OMERO guide MATLAB Documentation

Release 0.1.0

Open Microscopy Environment

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CONTENTS

This section shows how to install and use the OMERO MATLAB toolbox. The exercises demonstrate how to analyze data and store the results back to server.

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ANALYZE OMERO DATA USING MATLAB ONLINE

This workflow was contributed by the community, see https://github.com/mathworks/Open-Microscopy-Data-MATLAB. It allows to work with OMERO data using MATLAB Online.

This means that users do no need to download and install MATLAB locally as MATLAB is running in your browser.

You will just need a valid MathWorks account. An easy to understand environment with Jupyter Notebooks is provided.

Follow the steps on the https://uk.mathworks.com/matlabcentral/fileexchange/156034-open-microscopy-data-matlab.

INSTALL THE OMERO.MATLAB TOOLBOX

In this section, we show how to install the OMERO.matlab toolbox toolbox

2.1 Setup

- Download the toolbox.

- Make sure that the OMERO.matlab toolbox is on the MATLAB path. To add it to the path, you can

    – Launch MATLAB.

    – Under the *HOME* tab, click on *Set Path* (middle of the top task bar).
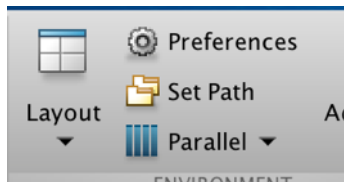
    – A *Set Path* dialog pops up.

    – Click on the button *Add with Subfolders...*

    – Select the OMERO.matlab toolbox, Click *Open*.

    – Close the *Set Path* dialog, you can either save the path for future use or not.

It is also recommended to install the Image Processing toolbox is only necessary for the image analysis. This is a convenient toolbox for analysis purpose. You do not need to install that toolbox to integrate OMERO and MATLAB.

ANALYZE OMERO DATA USING MATLAB

MATLAB is a powerful programming platform. We show here how you can analyze data stored in OMERO using MATLAB.

We will use https://docs.openmicroscopy.org/latest/omero/developers/Matlab.html as a reference.

3.1 Description

Here we demonstrate how to analyze a batch of images associated with the paper Subdiffraction imaging of centrosomes reveals higher-order organizational features of pericentriolar material.

We will show:

- How to connect to OMERO using MATLAB.

- How to load data (dataset, channels information, binary data).

- How to analyze images. The channel's name will be used to determine the channel to analyze.

- How to save the generated ROIs to OMERO.

- How to save the results stored in a CSV file locally back to the OMERO.server as a FileAnnotation.

- How to convert the CSV file into an OMERO.table.

3.2 Setup

Please read *Install the OMERO.matlab toolbox* first.

3.3 Resources

We will use:

- Images from IDR idr0021.

For convenience, the IDR data have been imported into the training OMERO.server. This is **only** because we **cannot** save results back to IDR which is a read-only OMERO.server.

3.4 Step-by-Step

The script used in this document is `idr0021_steps.m`.

1. In the *EDITOR* tab create a new script:
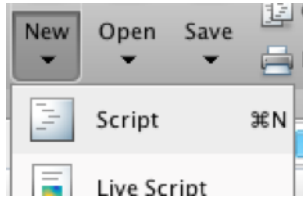
2. Copy the code for the exercises from `idr0021_steps.m`

3. Paste it into the new file and save the script under whatever name you like. **DO NOT RUN** the whole script.

4. To follow along the exercises only select the code block of each exercise and run it with "Evaluate Selection":
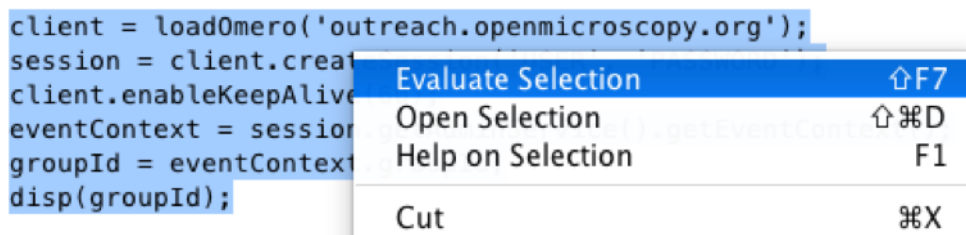
5. Later exercises cannot be run unless the previous exercises have been executed successfully.

6. If **you get stuck**, right-click on the *Workspace* tab, clear the workspace and start again from the beginning:
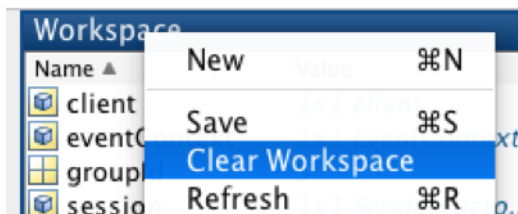
3.4.1 Exercise 1

Objectives: Connect to OMERO and print out your group ID.

Steps:

- Replace the USER and PASSWORD placeholders with your assigned credentials.
- Select the code block of **Exercise 1**
- Run it with "Evaluate Selection".

3.4.2 Exercise 2

Objectives: Load dataset and list the images contained in the dataset.

Steps:

- In OMERO.web find the dataset 'matlab-dataset' (in Project 'matlab-project')
- Copy its ID
- In the MATLAB code replace DATASET_ID with this ID
- Run the code block.

3.4.3 Exercise 3

Objectives: Read metadata; in particular find out which protein is the target in the images by looking through the image's map annotations (key-value pairs). It is the same protein for all four sample images.

Steps:

- Select one image from the dataset
- Load the map annotation linked to the image
- Select the entry whose key is 'Antibody Target'

3.4.4 Exercise 4

Objectives: Find out in which channels the target protein is stained.

Steps:

- Iterate through the dataset
- For each Image
  - Find the channel's name using the LogicalChannel
  - Determine the index of the channel whose name matches the value found in the previous exercise

3.4.5 Exercise 5

Objectives: Perform a simple image segmentation on one image and display the result.

Steps:

- Iterate through the dataset
- Analyze the image whose name is *siControl_N20_Cep215_I_20110411_Mon-1509_0_SIR_PRJ.dv*
- Retrieve the plane with `z=0, t=0, c=channel-1`. Indexes start at *0* in OMERO.
- Determine the mean, the standard deviation.

3.4.6 Exercise 6

Objectives: Perform the image segmentation on the whole dataset and save the results as ROIs and CSV file. The CSV file is saved as a FileAnnotation

3.4.7 Exercise 7

Objectives: Save the results as OMERO.table. This shows how to convert the CSV file into an OMERO.table

Steps:

- Run the code

- Go back to OMERO.web

- Select an image from the evaluated dataset

- Expand the *Tables* harmonica. You should see the results there.

- Double-click on the thumbnail of the image and inspect the ROIs in OMERO.iviewer.

- Note: You can also use OMERO.parade on the OMERO.table data created in this manner. As OMERO.parade works only on Projects, in OMERO.web

    - Create a new Project

    - Put the analyzed Dataset into that Project

    - Attach the OMERO.table created in **Exercise 7** to the Project

    - Now you can use OMERO.parade on the Project