



TOLOMEO

TOoLs for Open Multi-risk
assessment using Earth Observation data

TOLOMEO – WP4 – Protocol

Classification/Raster Regularization/Vector Regularization Chain

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1. Introduction

The project “Tools for Open Multi-Risk Assessment using Earth Observation Data” (TOLOMEO) is funded under the Marie Curie International Research Staff Exchange Scheme (PIRSES-GA-2009) with the ultimate goal to establish an international cooperation between partners in Europe and South-America focused on the development of free tools for remotely sensed data analysis.

The TOLOMEO project is composed by eight different work packages (WP). The WP 4, named ‘Earthquake Physical Vulnerability’ (ERVU), has the aim to define a tool for the extraction of the physical vulnerability of building structures using Earth Observation data sets with different spatial resolution, recorded by optical and SAR instruments.

In this framework, two methods were developed to regularize the shapes of buildings obtained by the classification of Remote Sensing (RS) images. The next section describes the steps to perform the regularization of buildings shapes.

2. Classification

The software used for this protocol is InterIMAGE v1.41. The method that will be described in the first part of this document allows the classification of an image using a Decision Tree classifier. This step is necessary to get the buildings segments.

New Project

First of all, it is necessary to define a new project:

3. Start InterIMAGE.
4. In the toolbar click on *File/New Project*.
5. In the ‘Project’ section, type a name for the project, then click the *Browse Folder* icon  and set a folder.

NOTE: Make sure the keys, names and paths in your project don’t have white spaces or non-ASCII characters, otherwise InterIMAGE won’t run properly.

6. In the 'Resources' section, click the *Browse Resources* icon  and select the input image, then type 'image' as the name that will identify it in 'key'. Check the box named 'Default Image'. Once complete click the *Add* icon  in 'Resource List'.
7. Click 'OK'.

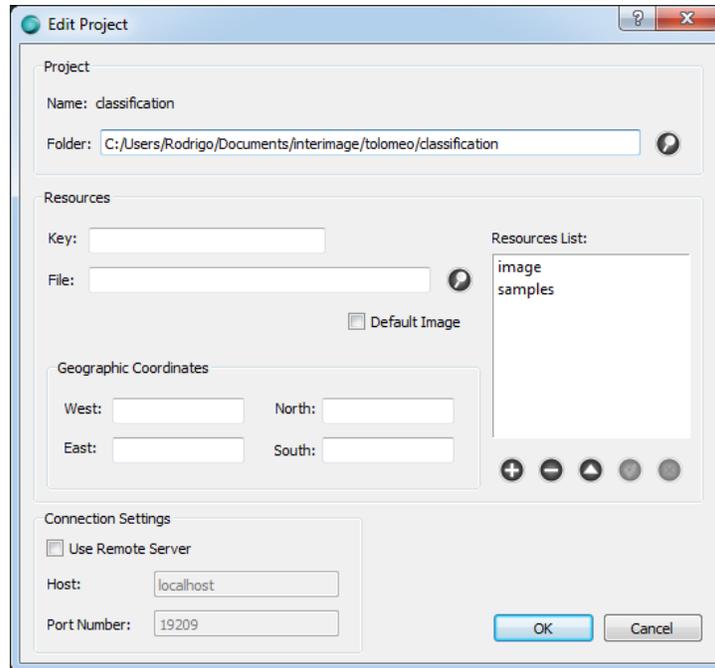


Figure 1. 'New Project' window.

Define the Semantic Network - Classification nodes

Now that the project is defined, we can define the semantic network.

- 1) In the 'Semantic Net' window, right click on the 'Scene' block  and select *Insert Child/Node*.
- 2) Select the node just created with the left mouse button.
- 3) In the 'Node Editor' window, type 'Roofs' as the name for the 'Class' and select the orange color in 'Color'.
- 4) Do the same for the other classes: 'Vegetation' (green) and 'Asphalt' (grey).

5) Select the 'Scene' node and then open the 'Samples Editor' .

