MOCUPY-Version0

USER GUIDE

HEPSCT Reconstruction software (stand-alone version)

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Introduction to software development

- Stand-alone version of HEPSCT：MOCUPY is a offline data tomographic reconstruction software, using CUDA for GPU hardware acceleration to achieve fast reconstruction, which contains modules such as Image import, Preprocessing, Phase retrieval (to be integrated) and Reconstruction. So as to meet the needs of users for "massive" X-ray CT data processing.

- This software provide several image reconstruction algorithms for tomography, such as FBP, Grid and EM. It only takes several seconds for tomographic datasets with image size of 2k*2k to reconstruct based on the grid algorithm. In the future, according to the continuous development of experimental technology we will successively develop new data analysis modules based on deep learning method to support the synchrotron radiation users' experiments.

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0. Installation

1. Installation Requirements:

The software of MOCUPY is based on CUDA Libraries，which requires Turing/Ampere cores or newer NVIDIA graphics/computing cards(*https://www.techpowerup.com/gpu-specs/?mfgr=NVIDIA&sort=name*). In addition, in order to achieve higher reconstruction speed, please use the NVMe SSD (such as WD:SN770/SN570、KBG40ZNS) to read and write data.

The recommended computer graphics card performance (or higher) is as follows：

| No.	Computer Performance			Data size	Total Time
	Graphics Card	**Hard Disc**	**Memory**		
1	NVIDIA GeForce RTX 3060 laptop (6GB)	WD_SN570	16 GB	2k*2k*1441p (11.3GB)	49s
2	NVIDIA GeForce RTX 3090 (24GB)	Samsung 980 Pro	200 GB	2k*2k*1441p (11.3GB)	35s
3	NVIDIA GeForce RTX 3090 (24GB)	Samsung 980 Pro	200 GB	5k*4k*1441p (56.2GB)	6mins 54s
4	NVIDIA GeForce RTX 3090 (24GB)	Samsung 980 Pro	200 GB	5k*4k*5120p (200GB)	11mins 34s

