Core Information for Data Management & Sharing Plan		
Core Name:	*Multiphoton Intravital & Tissue Imaging (MITI) Core*	
Core Director:	*Heather Jensen-Smith, PhD*	*heather.jensensmith@unmc.edu*
Core POC (if differs from Director):		*multiphotonintravital@unmc.edu*
Core Website:	*Multiphoton Intravital & Tissue Imaging (MITI) Research Core | VCR | University of Nebraska Medical Center (unmc.edu)* *https://coremarketplace.org/RRID:SCR_022478*	

Data Management & Sharing Services Description	
Core will assist with data upload in a repository:	*No*
If yes, estimated cost/data set for upload:	*N/A*
If no, please email Peng Xiao at peng.xiao@unmc.edu. The bioinformatics core may be able to assist with upload of different data types.	

Repository Information - https://www.nlm.nih.gov/NIHbmic/nih_data_sharing_repositories.html

Types of Data Generated in Core	Metadata provided by Core (automatically in image files)	Suggested Repository	Tips
Biomedical/ Research Images Olympus FVMPE-RS	**.oir image files contain the following* *1) Image settings: size, pixel type, scale (x,y,z), annotations* *2) Microscope Settings: objective, zoom, detector settings (gain, offset, voltage), pixel scale, fluorescent dyes selected, excitation and emission filters, dichroic, pixel dwell time, bit depth*	*1) NIH domain-specific repository (discipline and/or funding agency). This is researcher/funding source specific.* *Example: https://portal.imaging.datacommons.cancer.gov/* *2) Generalist repository if no appropriate domain-specific is available.* *Example: https://data.mendeley.com/*	*See 'Other' section for details/tips.*
Biomedical/ Research Images Miltenyi Biotech UltraMicroscope II (light sheet microscope, a *TIBA-affiliated instrument in the AMCF)*	**.ome tiff or *.ims (IMARIS file) contain the following* *1) Light Sheet Microscope meta data is stored in the first image (only), do not delete this file.* *2) Image settings (geometry): date, time, size, scale (x,y,z)* *3) Parameters: channels, display settings, laser settings, filters, x,y,z acquisition settings*	*NIH domain-specific repository (discipline and/or funding agency). This is researcher/funding source specific.* *Example: https://portal.imaging.datacommons.cancer.gov/*	*See 'Other' section for details/tips*

	4) The system currently registers the 515 nm laser as a 405 nm. This is incorrect and awaiting a software update from Miltenyi.	*Generalist repository if no domain-specific is available. Example: https://data.mendeley.com/*	
Biomedical/ Research Images Analyzed using IMARIS (TIBA-affiliated workstation in AMCF data analysis workroom)	*IMARIS Software (*.ims)* *Images are converted to *.ims files for analyses. These new files contain the following meta data.* *1) Dataset: Contains the actual image data (by channel and timepoint, from the original image meta data).* *2) Dataset Info: Contains descriptive image parameters for IMARIS. A creation histogram reports display and analysis settings for IMARIS image file.* *3) Thumbnail: 2D thumbnail of the image.* *See detailed summary: Imaris File Format - Imaris - Oxford Instruments (oxinst.com)*	***Only the raw image data is required to be uploaded at the end of funding according to funding source requirements. At the time of peer-reviewed publication, data analysis parameters for those datasets should be reported/shared.* *NIH domain-specific repository (discipline and/or funding agency). This is researcher/funding source specific.* *Example: https://portal.imaging.datacommons.cancer.gov/* *Generalist repository if no domain-specific is available. Example: https://data.mendeley.com/*	*See 'Other' section for details/tips*

Data Storage Details

Researchers are responsible for their data once it is collected (i.e. data should be immediately transferred to another location). Everything that happens to your data after collection (i.e., analyses) is the researcher's responsibility.

Research data is stored in the Olympus file format (*.oir, *.ome tif, *.ims).

The Olympus FVMPE-RS acquisition workstation is connected to the internet. Data may be securely transferred to individual researchers/research groups and/or temporarily stored (≤ 6 months) using the MITI SharePoint location or BOX account. Data may reside on the acquisition workstation 3 months and SharePoint or BOX location for *up to 6 months*. After this time, data will be removed from the acquisition workstation *without prior notification*. Once a month, data will be backed up and/or fully transferred to a network location.

