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Application Documentation

Application Name	Ki-67 Quantification Breast Cancer
Version	3.0.1
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Input Image(s)	2D Images (RGB)
Input Parameter(s)	Regions of interest (optional)
Keywords	pathology, ihc, ki67, ki-67, nuclei, microscopy, mamma, breast, tissue, detection, tumor, oncology, carcinoma
Short Description	Detection of tumor cell nuclei in immunohistochemically (IHC) stained sections of human breast cancer. Counting of positively (brown) and negatively (blue) stained nuclei and calculation of positive/negative ratio.
References / Literature	Reference department: Diagnostic and Research Institute of Pathology, Medical University of Graz, Dr.med.univ. Martin Asslaber
Important Information	Research Use Only! This application is not certified as a medical device and must not be used for diagnostic or therapeutic purposes.



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IKOSA® Image Analysis

You can use this or any other of our image analysis applications through your IKOSA® account. If it is not listed in the available applications, please contact your organization's IKOSA® administrator or our team at support@kmlvision.com.

Application Description

This application automatically detects and counts tumor cell nuclei in immunohistochemically (IHC) stained sections of human breast cancer. Positively (brown) and negatively (blue) stained nuclei are counted separately. The ratio of the detected positively and negatively stained nuclei is calculated. The application was developed and tested with microscopy images of human tissue sections.

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

Further Information

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.

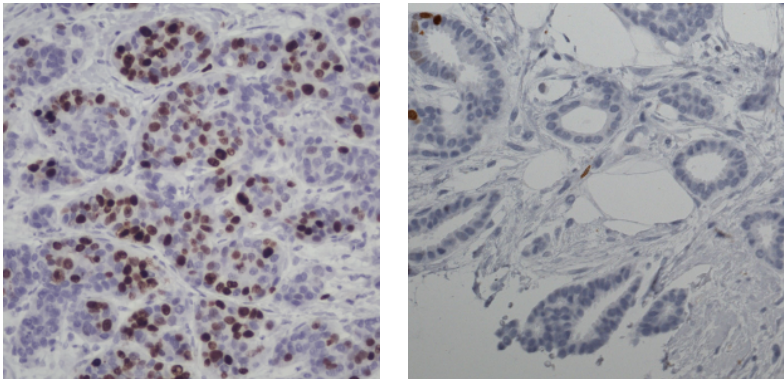
For more information, please visit www.ikosa.ai.



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	2D	2D	3 (RGB)	8 Bit	WSI formats: arbitrary Standard images: max. 25,000 x 25,000	Typically: 0.3 - 0.5
<p>Image Content: Microscopy image of IHC Ki-67 stained sample, typically taken with 20x magnification.</p> <p>Additional requirements:</p> <ul style="list-style-type: none"> • For imaging, UV and IR filters should be used. • Nuclei must have sizes (diameters) in the range of 25-90 Pixels for the algorithm to detect the nuclei. <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)

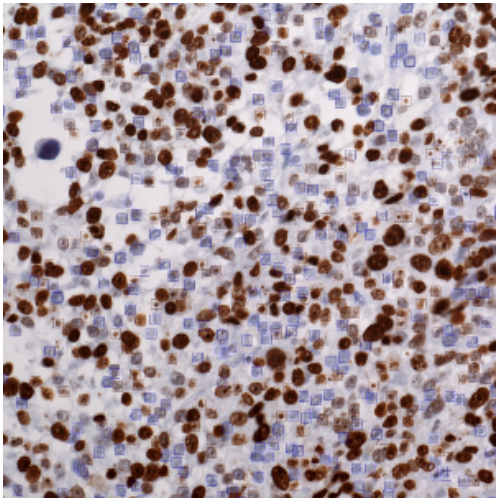
No additional input parameters are required for this application.

As an optional parameter, a single or multiple regions of interest (ROIs) can be defined in which the analysis should be performed ('inclusion ROIs').



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>  <ul style="list-style-type: none"> Brown and blue nuclei are visualized using orange and blue rectangles, respectively.
3	json	<i>annotation_results.json</i> : JSON file containing positions of detected nuclei. The position is measured from the left upper corner (1,1) of the image.
4	json	<i>roiMeta.json</i> : A json file containing all information regarding the ROIs defined for the analysis job to ensure reproducibility. The file is empty if no ROIs were defined for analysis.
5	jpg	<p><i>rois_visualization.jpg</i>: An overview visualization to show locations of all analyzed ROIs for the 2D image.</p> <p>This file is only created if inclusion ROIs were defined for analysis.</p>
6	json	<p><i>jobResultBundleMeta.json</i>: A json file containing all information regarding the analysis job (application name and version, project, etc.) to ensure reproducibility.</p> <p>This file is only included if bundled or merged analysis jobs are downloaded.</p>



Please note:

- For inclusion ROIs that are partially outside of the image, the ROIs are cropped to the areas that are inside of the image.
- For inclusion ROIs that are completely outside of the image, no analysis is performed, however, they are still listed in corresponding result files..
- `<roi-id>` is generated automatically by the application according to the creation date of ROI. The location of a ROI with a specific `<roi-id>` within an image can be seen in the file `rois_visualization.jpg`. ROIs that are completely outside of the image are not shown in this file.
- All visualizations are downscaled to 25 megapixels (MP) if the original image or inclusion ROI is larger than 25 MP.
- **Attention:** Results for a specific region of the same image may vary when performing an analysis on the whole image or ROIs that include this region.

Description of files

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

If one or more ROIs were specified, the results in a specific row refer to the ROI specified in the corresponding columns, otherwise (empty ROI columns) the results refer to the whole image.

Col. no.	Column name	Examples	Value range	Description
1	roi_id	ROI-03	ROI-01 -	<code><roi-id></code> starting from "ROI1". Empty, if no inclusion ROI is specified and the whole image was analyzed.
2	roi_name	"central"	text	Custom text to identify the ROI. Empty, if no inclusion ROI is specified and the whole image was analyzed.
3	roi_size [Px^2]	1212212	1 -	Size of the ROI that was analyzed in pixels^2. The size of the whole image is given if no inclusion ROI is specified and the whole image was analyzed.
4	nuclei count	1232	0 -	Number of detected nuclei.
5	blue nuclei count	386	0 -	Number of detected blue nuclei.
6	brown nuclei count	846	0 -	Number of detected brown nuclei.
7	ratio brown/blue nuclei	2.19	0 - inf	Number of brown nuclei divided by the number of blue nuclei. if blue=0 the result is "inf" (infinity).



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Error Information

If an image analysis job fails, an error code and error message are returned. Failed analysis jobs are listed in the *Failed* tab of the *Analysis Jobs* section on the *Image Analysis* page on IKOSA®. For more information regarding the errors, please check the [Application Errors Documentation](#).