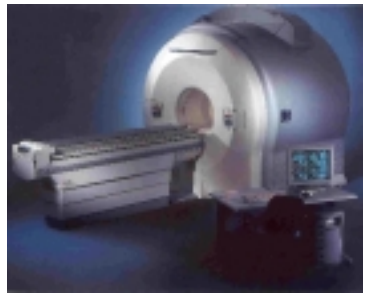
WG1 - Report on Software

Andrzej MATERKA,

Technical University of Lodz, Poland

COST B11: “Software and Statistics” Working Group



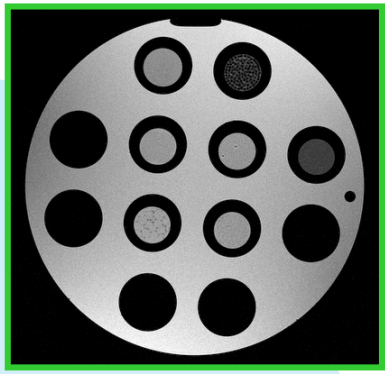
Context (activity in general)

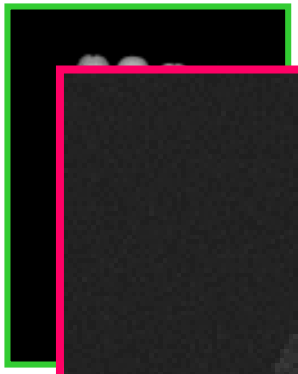
- Development of software tools for all Working Groups of COST B11 action.
- Stimulation of discussion of the functionality of the software.
- Searching for image processing and pattern recognition techniques adequate for MRI texture analysis

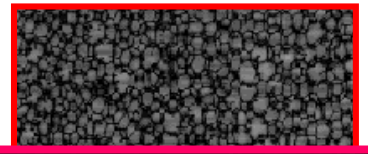
Goals

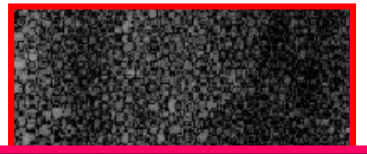
- To develop PC MS Windows computer programs with appropriate GUI and agreed set of functions.
- To develop efficient techniques of quantitative texture analysis in magnetic resonance images.