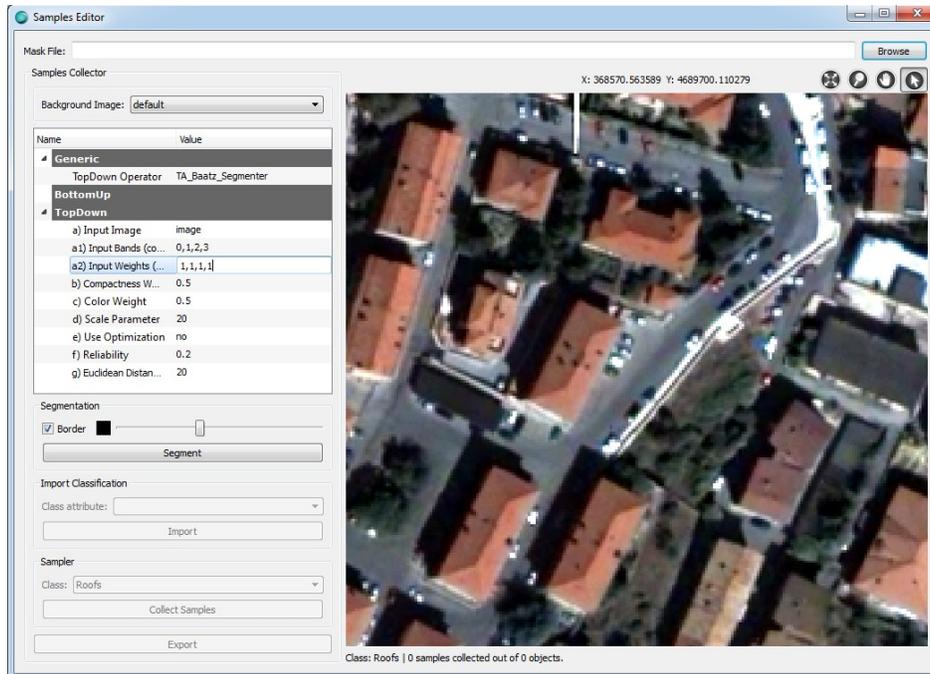


Figure 2. 'Samples Editor' window.

- 6) In 'Samples Editor', select the 'TA_Baatz_Segmenter' operator from the 'TopDown Operator' list.
- 7) In the 'TopDown' sub-section define the parameters of the operator:
 - a. Select 'image' as 'Input Image';
 - b. Type '0,1,2,3' for 'Input Bands';
 - c. Type '1,1,1,1' for 'Input Weights';
- 8) Start the segmentation pressing 'Segment'.
- 9) For the all 3 classes we collect samples from the segmented image by pressing "Collect samples" and just clicking the segments we want (remember to select the Selection Tool ). Around ten samples for each class should be fine. (It's possible to deselect a polygon by clicking it again).
- 10) To stop collecting samples just press again the "Collect samples" button.

- 11) Start the "Export Shapefile" window by pressing the "Export" button.
- 12) From the tab "Decision tree" select the "Class" block and after that select "All".
- 13) Then select the "Expression" block and insert the following blocks:

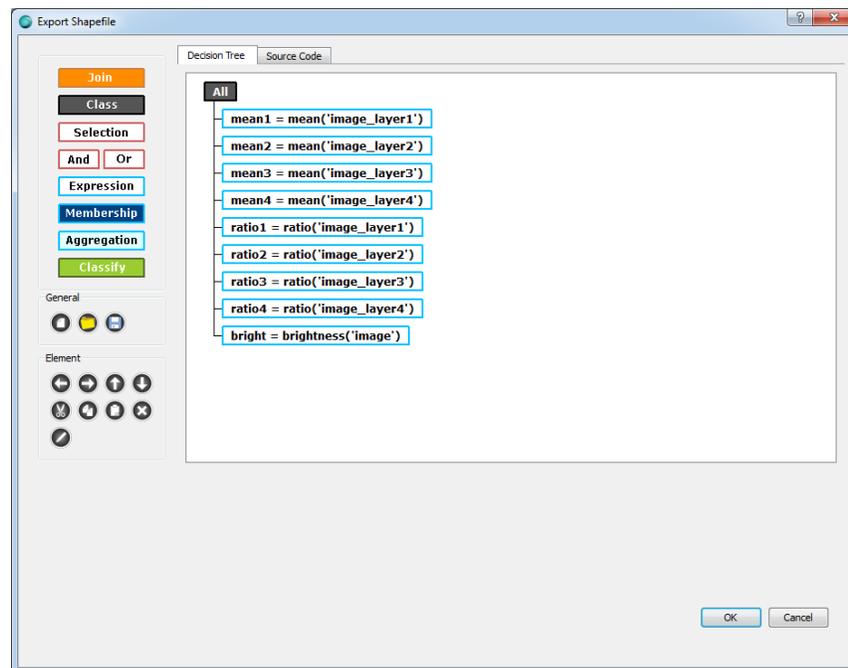


Figure 3. 'Export Shapefile' window.

- 14) Save it by clicking the "Save" button with the name "samples.shp".
- 15) Close the window pressing "OK" in the bottom right in the "Sample editor" window.
- 16) In the toolbar click on *File/Edit Project*.
- 17) In the 'Resources' section, click the *Browse Resources* icon  and select the shapefile created, then type 'samples' as the name that will identify it in 'key'.
Once complete click the *Add* icon  in 'Resource List'.
- 18) Click "Ok".
- 19) Select the class 'Roofs' and then set these parameters:

- Select 'TA_C45_Classifier' for 'TopDown Operator';
- Check the checkbox 'Top-Down Multi-Class';
- Select 'samples' for 'Training Set File';
- Select 'samples' for 'Input Shape File';

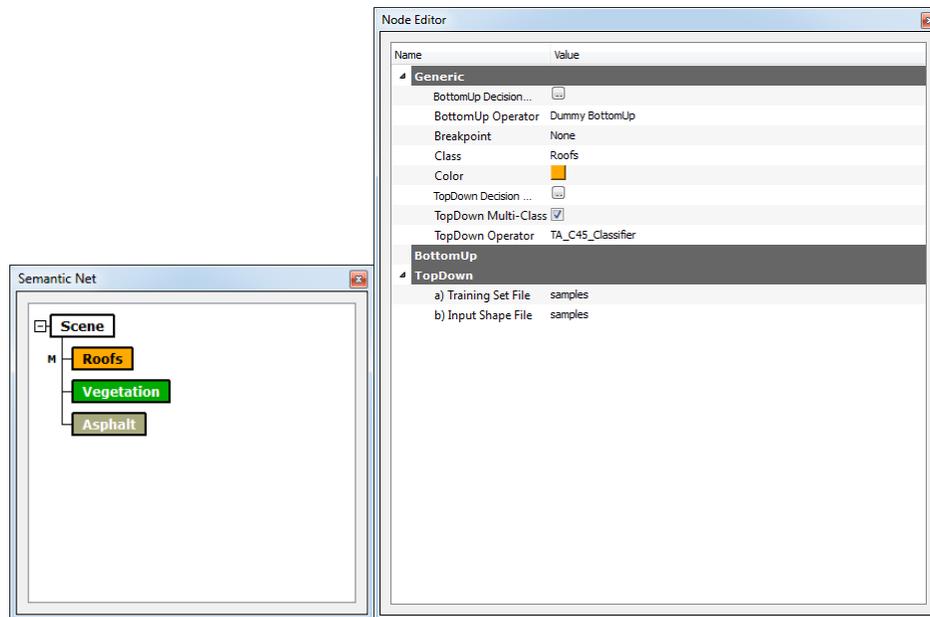


Figure 4. 'Semantic Net' and 'Node Editor' windows.

Execute the Project

Finally, the project can be executed:

- 1) In the toolbar click on *File/Save Project*.

