

Semi-automatic segmentation of anatomy from tomographic images for construction of detailed 3D models

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Existing 3D models of human anatomy

- Artistic models are unrealistically well-behaved
- Anatomy-derived models are too effort-intensive
- Many use cases go unfulfilled!



Artist's rendering, DAZ 3D "Michael 4 Muscle" set

Tractable workflow for labeled 3D models

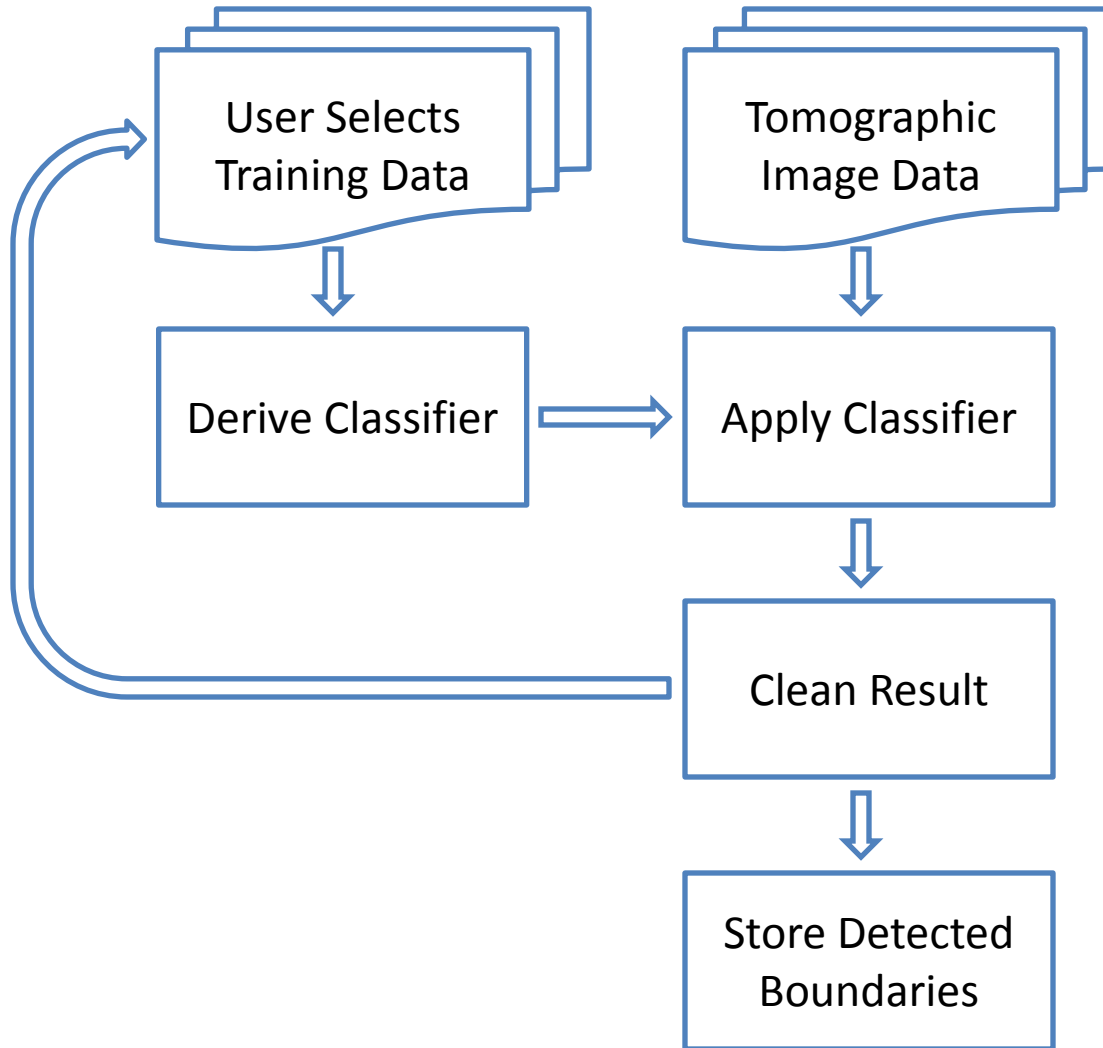
- Visible Human cryoslices afford high-quality tomography
- Provide a variety of tools, let user choose best result
- Provide for manual editing when necessary
- Apply labels via the Foundational Model of Anatomy

