Image Knowledge Builder

Image Learning and Recognition
powered by NeuroMem network

Version 2.6
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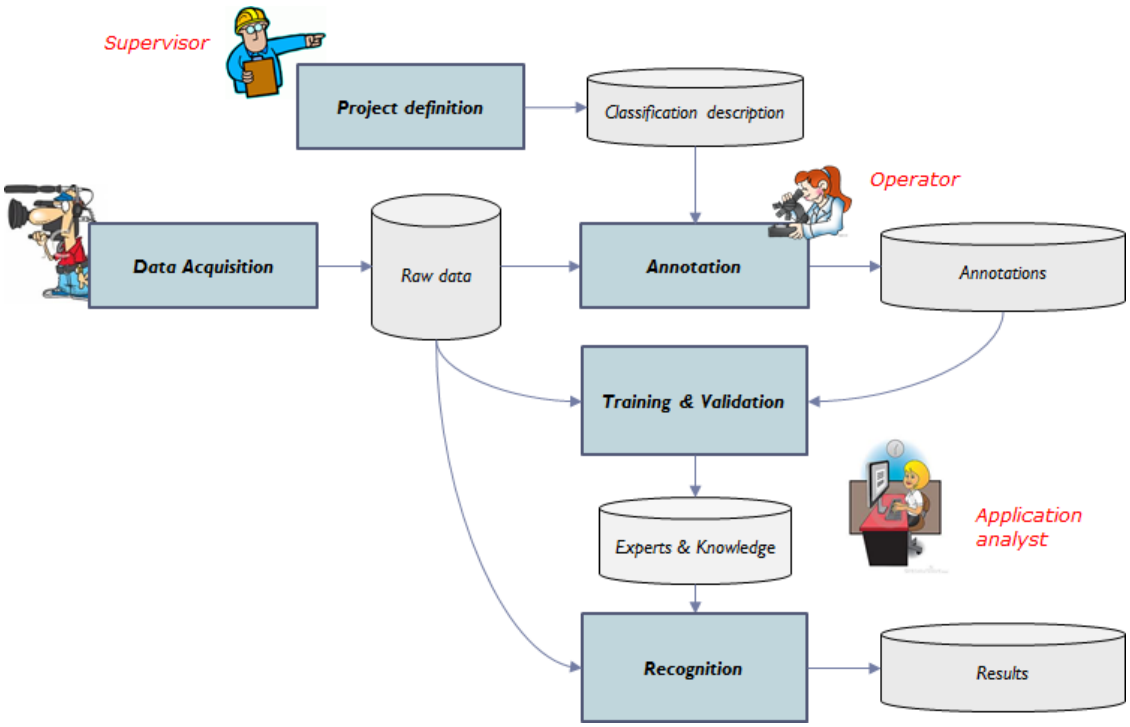
A. CONTENTS

Image Knowledge Builder is a product of General Vision, Inc. (GV)

1 INTRODUCTION

1.1 What can I do with Image Knowledge Builder?

- Learn objects and surfaces with or without supervision
  - Edit and save annotations in your images or video frames
  - Train the neurons in a step by step or batch mode
- Generate outputs showing the recognized objects
  - Visual color and text overlay
  - Text list of the recognized objects or anomalies
  - Map of the hit locations
  - Map of the category locations
  - Map of confidence



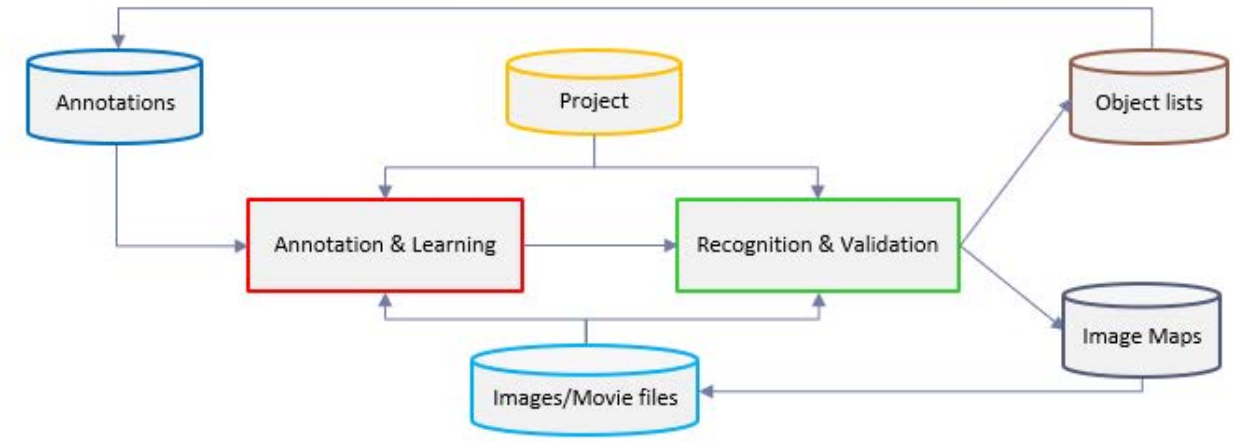
2 GETTING STARTED

2.1 Installation

- Double click at the setup.exe file and follow the instructions on the screen.
- After the display of the panel “Installing GV Image Knowledge Builder…”, you may get a pop-up message asking you to confirm the installation of the software from an Unknown Publisher. Click Yes to proceed.
- Upon termination, click at Start menu \All Programs\General Vision\Image Knowledge Builder

2.2 Interface and Workflow

The main panel is divided into two panels:
(1) Annotations and Learning on the left
(2) Recognition & Validation on the right



2.3 Practice with example projects

Image Knowledge Builder is supplied with example projects and their accompanying images and videos. They are usually organized per topic and the name of the project file matches the name of the folder where you will find the images used for the training and the verification.