2. How to run the software ：

Find the file named startCTRecon.bat in the folder and double clicked.
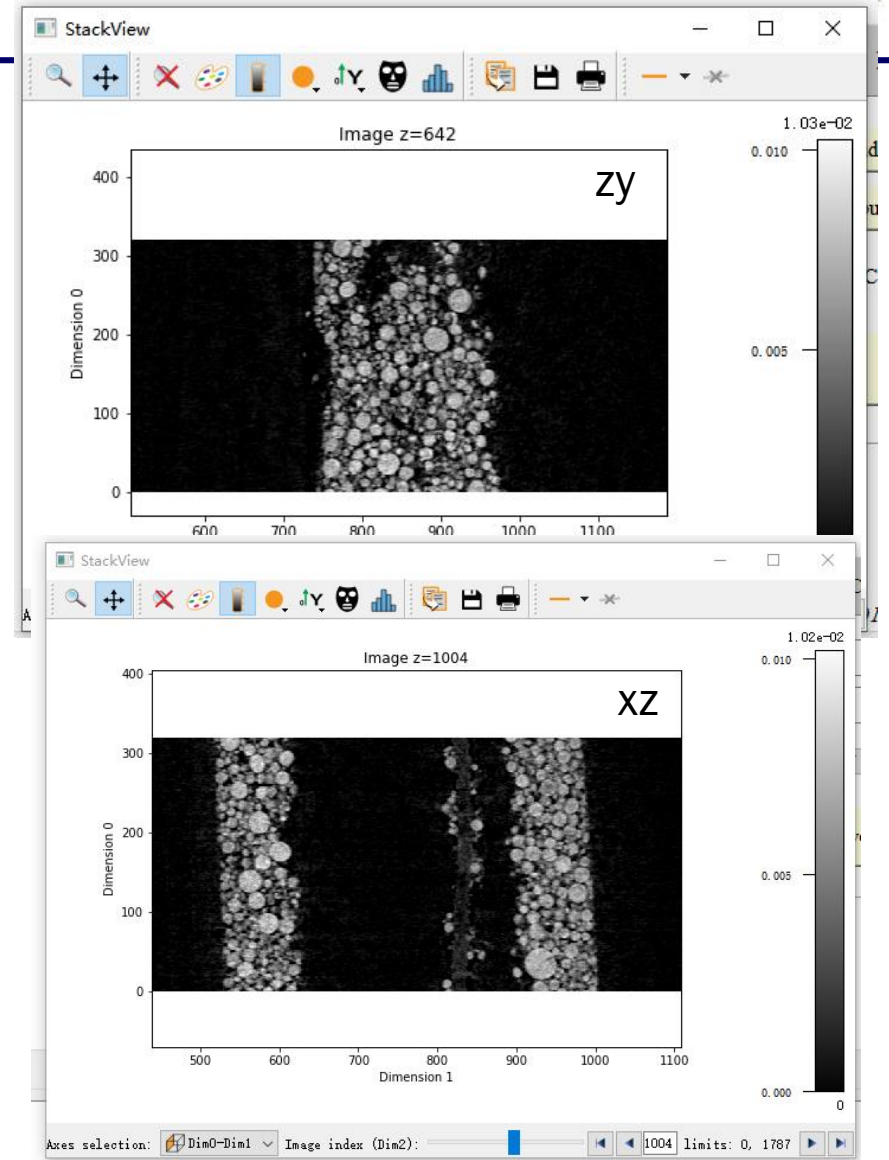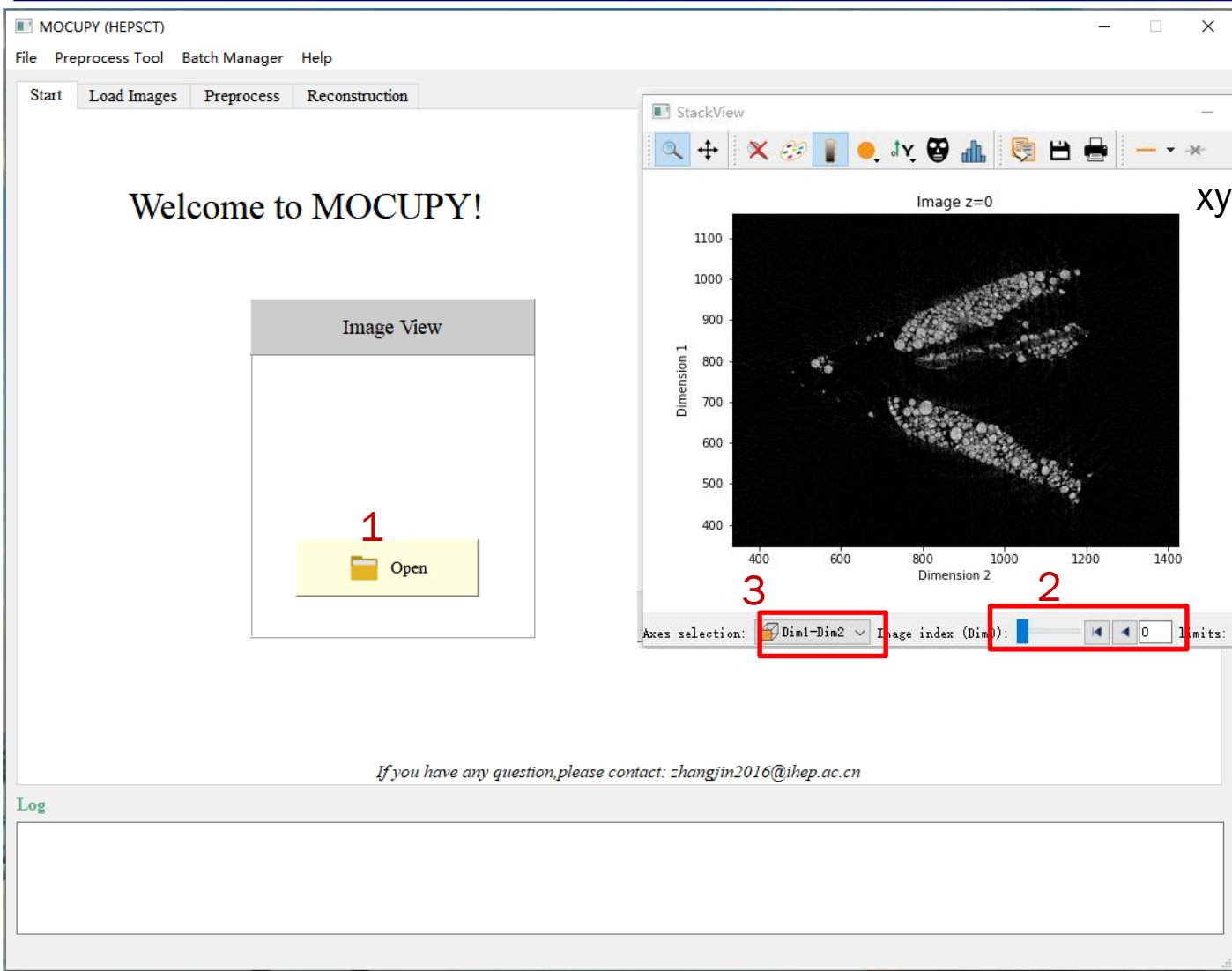
1. Image preview module