- 2) Click the 'Execute' icon  (Top-Left) to run start the processing.

The result show the polygons that represent the roads extracted.

Export the Result

The result of the processing could be exported as ESRI Shapefile:

- 1) In the 'Layers' window, select the 'Result' layer with left click.
- 2) Click the 'Export' icon . A new window with name 'Export Shapefile' will pop-up.
- 3) Click the 'Class' block , then select 'All', then click 'OK'.
- 4) Click 'OK'. A new window with name 'Choose Shapefile' will pop-up.
- 5) Select the location and the name for the Shapefile that will be created.
- 6) Click 'OK'.

8. Methodology - Raster Regularization

In this second part, we will describe the method that regularizes the shapes of the buildings based on their raster representation.

New Project

First of all, it is necessary to define a new project:

- 1) Start InterIMAGE.
- 2) In the toolbar click on *File/New Project*.
- 3) In the 'Project' section, type a name for the project, then click the *Browse Folder* icon  and set a folder.

NOTE: Make sure the keys, names and paths in your project don't have white spaces or non-ASCII characters, otherwise InterIMAGE won't run properly.

- 4) In the 'Resources' section, click the *Browse Resources* icon  and select the input image, then type 'image' as the name that will identify it in 'key'. Check the box named 'Default Image'. Once complete click the *Add* icon  in 'Resource List'.
- 5) Still in the 'Resources' section, click the *Browse Resources* icon  and select the shapefile created in the previous section, then type 'roofs' as the name that will identify it in 'key'. Once complete click the *Add* icon  in 'Resource List'.
- 6) Click 'OK'.

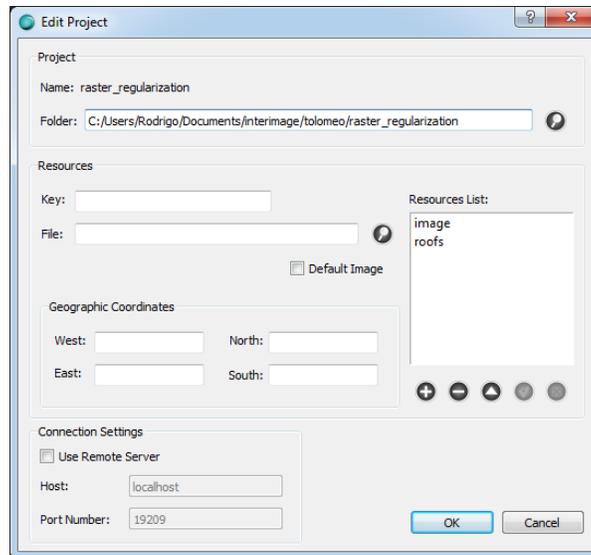


Figure 5. 'New Project' window.

Define the Semantic Network - 'Regularization' node

Now that the project is defined, we can define the semantic network. Firstly, we set up the 'Regularization' node:

- 20) In the 'Semantic Net' window, right click on the 'Scene' block Scene and select *Insert Child/Node*.
- 21) Select the node just created with the left mouse button.
- 22) In the 'Node Editor' window, type 'Regularization' as the name for the 'Class' and select the red color in 'Color'.
- 23) Select the 'BREC Building Regularizer' operator from the 'BottomUp Operator' list.
- 24) In the 'BottomUp' sub-section of the 'Semantic Net' section must be defined the parameters of the operator:
 - a. Type '25' for 'Detail Threshold';
 - b. Type 'Buildings' for 'Building Classes' (here more than one class could be defined separating the class names by commas);

NOTE: The parameter values are optimized for the example data. For different sensors, different values must be searched.