Our example projects are described in a next chapter.

2.4 Methodology Step-by-Step

- Select a folder of images to use for training
  - Default location c:\\MyDocuments\\General Vision\Images
- Select a project file if any already exist for your application
  - Default location c:\\MyDocuments\\General Vision\Projects
- Observations:
  - The status bar at the bottom of the screen reports the settings of the project and the size of the knowledge (i.e. number of committed neurons)
  - If any annotation file has the same rootname as the project in the image folder, the annotations associated to the image on screen are displayed.
- Possible actions on the first image
  - Learn existing annotations
  - Edit and learn new annotations
  - Recognize a region or the entire image
- Go to next image to observe the recognition results obtained with the current knowledge
- Possible actions on the next image
  - Learn existing annotations to teach the neurons with new examples
  - Edit and learn new annotations
  - Recognize a region or the entire image
- Observations:
  - If the scanning steps are to high, the report may skip some locations which should be recognized positively
  - Check Auto recognition and Full Image option allow to automate the search across multiple images
  - Annotations are saved to a log file as soon as they are learned. This log file can be saved for later or further use
- Try building a new knowledge delivering better accuracy using the same annotations, but a different feature
  - Go back to the first image
  - Clear the current knowledge
  - Open the Project/Settings menu and change your parameters
  - Proceed again with the learning of annotations

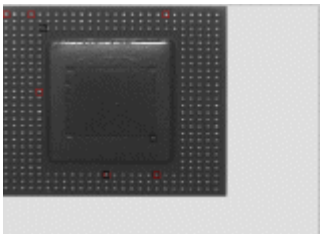
3 EXAMPLE PROJECTS

3.1 General Instructions

The proposed examples can be reviewed in a few minutes as follows:

- Use the navigation bar to open an image stored in C:\\yourUser\\Documents\\General Vision\\Images**Topic**.
- Select File\Open Project from the Main menu and look for an existing *.prj file with the **Topic** label.
- A summary of the project definition is displayed in the Status bar at the bottom of the screen: size of the knowledge, type of feature extraction, image scanning mode.
- If neurons are committed, their models can be viewed in the View/Knowledge menu, or you can click directly at the Reco button to view the results of the recognition.
- If annotations for the project exist in the selected folder of images, they are overlaid in the image.
- If no annotations exist for the selected image, you can edit your own manually.
- You can click at the Learn button and when done at the Reco button.

3.2 BGA inspection



Observe how the powerful non-linear classifier of a NeuroMem network is a simple remedy to learn a diversity of examples in a few mouse clicks.
Learn a variety of good solder balls and get their total count immediately.
Try to achieve the same results in less than a minute with a threshold technique!

1. Click Browse in the Navigation toolbar and load the image stored in Images/BGA folder.
    a. Assuming that the Learn method is set to the default “Annotations”, the program should automatically find and load the annotations associated to this image and stored in the file BGA_GT.txt stored in the same folder.
    b. Note that the annotations include “background” annotations (in black). They behave as counter examples to ensure that the neurons learning solder balls (in red) do not over generalize too much.
2. Select Load project in the File menu and load the file bga.prj stored in the Projects folder
    a. In the status bar at the bottom of the screen, notice that the knowledge is empty. The size of the region to learn and recognize is 12x12 pixels and the feature extraction a monochrome and subsample.
3. Checked the Auto checkbox to automatically recognize the image when a Learn operation or Load image is executed. Verify that the Reco method is set to Objects.
4. Click Learn to learn the annotations seen on in the learning panel. Verify that all the solder balls are highlighted in the right panel. Some appear more reddish than other when a solder ball is recognized at 2 adjacent positions.

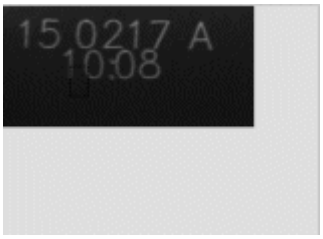
3.3 Face recognition on soccer teams and the ferret database

Observe how the model generator of a NeuroMem network can automatically over-generalize and correct mistakes if applicable.

The network taught with 7 faces of soccer players from a team can detect the faces in four other teams but also the faces from the ferret database!

1. Click Browse in the Navigation toolbar and load the image stored in Images/Faces_SoccerPlayers folder
2. Select Load project in the File menu and load the file faces_soccerplayers_kn7.prj stored in the Projects folder
    a. In the status bar at the bottom of the screen, notice that the knowledge is already built and consists of 7 neurons. The size of the region used to learn and recognize the characters is 27x 36 pixels. The feature extraction a monochrome normalized subsample.
3. The knowledge can be displayed by clicking “View Knowledge” button.
4. Click the Reco button to inspect the entire image. Note that this can take a few seconds in simulation.
5. Select the Auto checkbox next to the Reco button. Go to the next image by clicking at the “>” button in the navigation bar. Review the results. Proceed to next image.
6. Using the navigation bar, select the first image supplied in the Images/faces_ferret folder. The Ferret database is a known repository of faces looking at the camera from approximately the same distance. The region of interest is clearly too small in this case to cover the eye and nose area of the person. In the navigation bar, reduce the image by a scale 1/3 and you should observe that the face is then detected.
7. Go through several images of this same folder by clicking at the “>” button in the navigation bar.

3.4 Inkjet character recognition



Observe how the feature extraction can impact the ease of deployment of an application, and particularly reduce the number of examples to teach without compromising the accuracy of the recognition.

Image Knowledge Builder has been designed so you can easily find the best feature extraction for your application using the same images and annotations.

