

Using MoBIE in Fiji

A guide to the MoBIE plugin





embl.org/ells

EMBL Science Education and Public Engagement

About EMBL

EMBL is Europe's leading laboratory for the life sciences. We are an intergovernmental organisation supported by 27 member states and operating across six sites in Europe.

EMBL performs fundamental research in molecular biology, studying the story of life. Our research drives the development of new technology and methods in the life sciences, and we work to transfer this knowledge for the benefit of society.

About Science Education and Public Engagement

EMBL's Science Education and Public Engagement (SEPE) office leads and coordinates the institute's science education programmes and public engagement efforts.

Formerly know as European Learning Laboratory for the Life Sciences, ELLS, the office now not only leads the institute's science education activities but also coordinates its efforts in outreach and public engagement. We are building on EMBL's long history of science education and public engagement, and support EMBL's commitment of sharing and discussing our research with young learners, teachers and diverse publics.

The Science Education team of SEPE shares the scientific discoveries of EMBL through inspiring teaching andlearning experiences school science teachers, and to young people of all backgrounds aged between 10 and 19 years.

Our programmes convey complex, cutting-edge topics in life science research in an exciting and insightful way, fostering the discovery of current research trends, the scientific method, and scientific career paths. Our activities are developed and run in close collaboration with EMBL scientists.

Visit our website for further information about our activities: embl.org/ells

Introduction

Advances in cell biology research are heavily dependent on the development of imaging techniques, which provide ways to understand structures and biological functions at different scales. These tools are multidisciplinary and are being expanded constantly. From obtaining an image to the different ways it can be processed, these techniques are at the heart of state-of-the-art research at EMBL and are made available to the rest of the international scientific community. This resource will introduce you to one of the latest tools developed by EMBL scientists and show you how they use it to conduct cutting edge research. We hope that you will find this tool interesting and will use this resource to design your own activities for students on the topic of cell biology.

Overview

Modern electron microscopy (EM) and light microscopy (LM) produce vast amounts of images, which are then compiled into datasets to be later studied. The ability to visualise, explore and share these huge amounts of data both during and after the completion of a project was a challenge for the scientist working with them, so they developed MoBIE.

MoBIE (Multimodal Big Image Data Exploration) is an open-source framework for sharing and interactive browsing of multi-modal cloud-hosted big image data. It works as a plugin for <u>Fiji</u>, which is an image processing package.

This guide was created for the use of this software and the plugin MoBIE. The information in it is divided into two sections: "Setting up the working environment" and "Opening data for visualisation".

MoBIE is the result of a collaborative effort with the participation of members of the Developmental Biology Unit at EMBL, Heidelberg. By using electron microscopy, they generated a cellular atlas ("PlatyBrowser") of the marine worm *Platynereis dumerilii*, which enabled detailed analyses of the link between cells' morphology and the genes that are specifically expressed in them.





Since the size of the atlas data exceeded 2 TB, effective working with it was a challenge, so scientists developed MoBIE. The data used to generate the atlas was acquired in this study: <u>Whole-body integration of gene expression and single-cell morphology</u>¹ (Vergara et al., 2021) and the open-source project code can be found here.

Overall, MoBIE enables life scientists to seamlessly access, explore and share their often massive microscopy data through all stages of the lifetime of a project in a convenient Fiji plugin².

In the classroom, MoBIE is a great tool to visualise real-life images interactively manner, engaging students in identifying different cellular structures and giving a lot of flexibility to the teacher to tailor what activities they would like to have with their class.



How to use MoBIE

Setting up the working environment

1. Download Fiji via this link: <u>https://fiji.sc/</u>. You will need a stable internet connection. The downloaded zip file contains the installation file, in our case it will be called "ImageJ-win64.exe", since we downloaded the Windows 64-bit version.

🗊 Fiji: Imagel, with "Batteries Inclue 🗙 🕇		-	٥	×
← → C â fijisc	☆	Л	0	:
Fiji Home Wiki Source Forum Image: Fiji Source Forum Fiji Fiji Source Forum Fiji Source Forum Fiji Source Forum Forum Forum				
Why Fiji?				Ţ
B fij-win64.zip ^		Sh	ow all	×

2. Use your desired file archiver/extractor to extract the files inside the zipped folder. If you do not have one installed in your computer, you can use 7-Zip (<u>https://www.7-zip.org/</u>, free and open source).