Start module: includes the functions of preview, export and format convert of images.
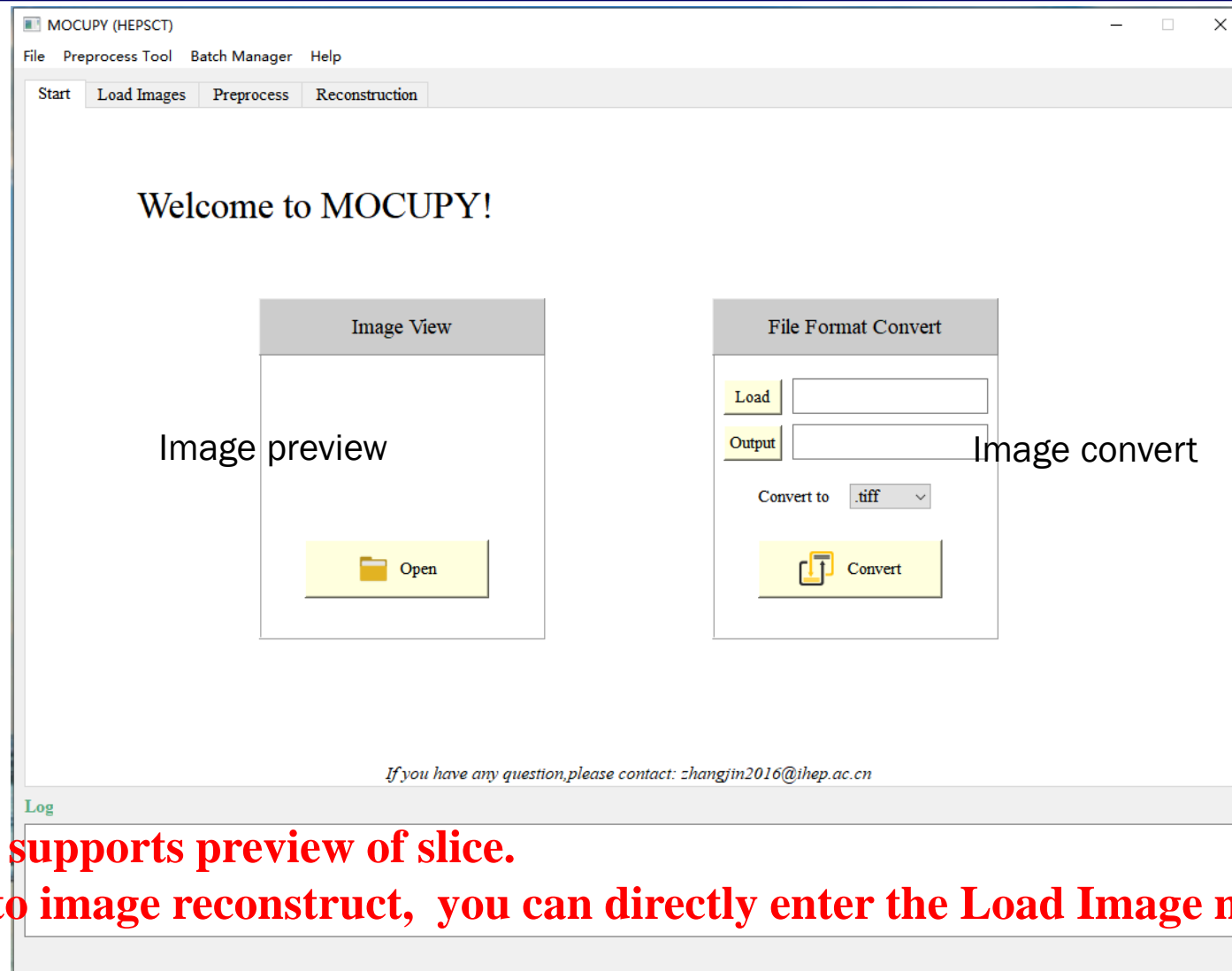
This module supports preview of slice.
If you want to image reconstruct, you can directly enter the Load Image module.