1. Click Browse in the Navigation toolbar and load the first image stored in Images/OCR_inkjet folder: Im_110217A_1008.jpg.
    a. Assuming that the Learn method is set to the default “Annotations”, the program should automatically find and load the annotations associated to this image and stored in the file Im_110217A_1008_GT.txt stored in the same folder.
2. Select Load project in the File menu and load the file ocr_inkjet.prj stored in the Projects folder
    a. In the status bar at the bottom of the screen, notice that the knowledge is empty. The size of the region to learn and recognize is 36x60 pixels and the feature extraction a monochrome and normalized subsample.
3. Checked the Auto checkbox to automatically recognize the image when a Learn operation or Load image is executed. Verify that the Reco method is set to Objects.
4. Click Learn to learn the annotations seen on in the learning panel. Verify that the digits are highlighted with the proper categories in the right panel. The color legend can be seen and changed in the Options/Settings menu.

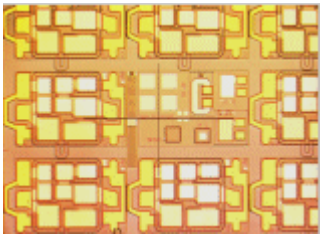
5. Click at the Next arrow in the navigation bar to proceed with the next image. Notice that on the third image, a new annotation appears for the digit “6” which has still not been taught. Click Learn to add it to the current knowledge composed of 7 neurons as reported in the status bar. You can review the results on the next and previous images navigating through the various images supplied in the OCR_inkjet folder.
6. Now, let’s repeat the same routine, but with a slightly different feature extraction:
    a. Erase the knowledge by selecting the Clear command in the Knowledge menu
    b. Open the Options/Settings panel and uncheck the “Normalize” checkbox. This means that the amplitude of the subsample will not be expanded to the range [0, 255].
7. Load the first image again with its annotations, learn and review the results of the recognition:
    a. Select Options/Details at cursor and move the cursor over the image
    b. Observe the number of misfiring such as in (320,90)
    c. Observe how the number of uncertainties such as in (54,70)

3.5 Glass surface anomaly detection

Observe how the neurons can autonomously model a good texture, even a patterned texture such as a solar glass panel, and later be used to detect anomalies in new images which are basically locations which do not look similar to the models they hold in memory.
A simple illustration of the power of the NeuroMem RBF classifier to detect novelty which in this case represents the occurrence of an anomaly.

1. Change the data source in the Navigation toolbar to “Image” and load the Glass0_good.png file stored in Images/Surface_Glass folder
2. Select Load project in the File menu and load the surface_glass.prj file stored in the Projects folder
    a. In the status bar at the bottom of the screen, notice that the knowledge is empty. The size of the glass area to learn and recognize is 16x16 pixels. The feature extraction a monochrome subsample.
3. Select the “Codebook” learning mode to build the knowledge and click the Learn button. Using the Maxif of 1500, and a learning step of 16 along the horizontal and vertical axes, 12 neurons are committed.
4. Select the “Anomalies” recognition mode, check the Auto checkbox and click the Reco button.
5. No anomaly is reported in the good image.
6. Go to the next image by clicking at the “>” button in the navigation bar. Anomalies should be reported in the other three images.
7. You can practice with the same routine using bigger or smaller values of the maximum influence field and observe the differences in the number of committed neurons and number of discrepancies identified in recognition.

3.6 Wafer template inspection



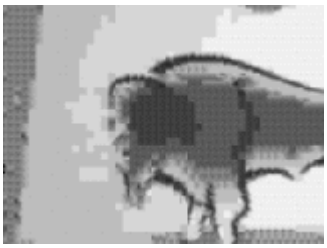
Observe how a large NeuroMem network can be used to store an entire reference image (wafer, printed circuit, printed material), and later be used to report locations in new images which do not match the right pattern at the right position.
A simple illustration of an unsupervised learning and high-speed template matching.

1. Click Browse in the Navigation toolbar and load the image Good.tiff stored in Images/Wafers folder
2. Select Load project in the File menu and load the file wafer_inspection.prj stored in the Projects folder

a. In the status bar at the bottom of the screen, notice that the knowledge is empty. The size of the region to learn and recognize is 16x16 pixels and the feature extraction with the value 3 means that the subsample includes the color information. The maximum influence field of 2000 is an important parameter in this example and tunes the conservatism of the neurons.

3. Select the "Golden template" learning mode to build the knowledge and click the Learn button. Using the Maxif of 2000, and a learning step of 16 along the horizontal and vertical axes, 674 neurons are committed.
4. Select the "Anomalies" recognition mode, check the Auto checkbox and click the Reco button.
5. No anomaly is reported in the good image.
6. Go to the next image by clicking at the ">" button in the navigation bar. Anomalies should be reported in the other three images.
7. You can practice with the same routine using bigger or smaller values of the maximum influence field and observe the differences in the number of committed neurons and number of discrepancies identified in recognition.

3.7 Introduction to image compression with NeuroMem



This example illustrates the use of an unsupervised learning method to build a codebook of reference codes over one or multiple images and reconstruct simpler images by replacing the original blocks by their closest matches.