22 C:\Users\leon\Downloads\fiji File Edit View Favorites To	-win64.zip\Fiji.app ols Help	p/							(300)		×
🕂 🗕 🤝 📫	→ × :	1									
Add Extract Test Copy N	love Delete In	fo									
C:\Users\leon\Download	ds∖fiji-win64.zip∖F	iji.app\									
Name	Size	Packed Size	Modified	Created	Accessed	Attributes	Encrypted	Comment			CRO
scripts	78 977	29 640								2FBE	E7D8
retro	814 151	709 267								672	67F60
plugins	11 279 040	10 572 649								BO3F	F5CF4
macros	19 157	7 112								6065	51AF4
luts	45 598	19 559								941D	CBD
licenses	1 103 690	279 072								C9C6	6BB31
lib	464 992	204 501								84AC	C934
java	179 574 164	76 374 239								582	5887
jars	271 877 098	253 127 719								7ED	2FE4
images	9 076 674	6 004 529								D862	25950
Contents	236 899	190 459								0D6E	E54C
WELCOME.md	5 498	2 339	2022-09-27 21:49				12			C76D	AA5
README.md	5 237	2 116	2022-09-27 21:49				1.0			4594	A906
ImageJ-win64.exe	150 016	88 093	2022-09-27 21:49			-rwxr-xr-x	-			049	35613
B dh xml az	300 841	300 899	2022-09-27 21:49				-			6464	1004

3. Install Fiji by running the installation file, in our case "ImageJ-win64.exe".

Tips for MAC

In case you are working with a Mac OS, once you download "fiji-macosx.zip", double click on it to unzip it. The application Fiji will appear as a new file. Next, copy/paste the Fiji to the Application folder. Next double click on the application. You might get the message below upon running the Fiji application for the first time.



You will need to allow opening for the application to open, by going to **System preferences**... found under the apple icon in the top left corner. Next, click on the **Security & Privacy** icon and on the bottom part of the window you will see the message as shown in the window below. Click the button **Open Anyway** and the Fiji application will open.

Allow apps downloaded from:	
O App Store	
 App Store and identified developers 	
"Fiji" was blocked from use because it is not from an identified developer.	Open Anyway

4. Open the programme. You may be prompted to run some updates, and it is always advisable to keep the software up to date

📴 (Fiji Is J	ust) Image	J														×
File Edi	t Image	e Pr	oces	ss A	Analy	ze	Plug	ins	Wind	ow	Help)				
	C O	1.	۷.	+++ ++	2	А	P.	4m	1	Dev	Stk	LUT	Ø	8	\$	≫
(Fiji Is Just)	ImageJ 2	2.3.0/	1.53t	/ Java	a 1.8.	0_17	2 (64	-bit)					Cli	ck her	e to sea	ırch

Add MoBIE by following the following steps:

5. Click on **Help** \rightarrow **Update**





ImageJ Updater		- 0
Name	Status/Action	Update Site
piugins/Auto_Local_Inresnoid.jar	Update It	Java-8
piugins/Fiji_Piugins.jar	Update It	Java-8
plugins/H5J_Loader_Plugin.jar	Update it	Java-8
plugins/HDF5_Vide2.jar	Update it	Java-8
plugins/interactive_SD_Surface_Plot.jar	Update it	Java-8
plugins/PIV_alialysel.jai	Update it	Java-o
plugins/Semples_jer	Update it	Java-o
plugins/Samples_jai	Update it	Java 9
plugins/frainable_segmentation.jar	Update it	Java 9
plugins/liakEwiz_jai	Update it	Java 9
plugins/View5D_jai	Update it	Java 9
plugins/volume_viewer.jai	Update it	Java 9
plugins/big formate_plugine jar	Update it	Java 8
nlugins/micha jar	Undate it	Java 8
nlugins/n5.viewer fiii jar	Undate it	Java 8
plugins/register virtual stack slices jar	Update it	Java-8
plugins/trakem2 tps.jar	Update it	Java-8
iars/FastInfoset.iar	Uninstall it	Java-8
iars/TrackMate.iar	Update it	Java-8
iars/aircompressor.iar	Install it	Java-8
jars/animal-sniffer-annotations.jar	Install it	Java-8
jars/antlr.antlr.jar	Install it	Java-8
jars/api-common.jar	Update it	Java-8
	Undate it	Laura D

