Andres Diaz-Pinto on behalf of MONAI Label Team (NVIDIA & KCL)

June 2021

https://github.com/Project-MONAI/MONAILabel

Outline:

- What is MONAI Label?
- Why use MONAI Label?
- How to create a MONAI Label App?
- Demo - Only training, only Inference, and both

What is MONAI Label?

- An intelligent open source image labeling and learning tool that enables users to create annotated datasets and build AI annotation models for clinical evaluation
- Framework for developing and deploying MONAILabel Apps to train and infer AI models
- Compositional & portable APIs for ease of integration in existing workflows
- Customizable design for varying user expertise
- 3D slicer support

MONAI Label Infrastructure

AppService

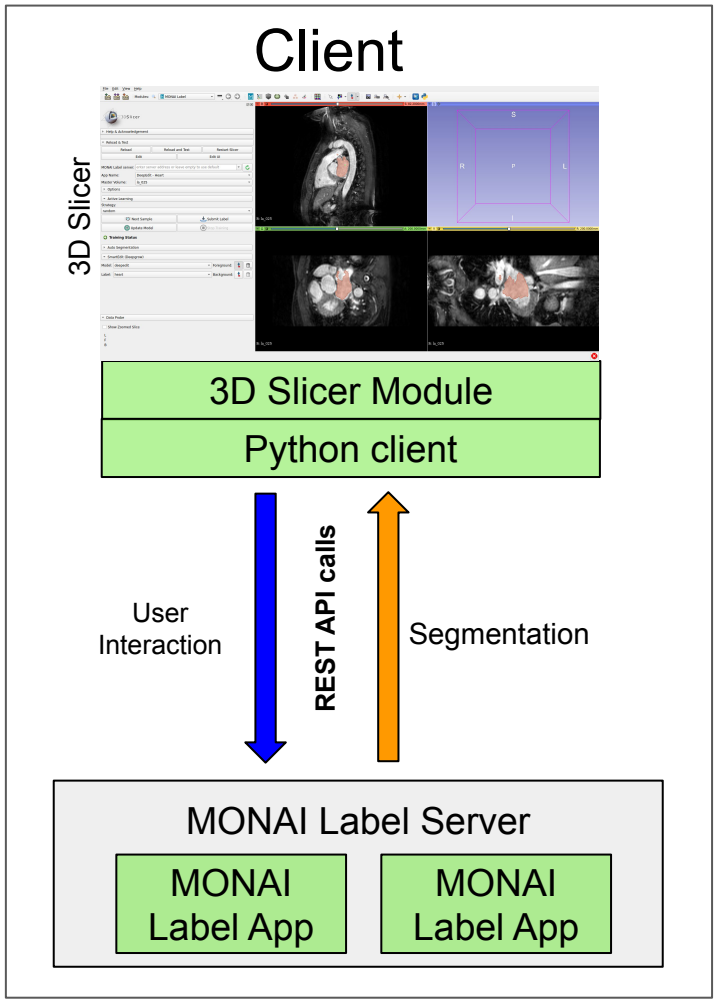
GET	/info/	Get App Info
GET	/download/{image}	Download Image

Infer

POST	/infer/{model}	Run Inference for supported model
GET	/batch/infer	Get Status of Batch Inference Task
DELETE	/batch/infer	Stop Batch Inference Task
POST	/batch/infer/{model}	Run Batch Inference Task

Train

GET	/train/	Get Status of Training Task
POST	/train/	Run Training Task
DELETE	/train/	Stop Training Task



Why use MONAI Label?