Prototype workflow for model generation

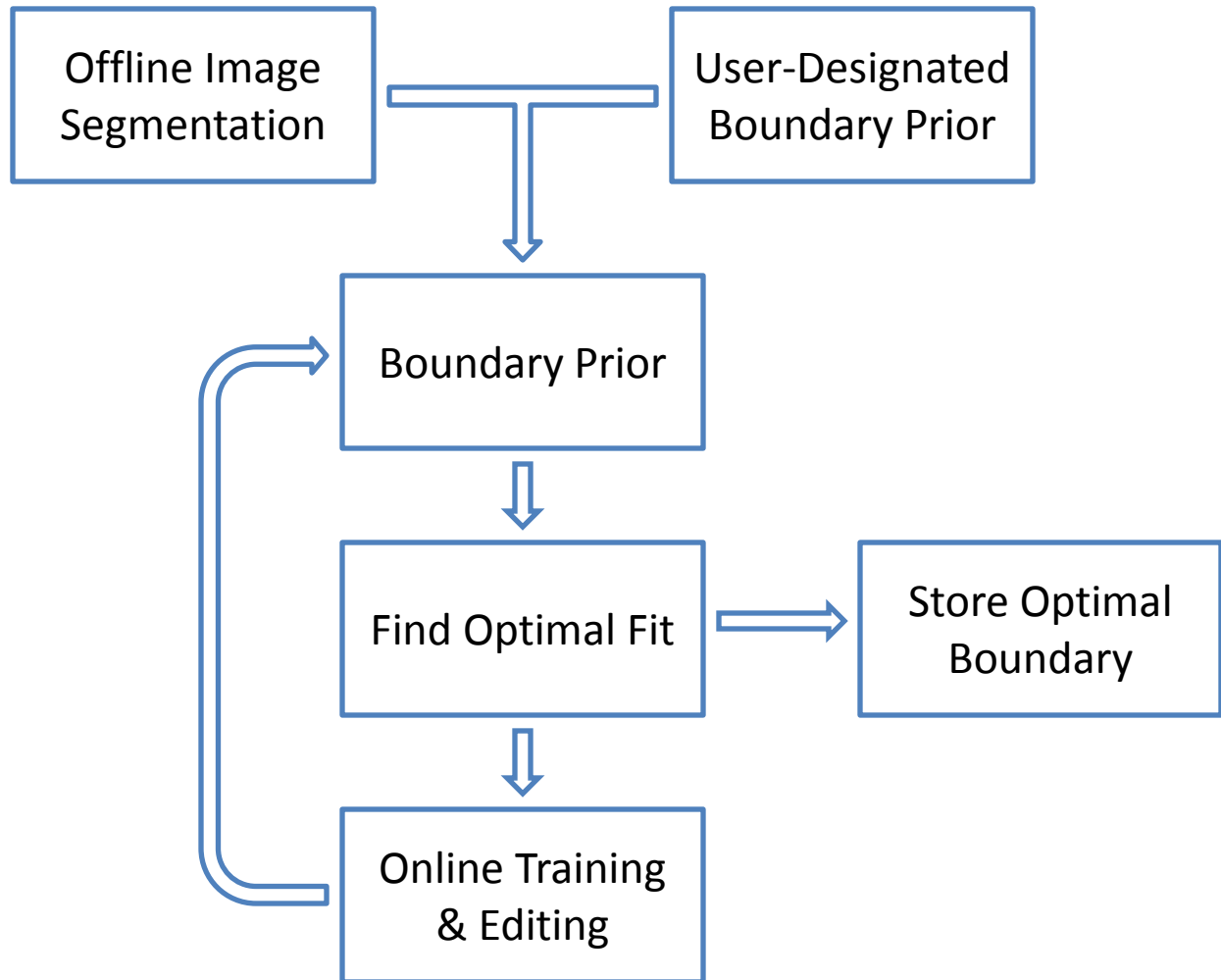


Sample screen layout for anatomy segmentation toolkit

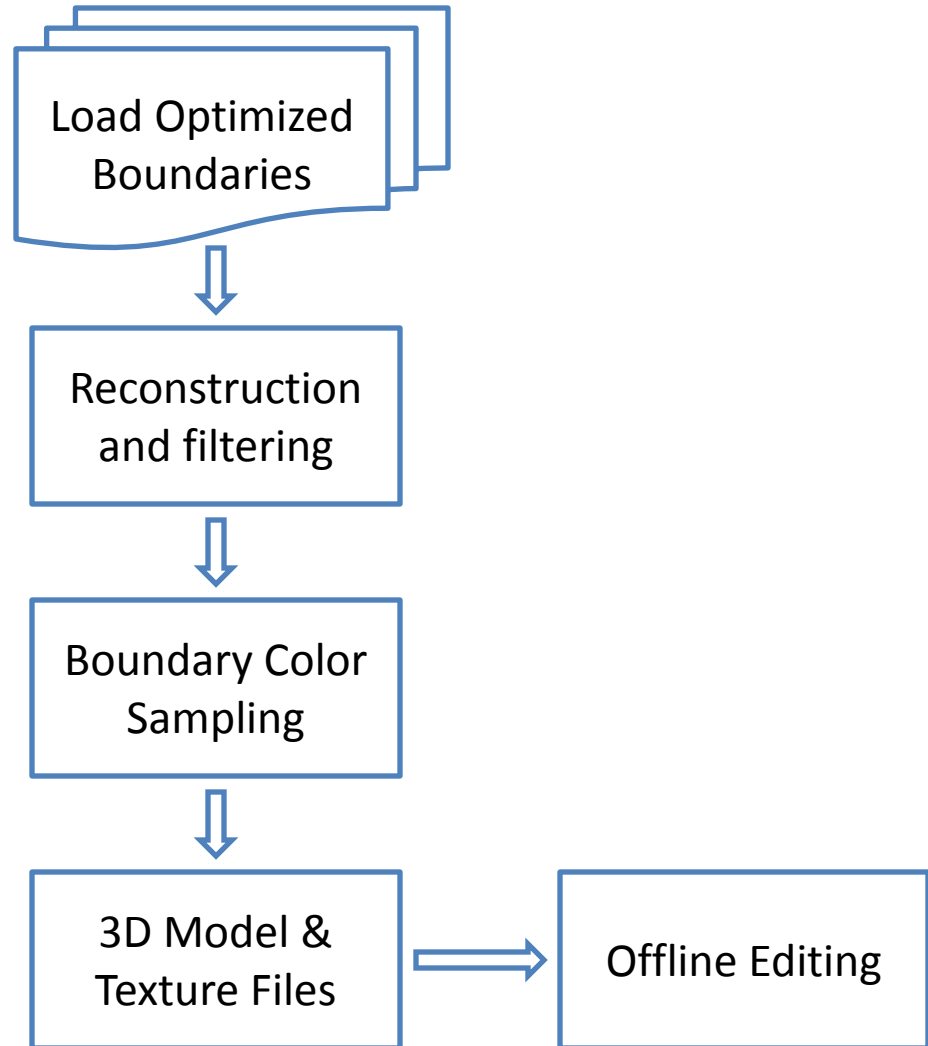
Feature-based image segmentation



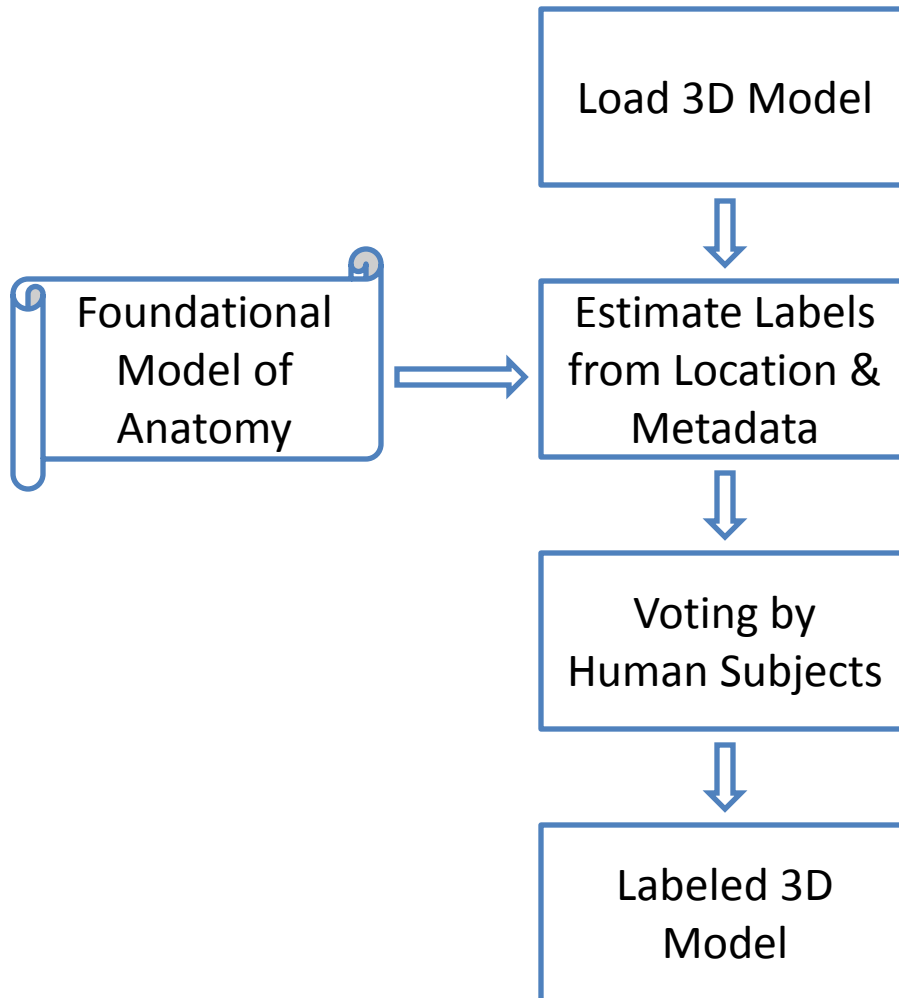
Segmentation with boundary priors