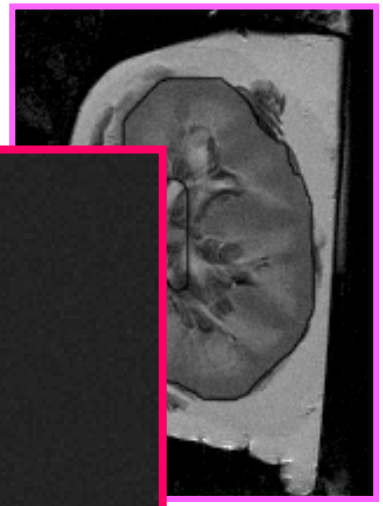
Material





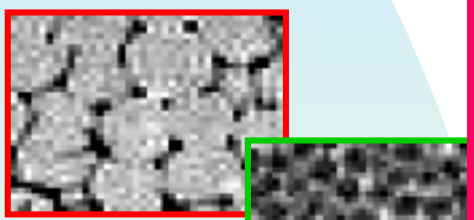


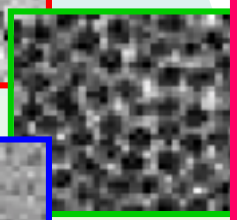


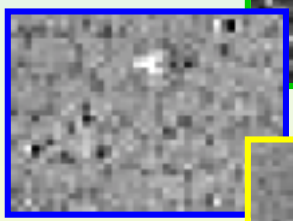


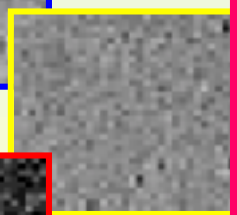
Foam phantoms

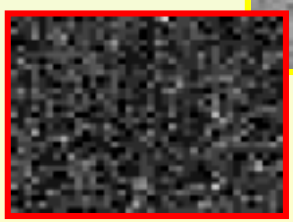
lney