1. Click Browse in the Navigation toolbar and load the first image stored in Images/MiscBWImages folder
2. Select Load project in the File menu and load the file compression.prj stored in the Projects folder
    a. In the status bar at the bottom of the screen, notice that the knowledge is empty. The size of the region to learn and recognize is 9x9 pixels and the feature extraction is a monochrome subsample includes the color information.
3. Select the "Codebook" learning mode to build the knowledge and click the Learn button. Using the Maxif of 2000, approximately 50 neurons are committed.
4. Select the "MapOfModels" recognition mode, check the Auto checkbox and click the Reco button.
5. A simplified image based of only 50 patches is generated.
6. Go to the next image by clicking at the ">" button in the navigation bar and observe the same compression effect.
7. If blocks appear in black in an image, click Learn. A few neurons should be added to the knowledge. They correspond to the blocks not recognized in the previous codebook.
8. You can practice with the same routine using smaller values of the maximum influence field and observe the differences in the number of committed neurons and the reduction of the error between the source and its Transform image.
9. You can practice with the same routine using smaller patches of pixels and observe a finer granularity and lesser error in the Transform images.
10. You can practice with the same routine using the images of the MiscColorImages folder. Change the feature to Color Subsample in the Options/Settings menu if you wish to build a codebook of color patches.

3.8 Kanji Character recognition

This example demonstrates that the NeuroMem network is (1) a good classifier which can easily discriminate between many models, and also (2) the recognition time is not impacted by the number of models which constitute the knowledge base (360 in this case).

Warning! If using a simulation of the NeuroMem network, the recognition may take several seconds. On the small image, the window of interest is moved across 68,432 positions and at each position, the block of pixels (256 bytes) is compared with 360 models. Assuming that each comparison between an input pixel and the same pixel stored in a neuron takes 4 operations, the recognition of the entire image is equivalent to 25.2 billions of operations. The CM1K chip will execute this in 2 seconds or 12.5 Giga ops.

1. Click Browse in the Navigation toolbar and load the image stored in Images/Kanji folder
2. Select Load project in the File menu and load the file kanji360.prj stored in the Projects folder
    a. In the status bar at the bottom of the screen, notice that the knowledge is already built and consists of 360 neurons. The size of the region used to learn and recognize the characters is 16x16 pixels. The feature extraction with the value 0 corresponds to a monochrome subsample.
3. Select Options/Overview at Cursor. Move the cursor over a character and view the result of the recognition in the Cursor Info box of the main panel. Note that positive recognition of a character only occurs when well centered over it.
4. The knowledge can be displayed by clicking “View Knowledge” button. Note that in this case, each character is represented by 3 models shifted by one pixel each. This training was done intentionally to allow the detection of a character at different offsets.
5. Click the Reco button to inspect the entire image. Note that this can take a few seconds in simulation, since the image is entirely scanned with a step of 1 pixel per column and 2 pixels per row, and at each position the block of 16x16 pixels is matched against 360 models.
6. Review the results in the Options/Results window

4 EXPERT SETTINGS

Regardless of the type of application you need to deploy, the patterns to be learned and recognized by the neurons will result from the extraction of a signature out of a nominal pixel area.

For a given project, you will have to define the size of a minimum Region of Interest (ROI) and the method to extract a signature or feature from this ROI size. Note that the feature extraction can be as simple as the pixel values read in raster format.

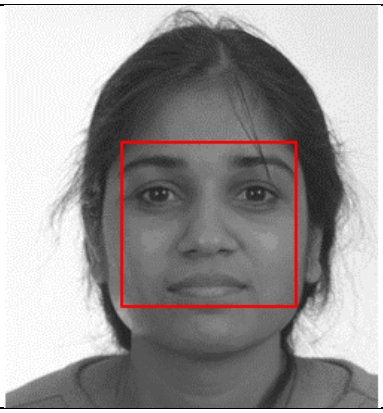
4.1 ROI Size

The Region Of Interest (ROI) is the smallest rectangular area including your object or a discriminant portion of your object.

It should be limited to the smallest discriminant portion of the object to recognize for the following reasons:

- The smaller, the less need to compress the information or extract a feature
- The smaller, the faster the readout of the pixel values
- Exclude as much as variability as possible

4.1.1 Example #2: Face detection

Too big - This ROI will teach the neurons to recognize a face in front of a white background - For example, recognition will fail if this person is placed in front of a painting on the wall. - You will have to train the neurons to also recognize the face in front of a dark or patterned background, etc)	Correct for face detection
	

4.1.2 Example #1: Part inspection

If a mechanical part can be classified as good or defective based on the presence or absence of a screw at a given position in the part, the region of interest should not be defined as the whole part but rather limited to the rectangle where the screw is expected.

The BGA project supplied with the IKB uses an ROI of 12x12. If you load this project and its annotations, clear the knowledge (Knowledge/Clear menu) and change the ROI to 16x16 (Project/Settings menu), you will observe that additional annotations are required to obtain the same satisfactory results.

4.1.3 Default 16 x16

The **default ROI size** is 16x16 which is a reasonable size for an iconic representation of simple object. Also the 256 pixels of such ROI can be assembled "AS IS" in a vector of 256 bytes which fits without compression in the memory of the neurons of the CM1K and NM500 chips.

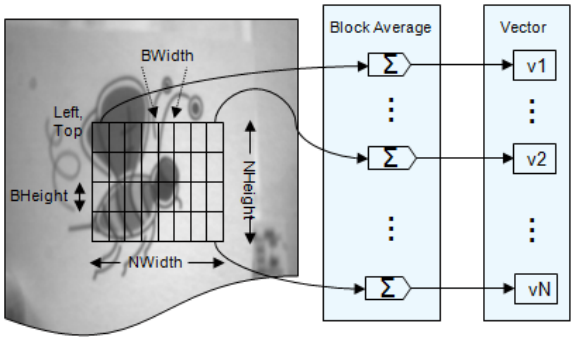
4.2 Feature extraction

The feature extraction is the method used to convert the pixel data within the region of interest into a vector of 256 bytes ready for broadcast to the neurons:

Subsample	Monochrome subsample, or average intensity of up to 256 blocks fitting inside the ROI
Histogram	Grey histogram, or the number of pixels per 256 grey-level values.
HistoCumul	Grey histogram cumulative
SubsampleRGB	Color subsample, or average Red, Green and Blue intensities of up to 85 blocks fitting inside the ROI
HistogramRGB	Color histogram, or sequence of the red, green and blue histograms, each of 85 values.
HistoCumulRGB	Color histogram cumulative
Composite profile	Average of the lines of pixels and columns of pixels
Horizontal profile	Average of the lines of pixels
Vertical profile	Average of the columns of pixels

4.2.1 SubSamples

Subsample is a vector which appends the average intensity of blocks of pixels extracted from the region of interest. The blocks are all the same size, but not necessarily square. They are surveyed in a raster displacement and their average intensity is assembled into vector.



