A web based graphical user interface for X-ray computed tomography imaging

Yu Hu[1], Haolai Tian[1], Qingbao Hu[1], Yan wang[1], Jianli Liu[1], Haokai Sun[1], Kai Zhang[1], Fazhi Qi[1]

[1]Institute of High Energy Physics, Chinese Academy of Sciences, Beijing 100049, China

Introduction

- Web-based interactive data processing platform.
- Authentication by IHEPSSO (IHEP single sign on interface) and Jupyterhub.
- The computing environment of the application is encapsulated in the container. Application software managed by CVMFS.
- Kubernetes orchestrate the container to heterogeneous resources.
- Integrates the package HEPSCT for CT slices reconstruction.
- MVC architecture is introduced for handling data objects, analysis workflow and presentation.
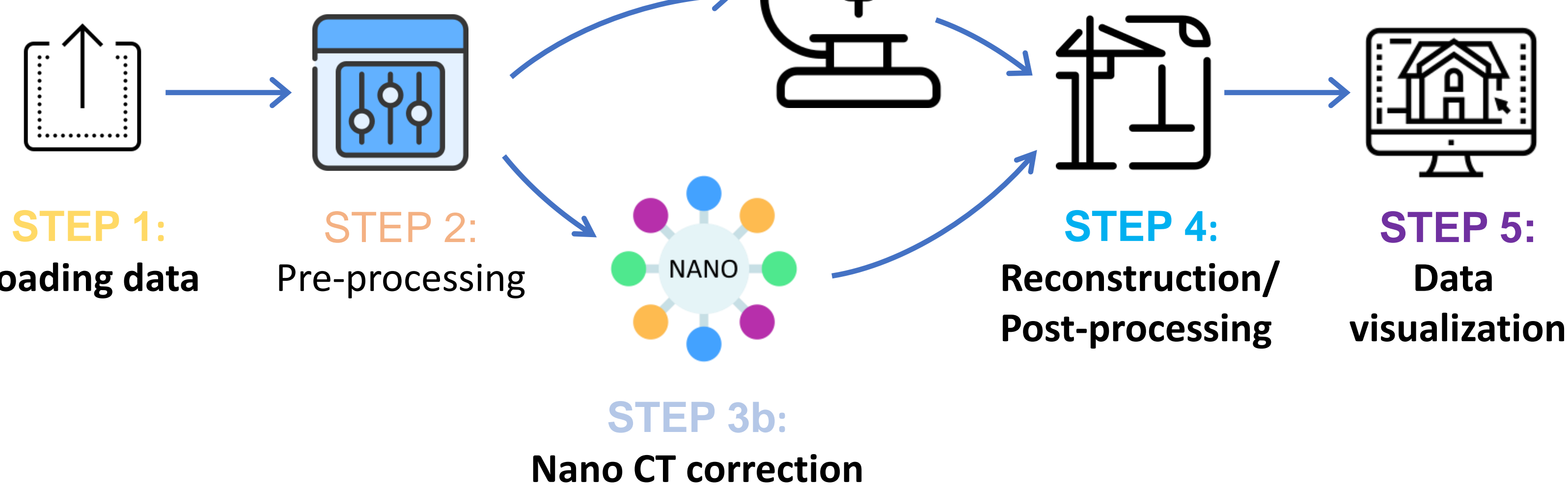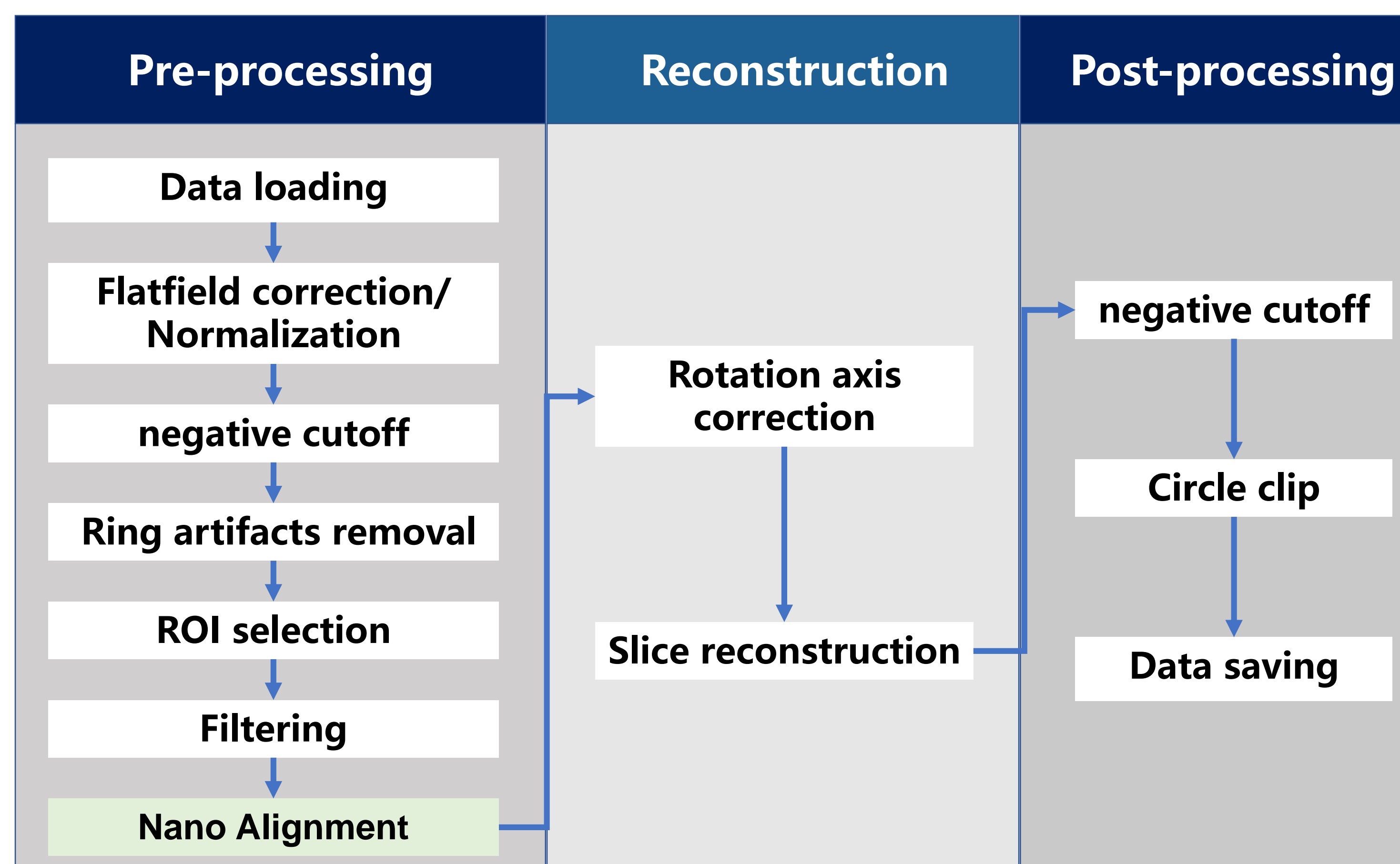
Method
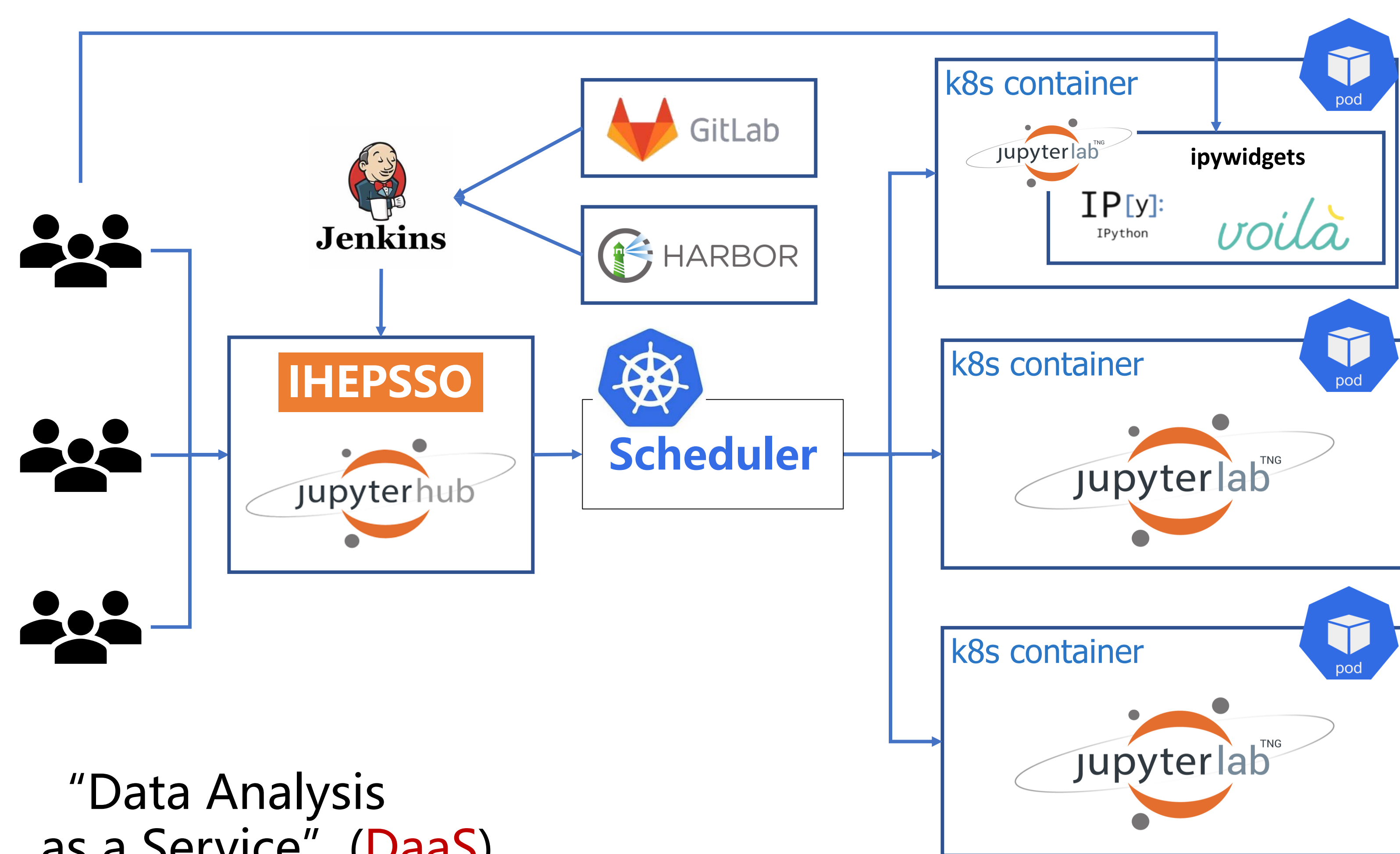
"Data Analysis as a Service" (DaaS)