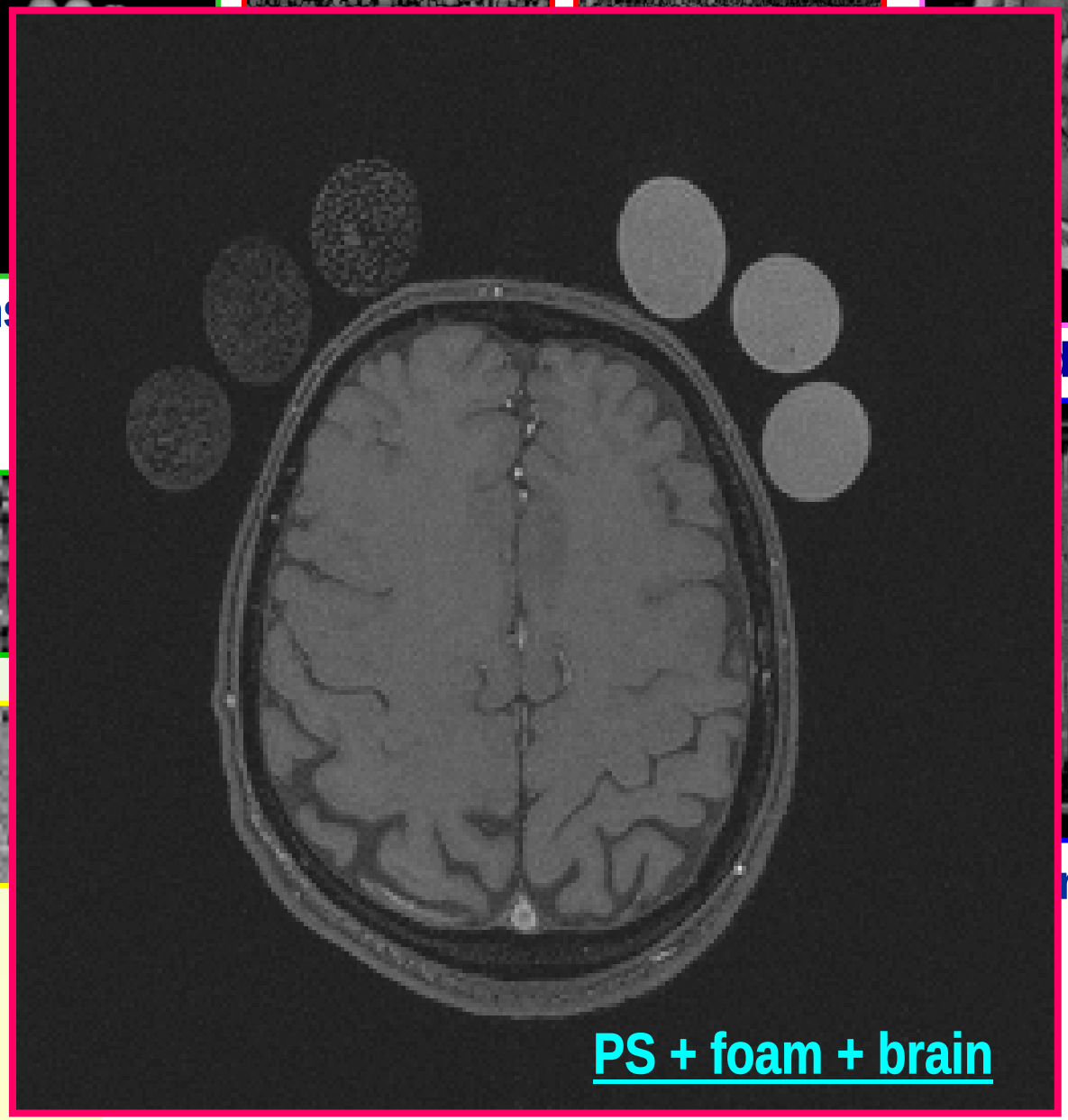




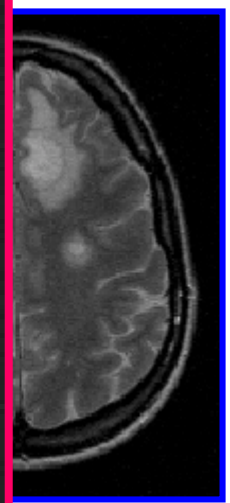






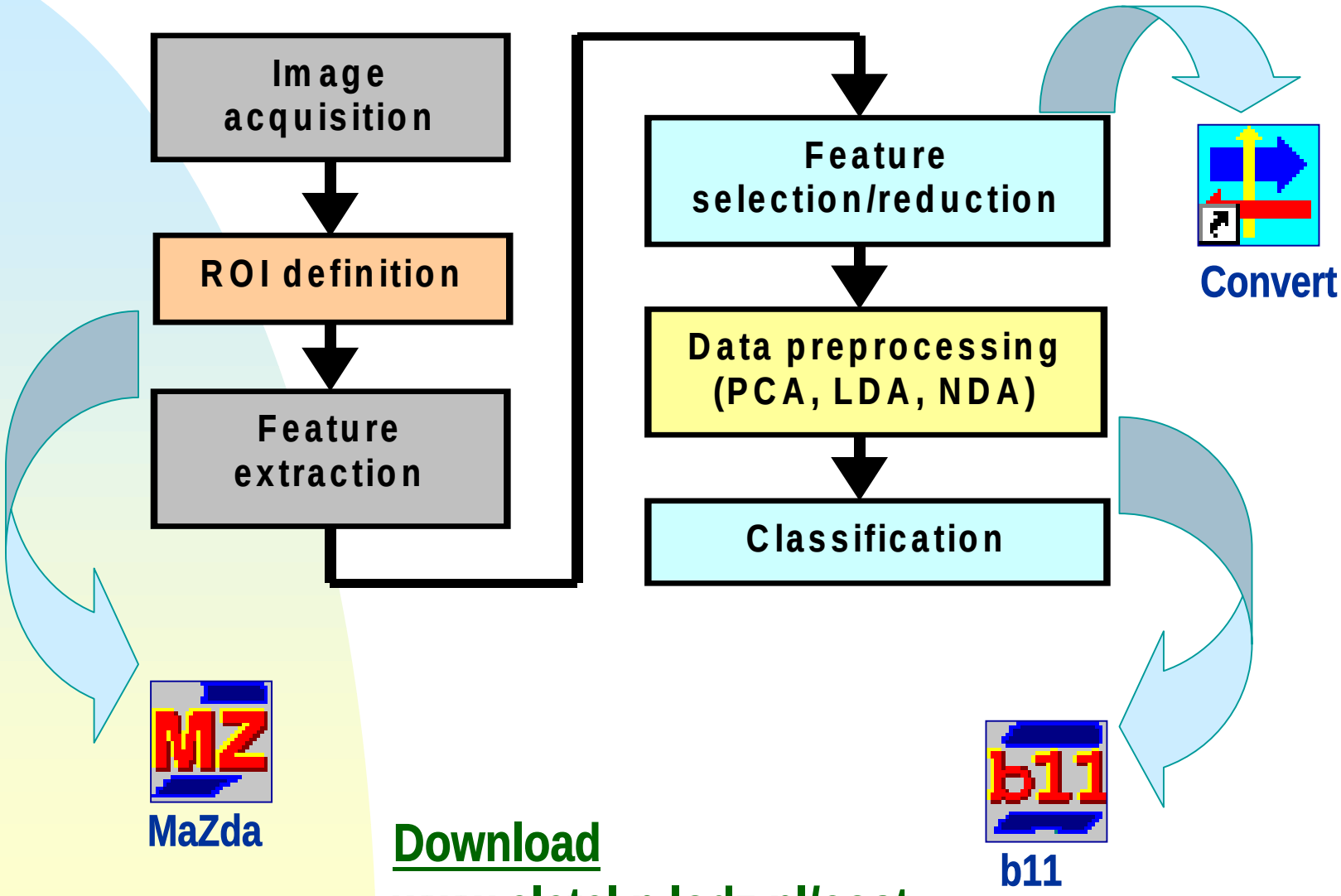


PS + foam + brain



mage

Methods



Download

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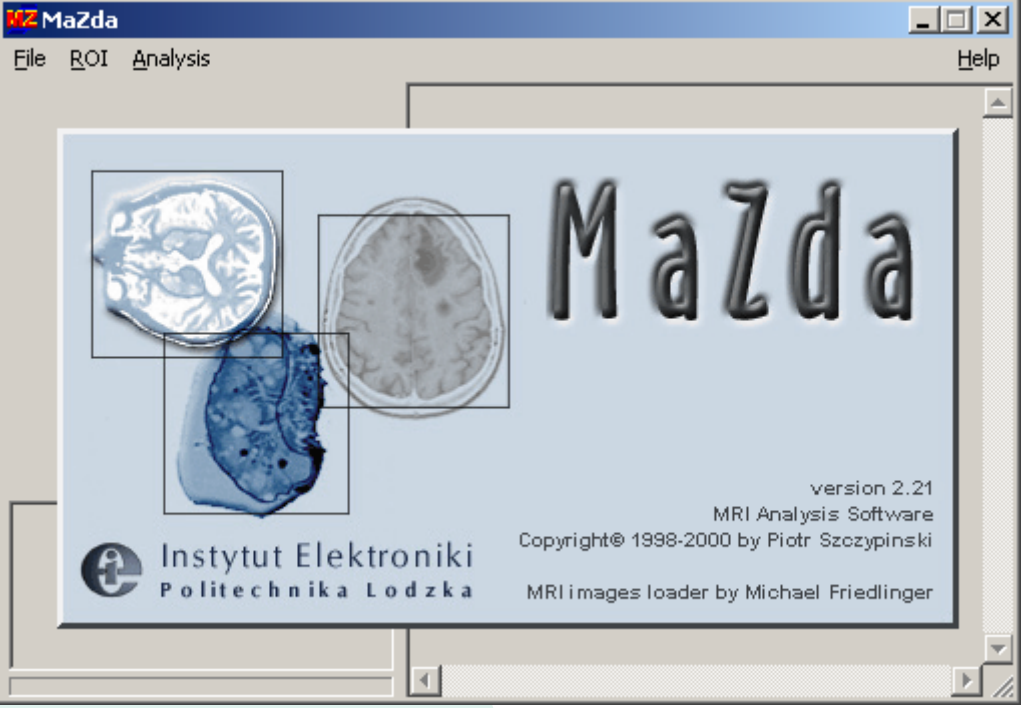
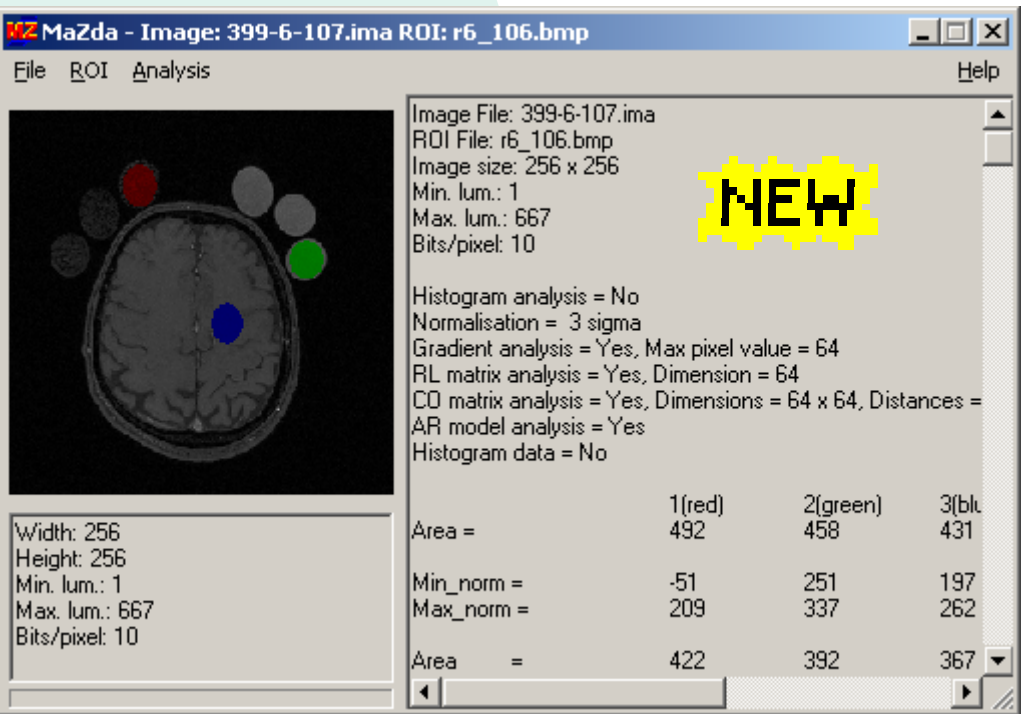




