eeDAP Registration Accuracy Evaluation

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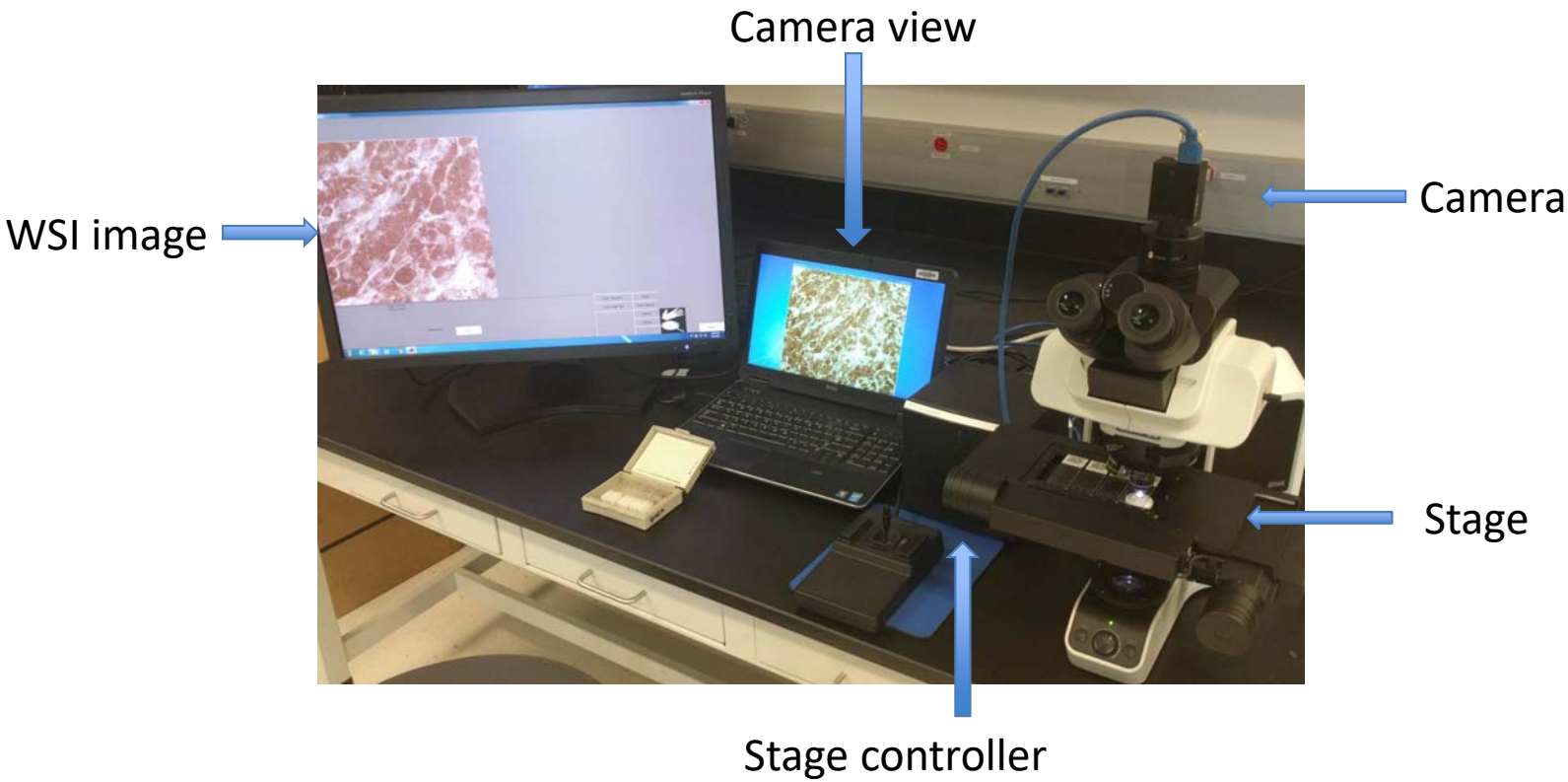
Outline

- eeDAP Introduction
- Registration Study Purpose
- Methods
- Results
- Conclusion and Discussion
- Future Plans

eeDAP

evaluation environment for Digital and Analog Pathology

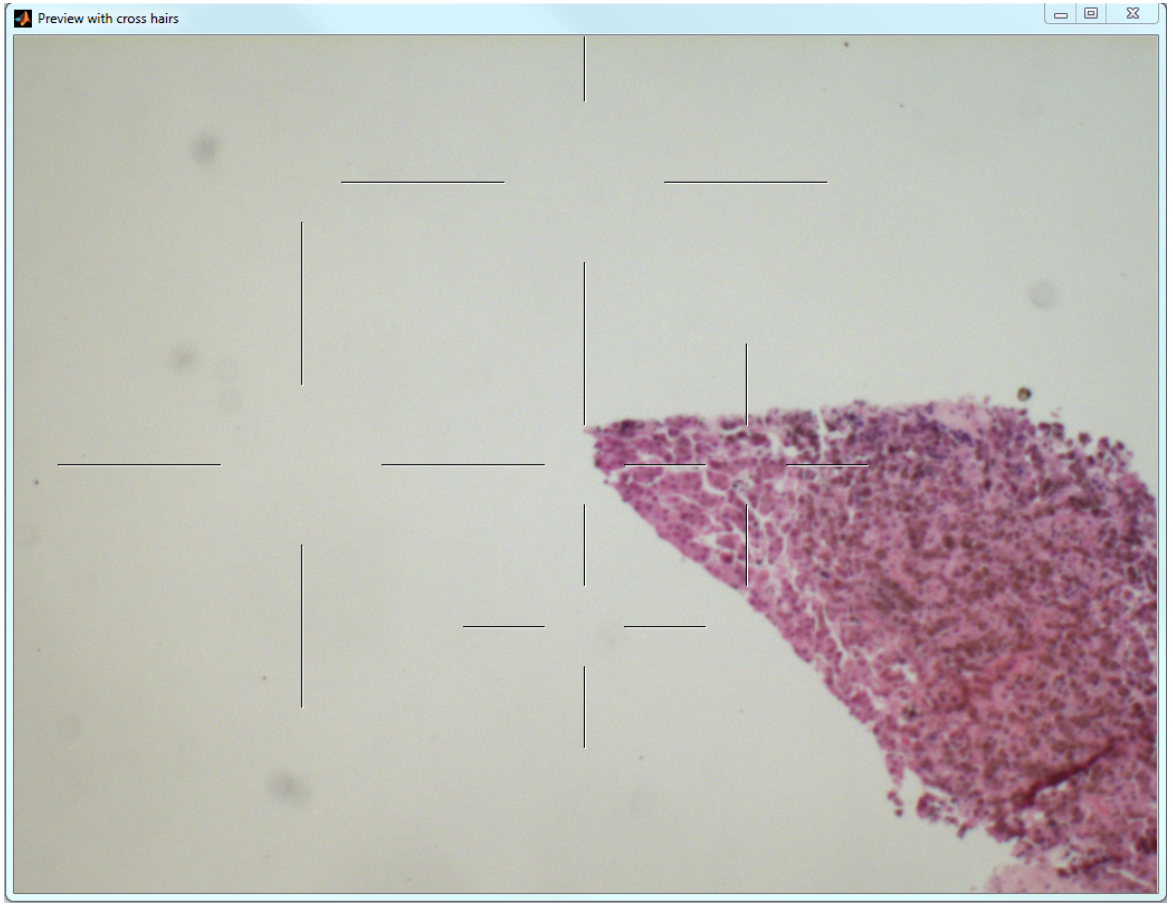
- Control the microscope stage so that a user can read the same tissue/cell from WSI and glass slide.



