segmentation and 3-D model construction.

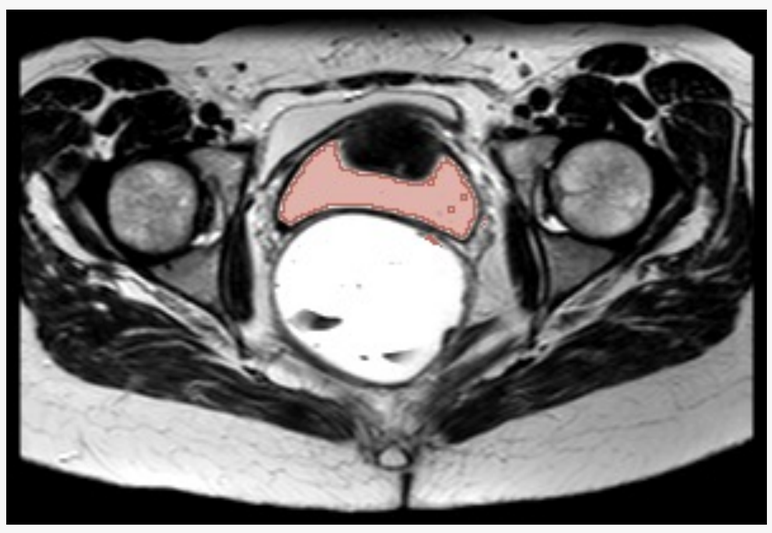


Fig. 1: Threshold set on MRI image of female pelvic organs

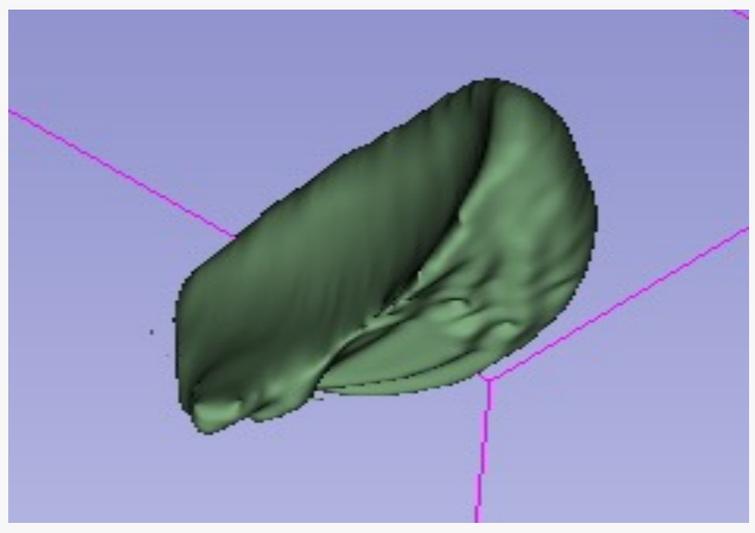


Fig. 2: 3D generated model of a vagina using 3D Slicer

Problem

The procedure of segmenting images and creating 3-D models of specific organs can be prolonged and repetitive.

Goal

The overarching goal of this research project is to streamline the process of converting MRI images of pelvic organs into 3-D model objects using artificial intelligence.

Technologies

3DSlicer
docker
PyTorch
aws
MONAI
NVIDIA CLARA

Data

- 16 3D Volumes (MRI) which after preparation, provide close to 600 records for training.



Fig. 3: Input volume split into patches in preparation for training

- An input image must pair with a corresponding label map.