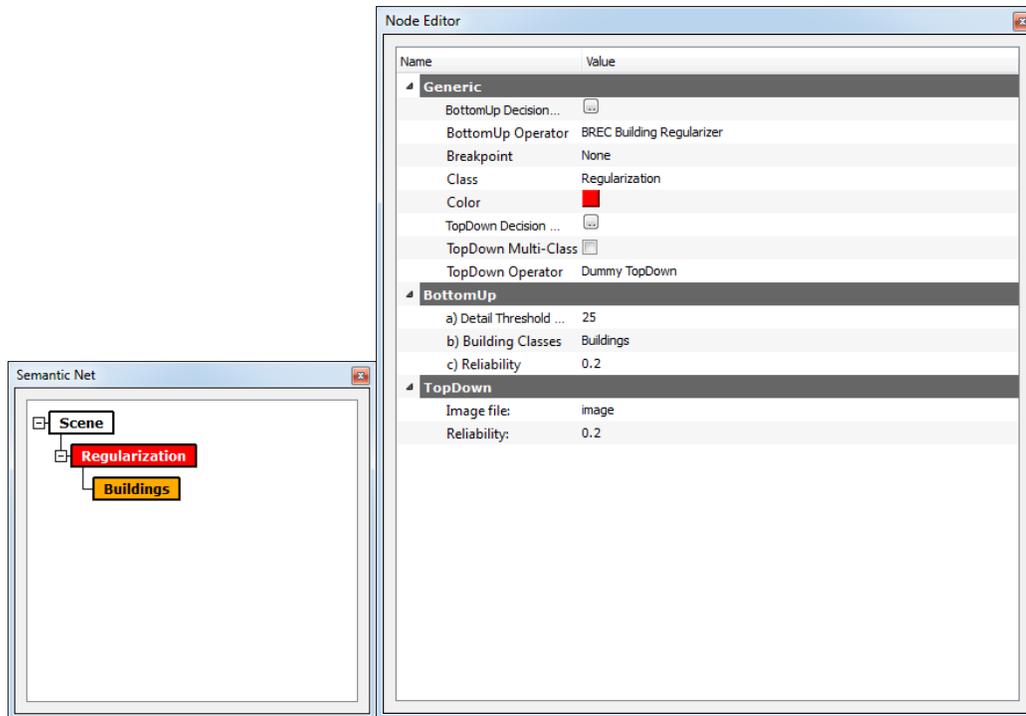


Figure 6. 'Semantic Net' and 'Node Editor' windows.

To the 'Regularization' semantic node was associated the 'BREC Building Regularizer' operator that regularizes the shapes of the buildings based on their raster representation.

Define the Semantic Network - 'Buildings' node

Now that the project is defined, we can define the semantic network. Firstly, we set up the 'Buildings' node:

- 1) In the 'Semantic Net' window, right click on the 'Scene' block Scene and select *Insert Child/Node*.
- 2) Select the node just created with the left mouse button.
- 3) In the 'Node Editor' window, type 'Buildings' as the name for the 'Class' and select the orange color in 'Color'.
- 4) Select the 'TA_Shapefile_Import' operator from the 'TopDown Operator' list.

5) In the 'TopDown' sub-section of the 'Semantic Net' section must be defined the parameters of the operator:

- a. Select 'roofs' for 'Shape File Name';
- b. Type '0.6' for 'Label Image Resolution'.

NOTE: The parameter values are optimized for the example data. For different sensors, different values must be searched.