MaZda, ver. 2.21

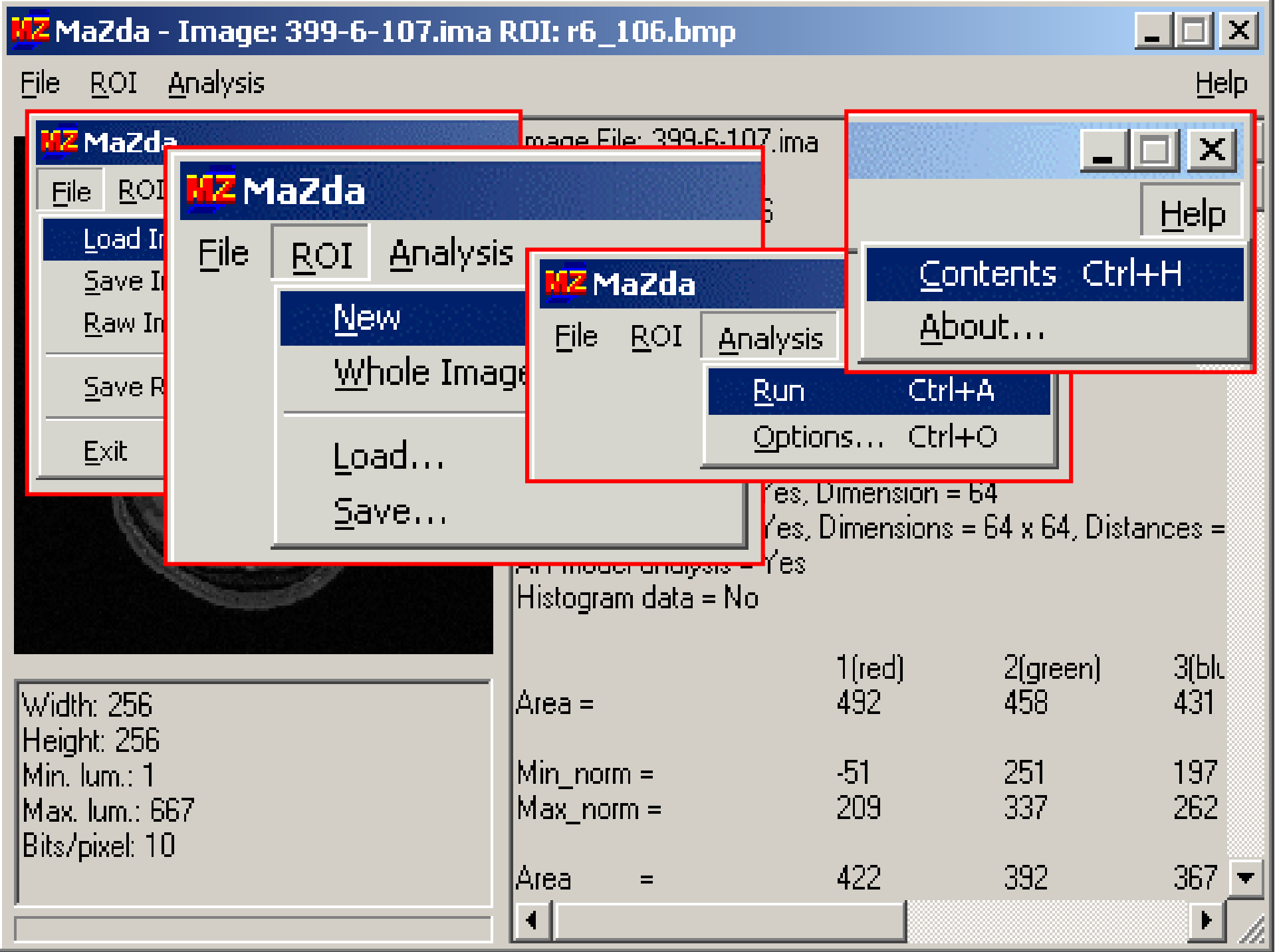
Input: images in 11 file formats

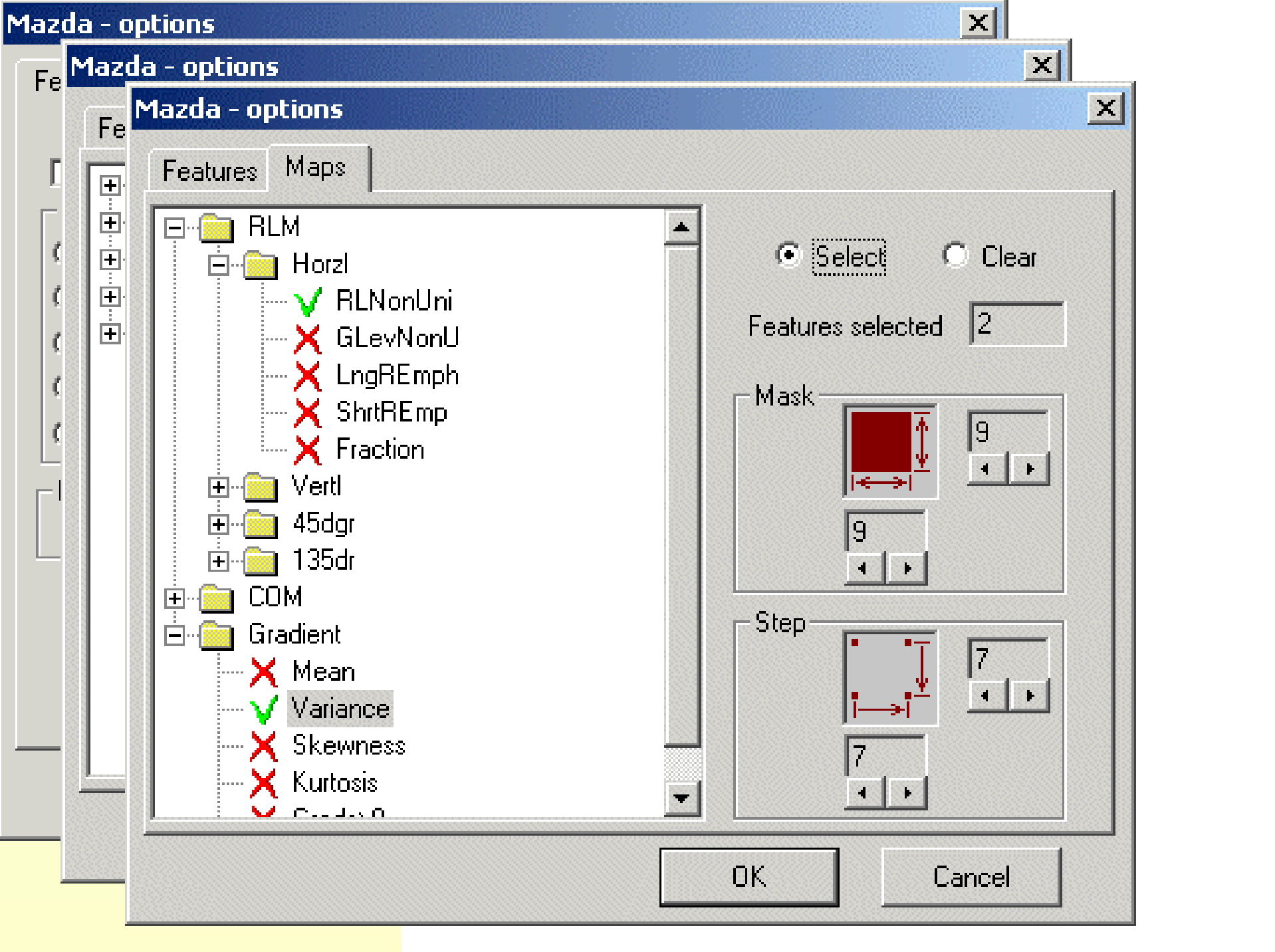
Methods

histogram, gradient, CO matrix,
AR model (total of 259 features)

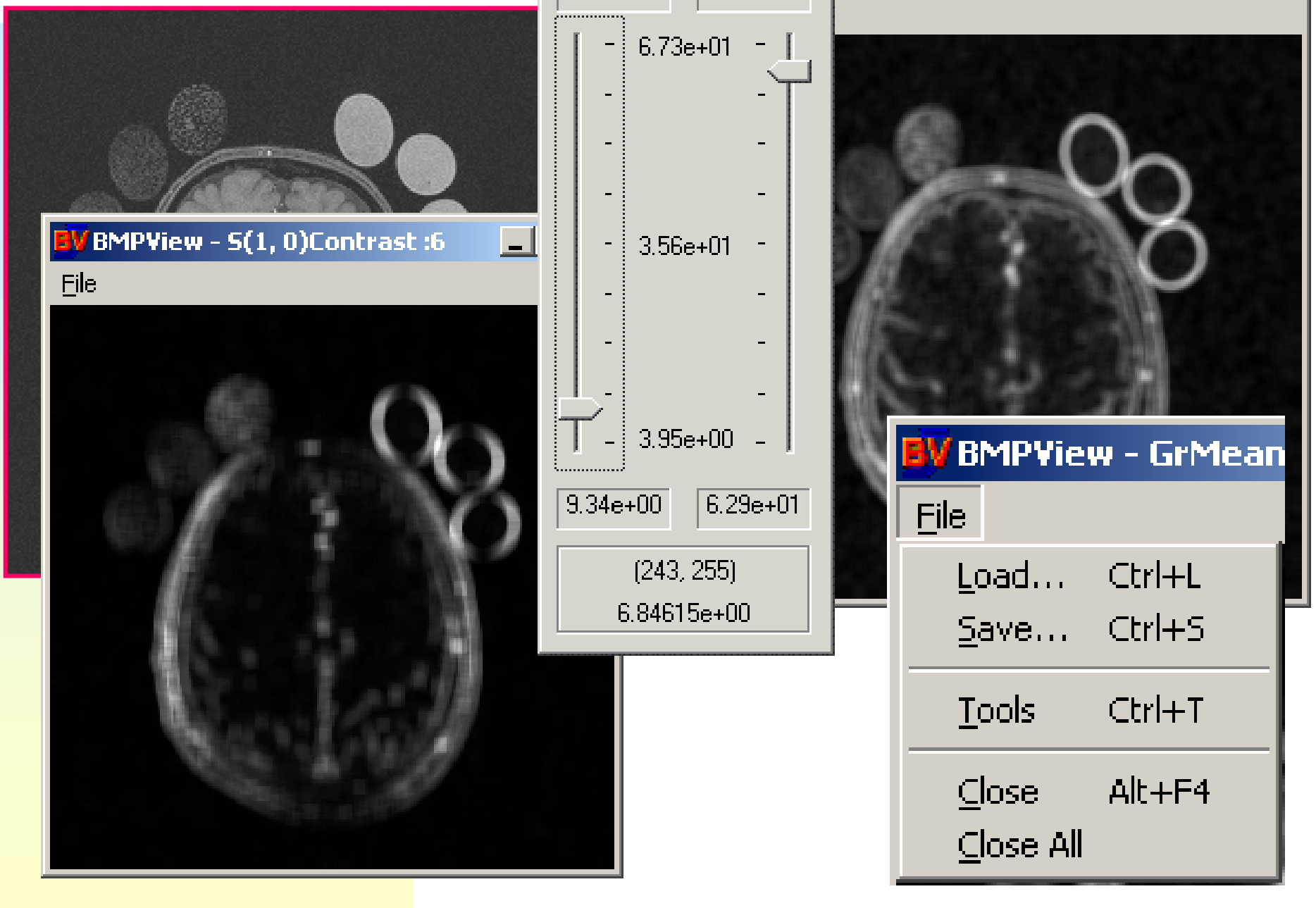
Output:

- (*.par) text file,
- (*.bmp) histograms
- (*.bmp) feature maps NEW

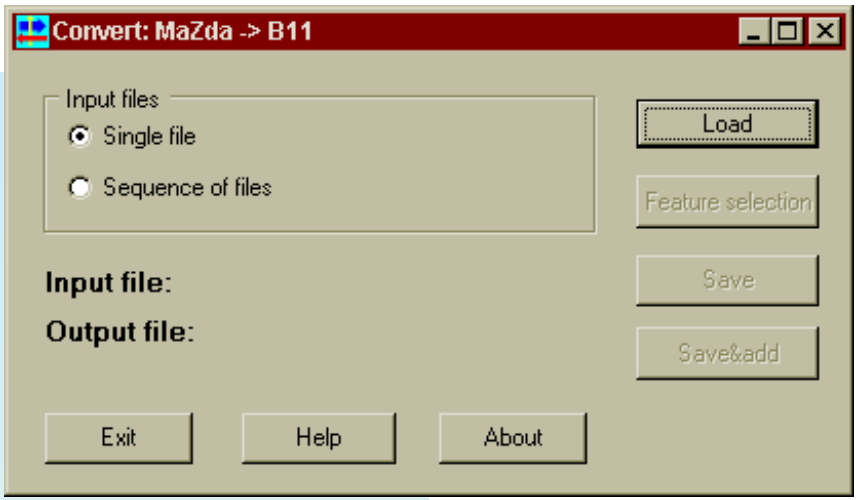

MaZda - Image: 399-6-107.ima ROI: r6_106.bmp
File ROI Analysis Help
MaZda
File ROI Analysis
New
Whole Image
Load...
Save...
MaZda
File ROI Analysis
Run Ctrl+A
Options... Ctrl+O
Help
Contents Ctrl+H
About...
Histogram data = No
Area = 492 458 431
Min_norm = -51 251 197
Max_norm = 209 337 262
Area = 422 392 367
Width: 256
Height: 256
Min. lum.: 1
Max. lum.: 667
Bits/pixel: 10

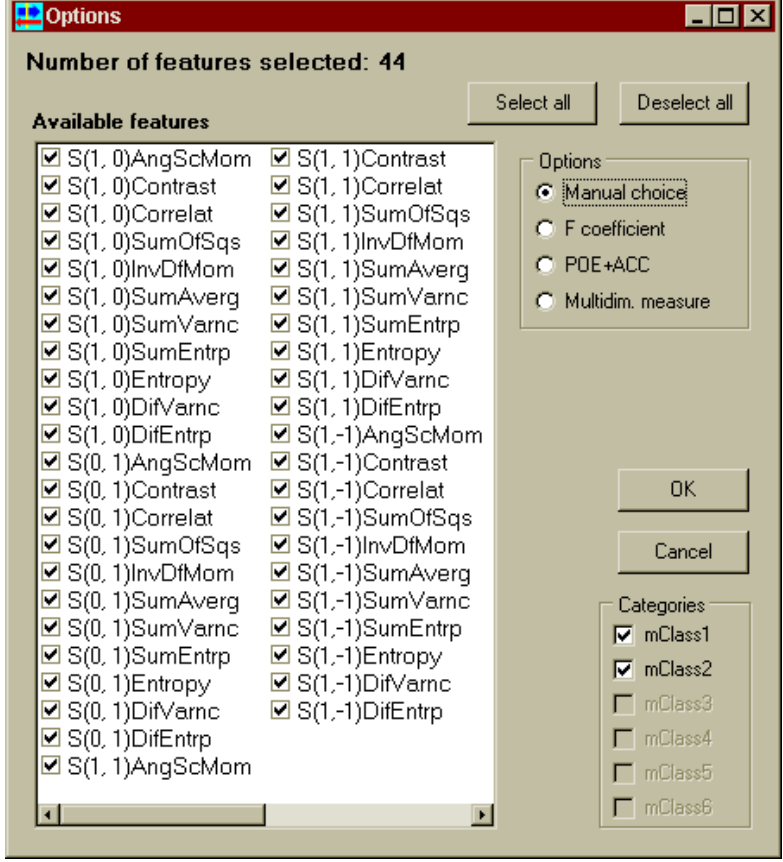

Mazda - options
Mazda - options
Mazda - options
Features
Maps
RLM
Horzl
RLNonUni
GLevNonU
LngREmph
ShrtREmp
Fraction
Vertl
45dgr
135dr
COM
Gradient
Mean
Variance
Skewness
Kurtosis
Select
Clear
Features selected
2
Mask
9
9
Step
7
7
OK
Cancel

MaZda - feature maps



Convert

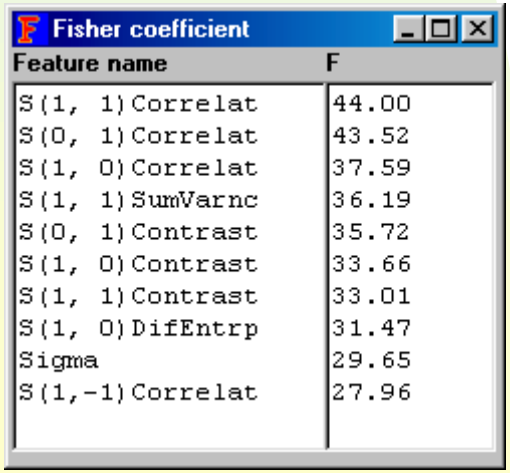


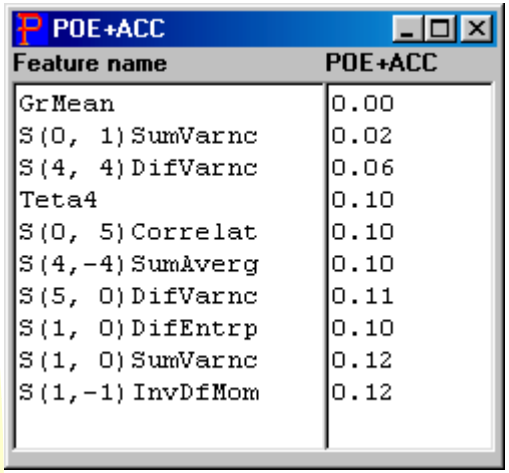


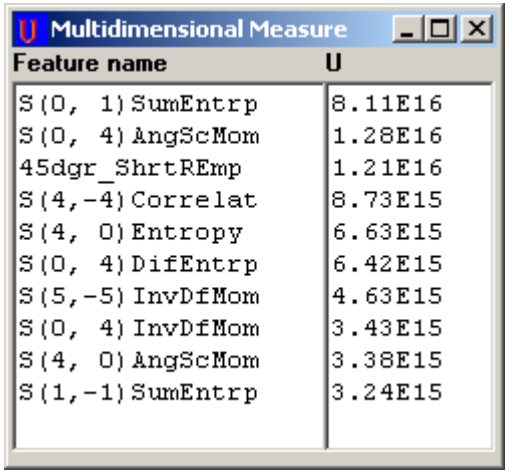
Input: (*.par) files from MaZda

Methods: Fisher coefficient, POE+ACC, multidimesional analysis of variance, manual choice