6. Click on Manage update sites. A new window will pop up.

7. Find MoBIE (the list of updates is in alphabetical order), select it and click **Close.**

	Edit Image Process	Analyze Plugins Window Help	8 8 ≫	•
	a ImageJ Updater			1 ×
	🕼 Manage update sites			>
A.,	Name	URL	Host	Direc
	LysoQuant	https://sites.imagej.net/LysoQuant/		
	Mars	https://sites.imagej.net/Mars/		
	MaMuT	https://sites.imagej.net/MaMuT/		
	Maskflow	https://sites.imagej.net/Maskflow/		
	Masks from ROIs	https://sites.imagej.net/MasksfromRois/		
	Mastodon	https://sites.imagej.net/Mastodon-jungle/		
	Mcat	https://sites.imagej.net/Mcat/		
	Micro-Magellan	https://sites.imagej.net/Hpinkard/		
	Microglia-Morphometry	https://sites.imagej.net/Microglia-Morphometry/		
	Mighty Data, Inc.	https://sites.imagej.net/mightydatainc/		
	MIST	https://sites.imagej.net/NIST-ISG-MIST/		
	MiToBo	https://sites.imagej.net/MiToBo/		
V	MoBIE	https://sites.imagej.net/MoBIE/		
	ModularImageAnalysis (https://sites.imagej.net/ModularImageAnalysis/		
	Molography	https://sites.imagej.net/VolkerGatterdam/		
	MoMA	https://sites.imagej.net/MoMA/		
	Morphology	https://sites.imagej.net/Landini/		
	MOSAIC ToolSuite	https://mosaic.mpi-cbg.de/Downloads/update/Fiji		
	MPIBPC	https://sites.imagej.net/MPIBPC/		
	MS-ECS-2D	https://sites.imagej.net/MS-ECS-2D/		
	MTrack	https://sites.imagej.net/MicrotubuleTracker/		
	Multifrac	https://sites.imagej.net/Multifrac/		
	MultiStackReg	https://sites.imagej.net/MultiStackReg/		
	Multi-Template-Matching	https://sites.imagei.net/Multi-Template-Matching/		
	Add	update site Remove Update URLs	Close	

- 8. On the "ImageJ Updater" window, click **Apply changes**. Your Fiji will download and update all selected sites.
- 9. Restart Fiji (ImageJ).

Name	2	Status/Action	Update Site
	Information	×	
	Updated suc	ccessfully. Please restart Image!	
		OK	



Opening data for visualisation

MoBIE is a cloud-hosted tool, which means you will need a stable internet connection in order to use it. Before following these steps, make sure you are connected.

- 1. On the Fiji panel, type MoBIE in the search box on the right. A "Quick Search" window will appear.
- 2. Choose Open MoBIE project on the Commands tab and click Run.



3. An "Open MoBIE Project" window will appear. Feed the following link into the "Project Location" search bar:

https://github.com/mobie/platybrowser-datasets.