- **Researcher Perspective:** MONAI Label allows researchers to
  - create new annotation methods
  - involve active learning techniques
  - verify their effectiveness in real-world scenarios
  - make incremental improvements
  - readily deploy labeling apps to wider audiences

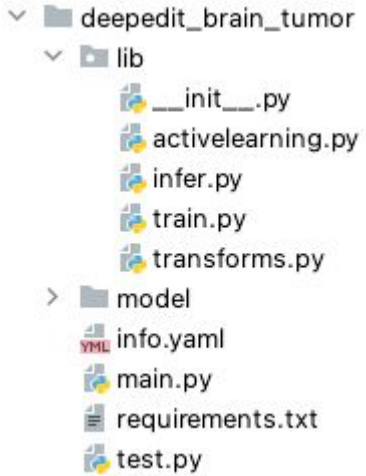
- **Clinician Perspective:** MONAI Label reduces the time and effort of annotating new datasets
  - Ready-to-use 3DSlicer plugin

How to create a MONAI Label App?

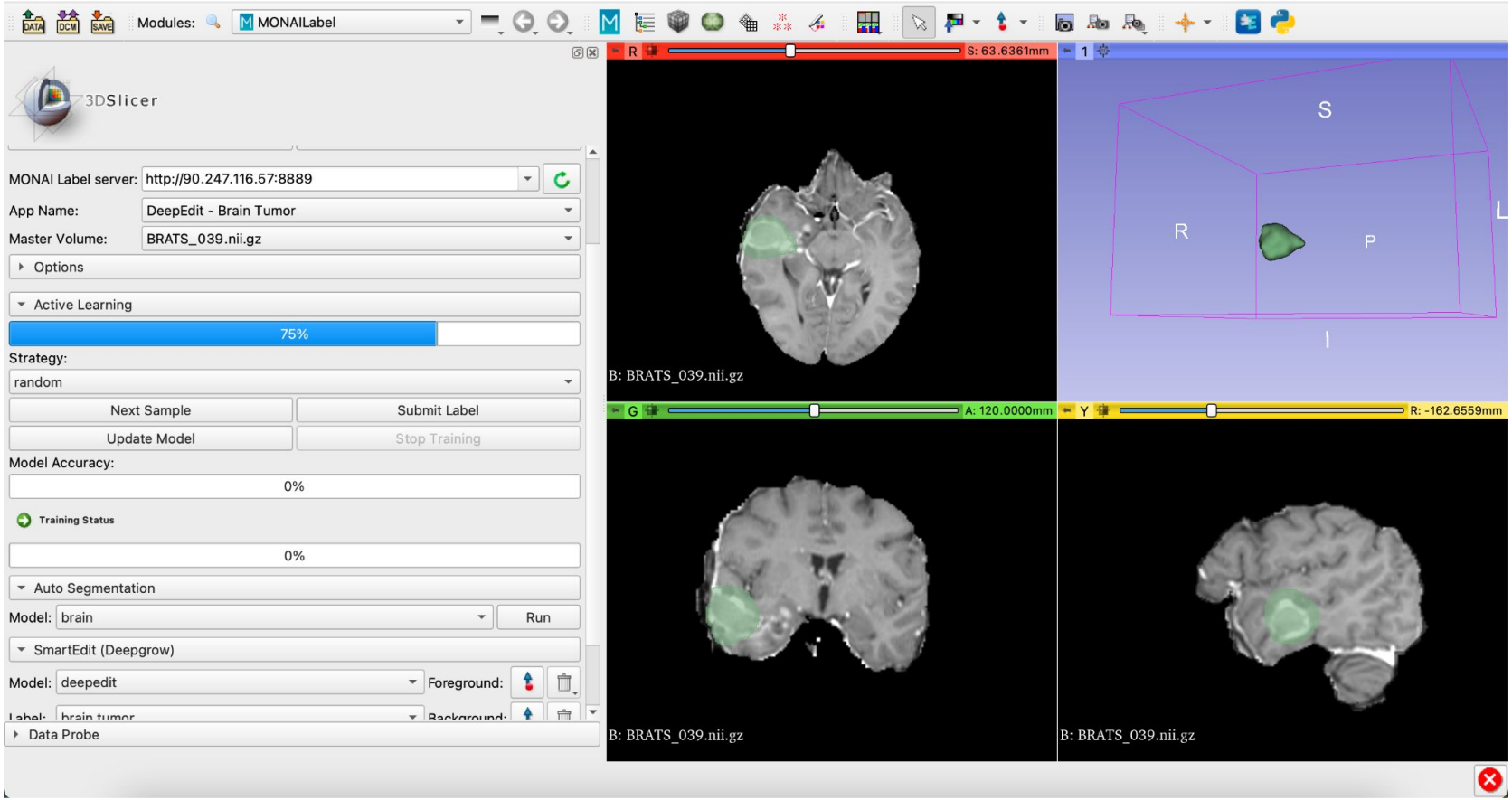
- Define the spatial/intensity transforms to preprocess images for training and inference
- Define the active learning technique use in the labeling app
- Define neural network architecture
- Preprocess points, ROI, closed curve, or any input sent to the MONAI Label server through the REST API