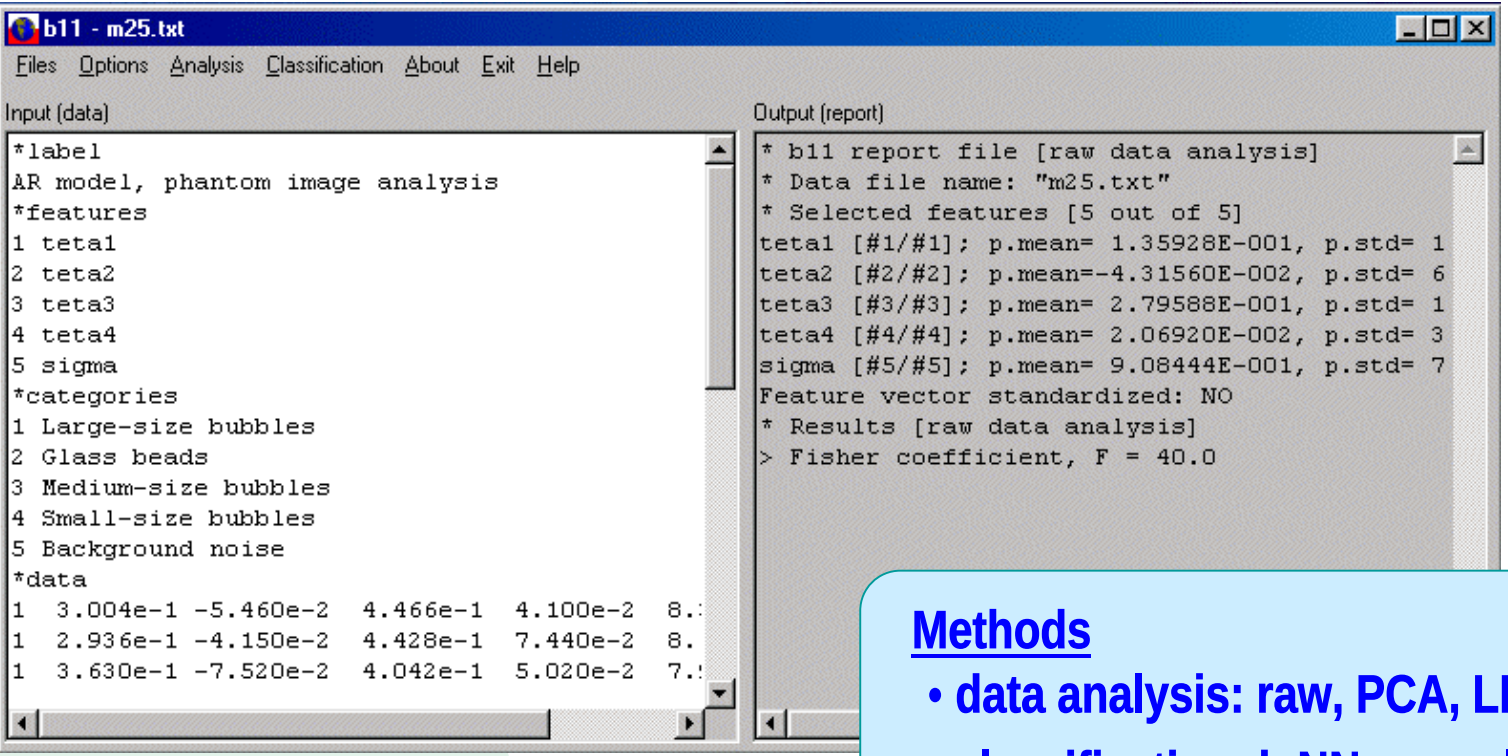
Output: (*.sel) files







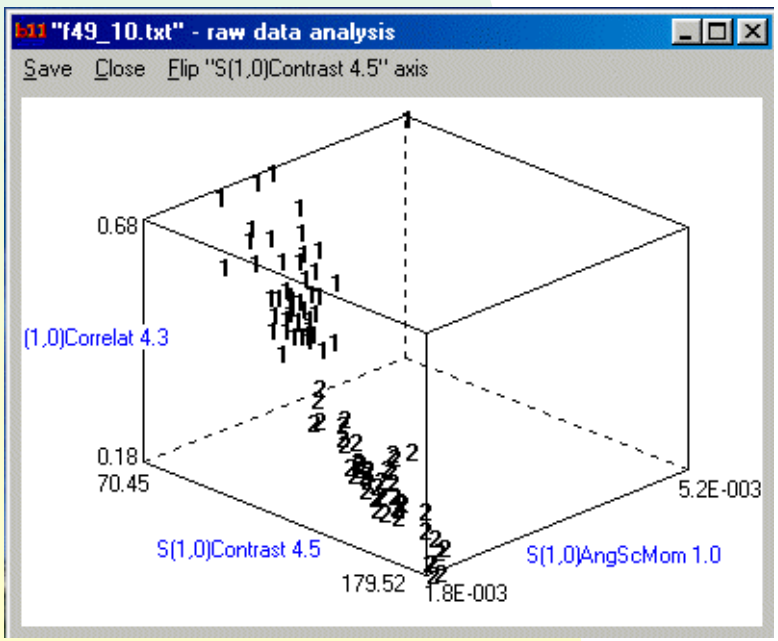
B11

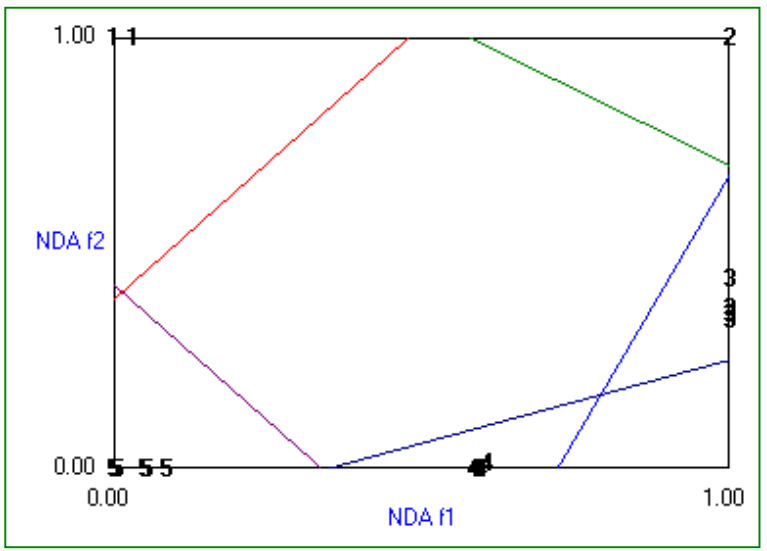


Input
- (*.sel) files

Output
- text files,
- BMP graphs

Methods
- data analysis: raw, PCA, LDA, NDA
- classification: k-NN, neural network





b11 - Options

Feature selection box

- [x] GrMean
- [x] S(1, 0)SumVarnc
- [x] S(1, 0)DifEntrp
- [x] S(0, 1)SumVarnc
- [x] S(1,-1)InvDfMom
- [x] S(4, 4)DifVarnc
- [x] S(4,-4)SumAverg
- [x] S(5, 0)DifVarnc
- [x] S(0, 5)Correlat