4. Click OK.

Open MoBIE Project X
Project Location
ОК

5. Multiple windows pop up. Focus on "MoBIE:platybrowser-datasets-1.0.1" and "MoBIE - BigDataViewer"

💵 (Fiji Is Ju	ust) Imagel									5.00	0	\times
File Ed	MoBIE: platybrowser-datasets-	-1.0.1			×	File Setting	s Tools	Help	MoBIE - BigDataViewer	- 0	×	
	P	Datasets Repository	~[show		y	×		Sector Sector Sector	211.4, 262.8,	e = 0 142.7 raw	
	dataset	1.0.1	~[view								
	anatomical-views	coronal	~[view								
	bookmark	Figure 1B: Epithelial cell	~	view					Colored and the second s			
	mobie-paper	Figure1a	~	view								
	prospr	ache	~	view					ENE E			
	prospr-mask	allglands	~[view								
	prospr-segmentation	virtual-cells	~	view								
	sbem	extrapolated	~[view								
	sbem-segmentation	cells	~[view								
	location	{"position":[120.5,115.3,201.5]}	Į.	move					An Andrew Contraction of the second			
		overlay	names	clear		50 microm	eter					
	1	raw FOCBX 🗹 S	□ v									
- iji Is Just) ImageJ 2.9.0/1.53t / Java 1	.8.0 172 (64-bit)			_					Click he	e to search	e 1

You can find useful information on how to navigate on the BigDataViewer window by clicking on the **Help** tab.

Navigation						
Using the mouse:						
Left-drag		Rotate (pan and tilt) around the point where the mouse was clicked.				
Right-drag or Middle-drag		Move in the xy-plane.				
Scroll		Move along the z-axis.				
Meta Scroll or Ctrl Shift Scroll		Zoom in and out.				
Using the keyboard:						
X/Y/Z	Select n	rotation axis.				
←/→	Rotate of	iotate clockwise / counter-clockwise around the choosen rotation axis.				
t/1	Zoom in	xom in / out.				
,/.	Move for	orward / backward along the z-axis.				
Shift X	Rotate t	to the zy-plane of the current source. (Look along the x-axis of the current source.)				
Shift Y or Shift A	Rotate t	to the xz-plane of the current source. (Look along the y-axis of the current source.)				
Shift Z	Rotate t	to the xy-plane of the current source. (Look along the z-axis of the current source.)				
[or n	Move to	previous timepoint.				
] or m	Move to	o next timepoint.				

Hold Shift to rotate and browse 10x faster. Hold Ctrl to rotate and browse 10x slower.

Finding cells and structures in the PlatyBrowser

The PlatyBrowser dataset window contains useful information for easy navigation of data. For example, use a specific location from the "bookmark" for the visualiser to take you to specific cells in the organism.

In this particular case, we will explore a predetermined region where a multiciliated cell resides and contains a rich population of mitochondria.

1. Copy the coordinate information below and feed it into the location bar on the MoBIE: platybrowser window.

{"normalizedAffine":[-0.03412397604987898,0.0030321151132691074, 0.009845289100542269,4.884586500918973,-0.0070447070370438574, -0.03172397300444243,-0.014646870674711356,9.17852774516154, 0.007516351661251353,-0.01596762335914084,0.030969479216659605, 0.5530290472093737],"timepoint":0}

2. Click **move**. Your Fiji screen should look like the screen shown in the image below. On the MoBIE - BigDataViewer window you will be able to see the bookmarked region, which in our case is a multiciliated cell.

You can explore the region by zooming in and out (Ctrl+Shift+Scroll or using the $\uparrow \downarrow$ keys on your keyboard), or moving from left to right (right-click your mouse and drag the picture).

Fiji Is Just) ImageJ					- 0
MoBIE: platybrowser-datas		- 🗆 ×	File Settings Tools Help	MoBIE - BigDataViewer	
20	Datasets Repository	 ✓ show 	12		
dataset	1.0.1	∽ view		and the second second	and the second
anatomical-views	coronal	v[view]	The Ison	Contraction of the second	
bookmark	Figure 1B: Epithelial cell	~ view	Law Contraction	and the second of the second	22 Real
mobie-paper	Figure1a	~ view	to the state of th		and a start
prospr	ache	√ view	The state		
prospr-mask	allglands	∨ view	Children and Child		A Teatrain
prospr-segmentation	virtual-cells	∨[view]	1 Alera		in Actor
sbem	extrapolated	~ view	Jan openie	1010.0000000000000000000000000000000000	A DEC
sbem-segmentation	cells	< ∨ view		and the second second	
location	9216659605,0.5530290472093737],"timepoint":	0} move	Star 1	A CONTRACTOR	
	overlay name	es clear	Non I	Red	6 2011
	raw F O C B X ☑S □V		ASY	in Direction 200	A CONTRACT
			2.5 micrometer	A A A A A A A A A A A A A A A A A A A	
					Part Part
Just) ImageJ 2.9.0/1.53t	/ Java 1.8.0 172 (64-bit)				Click here to search