- The feature called Subsample extracts the average of the intensity value of each block regardless if the image is monochrome or color. The region must contain less than 256 blocks so the output vector fits in the 256 bytes of memory of the neurons

- The feature called SubsampleRGB extracts the average of the Red, Green and Blue intensities of each block in the ROI, so three average values per block. Therefore, the ROI must contain less than 85 blocks so the output vector fits in the 256 bytes of memory of the neurons.

4.2.2 Histograms

- Histogram is a vector which gives the distribution of the grey-level values in the region of interest. It indicates the number of shades in the ROI, the presence of noisy pixels and more.
- HistoCumul or cumulative histogram is a mapping of the standard histogram which counts the cumulative number of pixels in all of the bins up to the specific bin.
- HistogramRGB is a vector which gives the distribution of the Red, Green and Blue intensities in the region of interest. It is assembled as a series of 3 histograms of 85 bins each representing 85 bins for the Red, 85 bins for the Green and 85 bins for the Blue.
- HistoCumulRGB or cumulative color histogram is a mapping of the standard histogram which counts the cumulative number of pixels in all of the bins up to the specific bin.

4.2.3 Horizontal, Vertical or Composite Profiles

The average intensity along a column or row of pixels, or both appended in a same feature vector. The composite profile can be helpful to classify the alignment of objects. The vertical and horizontal profiles to classify edges and geometric transitions.

4.3 Amplitude Normalization option

Regardless of the feature you select, you have the option to normalize the amplitude of the feature vector or not.

Positive effect of a Normalization: Practice with the OCR_inkjet project supplied with the IKB.
Negative effects of the Normalization: noisy pixel amplification and therefore signature deterioration.

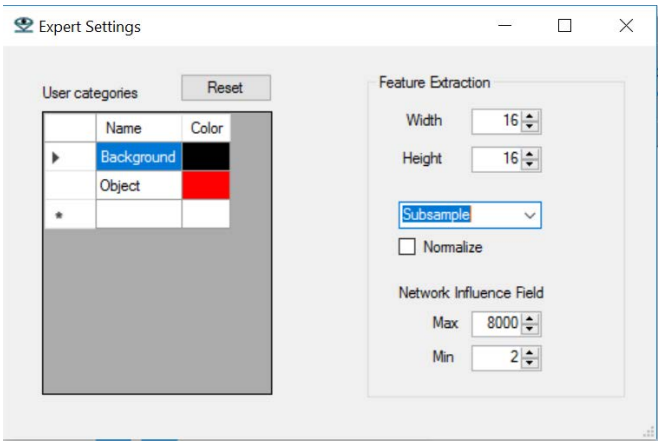
4.4 Minimum and Maximum Influence Fields

The smaller the MAXIF, the lesser generalization or over-fitting of the neurons. Note that the value of the MAXIF should be set in relation to the dimension represented by the feature vectors.

5 SUPERVISED LEARNING

5.1 Define your categories and associated color tags

A new project starts with a single generic category labeled “Object”, the other option being the “Background” category or “null” category. Names can be changed and validated by typing the Enter key. Depending on the colors of your images, you can change the colors which will be used to highlight your objects. For example, if your image has a red background, you may want to select a blue or green color to highlight your objects. Click at the color cell and select a new color in the color wheel.



Examples of categories for a part inspection

- Acceptable (category 1)
- Recyclable (category 2)

Or

- Grade A (category 1)
- Grade B (category 2)
- Grade C (category 3)

Examples of categories for a traffic monitoring application:

- Car (category 1)
- Truck (category 2)
- Van (category 3)

5.2 Annotate objects and Regions of interest

Select the “Annotations” learning mode

Option 1: Annotate an object

- Select the category of the object in the dropdown list above the Teaching panel
- Move the cursor over the object and Right Click with the mouse button
- To delete, the annotation, press Shift + Right click

Option 2: Annotate an area or surface

- Select the category of the area in the dropdown list above the Teaching panel
- Draw the area pressing down the left mouse button
- Select the stepX and stepY you want to use when learning an area
- To delete, the annotation, press Shift +Right click

5.3 Learn the annotations

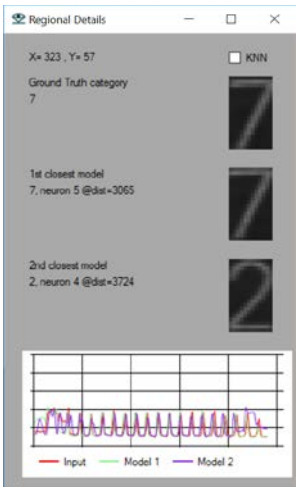
Select the “Annotations” learning mode

If the “Auto” checkbox next to the Learn button is marked, the annotations loaded with an image are automatically learned. Combine this setting with the use of the Play mode in the navigation bar and you can learn automatically all the “annotated images within a given folder.