eeDAP Introduction

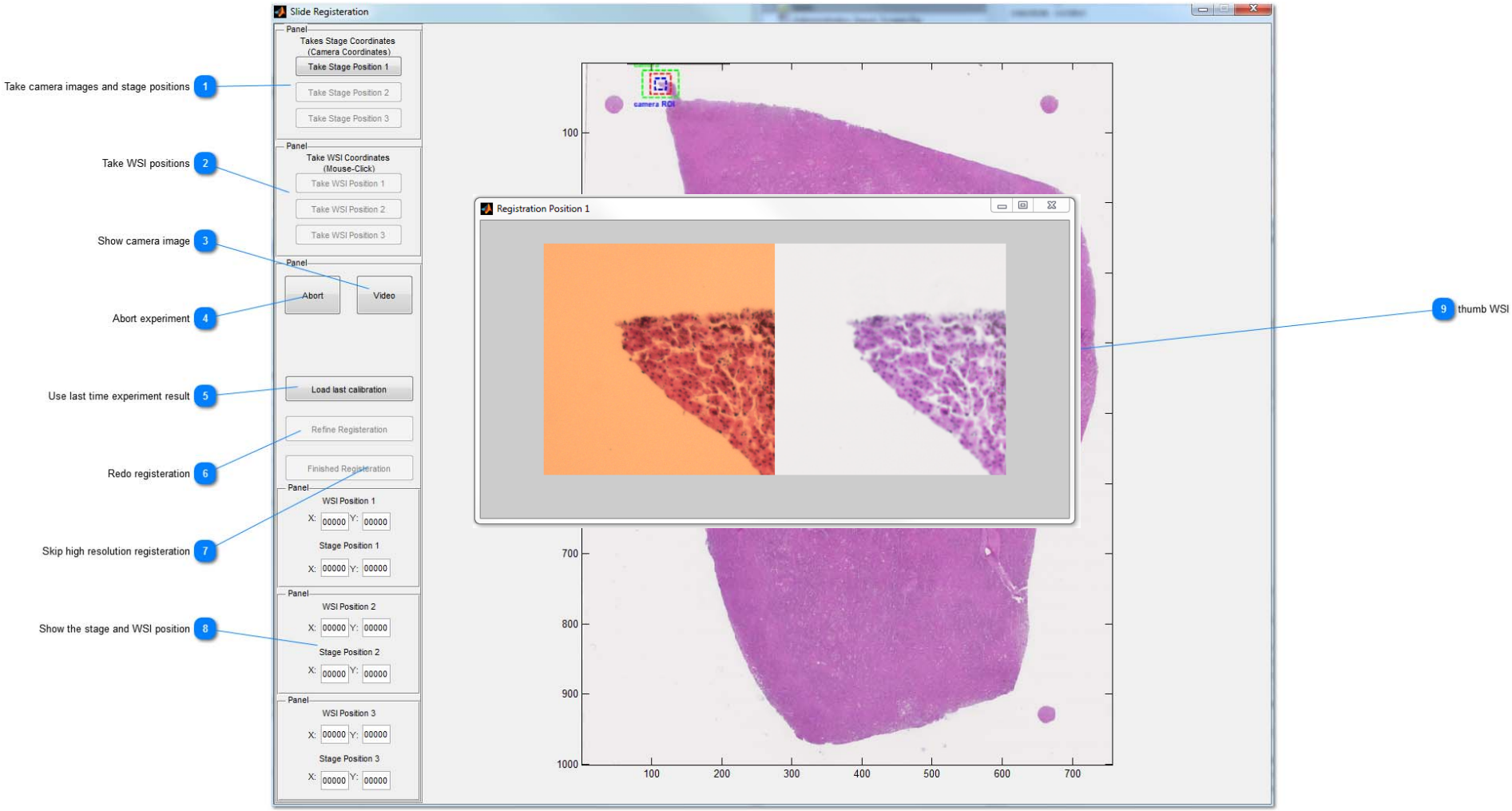
- Global Registration
  - Before reader starts
  - Requires 3 local registrations
  - Learn WSI-microscope relationship
- Local RE-registration
  - As reader is working
  - Possible for each FOV
  - Overcomes small errors from stage movement
- All registrations are based on cross correlation.