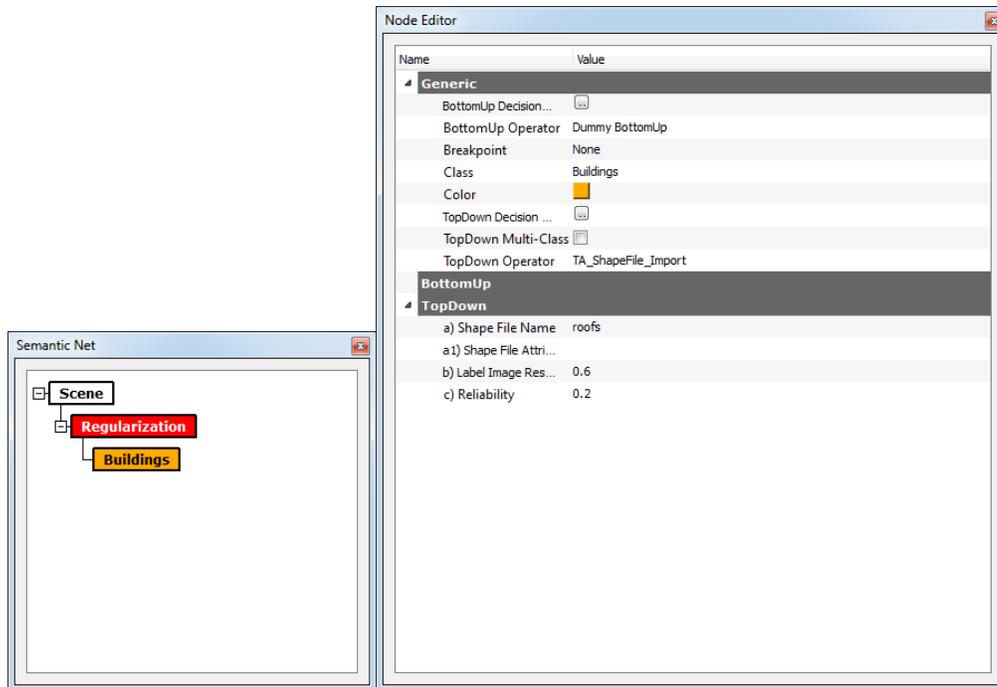


Figure 7. 'Semantic Net' and 'Node Editor' windows.

To the 'Buildings' semantic node was associated the 'TA_Shapefile_Import' that imports the shapefile with the buildings that were classified in the previous section.

Execute the Project

Finally, the project can be executed:

3) In the toolbar click on *File/Save Project*.

4) Click the 'Execute' icon  (Top-Left) to run start the processing.

The result show the polygons that represent the roads extracted.

Export the Result

The result of the processing could be exported as ESRI Shapefile:

7) In the 'Layers' window, select the 'Result' layer with left click.

8) Click the 'Export' icon . A new window with name 'Export Shapefile' will pop-up.

9) Click the 'Class' block , then select 'All', then click 'OK'.

10) Click 'OK'. A new window with name 'Choose Shapefile' will pop-up.

11) Select the location and the name for the Shapefile that will be created.

12) Click 'OK'.

9. Methodology - Vector Regularization

In the third part we will describe the method that regularizes the buildings polygons obtained in the previous section.

New Project

First of all, it is necessary to define a new project:

1) Start InterIMAGE.

2) In the toolbar click on *File/New Project*.

3) In the 'Project' section, type a name for the project, then click the *Browse Folder* icon  and set a folder.

NOTE: Make sure the keys, names and paths in your project don't have white spaces or non-ASCII characters, otherwise InterIMAGE won't run properly.

4) In the 'Resources' section, click the *Browse Resources* icon  and select the input image, then type 'image' as the name that will identify it in 'key'. Check the box  named 'Default Image'. Once complete click the *Add* icon  in 'Resource List'.

- 5) Still in the 'Resources' section, click the *Browse Resources* icon  and select the shapefile created in the previous section, then type 'raster_regularized' as the name that will identify it in 'key'. Once complete click the *Add* icon  in 'Resource List'.
- 6) Click 'OK'.