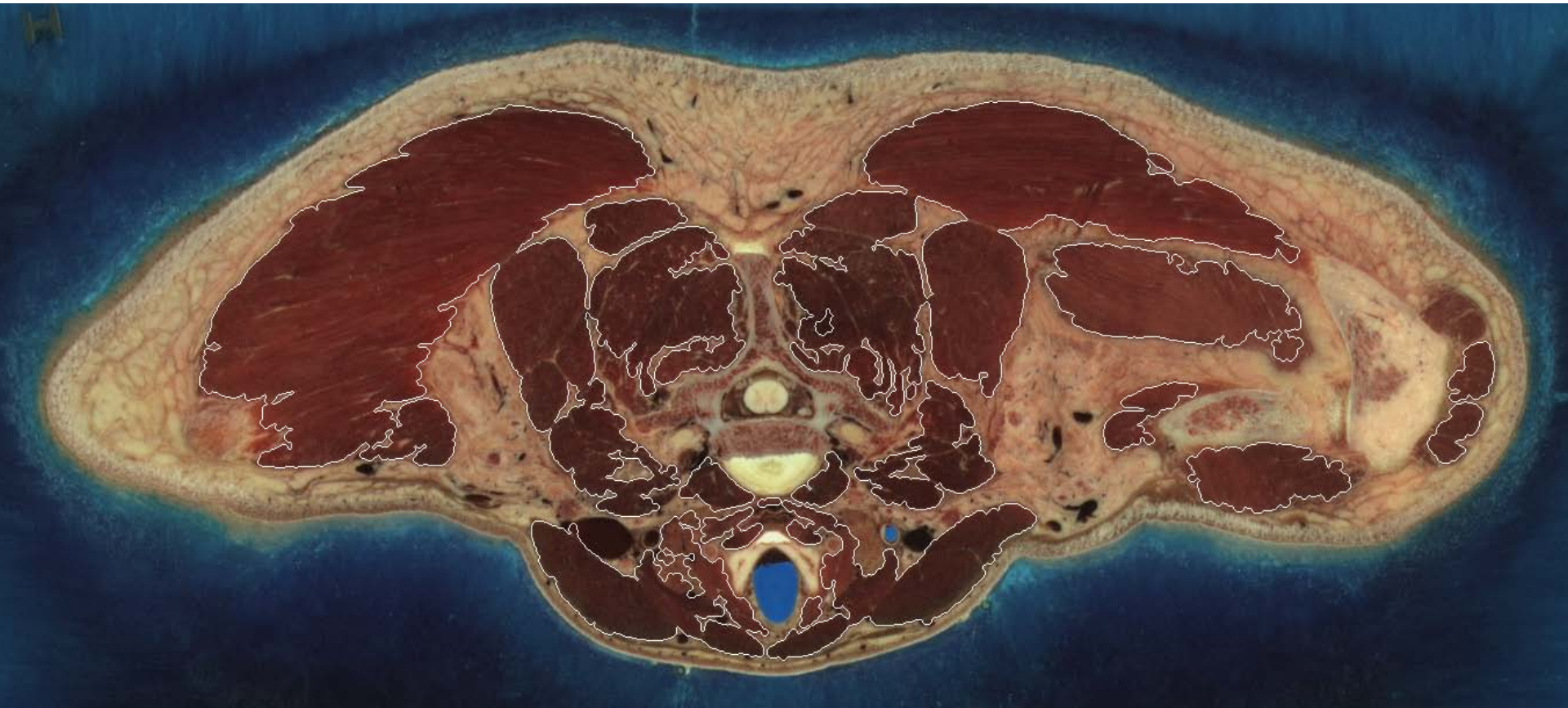
3D reconstruction



Labeling of 3D models

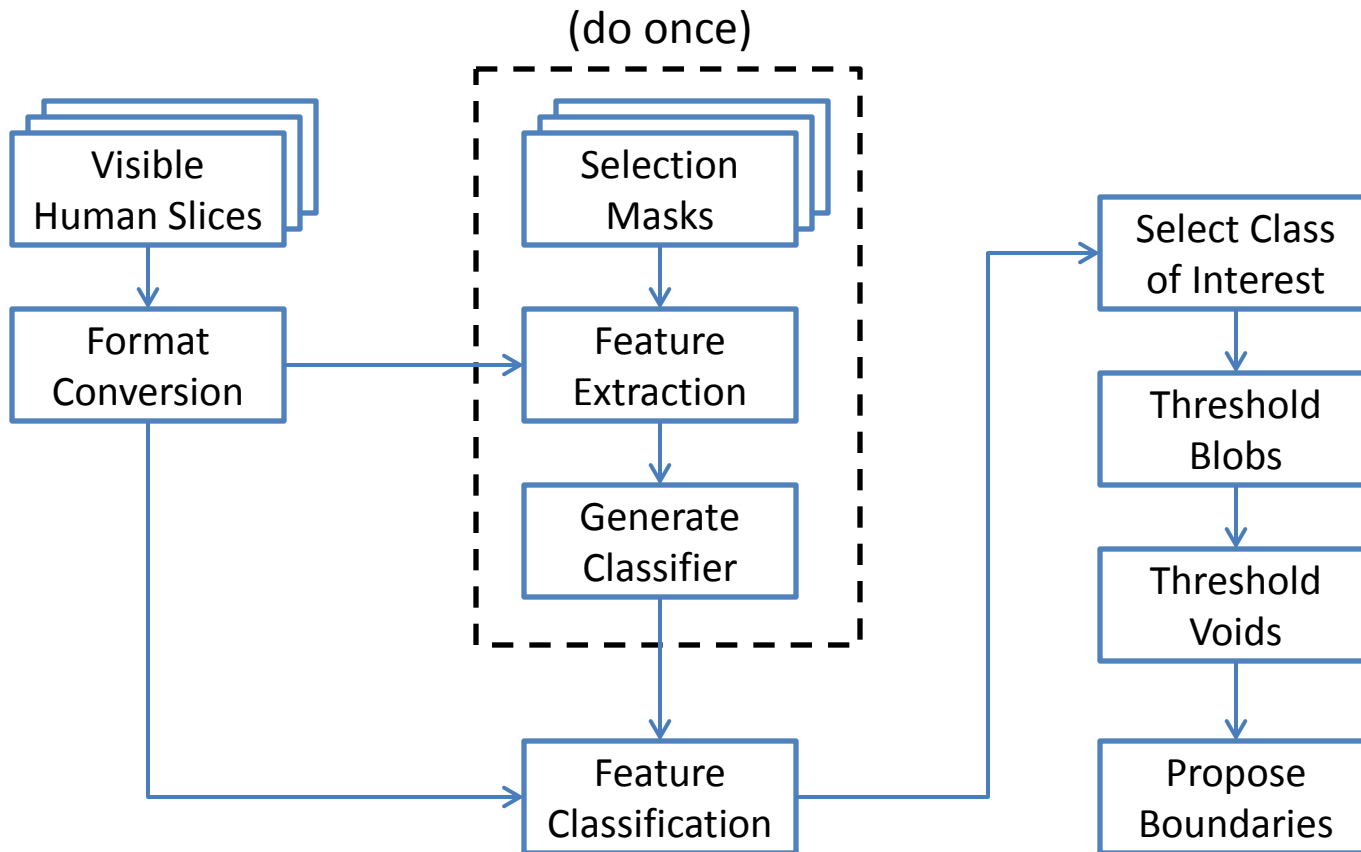


MuscleSelect: Sample Offline Bulk Process



Classification Result from Visible Human, Male

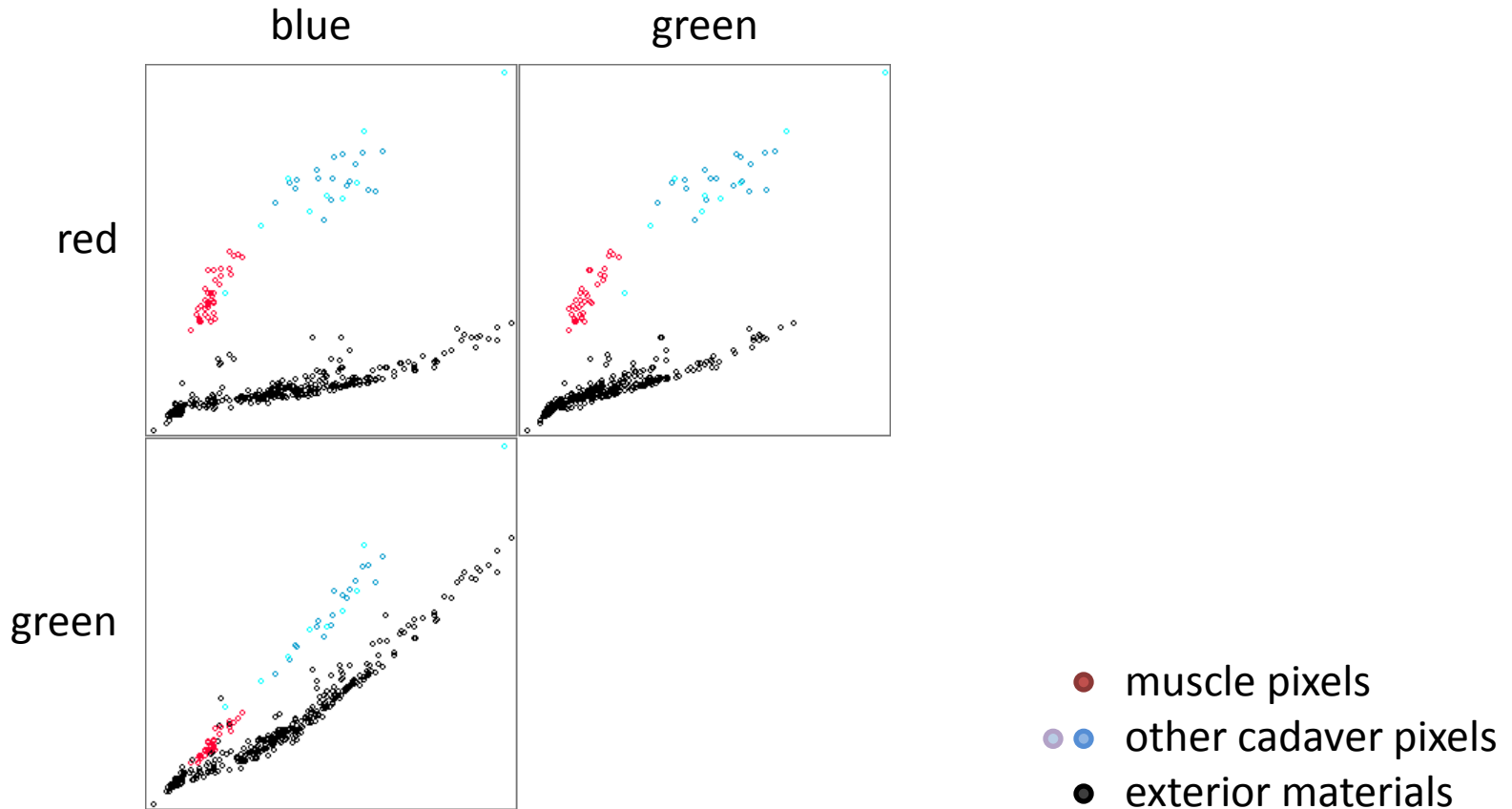