Global Registration

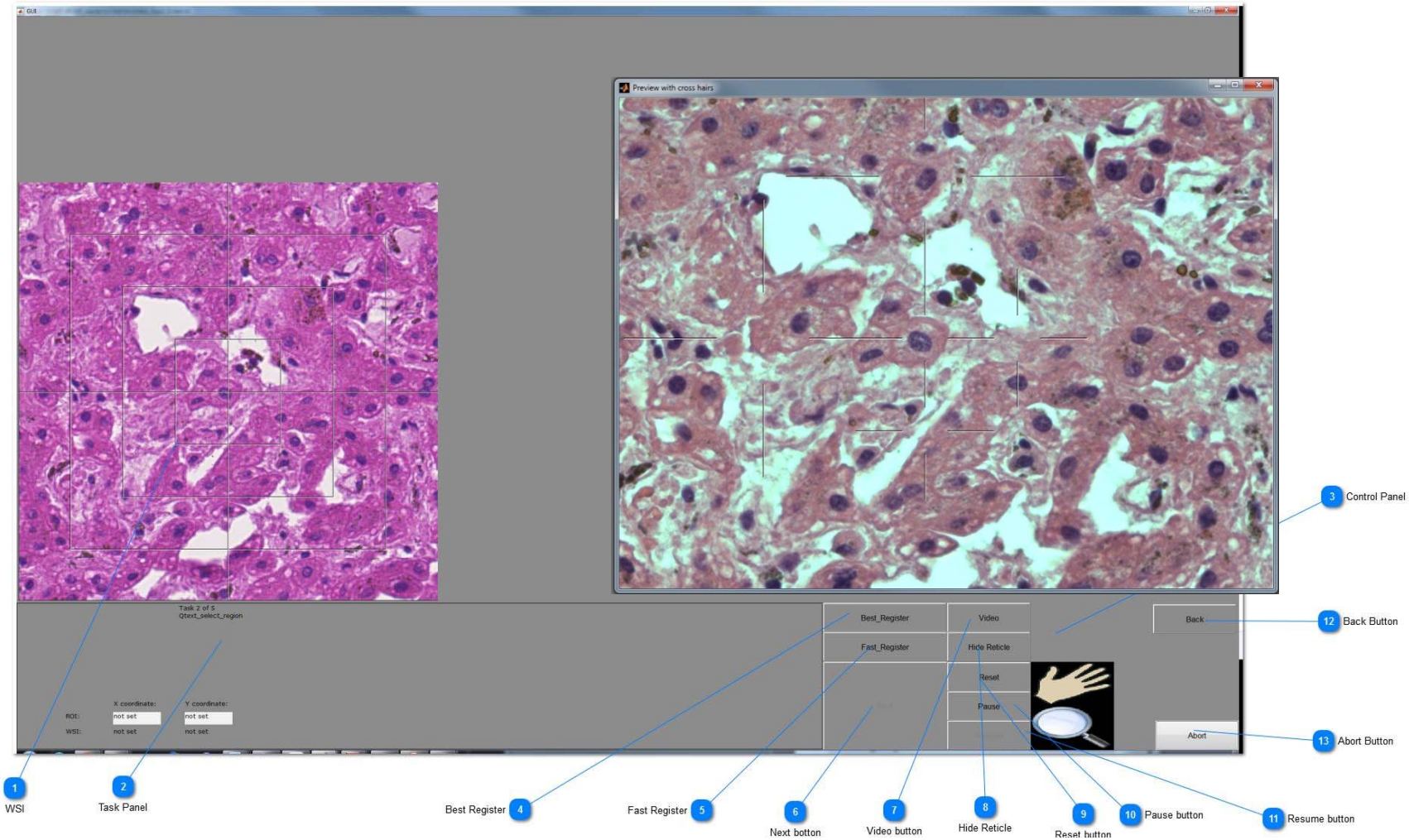


Camera image/eyepiece view

Global Registration



Local RE-Registration



Local RE-Registration

For each FOV …

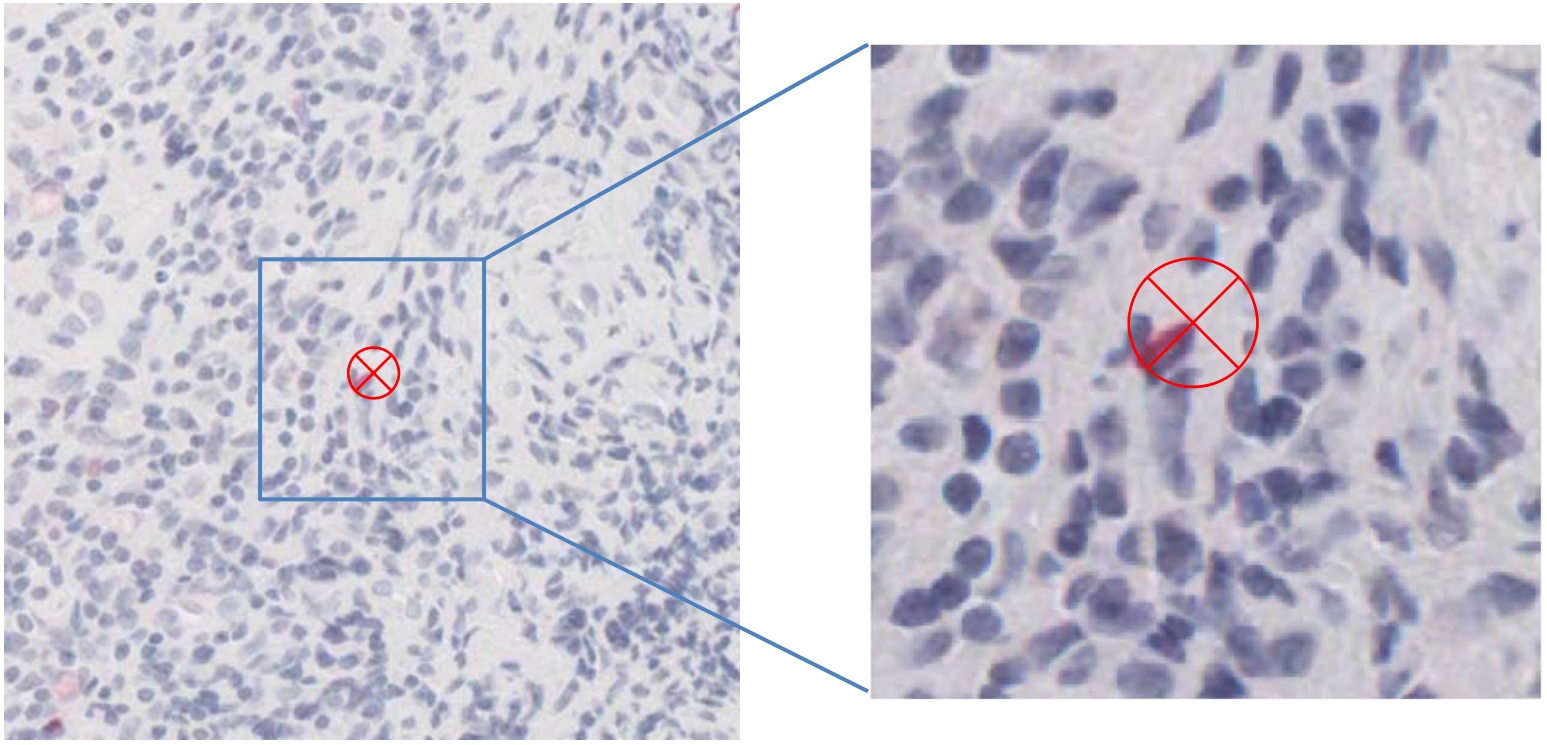
- **Automatic**:
  - When the microscope arrives at the task ROI, eeDAP will do Automatic Registration.
  - Use center patch of camera image.
  - Focus may not be good.
- **Fast**:
  - If the Automatic Registration fails, study administrator can focus microscope and do *Fast Registration.*
  - Use center patch of camera image.
- **Best**:
  - If the *Fast Registration* fails, study administrator can do the **Best Registration** (Use entire camera image).
- **Manual**:
  - Study administrator can use joystick
  - Visually register camera image and WSI

Registration Accuracy Study

- Objective: Evaluate the registration accuracy of eeDAP using real tissue.
- What is the registration error (distance) for each FOV?
- Does registration accuracy depend on tissue?