1. Image preview module

1.Click open button to select files； 2.Preview different slice;   3.Different dimension for slice display

The Process of CT data reconstruction

1. Load Image

Load Images module：mainly contains image import, display and histogram adjustment

1. Click Load Image button to switch the image import tab；

2. Click and select projection images；

3. Click and select flat(background) images；

4. Click and select dark images.
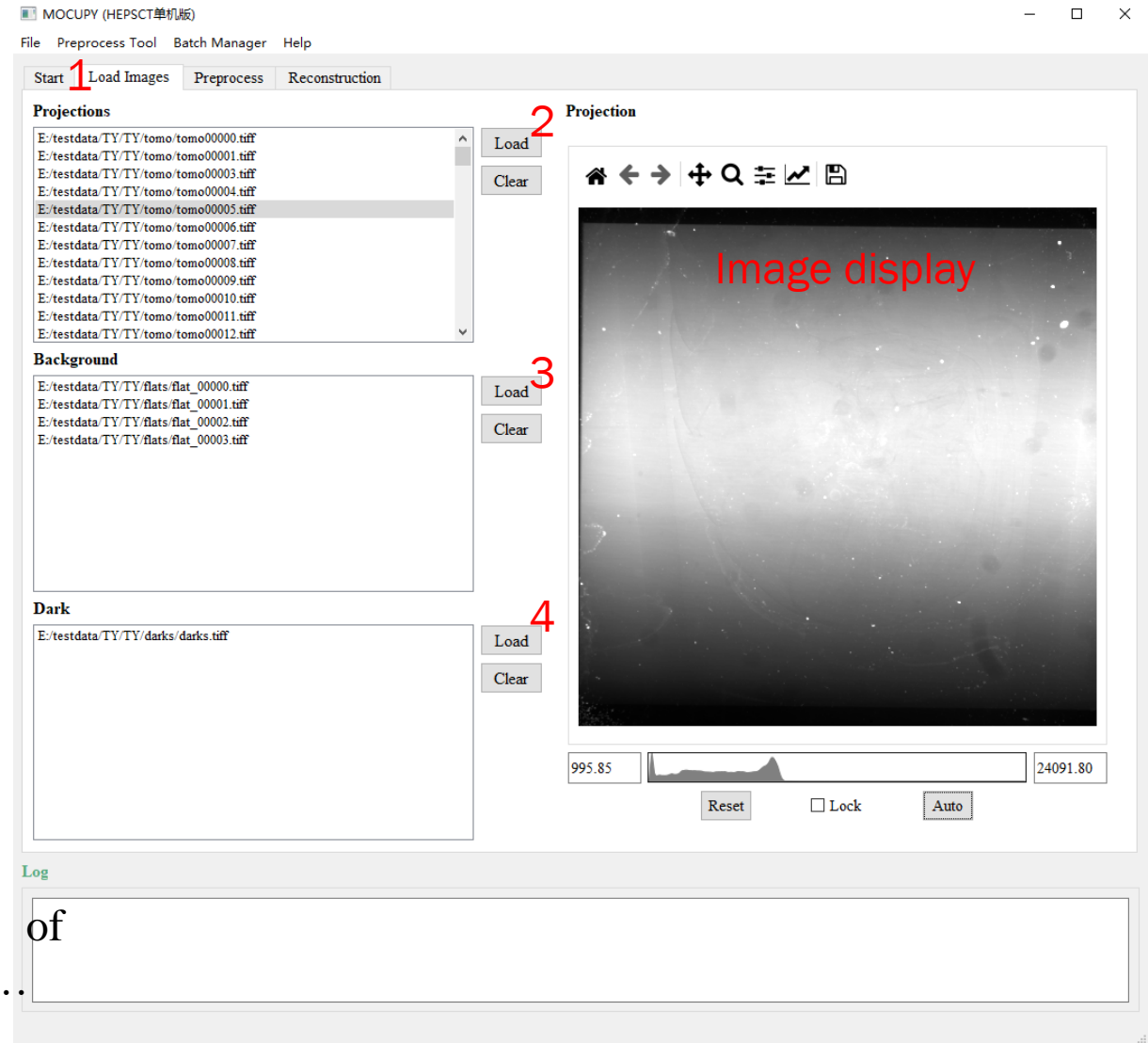
Note ： The data is loaded by the numerical order of the images' name. For example: 0001、0002、0003……