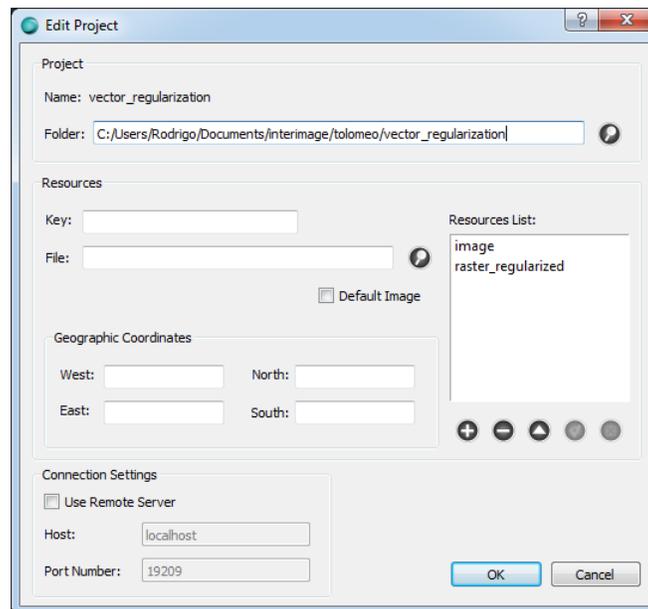


Figure 8. 'New Project' window.

Define the Semantic Network - 'Regularization' node

Now that the project is defined, we can define the semantic network. Firstly, we set up the 'Regularization' node:

- 25) In the 'Semantic Net' window, right click on the 'Scene' block  and select *Insert Child/Node*.
- 26) Select the node just created with the left mouse button.
- 27) In the 'Node Editor' window, type 'Regularization' as the name for the 'Class' and select the red color in 'Color'.
- 28) Select the 'BREC Shape Regularizer' operator from the 'BottomUp Operator' list.

- 29) In the 'BottomUp' sub-section of the 'Semantic Net' section must be defined the parameters of the operator:
- Type '2' for 'Distance';
 - Type '2' for 'Tolerance';
 - Type 'Buildings' for 'Building Classes' (here more than one class could be defined separating the class names by commas);

NOTE: The parameter values are optimized for the example data. For different sensors, different values must be searched.

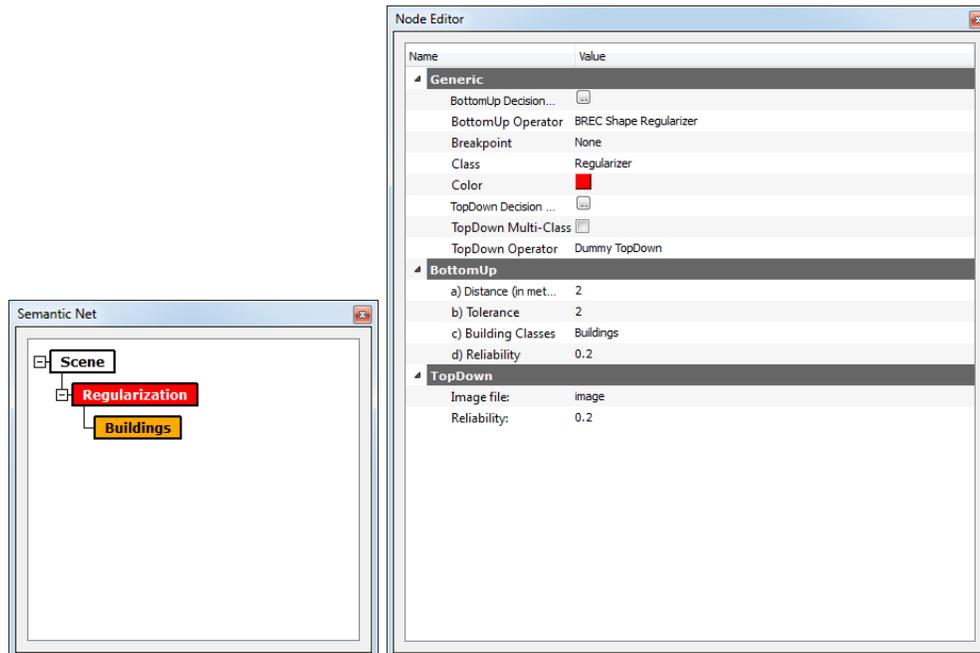


Figure 9. 'Semantic Net' and 'Node Editor' windows.

To the 'Regularization' semantic node was associated the 'BREC Shape Regularizer' operator that regularizes the shapes of the buildings polygons.