Offline bulk boundary detection



Selection and extraction

- Use set of N selection masks to mark points
- Class 1 is the target, Classes 2 to N are excluded
- Training data selected by non-expert from one frame
 - 116497 designated muscle pixels
 - 81340 non-muscle cadaver pixels
 - 1060023 external material pixels

Classifier exploration in Weka

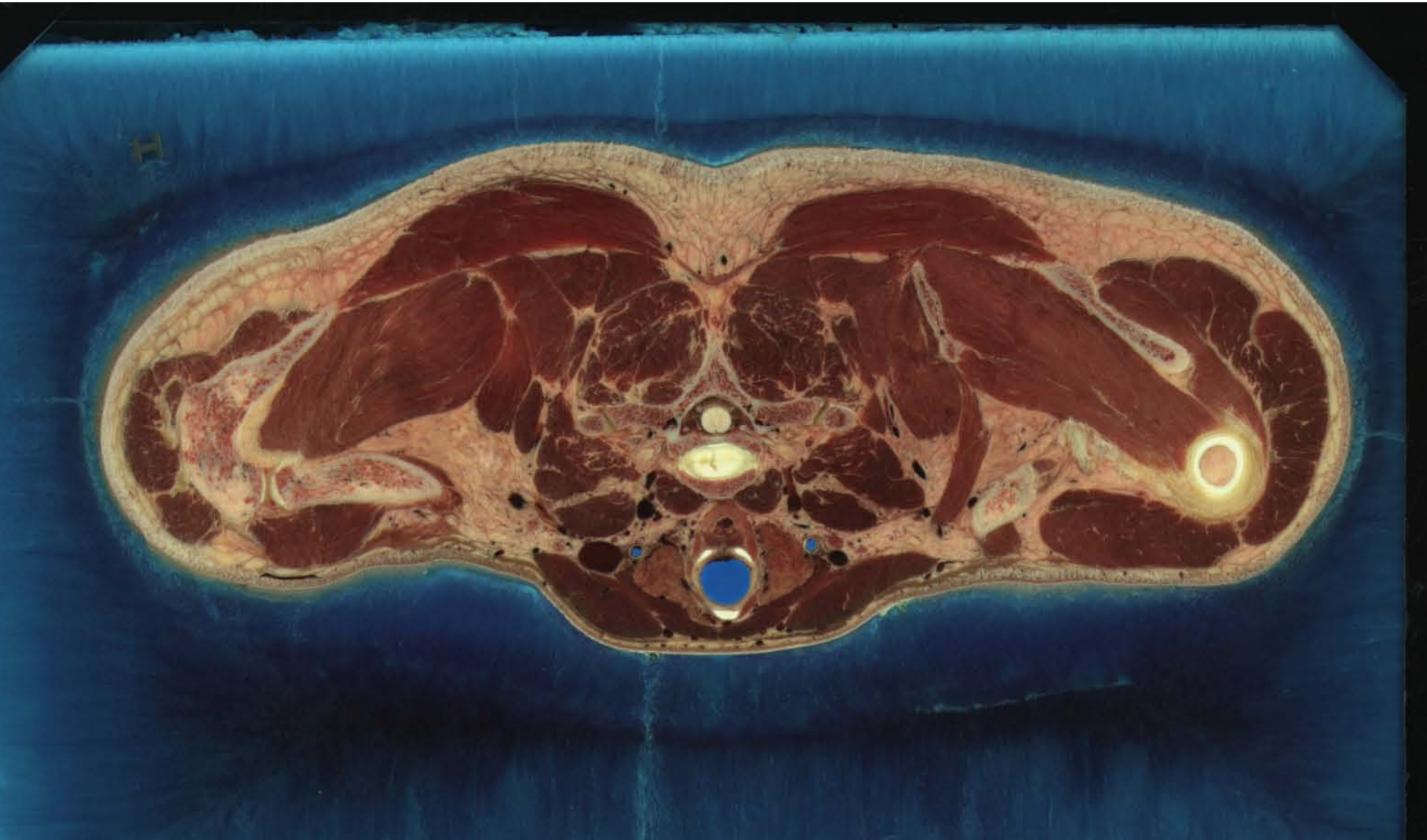


Model comparison

Model	Muscle TP Rate	Muscle ROC Area	Time to Build
NaiveBayes RGB	0.971	0.994	3.89 sec
NaiveBayes RGB/HSV	0.968	0.999	11.61 sec
RandomForest	0.994	1.000	277.65 sec