Researchers can also use sample apps (i.e. DeepGrow, DeepEdit and UNet) to jumpstart the development of their own custom labeling apps

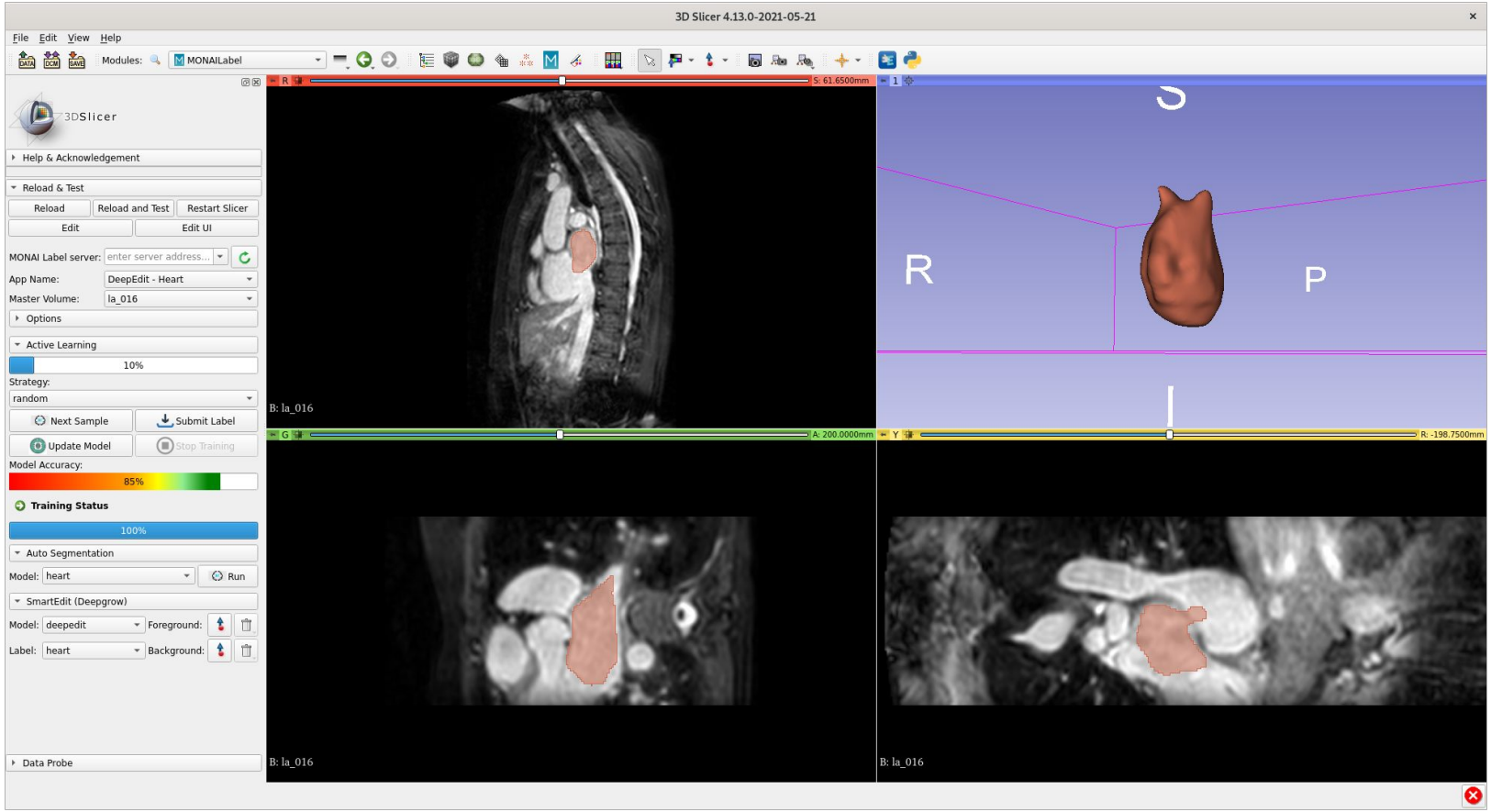
- For more details check out our tutorial