Study Methods

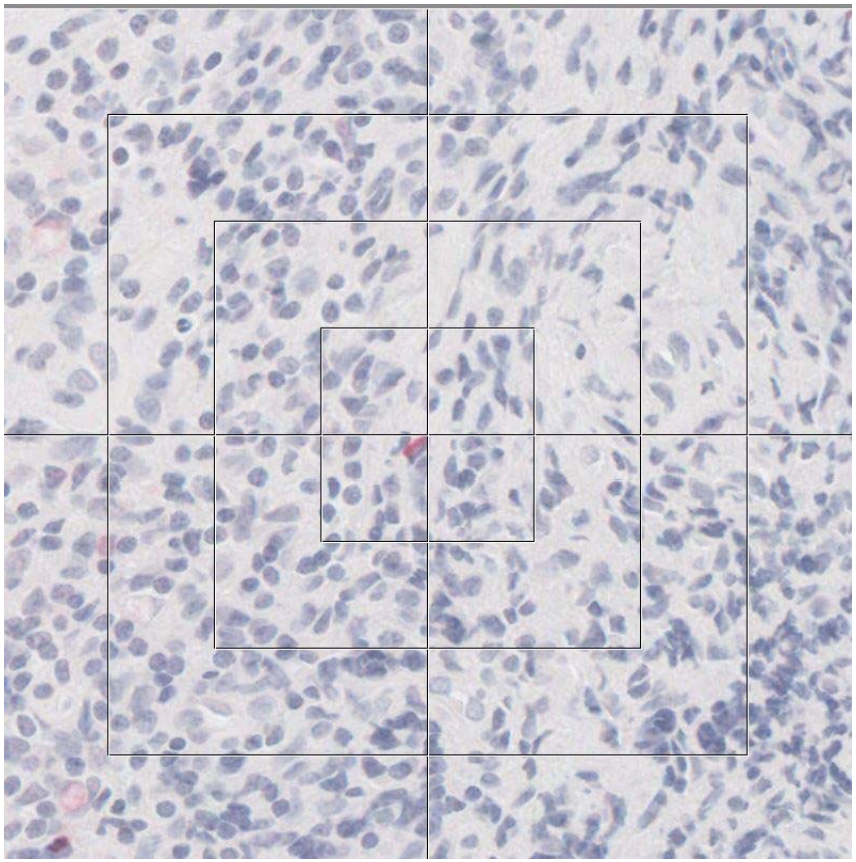
1. The center of each FOV should be a small target: a corner of cell or tiny structure.



Fiducial mark : ⊗ points out center feature.