- Muscle is distinct in color, classifies well
- Choice of color space unimportant (for muscle)
- Training time is critical for online tasks

Source image



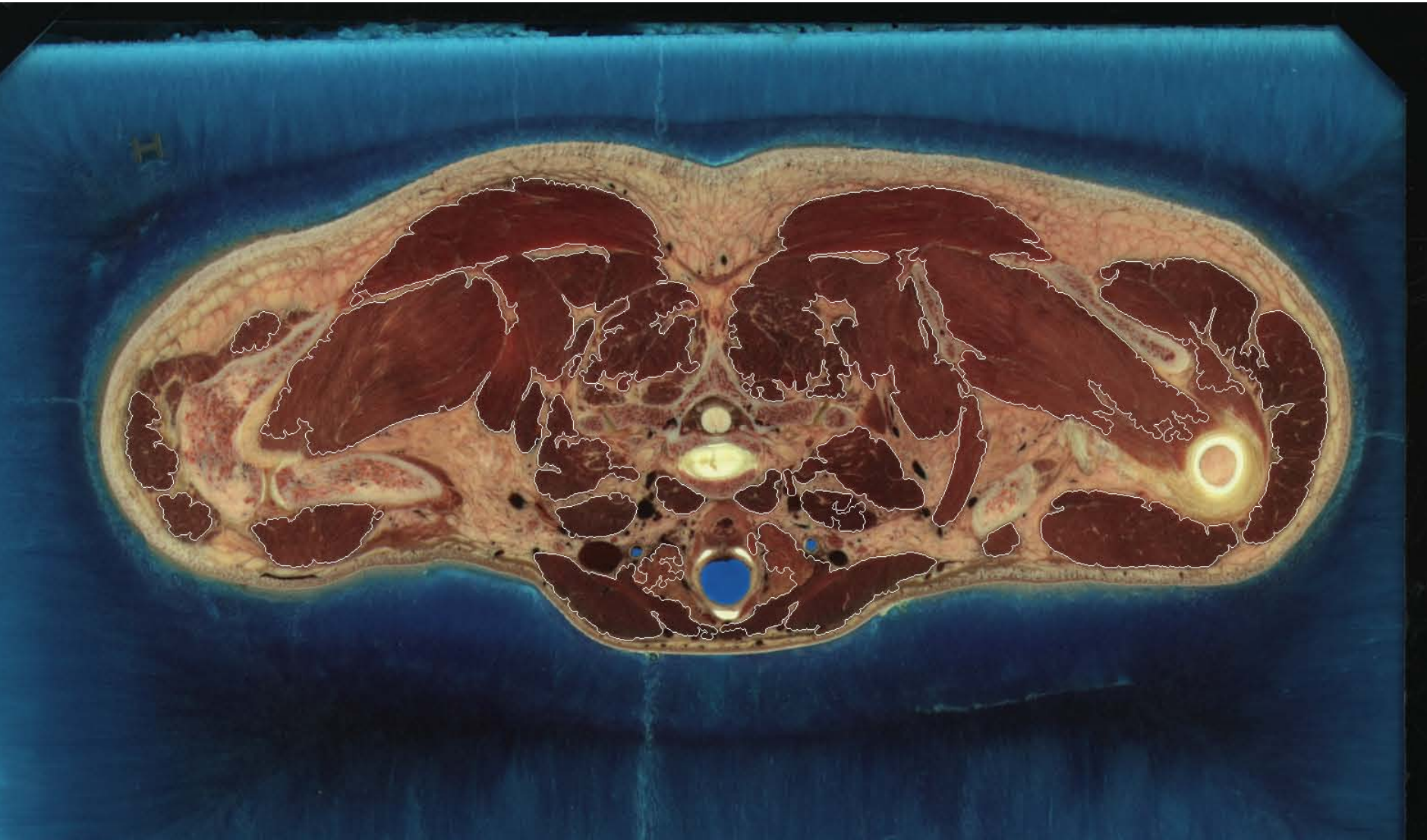