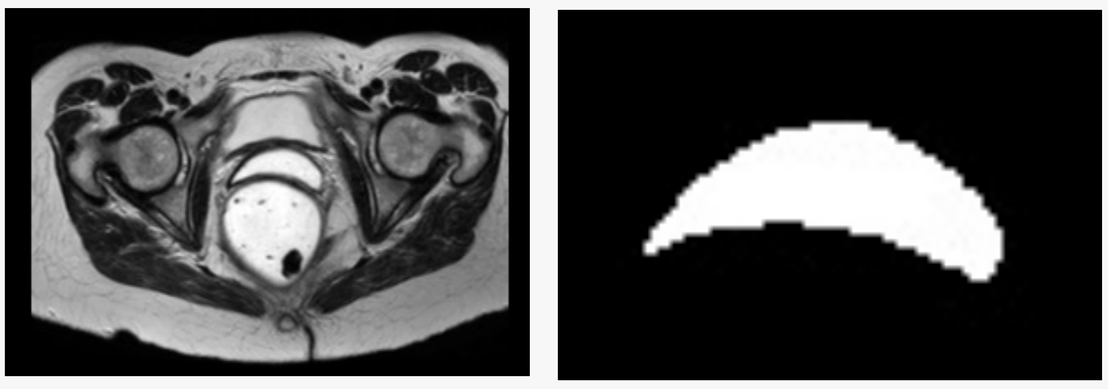
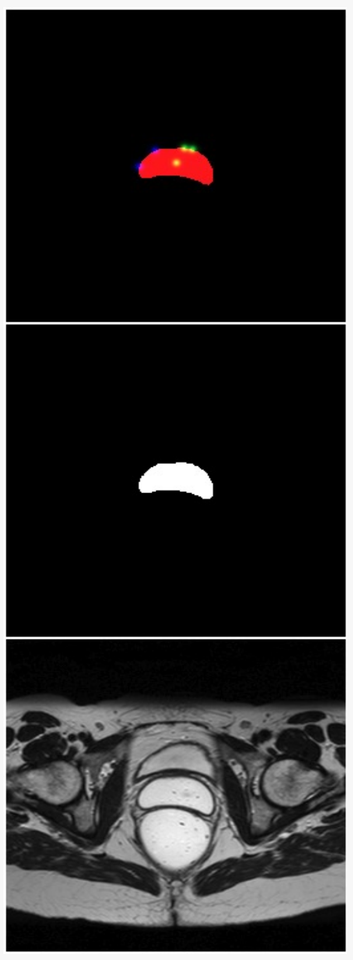


Fig. 4: Axial view of MRI image (left); Corresponding Label mask of vagina (right).

Results



The accuracy of the AI model was calculated through TensorBoard using the Dice Loss Function. The loss was cut in half after 1,000 iterations and approaches close to zero after 3,000 iterations.

$$Dice = \frac{2 \times TP}{(TP + FP) + (TP + FN)}$$

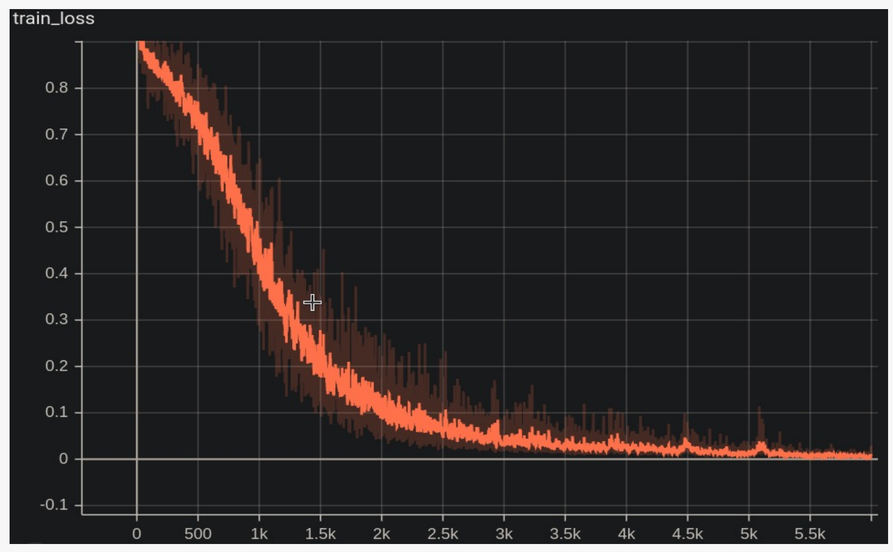


Fig. 5: Output segmentation from 3D U-Net (left); Loss function decreasing with each iteration (right).

Next Steps

- Gather more MRI data while continuing the AI training and integrate the model back into 3D Slicer.
- Research on GANs in the future.