2. Image Preprocess

Preprocess module：contains denoise, background correct, negative value remove, ROI select, line profile preview.

1. Chose the algorithm of denoise;
2. background correct ;
3. negative value remove ;

} Default: checked

4. ROI select of reconstruction：checked， click and drag the left mouse button in the image display area to select. After confirming the selection, click Set ROI. The red dashed line in the figure is the reconstruction area. Note: If you want to reconstruct the entire image, skip this step.
5. Check. Click and drag the left mouse button in the image display area. Select the area where there is no sample to normalize background. If confirmed, click Set BgROI (note: the selection of this area cannot exceed 300*300. If the sample filled all the area, this step can be skipped;)
6. Manual Update
7. Auto Update：If checked, the image display area will auto update.

The line profile preview of dash line(green).

Log display

3.Reconstruction

Parameters Setting

1. **Reconstruction algorithm**：FBP、grid（fast）、em；
2. Iteration number，default 20；
3. Batch size：related to computer performance, default 64;
4. Starting Angle: according to actual data collection, default 0;
5. stop Angle: according to the actual data acquisition, default 180;
6. The value is calculated from the number of projections loaded and the input of 4 and 5. Note: You need to check that Step Size is correct before reconstruction.
7. If checked, the reconstruct area will be masked, and the value outside the circle will be set zero;
8. If checked, the negative value will be removed after reconstruction;
9. If checked, ring artifacts will be removed.

3.Reconstruction

Axis correct：

1. Adjust different slice;
2. Adjust the Axis;
3. Click, and the axis can be calculated by algorithm. If the calculation is not accurate, you can manually adjust by dragging 2 or clicking +/- in 4.
4. If the sample the axis values is different greatly between upper and lower, you can drag 1 to select the upper and lower slice, and adjust 2 to calculate a **optimal axis value**. Then click 5, Set Axis1 and Axis2. If there is little difference between the upper and lower slice, you can skip this step directly.
5. After setting Axis1 and Axis2, check 6 to lock the rotation axis. When you preview the results, the value of axis will be calculated according to the Axis1 and Axis2 Settings;
6. Click 7 to select the saved folder (Note: the folder name does not recognize Chinese characters).
7. When all parameters are set correctly, click 8 to start reconstruction.
8. If you want to quit, click 9 to stop.

4. Common problems

- MOCUPY is a fast CT reconstruction software for GPU acceleration based on CUDA. Therefore, the graphics card needs to support CUDA. When the graphics card does not support CUDA acceleration, the software may fail to run.

- If the CT data missing too much angles or the sample is out of the projection field of view, Guess axis may not calculate accurately. You can manually adjust the Axis value.