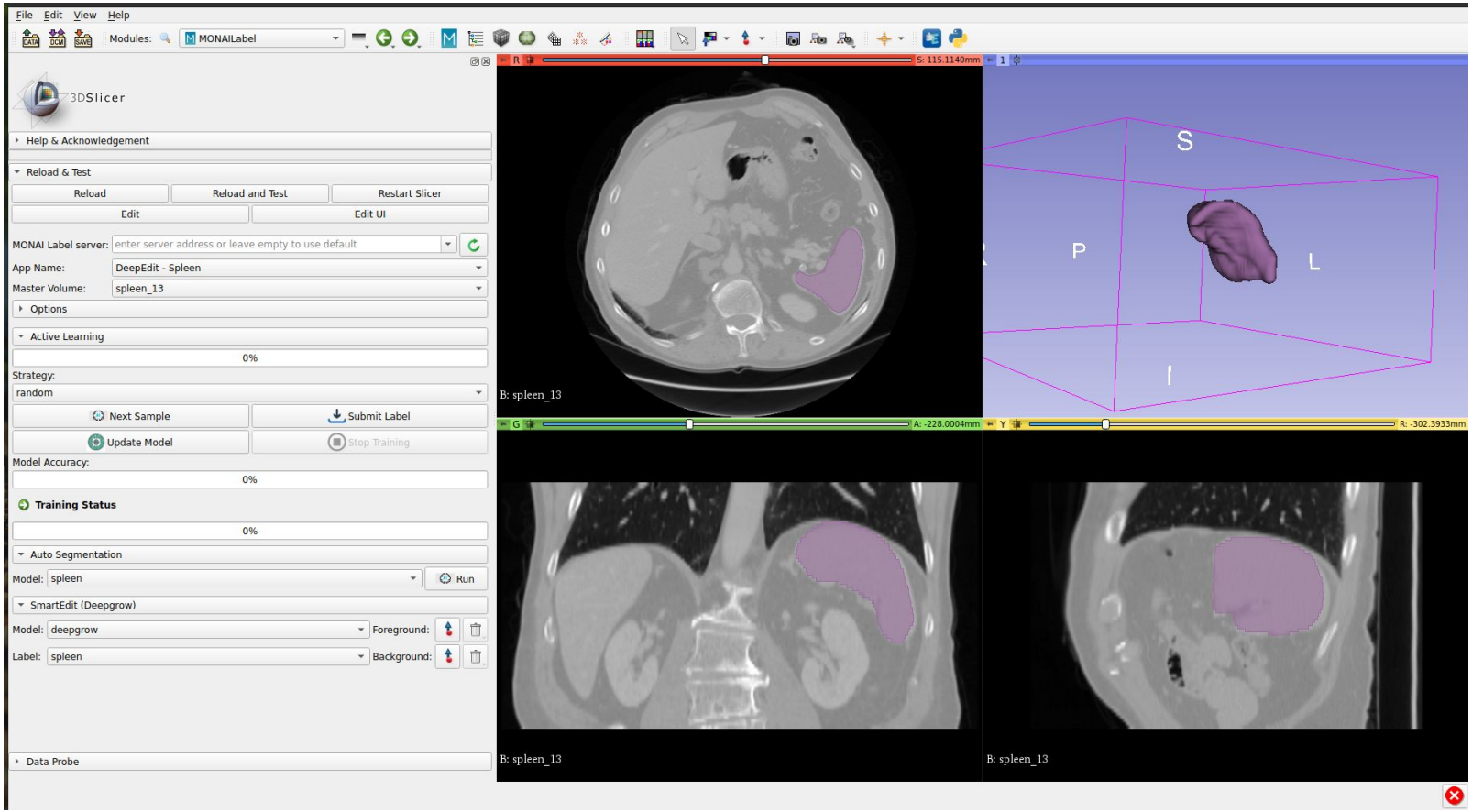
Demo - Brain Tumor



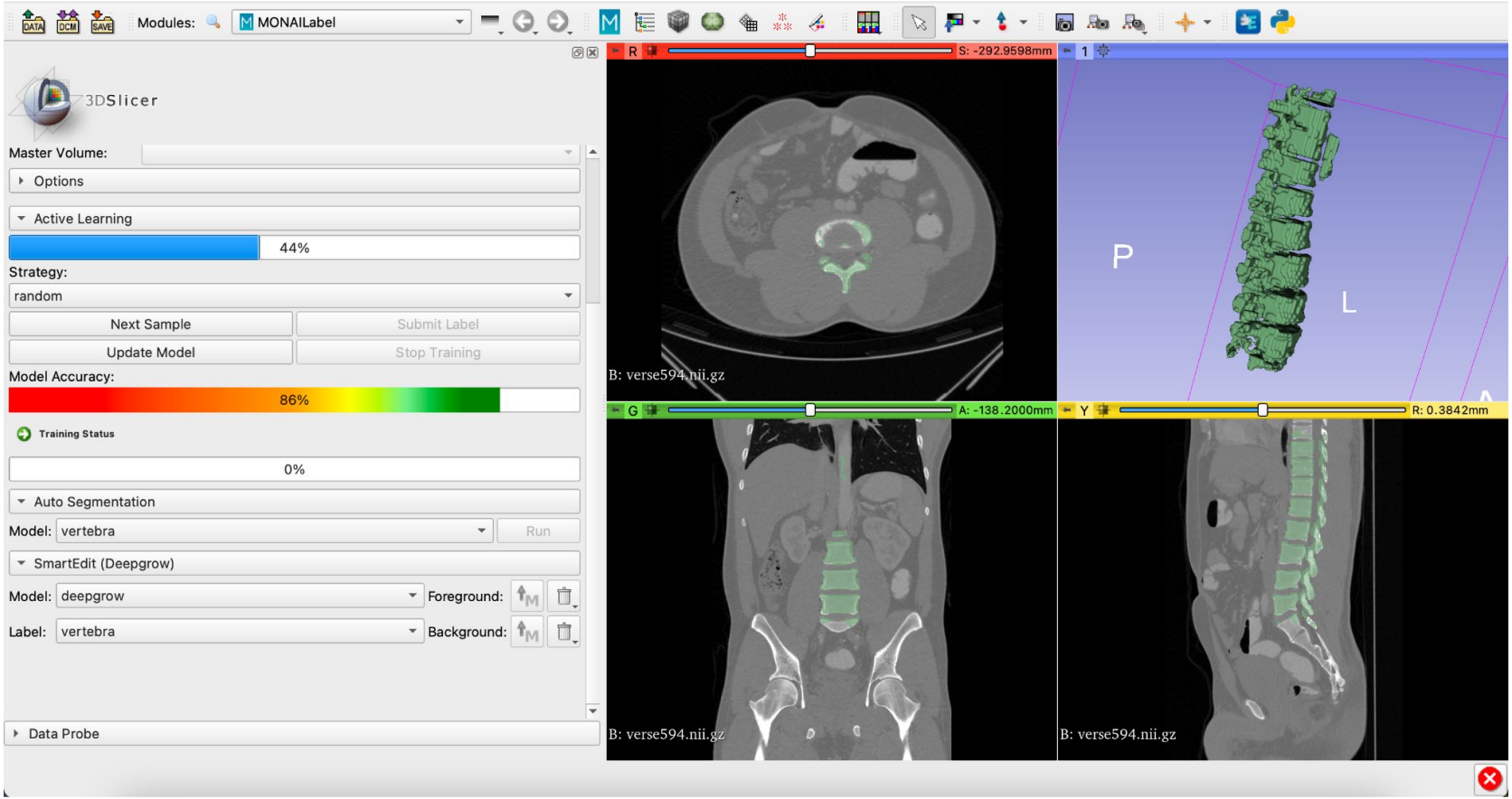
Demo - Left Atrium



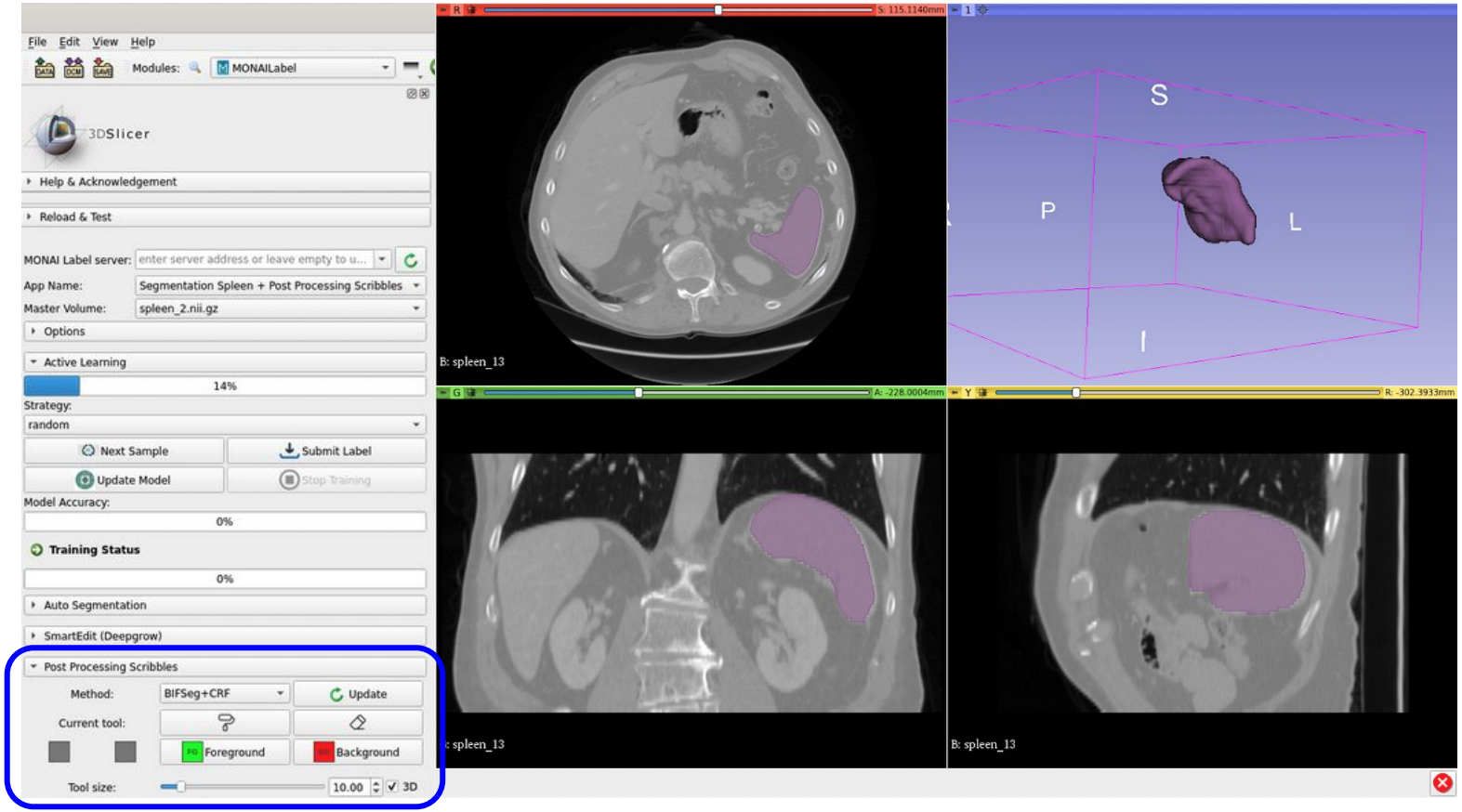
Demo - Spleen


File Edit View Help
Modules: MONAILabel
3DSlicer
Help & Acknowledgement
Reload & Test
Reload
Reload and Test
Restart Slicer
Edit
Edit UI
MONAI Label server:
enter server address or leave empty to use default
App Name:
DeepEdit - Spleen
Master Volume:
spleen_13
Options
Active Learning
0%
Strategy:
random
Next Sample
Submit Label
Update Model
Stop Training
Model Accuracy:
0%
Training Status