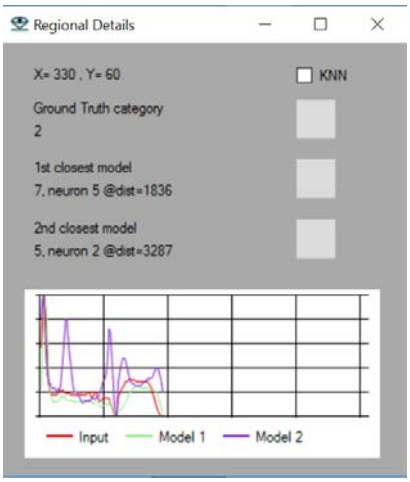
5.4 View Local Classification

To help understand the recognition at specific locations, select Options/ Details at Cursor. As you move the cursor, the feature extracted from its location is displayed and, if applicable, the models of the first and second closest firing neurons along with the distance between the feature and their models. This utility can be useful to correct mis-firing neurons which recognize a feature vector with an incorrect category at a specific location.

Report of subsample vectors



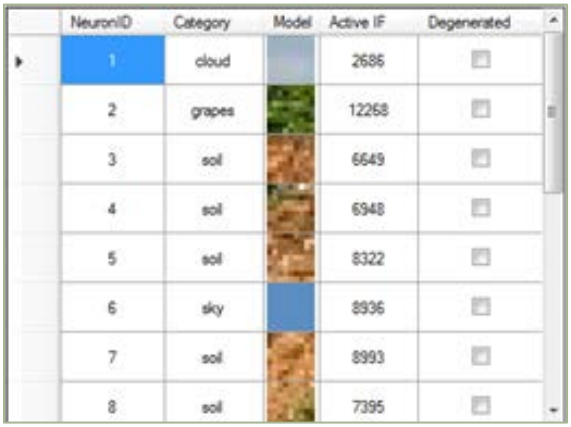
Report of composite profile vectors



5.5 View Knowledge Content

The View Knowledge menu allows reviewing the contents of the neurons, the pattern they hold, their category and active influence field (AIF). This utility can be helpful to understand why some erroneous or uncertain classifications occur.

The AIF is a dynamic attribute entirely controlled by the neuron itself. From the time the neuron is created, its influence field can be reduced as new and contradicting examples are taught.



NeuronID	Category	Model	Active IF	Degenerated
1	cloud		2686	
2	grapes		12268	
3	soil		6649	
4	soil		6948	
5	soil		8322	
6	sky		8936	
7	soil		8993	
8	soil		7395	

5.6 Undo last learning

This command is accessible under the Knowledge menu and allows to cancel the last Learn function by restoring the image of the knowledge prior to that.

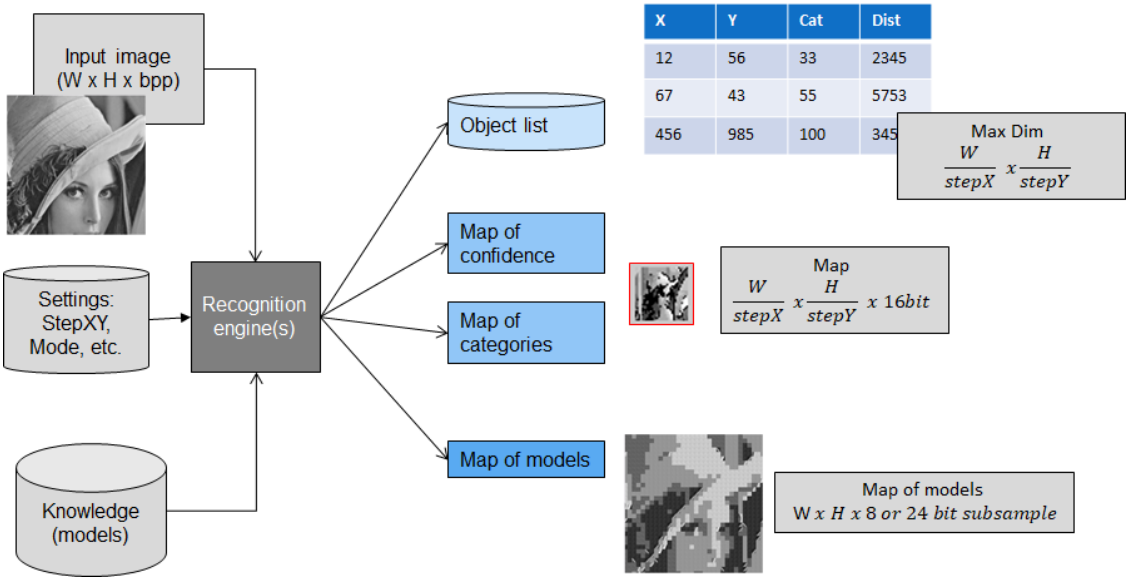
Note however that this function does not restore the annotations prior to the last Learn function. If the reason to Undo the Last learning was an erroneous annotation, you will have to remove it manually.

6 RECOGNITION AND VALIDATION

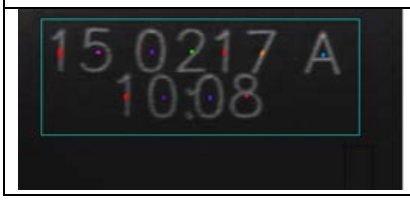
The recognition is executed by moving the ROI over the ROS using a raster displacement and a given step along the horizontal and vertical axis.

The IKB can format the results of the scanning with different format:

- Objects
- Clusters
- Anomalies
- Map of the categories
- Map of the closest models (useful when the neurons contain a codebook)
- Map of the distances (inversely proportional to the confidence of the neurons)



6.1 Objects, Clusters or Anomalies

Objects	Clusters	Anomalies
Objects, or all locations with a positive recognition.	Clusters, or groups of locations recognized with a same category.	Locations which are not recognized by the neurons
		Review the Glass surface inspection project supplied with the IKB

6.2 Map of Categories, Distances or Identifiers

A Map is a transform image of a Region of Search (which can be the entire image) showing the spatial distribution of the recognized objects in term of category value, distance/confidence value or neuron identification value.

