MaZda 4.5 Tutorials
Grey-scale Image Analysis

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Loading image

There are several ways to load image into the MaZda program:

1. Open Explorer and double-click on the image file icon which is associated with MaZda. It will automatically start MaZda program and load the selected image.
2. Start MaZda, select *File→Load image…* or click *Load image* button, then select a file to be loaded with a *Load image* dialog window.
3. Drag-and-drop image file from Windows Explorer into the MaZda window
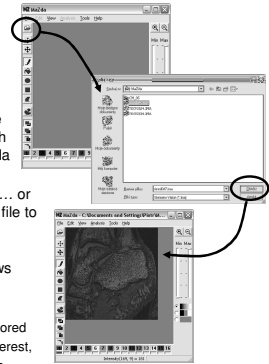
By default the image after being loaded will be colored with red. Colors are used to indicate regions of interest, which will be covered later during this presentation

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Loading RAW images

MaZda is capable of loading images without headers or formatting information, called raw images. In case of loading raw image the user must provide additional information to correctly present the image. To set raw image formatting parameters, select *File→Raw options…* from the menu and use the *Raw options* dialog box.
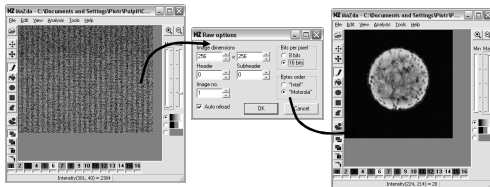
Hint: if the image formatting is unknown, check *Auto reload* and observe image while adjusting image parameters

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Viewing image

- To zoom image use *zoom-in/zoom-out* buttons or select View→Zoom option from the menu
- To set image grey-scale window or to adjust brightness and contrast, use *Min/Max* sliders.
- To view thresholded image or to switch the image view off, use the radio buttons located below the sliders.

Remark: Adjusting the image view options described here will not affect the image analysis procedure.

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Viewing image information

To view information on the loaded image select
*View→Image info…*
from the menu

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Regions of interest

MaZda computes numerical values (textural features), which characterize an image or an image fragment (region of interest or ROI). To compute features within a ROI the shape of such ROI must be defined.

Since MaZda works with grey-scale images, the ROI is indicated with a color superimposed on the grey-scale image. Up to 16 ROI shapes may be defined with use of 16 unique colors. These shapes may overlap if needed.
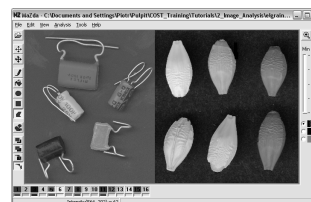
Example of an image presenting 11 separate objects, each object marked with unique color, which indicate they are separate ROIs

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ROI editing tools

Drawing tools:
- draw line (right-click for width changing)
- fill-in
- draw elypsis or circle (while *Ctrl* pressed)
- draw rectangle or square (*Ctrl*)
- draw polygon

Morphology transformation tools

ROI drawing mode buttons:
- non-overlapping regions
- overlapping regions
- erasing selected region
- erasing all the regions

ROI color selection bar. Right-clicking on the color button lets to assign a class name for a ROI
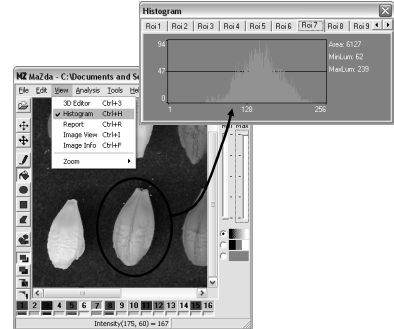
Created ROI indicator bar. Buttons may be used for switching ROI on and off for viewing
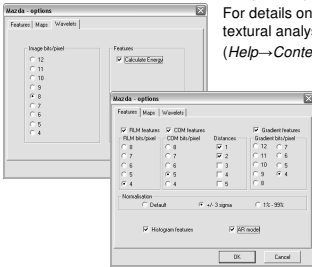
Move or copy the selected ROI
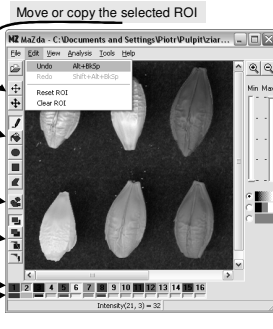
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Image histogram