0%
Auto Segmentation
Model:
spleen
Run
SmartEdit (Deepgrow)
Model:
deepgrow
Foreground:
Label:
spleen
Background:
Data Probe
B: spleen_13
S
P
L
I
B: spleen_13
B: spleen_13

Demo - Vertebra



If needed, create custom Slicer Module to interact with the MONAI Label App.



More dynamic extensions!

Dorent R. et al., **Scribble-Based Domain Adaptation via Co-segmentation**. MICCAI 2020.

How does MONAI Label help clinicians to save time on image annotation? - Using Spleen MSD dataset

ANNOTATION TIME COMPARISON

	Total Volumes Annotated	Equivalent Manual Annotation Time (Basic: Paint Brush)	Equivalent Manual Annotation Time (Advanced: Contour based)	Manual + AI Annotation Time per 3D volume spent by User	Total Annotation Time Spent by User	Training Time (DeepGrow 2D + 3D)	Validation Dice Score DeepgGrow 2D	Validation Dice Score DeepgGrow 3D
Stage 1	11	275 mins	137.5 mins	~25 mins	275 mins	90 mins	0.891	0.730
Stage 2	16	400 mins	200 mins	~6 - 7.5 mins	305 mins	135 mins	0.924	0.873
Stage 3	26	650 mins	325 mins	~3.5 - 5 mins	340 mins	250 mins	0.948	0.945
Stage 4	36	900 mins	450 mins	~1 - 2.5 mins	350 mins	360 mins	0.967	0.959

** Please note that all Dice Scores are reported on a fixed validation split which has 6 3D volumes. The 6 volumes are included in 'Total Volumes Annotated'
** Basic: A single paint-brush annotation takes ~25 mins per 3D CT Volume for Spleen
** Advanced: A single paint-brush annotation takes ~12.5 mins per 3D CT Volume for Spleen

Spleen dataset: http://medicaldecathlon.com/

Further work:

- Multilabel support
- Multimodality support
- Multiple apps under single server
- Modality agnostic App using heuristic fingerprint algorithm
- Few-shot and self-supervised learning

Thanks!