The size of the map is the dimension of the ROS divided by the selected scanning step.
The amplitude of the CatMap array can range between [0,32,364].
The values of the DistMap array can range between [0, 65535].
The display of these maps uses a color lookup table.

6.3 Map of Models

This transform is only available of the selected feature extraction is a monochrome or color subsample

Each recognized ROI is replaced with its closest model. The effect is a posterization/simplification of the ROS using the models stored in the neurons.

Such display is useful to apprehend if the current knowledge is rich enough to compress the image without significant loss of information. In such case, it is usually assumed that the knowledge has been built using the Codebook learning method and composed of primitive pixel subsamples.

If the map of models does not render the important information present in the original image, the alternatives are to (1) train the neurons on more annotations, or (2) build a new knowledge with different value of the Maxif or different ROI size (Project/Settings menu).

6.4 Coping with change of scale

Alternative #1:

- Learn at a given ROI size (as specified in the Options/Settings menu)
- In recognition, the image scale can be changed in the navigation bar at the bottom of the screen.

The project faces_soccerplayer is a good illustration of this approach: the ROI has been sized to learn on the images of the soccer players. However, if you load an image from the folder faces_Ferret, you can notice that the ROI size is too small, but if you scale down the image by 3, then it becomes suitable and the face is recognized. Refer to manual paragraph 4.2.3.

Alternative #2:

- If the feature extraction can be a subsampling, it is scale invariant if the number of blocks within the ROI remain the same. It is then possible to learn objects at different compatible ROI sizes (as specified in the Options/Settings menu). For example, an ROI of 64x64 with blocks of 4x4 creates a vector of 16x16 components, but similarly an ROI of 128x128 with blocks of 8x8 also creates a vector of 16x16 components.
- In recognition, the neurons holding models of the objects at the proper scale will fire.

7 UNSUPERVISED LEARNING

7.1 Annotate Regions of Interest

- Draw the area pressing down the left mouse button
- To delete, the annotation, press Shift +Right click

7.2 Codebook generation

The Build Codebook function uses the neurons to decide if a region brings novelty to the current knowledge or not.

Parameters to verify prior to using the BuildCodebook:

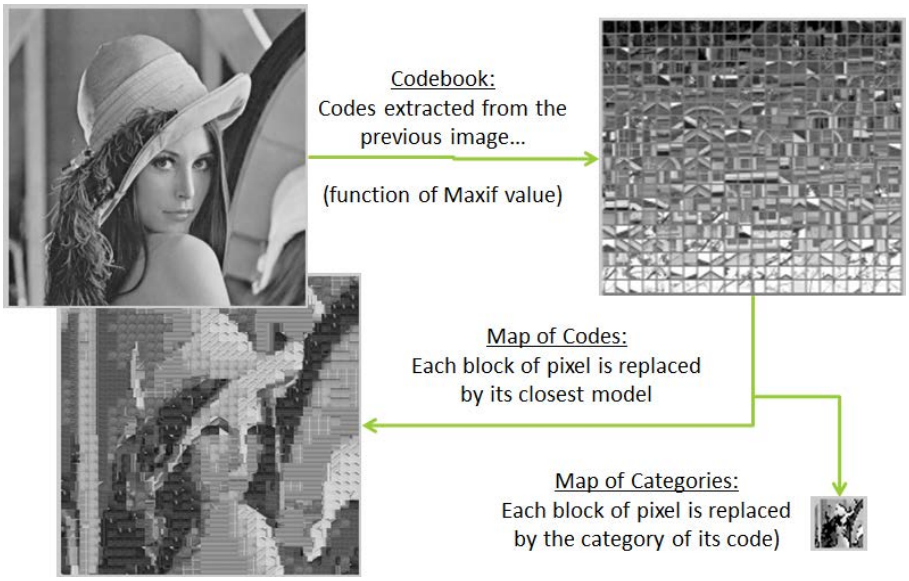
- Block size
- Feature extraction
- Maximum Influence Field
- Option to clear the current knowledge
- Scanning Step X and Y

Select the method to automatically allocate the categories:

- A constant value
- An incremental value
- Max Delta Amplitude
- Average Amplitude
- Raster position of the region in the image

The knowledge or contents of the neurons is then called a codebook, or a book of codes (or features) which the neurons have learned and detected as significant.

The codebook can be used to generate simpler transform images such as a map of models, a map of code IDs, a map of confidence, etc.



8 FILE MANAGEMENT

8.1 Annotation and Result files

Annotations are generated and appended to a Log file whenever you click the Learn button under the “Annotations” learning mode. The file can be cleared, saved or loaded from the Annotations menu.

Results are generated and appended to a Log file when you click the Recognize button and if the selected Recognition mode is not a map style. The file can be cleared, saved or loaded from the Annotations menu.

The Annotations and Results files have the same format which is described in the next paragraph.

They are saved in the same folder as the last processed image. As a consequence, you will be prompted with the option to save your annotations or results files whenever you select a new folder of images or the image source type.

8.1.1 Common format

Annotations and Results both have the same format described below.
They can be either comma delimited or tab delimited.

