



IKOSA®

Application Documentation

Application Name	TEM Myocardium Assay
Version	1.0.0
Documentation Version	15.03.2020 - 1
Input Image(s)	Single Image (standard, grayscale, 8 bit or 16 bit) RGB images are automatically converted to grayscale images
Input Parameter(s)	None
Keywords	cardiovascular, in-vivo, myocardium, organelle, mitochondria, lipid droplet, sarcomere, z-stripe, microscopy, transmission electron microscopy, tem
Short Description	Segmentation of mitochondria, lipid droplets, sarcomere, and z-stripes in myocardial tissue sections imaged by transmission electron microscopy.
References / Literature	Reference laboratory: Core Facility Ultrastructure Analysis Graz: Dr. Dagmar Kolb.

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IKOSA® Image Analysis

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Application Description

This application automatically segments and measures different types of structures (mitochondria, lipid droplets, sarcomere, z-stripes) in myocardial tissue sections imaged by transmission electron microscopy. The application was developed and tested with images of myocardial tissue sections of mice.

In the following, the requirements for an accurate analysis are given and the output of the applications is described.

Sample Data and Further Information

Sample Data: To try out this application, sample images can be downloaded here: https://drive.google.com/open?id=1WnUnZr4qbXp6-vpEvPfla8yBqW_Ko3-P.

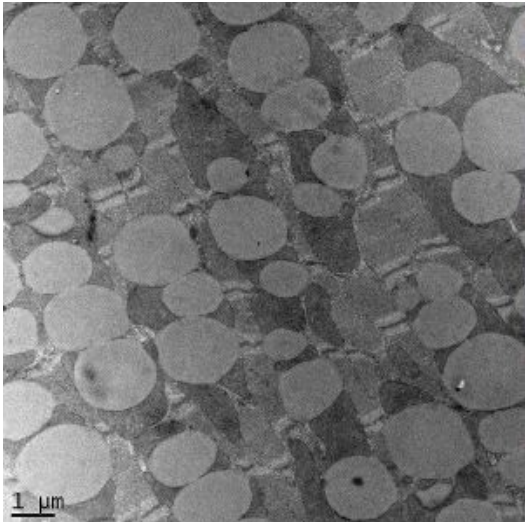
If you have any questions regarding this application or if you want to know if your specific type of images can be analyzed, please get in touch with us at support@kmlvision.com. Also, if you have requests or ideas regarding additional image analysis applications that you would require, please get in touch with us at support@kmlvision.com.

For more information, please visit www.ikosa.ai.

Requirements

Input Image(s)

Input for this application is the following image data:

No.	Image data	Type of image	Color Channels	Color Depth (per channel)	Size [Px]	Resolution [$\mu\text{m}/\text{Px}$]
#1	Single image	Standard	1 (Greyscale) 3 (RGB)	8 Bit or 16 Bit	Min: 512 x 512 Max: 6144 x 6144	typically: 170-340
<p>Image Content: Transmission electron microscopy image of myocardial tissue section.</p> <p>Additional requirements: Before imaging, the sample is embedded in synthetic resin, then sliced into ultra-thin sections of approximately 70 nm. Platin blue and lead citrate are used for contrasting.</p> <p>Examples:</p> 						

For all images, the following requirements apply:

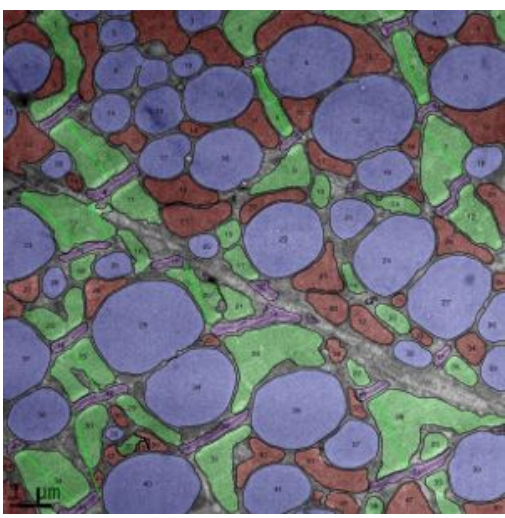
- The illumination must be constant throughout the image(s).
- The sample must be in focus, i.e. no blurry regions in image(s).

Input Parameter(s)

No additional input parameters are required for this application.

Results

Files

No.	File type	Content and Description
1	csv	<i>results.csv</i> : A csv file containing global analysis results for the input image.
2	jpg	<p><i>results_visualization.jpg</i>: A visualization of the analysis:</p> <div style="display: flex; align-items: center;">  <div style="margin-left: 20px;"> <ul style="list-style-type: none"> ● lipid droplets are shown in blue, ● mitochondria are shown in red, ● sarcomeres are shown in green ● z-stripes are shown in purple <ul style="list-style-type: none"> ○ the lengths that were used to measure the z-stripe distances are shown as green lines ● the numbers written within each detected object show the ID of each object. The same IDs are used within the different CSV files. </div> </div>
3	csv	<i>results_01_lipid_droplets.csv</i> : lipid droplet results
4	csv	<i>results_02_mitochondria.csv</i> : mitochondria results
5	csv	<i>results_03_sarcomeres.csv</i> : sarcomere results
6	csv	<i>results_04_zstripes.csv</i> : z-stripe results



Description of files

File no. 1 (results.csv): Single csv-file with the following content:

Col. no.	Column name	Examples	Value range	Description
1	Lipid Droplets - count	5	0 -	number of lipid droplets
2	Lipid Droplets - total area [Px ²]	5432	0 -	total area covered by lipid droplets in Pixel ²
3	Lipid Droplets - total area [%]	2.523	0 - 100	total area covered by lipid droplets in % of image size
4	Lipid Droplets - completely within image - count	4	0 -	number of lipid droplets that are completely within the image (i.e. instances that do not touch the image borders)
5	Lipid Droplets - completely within image - total area [Px ²]	1321	0 -	total area covered by lipid droplets that are completely within the image (i.e. instances that do not touch the image borders) in Pixel ²
6	Lipid Droplets - completely within image - total area [%]	1.245	0 - 100	total area covered by lipid droplets that are completely within the image (i.e. instances that do not touch the image borders) in % of image size
7	Mitochondria - count	5	0 -	number of mitochondria
8	Mitochondria - total area [Px ²]	5432	0 -	total area covered by mitochondria in Pixel ²
9	Mitochondria - total area [%]	2.523	0 - 100	total area covered by mitochondria in % of image size
10	Mitochondria - completely within image - count	4	0 -	number of mitochondria that are completely within the image (i.e. instances that do not touch the image borders)
11	Mitochondria - completely within image - total area [Px ²]	1321	0 -	total area covered by mitochondria that are completely within the image (i.e. instances that do not touch the image borders) in Pixel ²
12	Mitochondria - completely within image - total area [%]	1.245	0 - 100	total area covered by mitochondria that are completely within the image (i.e. instances that do not touch the image borders) in % of image size
13	Sarcomeres - count	5	0 -	number of sarcomeres
14	Sarcomeres - total area [Px ²]	5432	0 -	total area covered by sarcomeres in Pixel ²
15	Sarcomeres - total area [%]	2.523	0 - 100	total area covered by sarcomeres in % of image size
16	Sarcomeres - completely within image - count	4	0 -	number of sarcomeres that are completely within the image (i.e. instances that do not touch the image borders)
17	Sarcomeres - completely within image - total area [Px ²]	1321	0 -	total area covered by sarcomeres that are completely within the image (i.e. instances that do not touch the image borders) in Pixel ²



18	Sarcomeres - completely within image - total area [%]	1.245	0 - 100	total area covered by sarcomeres that are completely within the image (i.e. instances that do not touch the image borders) in % of image size
19	Z-Stripes - count	5	0 -	number of Z-Stripes
20	Z-Stripes - total area [Px ²]	5432	0 -	total area covered by Z-Stripes in Pixel ²
21	Z-Stripes - total area [%]	2.523	0 - 100	total area covered by sarcomeres in % of image size
22	Z-Stripes - completely within image - count	4	0 -	number of Z-Stripes that are completely within the image (i.e. instances that do not touch the image borders)
23	Z-Stripes - completely within image - total area [Px ²]	1321	0 -	total area covered by Z-Stripes that are completely within the image (i.e. instances that do not touch the image borders) in Pixel ²
24	Z-Stripes - completely within image - total area [%]	1.245	0 - 100	total area covered by Z-Stripes that are completely within the image (i.e. instances that do not touch the image borders) in % of image size
25	Z-Stripes - mean distance [Px]	327.0	0 -	Mean distance between Z-Stripes (i.e. the mean length of sarcomeres) in Pixels. This parameter is only estimated in transverse muscle sections. The distance between Z-stripes is estimated by finding Z-stripes that are parallel (+/- 30°)

File no. 3 (results_01_lipid_droplets.csv): Single csv-file with the following content:

Col. no.	Column name	Examples	Value range	Description
1	id	1, 2, 3, ...	1 -	id of each lipid droplet
2	area [Px ²]	1532	1 -	area of each lipid droplet in Pixel ²
3	area [%]	1.95	0 -	area of each lipid droplet in % of image size
4	completely within image	yes	{yes, no}	yes if the lipid droplet is completely within the image (i.e. the lipid droplet does not touch the border), otherwise no.

File no. 4 (results_02_mitochondria.csv): Single csv-file with the following content:

Col. no.	Column name	Examples	Value range	Description
1	id	1, 2, 3, ...	1 -	id of each mitochondria
2	area [Px ²]	1532	1 -	area of each mitochondria in Pixel ²
3	area [%]	1.95	0 -	area of each mitochondria in % of image size
4	completely within image	yes	{yes, no}	yes if the mitochondria is completely within the image (i.e. the mitochondria does not touch the border), otherwise no.

**File no. 5 (results_03_sarcomeres.csv): Single csv-file with the following content:**

Col. no.	Column name	Examples	Value range	Description
1	id	1, 2, 3, ...	1 -	id of each sarcomere
2	area [Px ²]	1532	1 -	area of each sarcomere in Pixel ²
3	area [%]	1.95	0 -	area of each sarcomere in % of image size
4	completely within image	yes	{yes, no}	yes if the sarcomere is completely within the image (i.e. the sarcomere does not touch the border), otherwise no.

File no. 6 (results_04_zstripes.csv): Single csv-file with the following content:

Col. no.	Column name	Examples	Value range	Description
1	id	1, 2, 3, ...	1 -	id of each z-stripe
2	area [Px ²]	1532	1 -	area of each z-stripe in Pixel ²
3	area [%]	1.95	0 -	area of each z-stripe in % of image size
4	completely within image	yes	{yes, no}	yes if the z-stripe is completely within the image (i.e. the z-stripe does not touch the border), otherwise no.