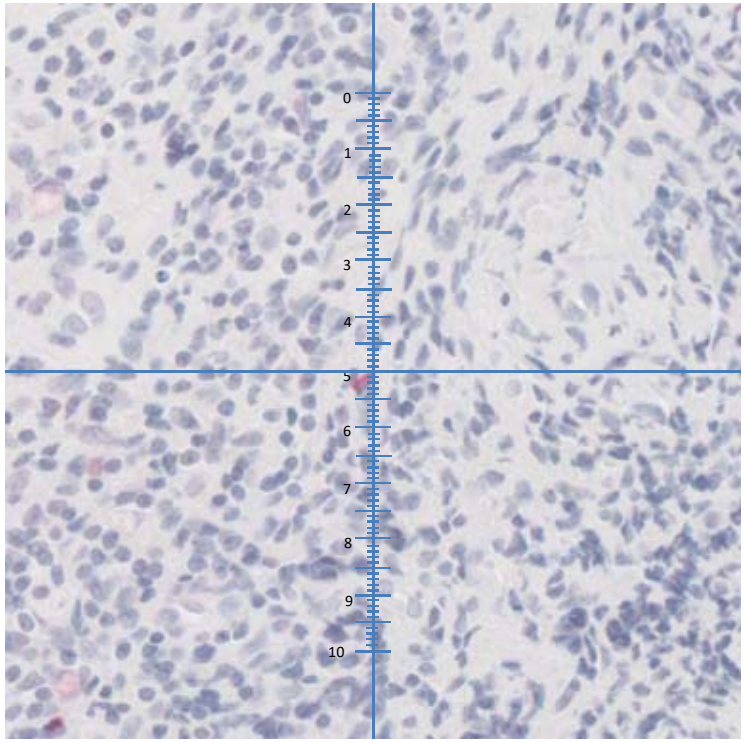
Study Methods

2. In WSI, use virtual reticle to identify the target.

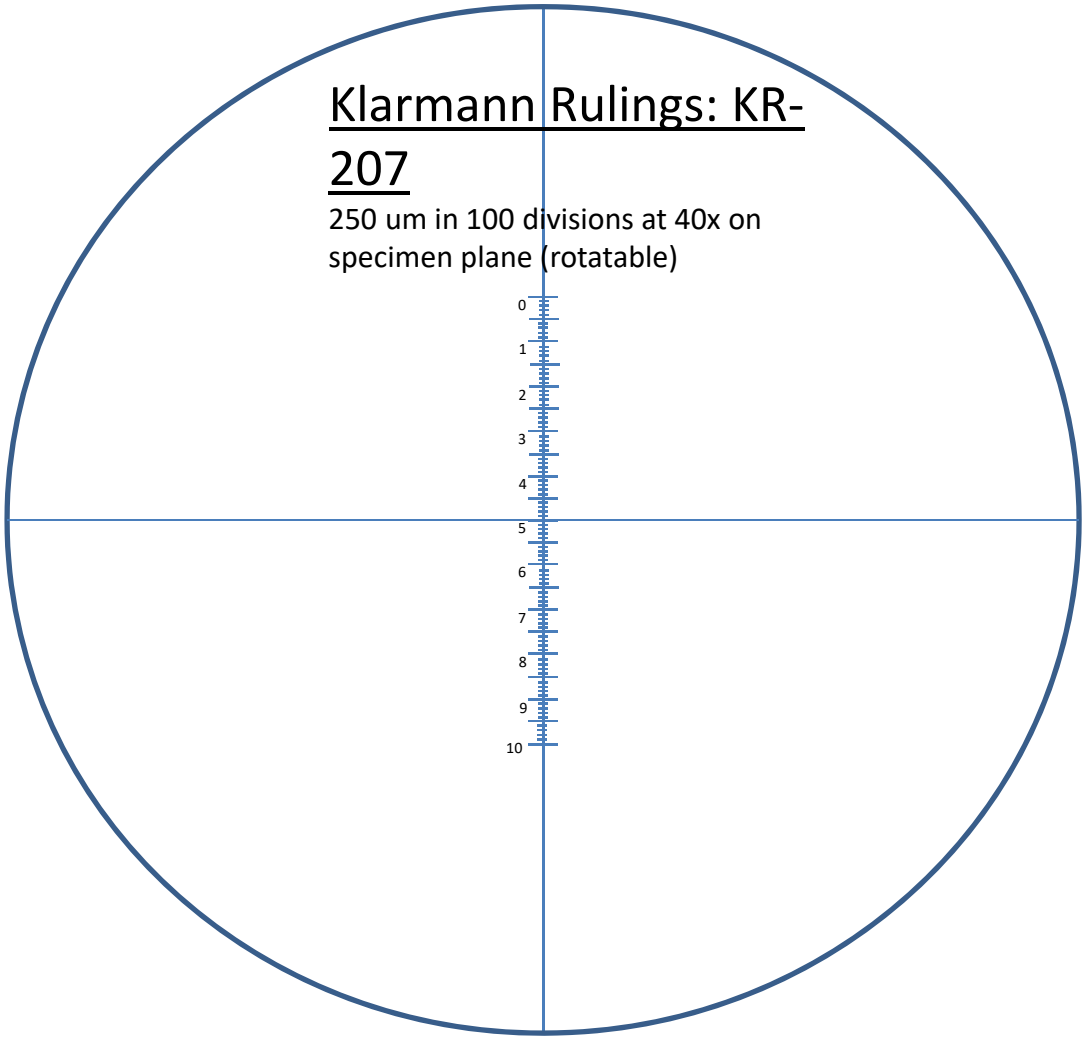


Study methods

3. On microscope, use reticle in eyepiece
   - Rotatable ruler
   - Measure distance: target to center (human)



Reticle Choice

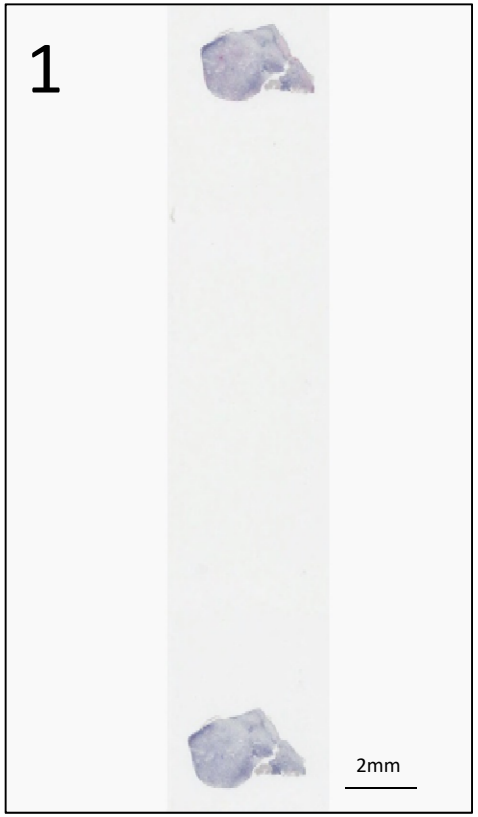


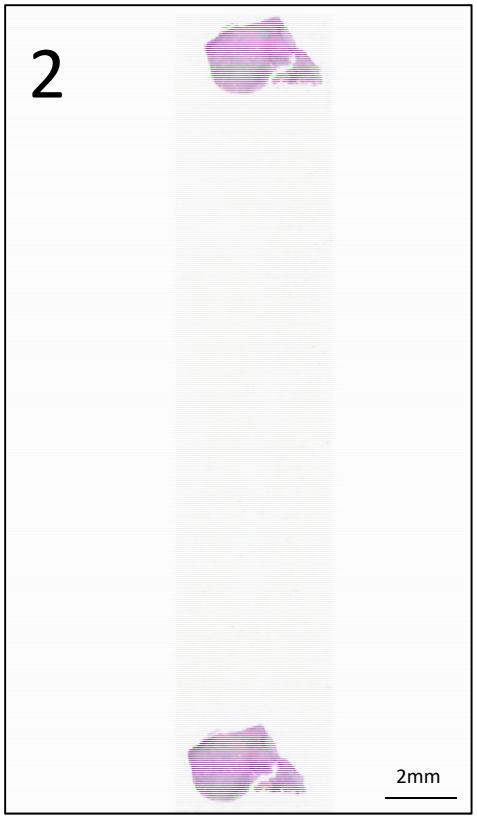
Measurement data

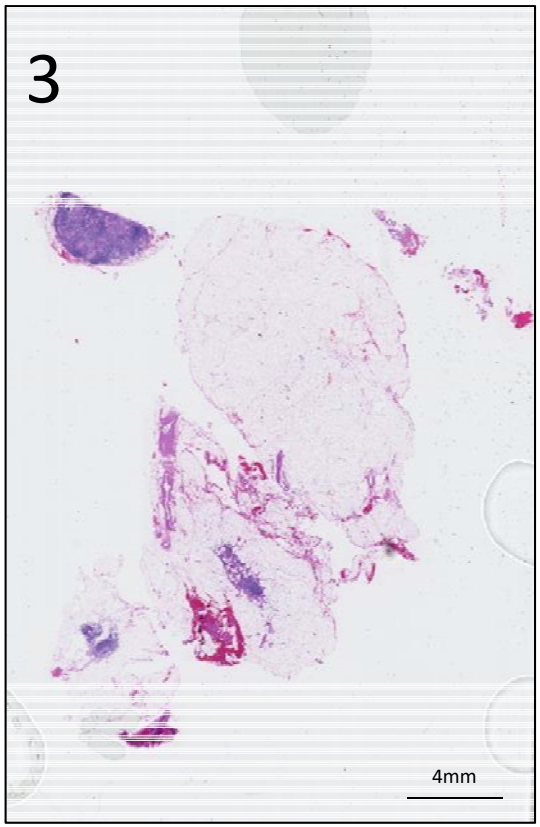
- **Automatic**:
  - Not part of this preliminary study.
- **Fast**:
  - 2 readers (one eeDAP expert, one novice) , 3 slides, 10 ROIs/slide.
- **Best**:
  - 1 reader (eeDAP expert), 3 slides , the same 10 ROIs/slide.
- **Manual**:
  - Not part of this preliminary study