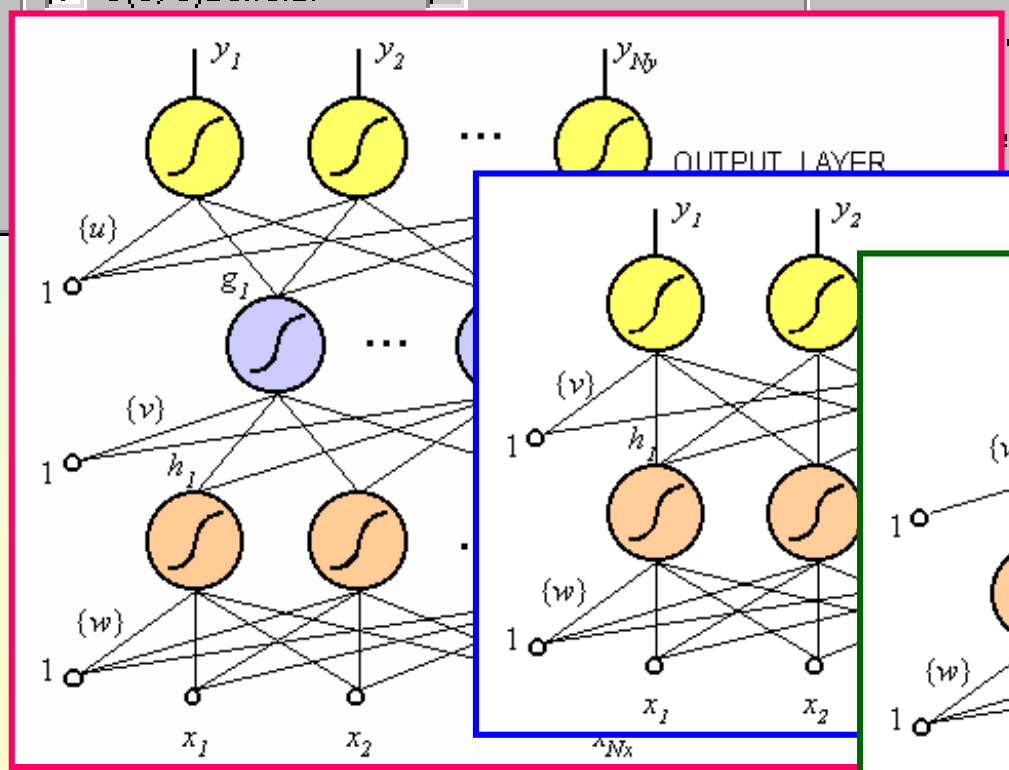
Neural network parameters

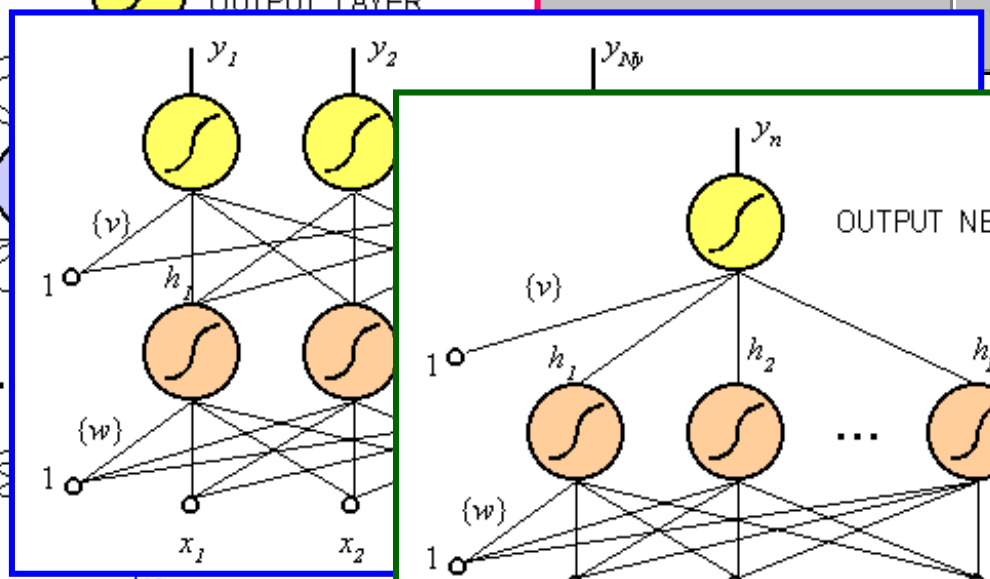
1st hidden layer <1..10>	2
2nd hidden layer <2..4>	2
backprop eta <0.01-0.99>	0.15
backprop iter.limit <50000..1000000>	300000
optimization iter. limit <1..1000>	50

ation

d category 1

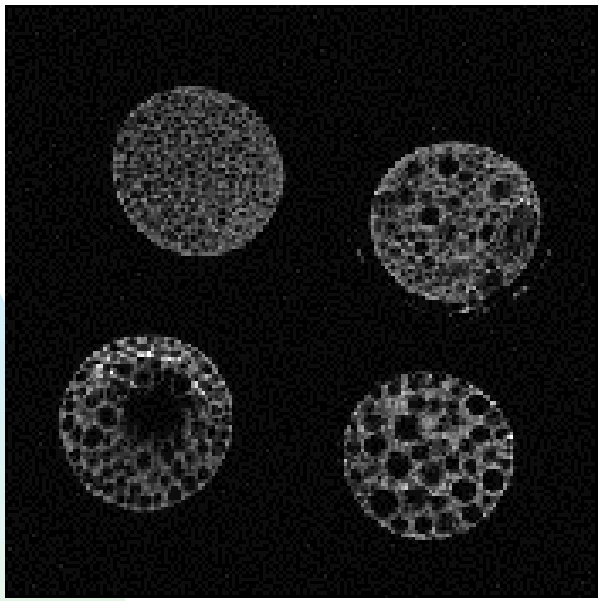
OK

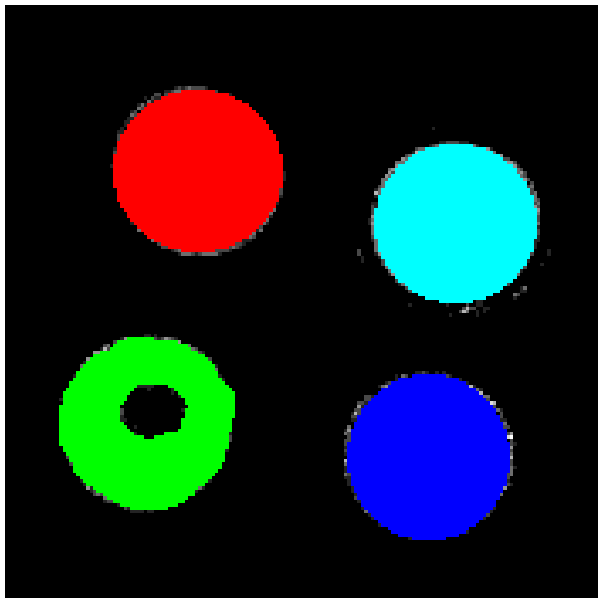




Example - PS phantom image analysis

22 images





class 1
class 2
class 2
class 2

MaZda → 22 (*.par) files, each contains 259 texture parameters

Convert → 2 (*.sel) files, each of 10 parameters (F, POE)