Long-Term Data Transfer and Storage Plans (underway, NOT currently implemented): The AMCF (an affiliated imaging core) is working the RITO to establish additional temporary and long-term biomedical image storage, management, and sharing options using the OMERO platform. OMERO is a critical organizational infrastructure for managing imaging data, is universally/internationally accepted for publication-ready datasets, recognized by existing NIH data repositories, will allow us to eventually offer our own shareable data repository, directly reads/interfaces/integrates all imaging data collected on our imaging core acquisition workstations, and is capable of organizing curated datasets with meta data meeting community standards for biomedical imagery. The OMERO server will automatically read and organize meta data contained within biomedical images from hundreds of different systems (both inside

and outside the imaging cores). As soon as the OMERO server is active, researchers will be notified regarding specific features and storage options.
More information about OMERO can be found at https://www.openmicroscopy.org/omero/

Other

1) *BEFORE IMAGING,* make sure you have an appropriate (funding specific) data sharing and management plan in place. *DISCUSS* your plan with the MITI core. Each repository has its own requirements with significant variability across data repositories. Researchers must let core staff now prior to imaging if additional meta data is required.

2) Per NIH, "Regardless of the mechanism used to share data, each dataset will require documentation. Documentation provides information about the methodology and procedures used to collect the data, details about codes, definitions of variables, variable field locations, frequencies, and the like. *The precise content of documentation will vary by scientific area, study design, the type of data collected, and characteristics of the dataset."* This is your meta data. When not otherwise stipulated by funding agency, researchers are strongly encouraged to use community metadata standards (reference manuscripts below describe *evolving community standards*). Community standards generally exceed repository reporting requirements. Individual data repositories often provide guidance regarding appropriate metadata standards.

- Montero Llopis, P., et al. Best practices and tools for reporting reproducible fluorescence microscopy methods. Nat Methods 18, 1463–1476 (2021). https://rebecca-senft.shinyapps.io/MicCheck/
- Hammer, M., et al. Towards community-driven metadata standards for light microscopy: tiered specifications extending the OME model. Nat Methods 18, 1427–1440 (2021).

3) Researcher (funding source)-specific data management and sharing plans may require differing types of meta data/information. Basic system information (instrument type, date, time, excitation type/power, detector and scan settings) are automatically contained in the image meta data. Additional information regarding objective specification (i.e., NA), filter parameters (i.e. center wavelength and bandwidth) can be found on the MITI website under equipment. The MITI will assist researchers in obtaining additional information regarding global system configurations, as needed.
Equipment | VCR | University of Nebraska Medical Center (unmc.edu)

4) Olympus files (*.oir) can be opened outside the MITI using open-source software including ImageJ with bioformats plugin or FIJI, and QuPath. Individual repositories have specific requirements for acceptable file formats. If required by a repository, conversion of image files to opensource file formats such as OME tiffs (Open Microscopy Exchange) can be used to preserve meta data in a universal file format. This option is available in most programs readily interfacing with *.oir files.

https://imagej.net/formats/bio-formats
https://imagej.net/software/fiji/downloads
https://qupath.github.io/

5) Raw/unaltered image data is maintained in the oir file, if anything other than the initial raw data is analyzed for the final dataset, researchers should verify and record all downstream analysis parameters.

6) Volumetric mosaic images from the UltraMicroscope II/Light Sheet Microscope (TIBA affiliated instrumentation) can be stitched together using ImageJ/FIJI BigStitcher (ome tiff) or using the IMARIS stitch program (requires initial storage as, or conversion to *.ims file type). IMS files can be viewed using free viewer software.

https://imaris.oxinst.com/imaris-viewer
https://imagej.net/plugins/bigstitcher/advanced-stitching

7) Conversion/storage as *.ome tiff can significantly increase files sizes (2-3x). Please ensure adequate storage space and upload times. The AMCF has installed 10 Gb ethernet connections between the new

instrumentation (Axioscan whole slide imager, Light Sheet Microscope) and the Data analysis room. Additional high-speed connections will be established as quickly as possible. Many locations on campus are 10 Gb 'ready,' not actively installed/configured. Researchers should verify individual transfer capabilities in their location/building and plan accordingly.

- Data write *speeds* under good conditions are:
  - 10 Gb Ethernet: 500 Mb/s
  - 1 Gb Ethernet: 50-100 Mb/s
  - USB3: 50 Mb/s
- Data write *times* are shown in Table 11.1.

	Transfer method		
Amount of data	**10 Gb Ethernet**	**1 Gb Ethernet**	**USB 3**
1 Gb	2s	10-20s	20s
10 Gb	20s	1-3 min	3 min
100 Gb	3 min	15-30 min	30 min
1000 Gb	30 min	2.5-5 hours	5 hours

Table 11.1 Data write times for different amounts of data and transfer methods. Note that these are best-case values which are not always achieved in practice.

Want more detail?

Some helpful links: ABRF presentation & recording; NIH Webinar Part 1 & Part 2; NIH Webpage.
UNMC data sharing website.
Harvard Biomedical Data Management website.