Slide choice

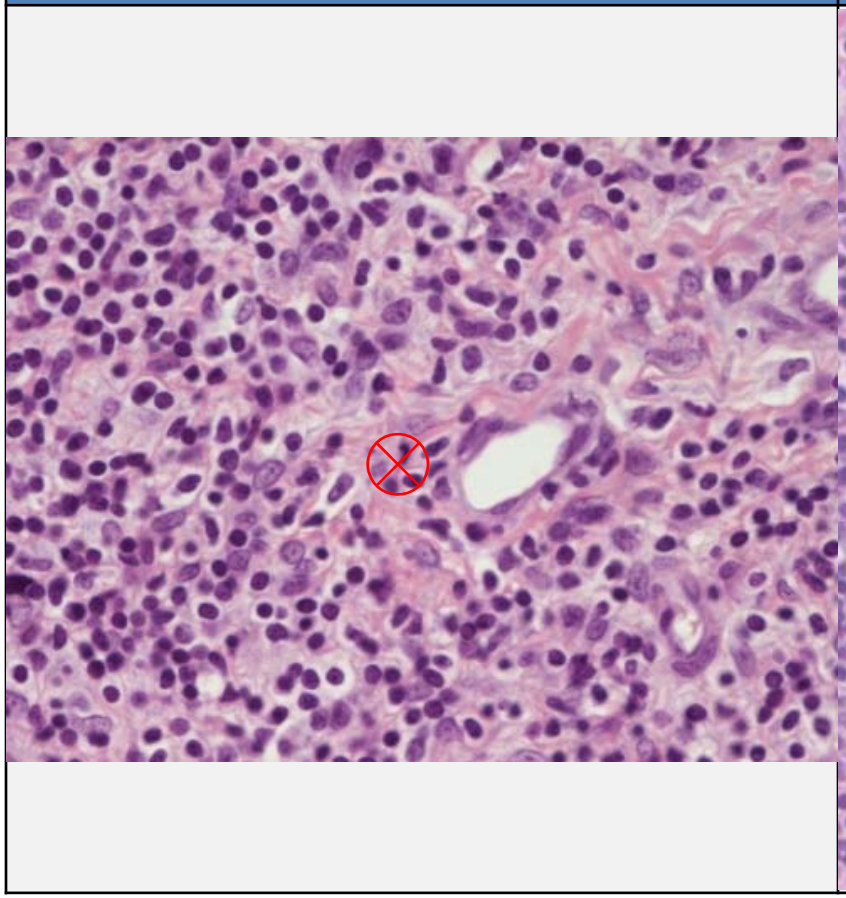
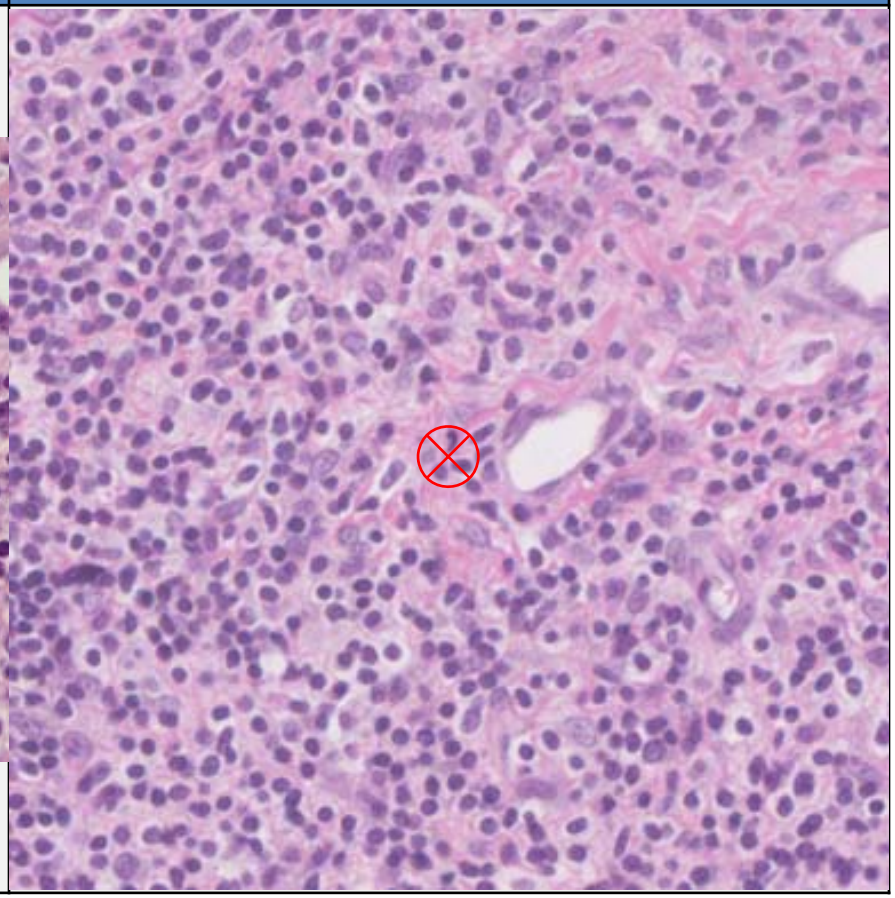
1. Canine oral melanoma, phosphohistone H3 (pHH3) stain.
2. Canine oral melanoma, hematoxylin and eosin (H&E) stain.
3. Human lymph node, hematoxylin and eosin (H&E) stain.
   (challenging case due to uneven tissue: out of focused scanned WSI)







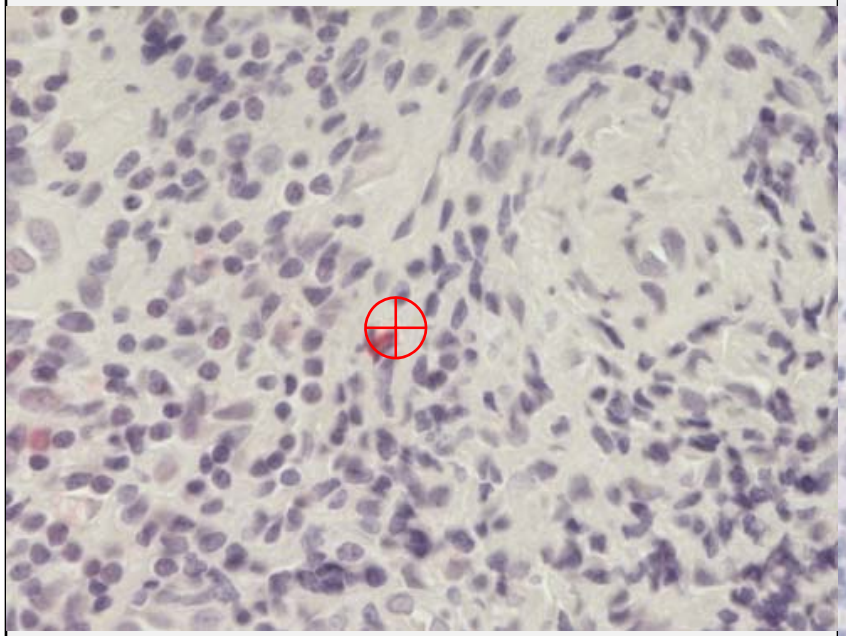
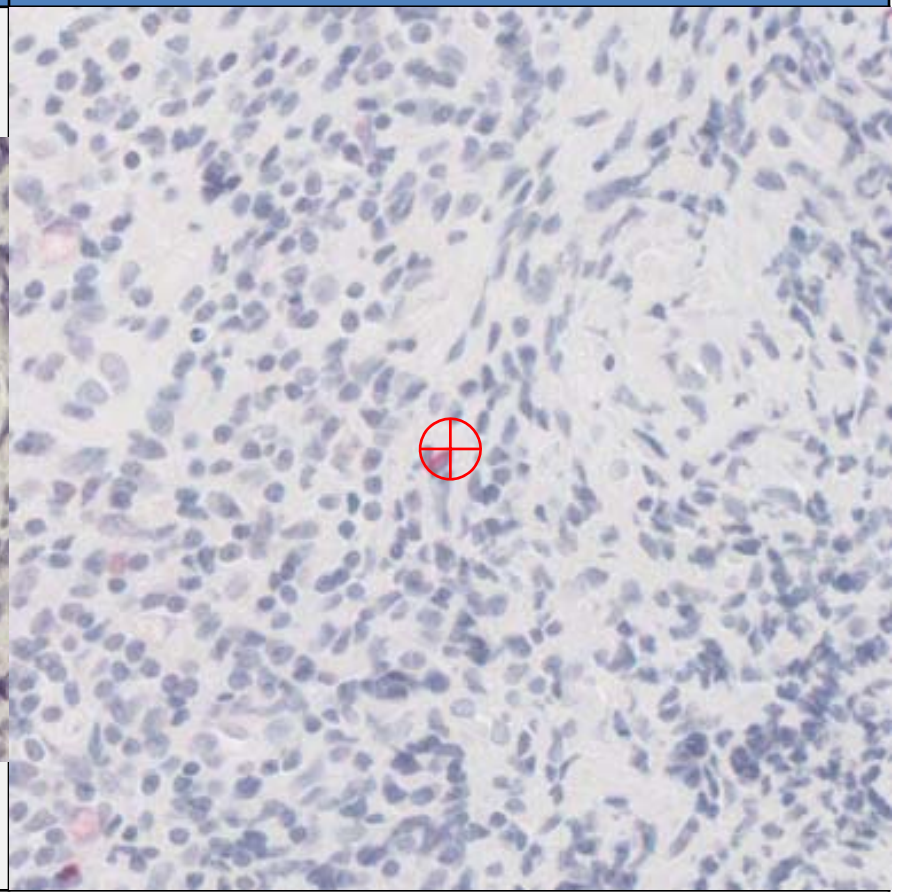
Fast Registration Success Case