Define the Semantic Network - 'Buildings' node

Now that the project is defined, we can define the semantic network. Firstly, we set up the 'Buildings' node:

- 6) In the 'Semantic Net' window, right click on the 'Scene' block Scene and select *Insert Child/Node*.
- 7) Select the node just created with the left mouse button.
- 8) In the 'Node Editor' window, type 'Buildings' as the name for the 'Class' and select the orange color in 'Color'.
- 9) Select the 'TA_Shapefile_Import' operator from the 'TopDown Operator' list.
- 10) In the 'TopDown' sub-section of the 'Semantic Net' section must be defined the parameters of the operator:
 - a. Select 'raster_regularized' for 'Shape File Name';
 - b. Type '0.6' for 'Label Image Resolution'.

NOTE: The parameter values are optimized for the example data. For different sensors, different values must be searched.

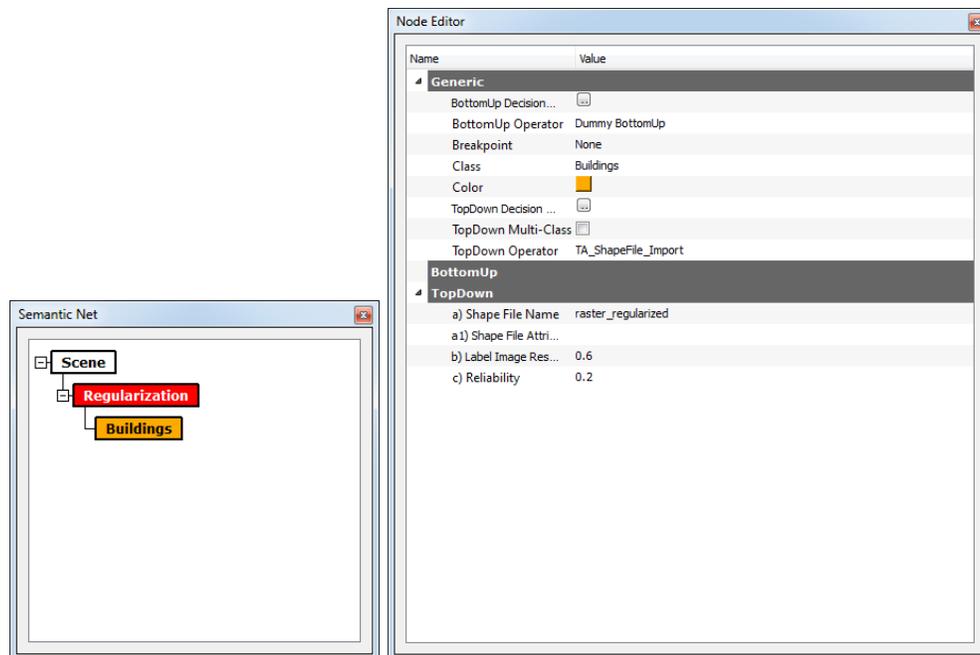


Figure 10. 'Semantic Net' and 'Node Editor' windows.

To the 'Buildings' semantic node was associated the 'TA_Shapefile_Import' that imports the shapefile with the buildings that were regularized in the previous section.

Execute the Project

Finally, the project can be executed:

5) In the toolbar click on *File/Save Project*.

6) Click the 'Execute' icon  (Top-Left) to run start the processing.

The result show the polygons that represent the road crossings detected.

Export the Result

The result of the processing could be exported as ESRI Shapefile:

13) In the 'Layers' window, select the 'Result' layer with left click.

14) Click the 'Export' icon . A new window with name 'Export Shapefile' will pop-up.

15) Click the 'Class' block , then select 'All', then click 'OK'.

16) Click 'OK'. A new window with name 'Choose Shapefile' will pop-up.

17) Select the location and the name for the Shapefile that will be created.

18) Click 'OK'.

10. Conclusions

This protocol described two methods that permit to classify and regularize the buildings shapes using the InterIMAGE software.