HEPSCT workflow

STEP 1: Loading data
STEP 2: Pre-processing
STEP 3a: Micro CT correction
STEP 3b: Nano CT correction
STEP 4: Reconstruction/Post-processing
STEP 5: Data visualization

Analysis workflow

| Pre-processing	Reconstruction	Post-processing
Data loading		
Flatfield correction/Normalization		negative cutoff
negative cutoff	Rotation axis correction	
Ring artifacts removal		Circle clip
ROI selection	Slice reconstruction	
Filtering		Data saving
Nano Alignment		

- Pre-processing aims to improving the quality of projection image.
- Reconstruction is executed on GPU for accelerated computing.
- Post-processing aims to set the mask and remove the outliers.

Graphical User interface

- Based on IPywidget.
- Render by Voila.
- Each parameter is displayed as a widget set on a grid.
- User can interactively select the ROI and background region.
- Nano alignment support manual and auto mode.
- In manual alignment mode, user can select the coordinates of the marker by click on the image interactively.
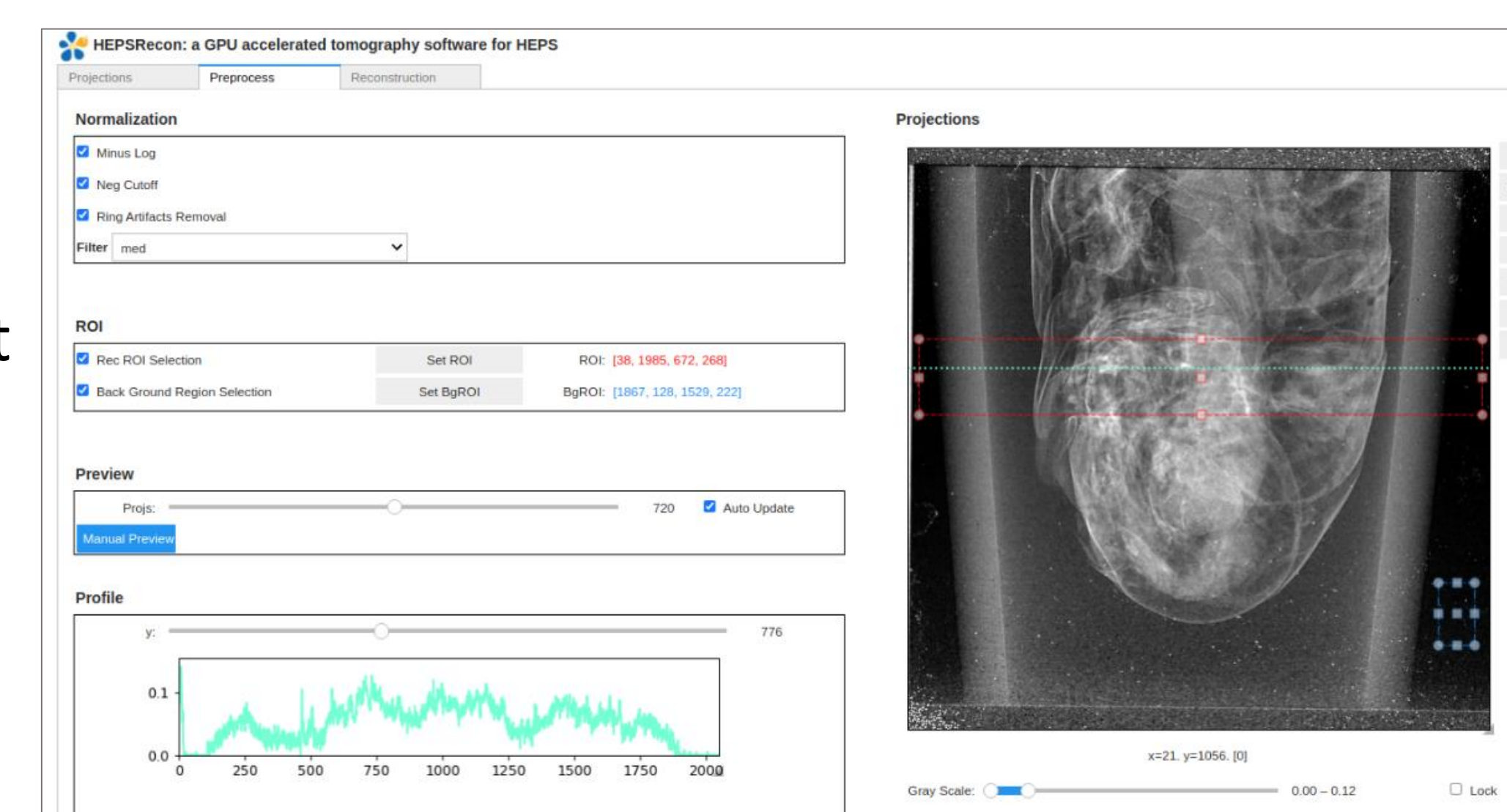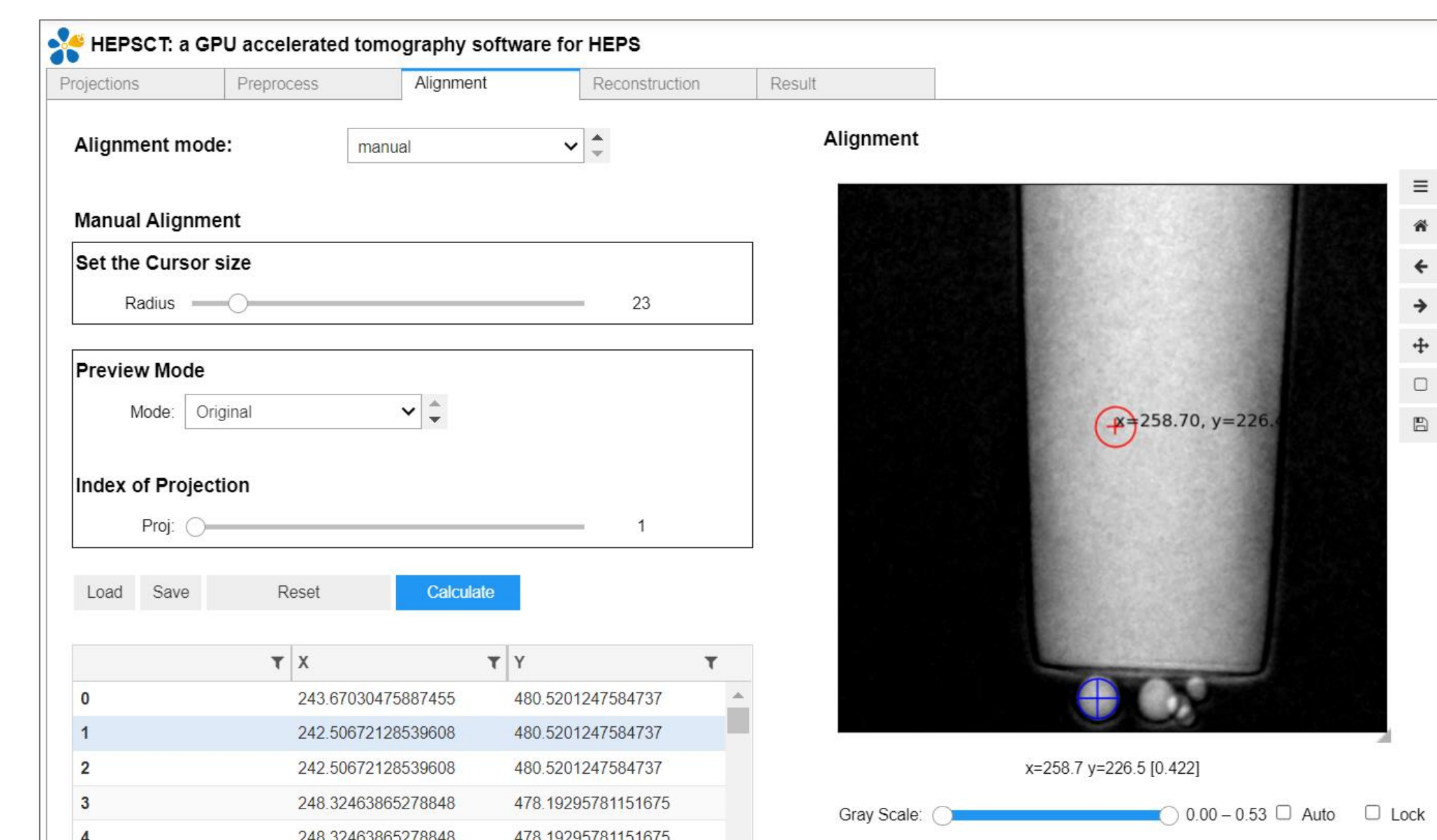
Conclusion

- User-friendly web interface.
- Local or remote use with JupyterHub.
- Computing resource are scalable and heterogeneous.
- Tiff or HDF5 data, provide multiple reconstruction methods.

References

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2. Zhibin Liu et al. "Evolution of the HEPS Jupyter-based remote data analysis System." *EPJ Web of Conferences* : 251, 02046 (2021).

3. Hu Yu and Tian Haolai. "Data Analysis Integrated Software System in IHEP, design and implementation." *PoS(ISGC2022)*: 415, 0028 (2022).

Future development

- Follow the meta data schema.
- Use distributed and parallel processing when relevant.
- Employ the artificial intelligence method in the post processing.