Camera Image/ eyepiece view	WSI Image
	

Canine oral melanoma, H&E stain

Fiducial mark : ⊗ points out center feature.

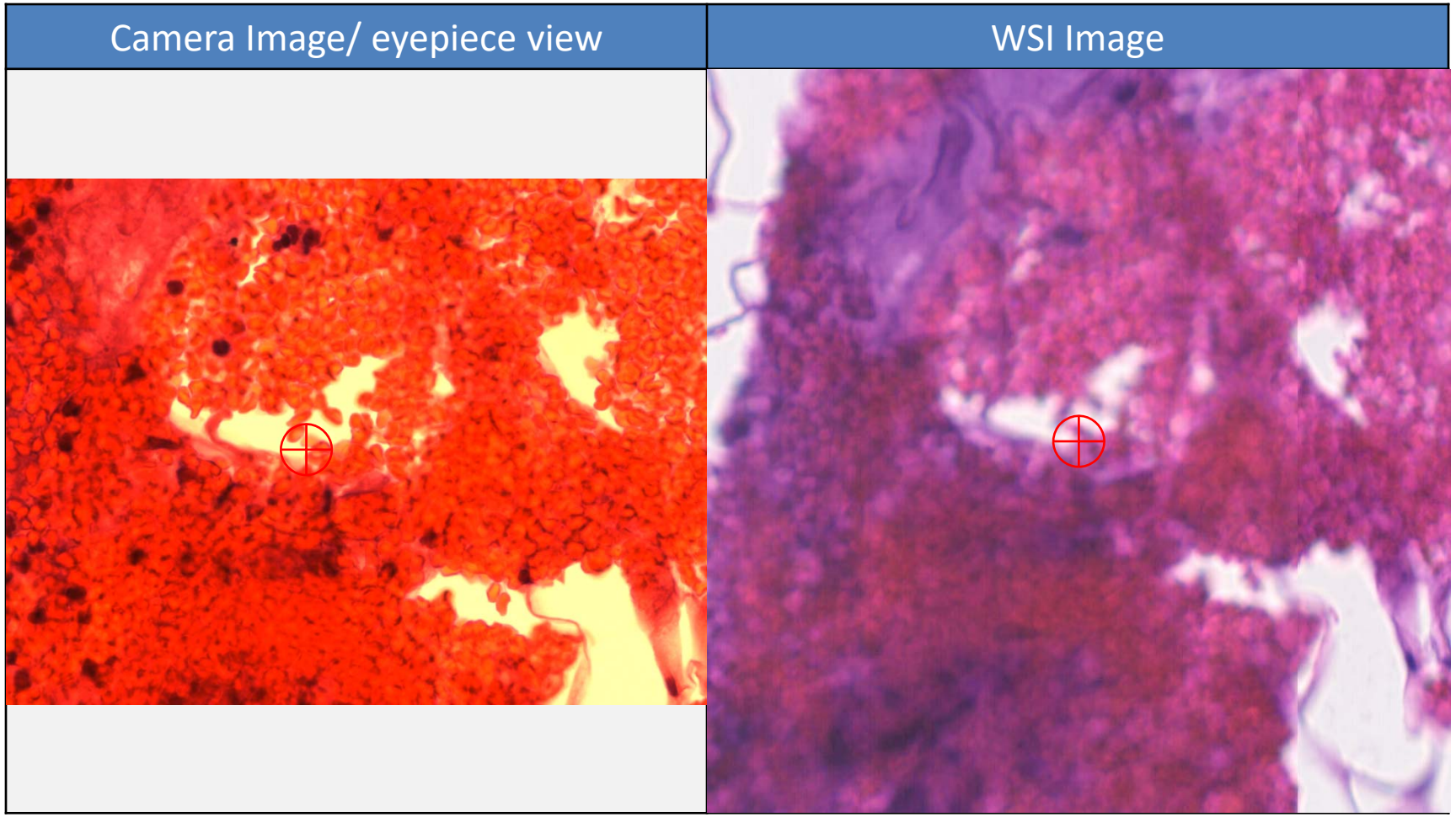
Fast Registration Success Case

Camera Image/ eyepiece view	WSI Image
	

Canine oral melanoma, pHH3 stain.

Fiducial mark : ⊗ points out center feature.