A header listing a version number, the labels associated to the category values and a listing of the colors associated to the category values, followed by one line item per annotation:

```
string sourceFile; // image file name, movie file name
long indexFile = -1; // a user defined index, a frame number in case of movie file, etc.
decimal Scale = 1; // scale at which annotation is edited
int Type = 0; // 0=object, 1=area
int Left = 0;
int Top = 0;
int Width = 0;
int Height = 0;
int Category = 1;
```

Example of GT annotation file
Version, 0317
CatNbr,3
Nobody
John
Debbie
CatColors,3
0,0,0
255,0,0
0,255,0
Annotations,8
Im_110217A_1008.jpg,0,1,37,28,36,60,1
Im_110217A_1008.jpg,0,1,88,28,36,60,5
Im_110217A_1009.jpg,0,1,160,28,36,60,10
Im_110217A_1016.jpg,0,1,388,32,36,60,11
Im_110217A_1016.jpg,0,1,286,86,36,60,8
Im_110217A_1016.jpg,0,1,126,99,36,60,0

8.1.2 Importing annotations

You may import annotations files generated outside of the IKB if they verify the following format:

- Must be comma delimited format
- 1st line = “Version, 0317”
- 2nd line = “Annotations” followed by the number of annotation appended in the file
- Next lines are the annotations:
    - Image name, Index, Scale, Type, Left, Top, Width, Height, Category

8.2 Project and Knowledge files

Projects defined under Image_Knowledge_Builder can be saved to disk in a project file or to the Flash memory of the camera.

A project is composed of two files associated to the same rootname:

- A project file (*.csp) containing the description of the recognition engine
- A settings file (*.prf) with the description of the GUI preferences

8.2.1 CogniSight Project file

- The *.csp file describes the recognition engine. It contains all the information necessary to resume the project including the knowledge, the region of interest, the region of search and sensor settings

8.2.2 Preference file

- *_settings.csv describes the settings of the graphical user interface including the names and colors associated to the category values, as well as the preferred learning and recording settings.

Example of preference file

```
ImageSource,Image
LearningMode,Annotations
RecoMode,Clusters
Scale,1
StepLX,1
StepLY,1
StepRX,1
StepRY,1
SkipX,1
SkipY,0
CatAlloc,Increment
CatNbr,2
Background
ball
CatColors,2
0,0,0
255,0,0
FrameIncrement,1
```

9 APPENDIX B: WHAT IS NEW?

9.1 IKB Version 2.6

The cursor color can be changed in the Options menu. The default color is black, but this can be an inconvenience to locate dark features.

Annotations loaded from a new file are automatically sized to match the current Scale selected in the main panel.

The Codebook learning method has been extended to support the use of annotations. This means that you can generate a knowledge of primitive codes based of specific regions selected in a single or multiple images. Since the annotations are saved, you can easily test various settings to build different codebooks and observe the transforms they can produce. The settings include the feature to extract and the value of the Maximum Influence Field.

The Codebook function has been tuned to better generalize and use the value of the Maximum Influence Field edited under the Settings menu.

A bug has been fixed to produce a proper display of the maps generated in recognition when the scaling was changed.

Applying a recognition to the entire image is now made through a simple checkbox (instead of a double key entry with mouse click).

Learning a Golden Template based on the entire image is now made through a simple checkbox (instead of a double key entry with mouse click). Note that this option is not available when the learning method is “Annotations”.

The format of the Preference file (*.prf) saved with a Project file (*.csp) has been changed so that both the learning and recognition method are described with their text label and not their numeric code. This is easier to read if you open the file in a text editor. The older format is still supported.

9.2 IKB Version 2.5.4

The program can load annotations saved in comma delimited and tab delimited format.
The annotations loaded from file are automatically converted to the current scale selected on the main panel.
When scaling an image, the location of existing annotations and/or results are updated accordingly. Their size is not since this is related to the project settings.

Automatic option to fit the region of search to the entire image

9.3 IKB version 2.5.1

Fixed bug preventing to edit steps and scales with more than 1 digit

Addition of a Settings button to access the project settings directly from the main panel

Addition of 3 display options to report the recognized objects and anomalies: a single point, a box, a shade

Bug fix and Improved display of the maps of the categories, distances, and identifiers: The maps are shown with their true dimension in pixel after the decimation by the selected scanning steps. The maps are pasted into a background image to clearly show their position relative to the original image.

The outline of the region of search if always visible even if the region is set to the entire image. This prevents the mis-interpretation of results due to an incorrect ROS selection.

9.4 IKB version 2.4

The Arrow cursors can be used to move the Region of Search in the recognition window.

The Details at Cursor panel has been improved so it can report more that the first 2 firing neurons if application. The plot display has been improved.

The last project can be retrieved in the C:\\MyDocuments\\General Vision\\Project folder. This project is saved automatically before each learning operation.

The learning mode through Annotations now supports the annotations of single objects (ROI, Region of Search) but also areas (ROS, Region of Scan). The key controls have slightly been changed as described under the Learning and Utilities paragraph.

9.5 IKB version 2.3

- Menus have been re-arranged
- Data logging functionalities have been added
- Fix the bug with the Knowledge\Undo last learning command
- The Settings panel allows to edit the Minimum Influence Field
- The Auto-Learn check box is active and triggers the automatic learning of the annotations associated to the newly loaded image.
- The Auto-Reco check box is active and triggers the automatic savings of the recognized objects (or clusters or anomalies) to a "results" file (see below).
- Annotations are now apended in a single file which can be saved and reviewed in a new panel. This file must reside in the same folder as the images it relates to.
- Results are now appended in a single file which can be saved and reviewed in a new panel. This functionality replaces the former "View Results" menu.
- The feature vectors extracted from annotations and/or results can be exported in a csv format compatible with NeuroMem Knowledge Builder

10 TROUBLESHOOTING

10.1 Unable to load DLL “CogniSight_xxx.dll”

Download Visual C++ Redistributable for Visual Studio 2015 from the Microsoft Download Center.
Apply (execute) both files:
vc_redist.x86
vc_redist.x64