Here are coordinates which can be used to locate:

Mitochondrion

{"normalizedAffine":[0.09006388844614853,-0.10002608164247305, -4.667503493061111E-50,1.7764018816859748,0.10002608164247305, 0.09006388844614853,-1.2159262309193589E-49,-25.988671222311197, 1.2159262309193589E-49,4.667503493061111E-50,0.13459836927239138, -29.70988208130259],"timepoint":0}

• Golgi apparatus

{"normalizedAffine":[0.09006388844614853,-0.10002608164247305, -4.667503493061111E-50,1.362512992797086,0.10002608164247305, 0.09006388844614853,-1.2159262309193589E-49,-25.72061566675564, 1.2159262309193589E-49,4.667503493061111E-50,0.13459836927239138, -29.463701525746846],"timepoint":0}

You can also use the project's own bookmarks to explore the atlas, as shown in this case by looking at some muscle cells. Simply choose your bookmark of interest from the list and click **view**.



OPENING DATA FOR VISUALISATION

😈 (Fiji Is Just) ImageJ					- 0
File Edit Image Pro	ocess Analyze Plugins Window	/ Help	. [
MoBIE: platybrowser-datas	ets-1.0.1	×	> File Settings Tools Help	MoBIE - BigDataViewer	>
2	Datasets Repository	~ show	LASA X	L-P-1	- The
dataset	1.0.1	~ view		$\mathcal{N} : \mathcal{T} : \mathcal{N}$	2 1 1
anatomical-views	coronal	~ view	NY X	A.X.	1.1
bookmark	Figure 1D: Muscles	✓ view	ACIES	λ λ	117
mobie-paper	Figure1a	∨ view	EN EN	X. F. K.	NE
prospr	ache	✓ view	HAS ST	121112	- V.
prospr-mask	allglands	∨ view	Nº N	X.F. A	-1
prospr-segmentation	virtual-cells	✓ view	16 prop		K-T
sbem	extrapolated	✓ view	242	The S ?	1 - 1
sbem-segmentation	cells	✓ view	1 AM	No the	1.1
location	{"position":[120.5,115.3,201.5]}	move	NER NY	1 Aget	. 4.
	ove	rlay names clear	. 1815 1		101-
	raw FOCBX	s 🗆 v	KAX.	X Z	No Se
			181-21	-3115	190
			Con Carl		1 54
			1 micrometer		1 - all
			The first	NON 1	
iji Is Just) ImageJ 2.9.0/1	.53t / Java 1.8.0_172 (64-bit)				Click here to search

You are welcome to find your own areas of interest by browsing the atlas, and create your own bookmarks to revisit them in the future. The MoBIE team have created great resources on this and other topics, and you can find them here: https://mobie.github.io/. Their MoBIE core functionality video and their Views and locations tutorial page are particularly useful for this purpose.

Furthermore, browse through other projects with interesting data that you can also use to extract impactful images for your lessons.

Examples:

Arabidopsis project: https://github.com/mobie/arabidopsis-root-lm-project
COVID project: https://github.com/mobie/covid-if-project

- 1. Whole-body integration of gene expression and single-cell morphology, Vergara, Hernando M. et al., Cell, Volume 184, Issue 18, 4819 - 4837.e22
- 2. https://www.biorxiv.org/content/10.1101/2022.05.27.493763v2
- 3. https://www.embl.org/news/science/platybrowser/



Science Education and Public Engagement

EMBL Meyerhofstraße 1 69117 Heidelberg Germany

Tel: +49 6221 387 8805 Mail: sepe@embl.org Website: embl.org/ells



Terms of use

The educational resource is licensed under the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International (CC BY-NC-SA 4.0) License. To view a copy of this license, visit <u>https://www.creativecommons.org/licenses/by-nc-sa/4.0/</u>