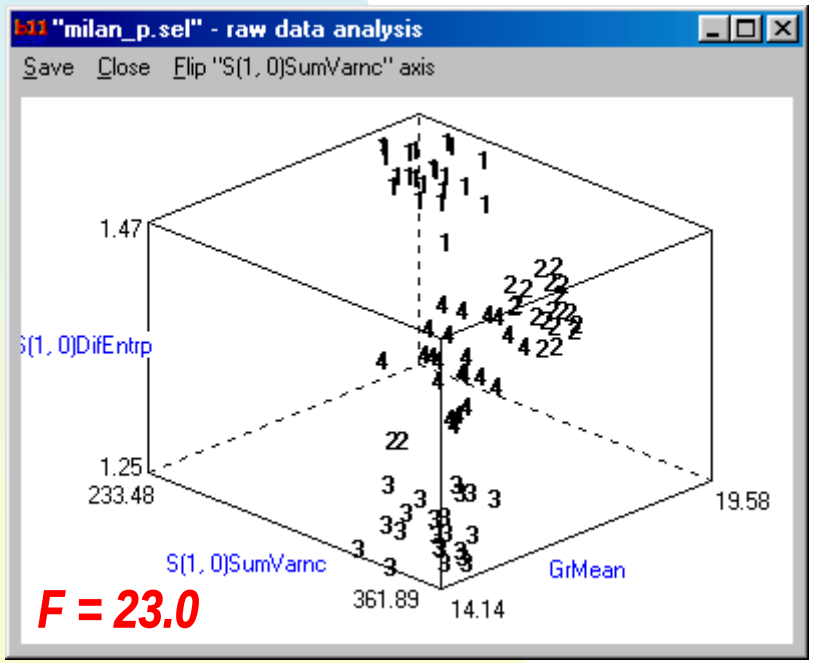
b11 → Exploratory data analysis and classification

Example - PS phantom image analysis

b11

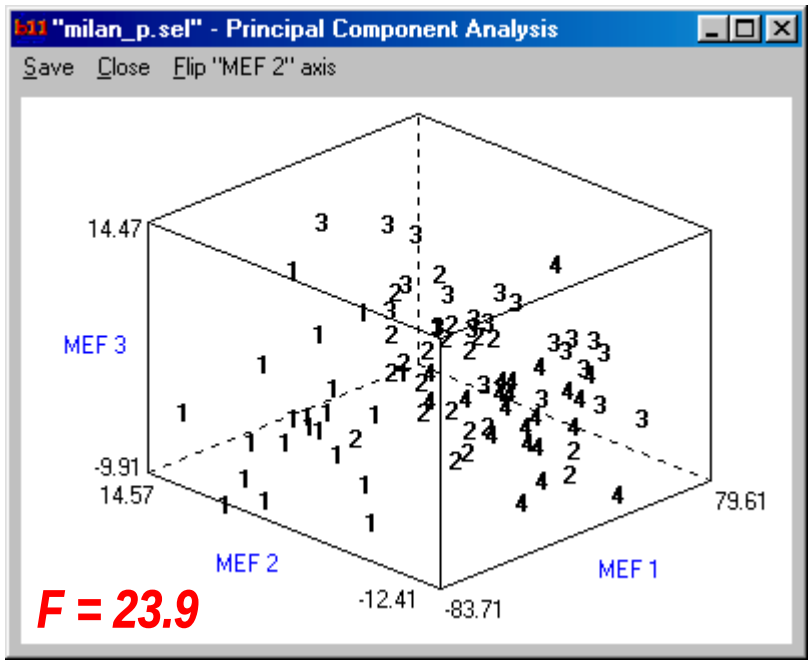
Exploratory data analysis and classification

Raw data



1-NN: 8 classification errors

First 3 PCAs



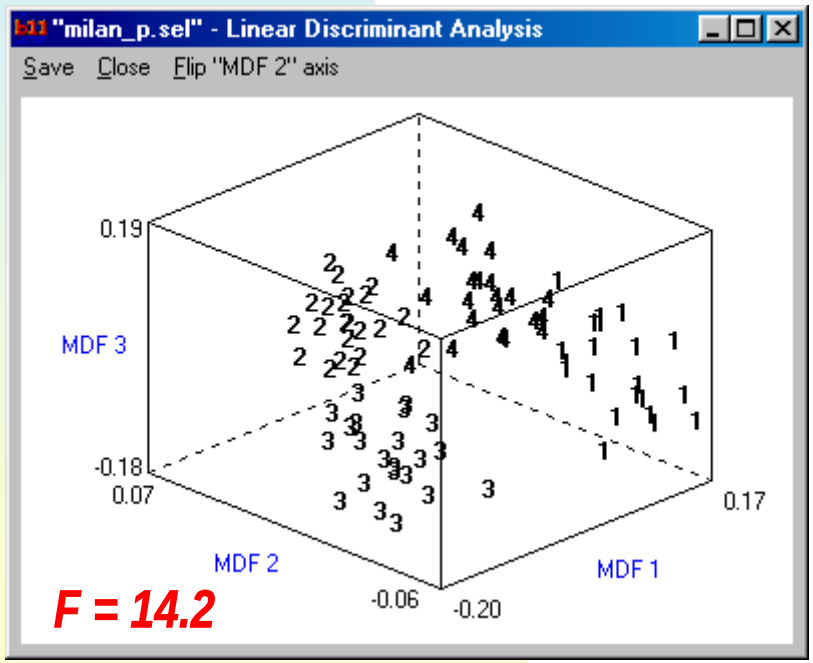
1-NN: 10 classification errors

Example - PS phantom image analysis

b11

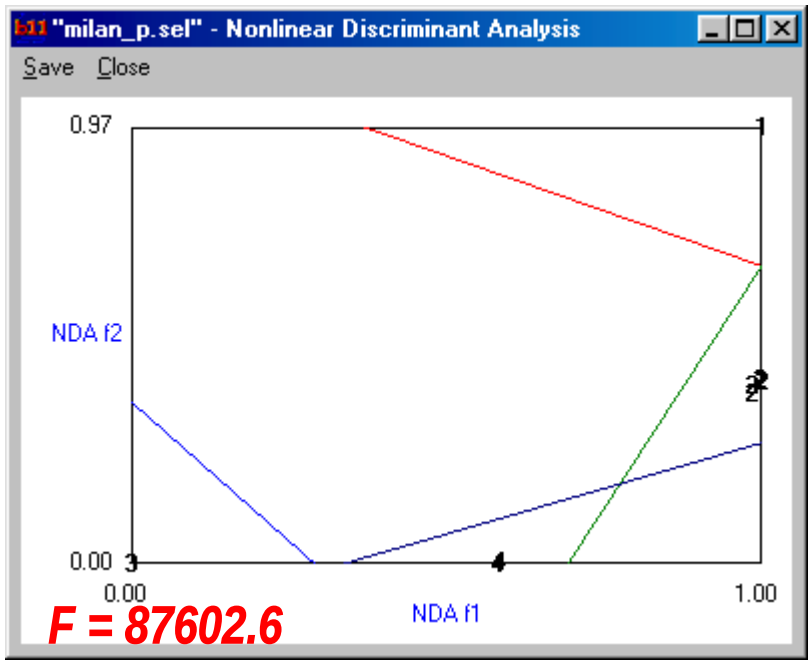
Exploratory data analysis and classification

Linear Discriminant Analysis



1-NN: 0 classification errors

Nonlinear Discriminant Analysis



0 classification errors

Projects under way

- MaZda: ROI editor (to replace MS Paint)
- MaZda: new texture features (wavelets and mathematical morphology).
- Convert: feature reduction and selection techniques.
- B11: ANN classifier testing (expansion of B11)
- Methods for texture segmentation.
- Extensive experiments using test object and biological MRI.