Classifier output



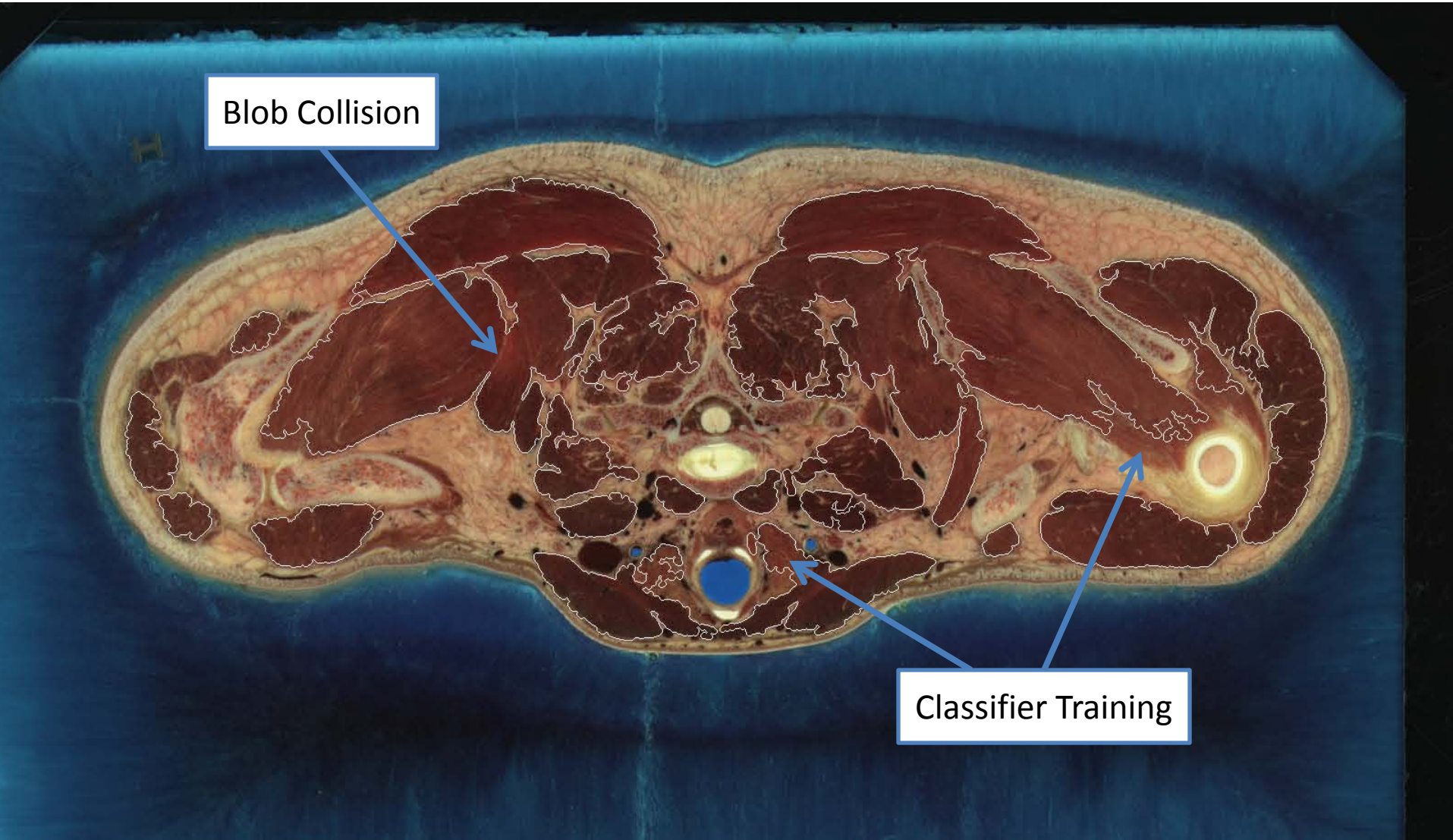
Cleaned blobs



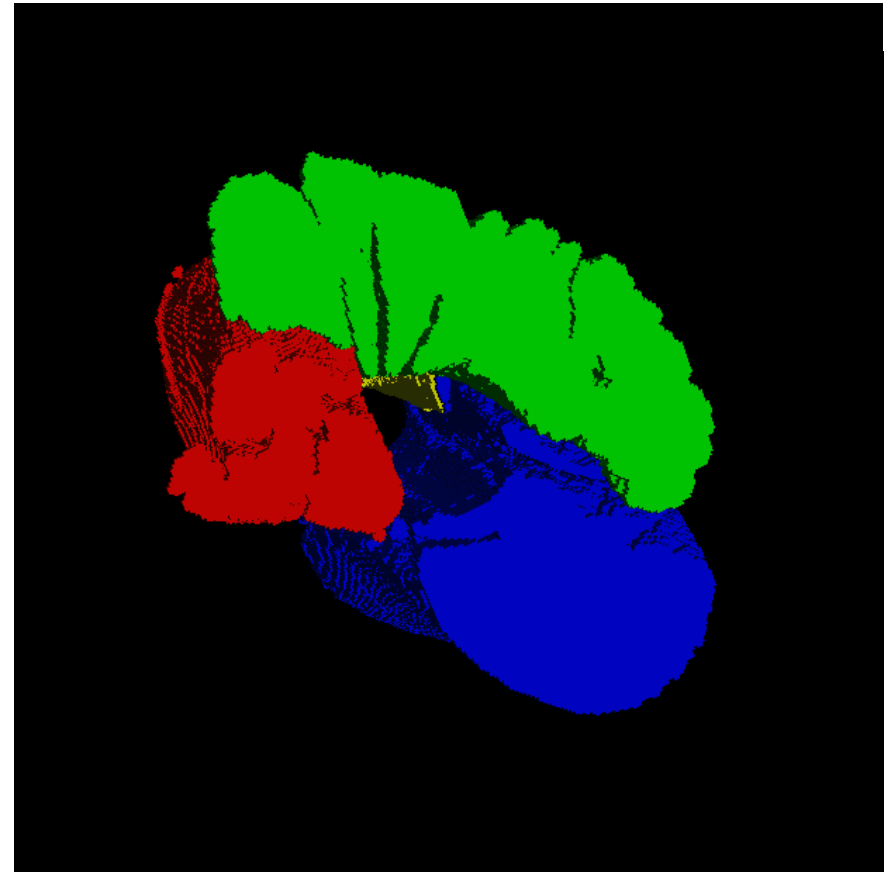
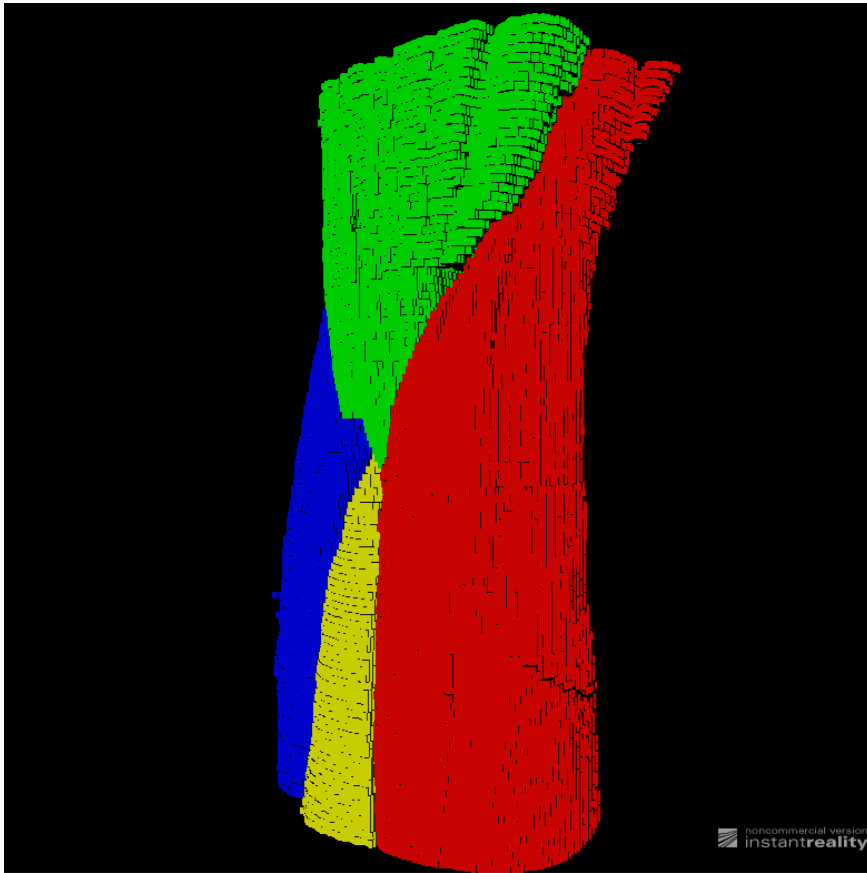
Proposed boundaries