To view an image histogram within region of interest select *View→Histogram* from the menu.
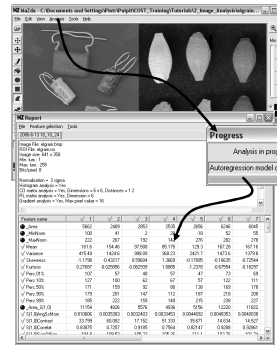

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ROI analysis options

To set the analysis options select *Analysis→Options…* from the MaZda menu. For details on the methods implemented for textural analysis refer to the MaZda manual (*Help→Contents*)

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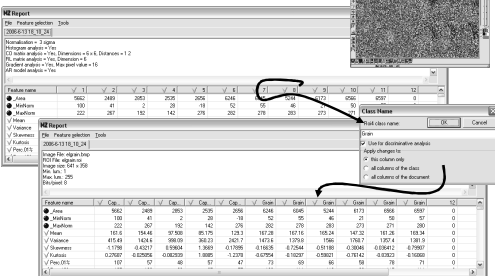## Image analysis

To start the analysis select *Analysis→Run* from the MaZda menu.

The results are presented in a Report window:
✓ Tab-page per analysis
✓ Column per ROI
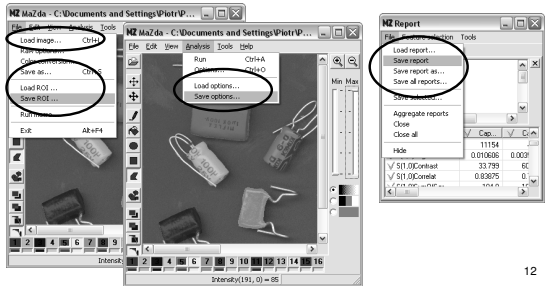✓ Row per feature

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Classes of ROIs

To assign a class name to a column, a feature vector computed for a particular ROI, click on the column header. Then, use a *Class Name* dialog box to set appropriate class name.

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Saving data

Images, region of interest, option sets or reports may be saved to a disk files or loaded from disk files. Save your work before it's too late!

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Exercise 1

- Start MaZda
- Load image *elgrain.bmp* from *Tutorials\2_Image_Analysis* folder
- What is a height and width of the image in pixels?
- Define regions of interest, one per individual object.
  - For capacitors use *Draw polygon* tool
  - For grains set image view to three grey levels (thresholded), adjust thresholds to distinguish grain areas, and use *Fill* tool
- Set analysis options (Normalisation: +/- 3 Sigma, 6 bit COM analysis, Calculate wavelets energy, AR Model, and set other parameters of your choice)
- Run the analysis
- Set up appropriate class names in a report window
- Observe the *S(1,0)Contrast* feature has higher values for Capacitors then for grains, and the *Teta1* has higher values for grains.
- Find some other features that may be useful for discrimination of the two classes
- In the *Report* window select *Feature selection→Fisher* from the menu. It will start a procedure searching for the most discriminative features. Do the selected features discriminate the two classes?

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Exercise 2

- Start MaZda or, if it is already started, close all the report tab-pages
- Load image *texture1.bmp* from *Tutorials\2_Image_Analysis* folder
- Switch to the overlapping mode and create 16 regions of interest of an approximate size 60x60 pixels (observe the status bar for a size information) with *Draw rectangle* tool
- Set analysis options and run the analysis
- In a Report window set class name *Biology* for all the columns
- Load image *texture2.bmp* from *Tutorials\2_Image_Analysis* folder
- Run the analysis (use the same regions and analysis options as previously)
- In a Report window set class name *Mineral* for all the columns of the second tab-page
- Find features that may be useful for discrimination of the two classes
- In the *Report* window select *Feature selection→Mutual information* from the menu. It will start a procedure searching for the most discriminative features. Do the selected features discriminate the two classes?

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Exercise 2 (continued)

- Perform automatic feature selection with Fisher criterion using **Feature selection->Fisher**
- Save selected features to a file *fisher.sel* using **File->Save selected**
- Run **b11** using **Tools->B11 analysis**
- Observe **b11** options window selecting **Options**
- Select only three top features in Feature selection box
- Observe feature distribution using Analysis->Row data
- Perform PCA and LDA analysis and observe feature distribution in the new data space

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