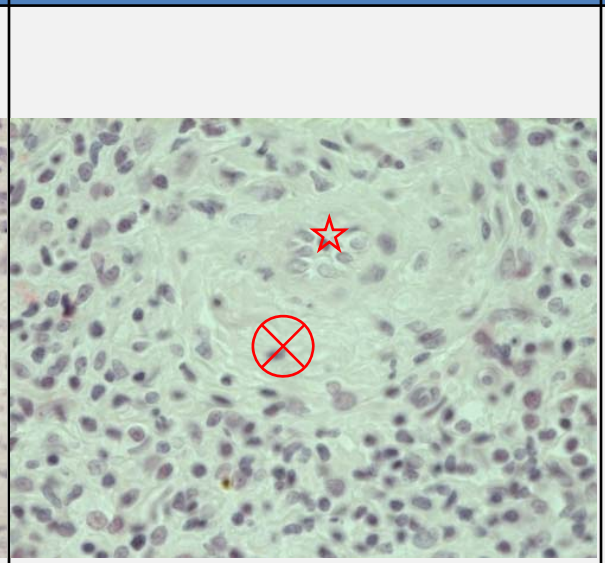
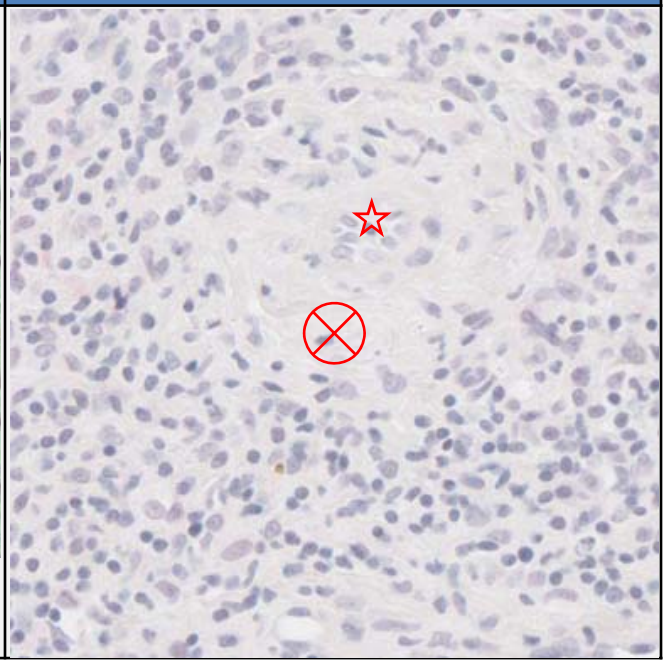
Fast Registration Success Case



Human lymph node, H&E stain

Fiducial mark : ⊗ points out center feature.

Best Registration Success Case

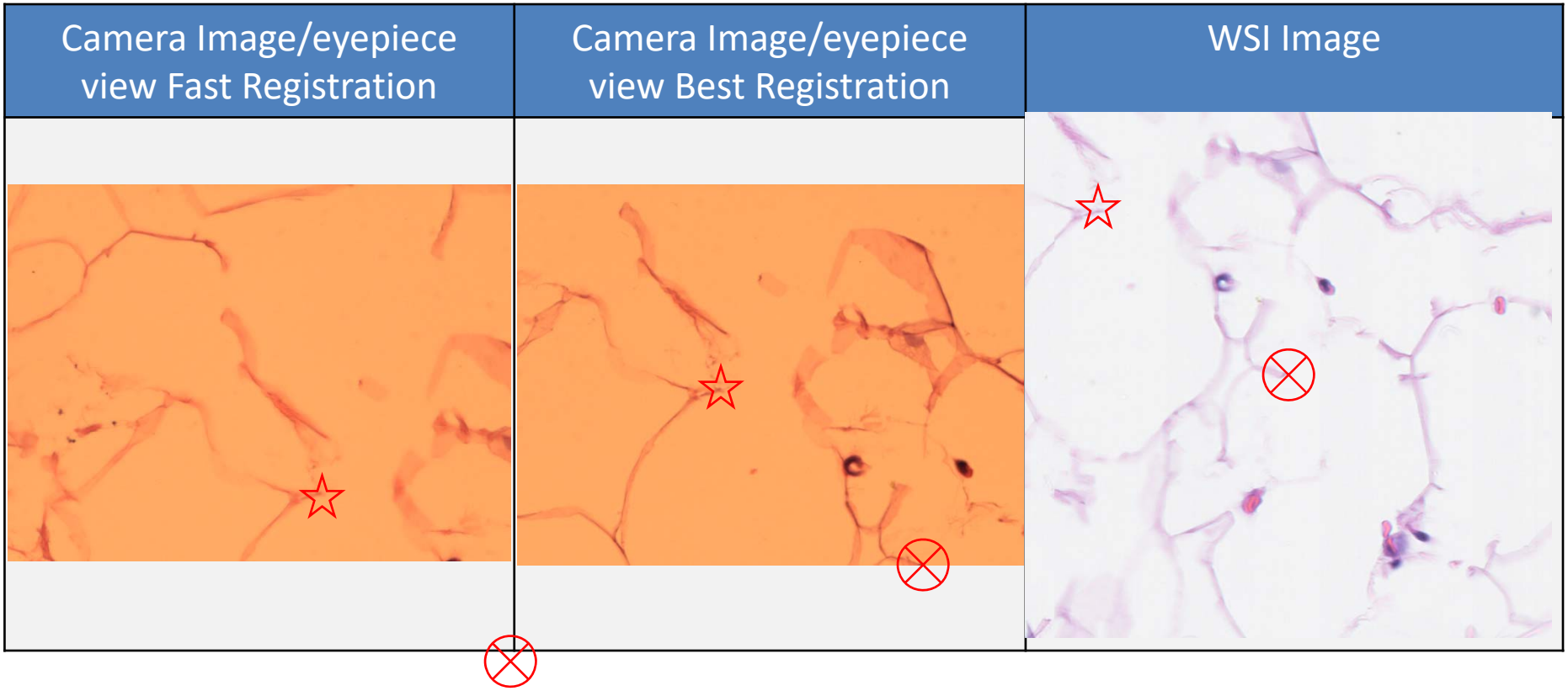
Camera Image/eyepiece view Fast Registration	Camera Image/eyepiece view Best Registration	WSI Image
		

Canine oral melanoma, pHH3 stain.

Fiducial mark : ⊗ points out center feature.

☆ : another landmark cell

Failed Case



Human lymph node, H&E stain

Fiducial mark : ⊗ points out center feature.

☆: another landmark cell

Results: Reader 1

Fast registration

- 27 out of 30 FOV "Successes"
  - Successful registration: error less than 2.5 µm (first tick mark of ruler, diameter of cell in the study is about 8 µm).
- 3 out of 30 FOV "Failures"
  - When it fails, it fails badly: observed error large (between 100 and 150 µm).

Best registration

- Fix 2 out of 3 cases. The failed case error was 75 µm.

	Fast Registration	**Best Registration**
Canine H&E	10	10
Canine pHH3	9	10
Human H&E (challenging slide)	8	9

Results: Reader 2

- Independent global registration.
- Independent focus for Fast Registration.
- 100% matching results with first reader.

Conclusions and Discussion

- eeDAP registration was found to be accurate.
  - **Fast** registration was successful in 90% cases.
  - **Best** registration fixed mis-registration in 2 out of 3 failures.
  - When successful, error is less than 2.5um.
- Registration accuracy measurements by two readers matched 100%.
- Registration errors depend on content at center of FOV.
  - There are potentially problems when the content is low contrast, homogeneous, or sparse.
- Recommendation: Evaluate registration accuracy before starting study.
  - Be aware of problem FOVs and have a plan.
  - Replace problem FOVs (if possible).
- Manual registration is always possible.

Future Plans

- Evaluate registration accuracy of
  - Automatic registration, and
  - No automatic registration

    (measure stage accuracy, global registration).

- Evaluate more stains & tissue types, more readers & sites.
  - Accuracy

- Improve methods

Thank You !

Welcome to visit our exhibit this week

eeDAP website https://github.com/DIDSR/eeDAP