Major error cases

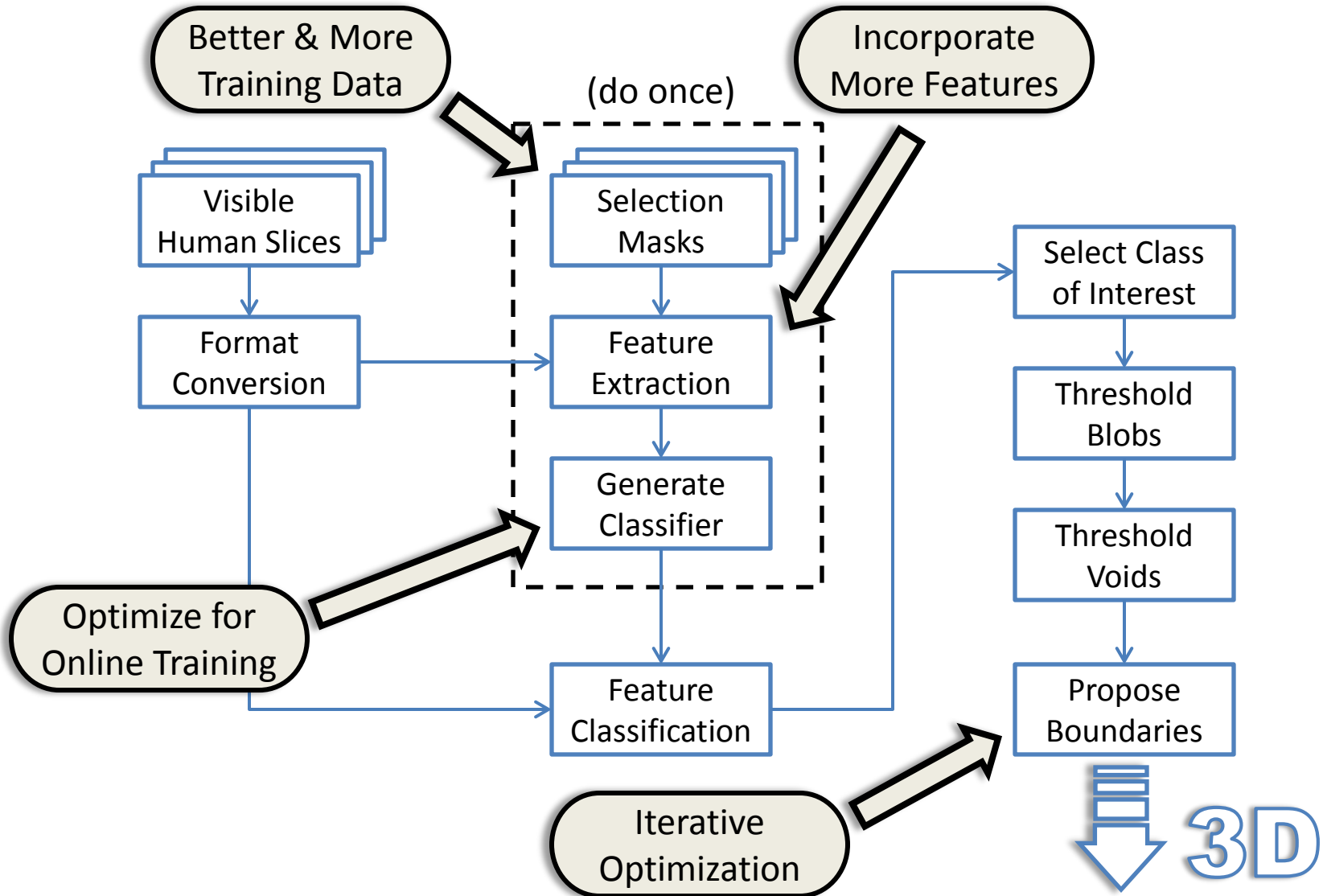


Sample 3D results: arm section from VH Male



- deltoid muscle
- biceps brachii
- triceps brachii
- long head

Upgrade paths



Questions?

