

## ESP 2 (Estimation of Scale Parameters 2) – User Guide

### Theoretical background:

Drăguț, Lucian, Csillik, Ovidiu, Eisank, Clemens and Tiede, Dirk (submitted) 'Automated parameterization of multi-scale image segmentation on multiple scales'

### Preparation

- Unpack the zip File (ESP2.zip) to a new folder. It should include the following files:
- ESP2\_estimation\_scale\_parameter2.dcp (eCognition rule-set)
- ESP2\_User\_Guide.pdf (this document)
- ESP\_Estimation\_Scale\_Parameter\_Chart.exe (a stand-alone tool for visualizing and interpreting the results. This tool is programmed in .NET, therefore the .NET framework needs to be installed on your machine. If it is not installed you can download it via the Windows Update function or here: <http://www.microsoft.com/en-us/download/default.aspx>.
- ZedGraph.dll (a dynamic link library which is needed to run the ESP\_Estimation\_Scale\_Parameter\_Chart.exe tool)

### Processing steps

1. *Loading and running the tool (it's a so called customized algorithm) in eCognition 8*
2. *Visualizing and interpreting the automated extracted outputs.*
3. *Visualizing and interpreting the output file using the Chart tool (ESP\_Estimation\_Scale\_Parameter\_Chart.exe)*

#### 1. Loading and running the tool in eCognition

- Open eCognition and start a new project. Note that ESP2 works now on multiple layers (maximum of 30) and it will take into account all layers loaded into a project to perform multiresolution segmentation (regardless of their name), to produce 3 levels. If you want to exclude specific layers/multispectral bands in the analysis you can load them after the execution of the tool. ESP2 can handle both entire images, and defined areas of interest within images (e.g. administrative boundaries). In the later case, no data values must be defined for the respective layer in order to prevent segmentation outside the area of interest. Otherwise, the segments outside the area of interest will impact on the results!

- Load the rule set / customized algorithm '**ESP2\_estimation\_scale\_parameter.dcp**' (indicate the path where ESP is stored on your computer) and append the new process ('**Append New...**'). Find the ESP2 in the Algorithm section under '**Customized**' (see figure below). If the ESP2 algorithm is not appearing there, you have to click the 'more' tab to add the algorithm to the list.

- Run ESP2. Indicate (see Figure 1):

- '**Use of hierarchy**' (0= each scale parameter is generated independently, based on the pixel level; 1= each scale level is generated within a hierarchy, in a top-down approach, where lower level is based on segmentation results at higher level. Note: Processing without using a hierarchy takes much more time, but the individual results are independent from other segmentation levels; by default, 'Use of hierarchy' = 1)
- '**Starting scale\_Level 1**', '**Starting scale\_Level 2**' and '**Starting scale\_Level 3**' (the minimum scale parameters at which the processing starts, for the three levels which are going to be created; by default, all starting scales = 1)
- '**Step size\_Level 1**', '**Step size\_Level 2**' and '**Step size\_Level 3**' (the increments of scale parameter for the step-wise segmentation processing, for the three levels which are going to be created; default values are 1, 10 and 100 respectively – for details, see Drăguț and Eisank (2012))
- '**Shape**' and '**Compactness**' (composition of the homogeneity criterion as implemented in the multiresolution segmentation; default values of 0.1 and 0.5 respectively)

- **'Produce LV Graph'** (0 = it does not produce a \*.txt file with LV values stored; 1 = it produce a \*.txt file with LV values and see the results with the help of ESP\_Estimation\_Scale\_Parameter\_Chart.exe tool; default value is 0, since it is recommended for advanced users)
- **'Number of loops'** (the number of scales to be generated, if Produce LV Graph = 1; e.g. 100).

Parameter	Value
Use of Hierarchy (0=no; 1=yes)	1
Starting scale_Level 1	1
Step size_Level 1	1
Starting scale_Level 2	1
Step size_Level 2	10
Starting scale_Level 3	1
Step size_Level 3	100
Shape (between 0.1 and 0.9)	0.1
Compactness (between 0.1 and 0.9)	0.5
Produce LV Graph (0=no; 1=yes)	0
Number of Loops	100

Figure 1. ESP2 customized algorithm interface.

## 2. Visualizing and interpreting the automated extracted outputs

- The tool automatically extract 3 levels, depending on what parameters were used (described above). For Use of hierarchy = 0, the results are stored in maps named: Level 1, Level 2 and Level 3. For Use of hierarchy = 1, the results are stored in map called Hierarchy, with levels named: Level 3 (coarser), Level 2 and Level 1 (finest) (see Figure 2).
- For Non-Hierarchy version, 3 levels are created independently, thus no relationship between them can be distinguished. Beginning with Starting scale\_Level x and constantly increasing the SP with Step size\_Level x, the iterative algorithm stops when LV of previous level is higher or equal than LV of present level, thus SP of previous level is selected as first meaningful SP.
- Hierarchy version creates 3 levels in a top-down approach, starting from Level 3 (coarser) to Level 2 and Level 1 (finest), where a parent-child relationship exist between the levels.
- In the Image Object Information window within eCognition, final SP for all three levels can be seen (Current scale\_Level x).



Figure 2. Maps and levels created using Non-Hierarchy (left) and Hierarchy (right) options of ESP2.

### 3. Visualizing and interpreting the output file using the Chart tool

#### (ESP\_Estimation\_Scale\_Parameter\_Chart.exe)

- In the case: Produce LV Graph = 1, results of processing are saved as a \*.txt file (where \* will be automatically replaced by the name of the current eCognition project, followed by Hierachy or Non-Hierarchy), which is written in the folder where the eCognition project was saved. Note that for computing the \*.txt file, the scale-specific parameters used are Starting scale\_Level 1 and Step size\_Level 1. Important: if a new run of ESP is needed, make sure the previous .txt file has been renamed or moved into another folder; otherwise, it will be overwritten!
- Run the **ESP\_Estimation\_Scale\_Parameter\_Chart.exe** tool (no installation needed)
- Load the processing result (\*.txt file) using the “**Data Source**” button. Press the “**Calculate**” button to start the visualization of the data
- The tool plots values of local variance (**LV**) and rate of change (**ROC** = rate of change in local variance between the scale level of interest and the previous one) against scale levels. The graph shows a sudden decrease in ROC of local variance at the lowest scales, followed by level off. However, if ROC extremely high at first scale levels, the evolution of local variance is not visible (see figure below). In the case of LV, the graph shows a step-wise increasing of its value, while scale parameter increases also.
- Adjust values of vertical axis in order to see both curves. This can be done by reducing the **Rate of Change Max. Value** or **Local Variance Max. Value** in the field above the curve, refresh the plot by clicking the corresponding button.
- **Zoom** function (just open a zoom rectangle by dragging using the left mouse button) and **export** function (right mouse-click) are also available.
- **Interpretation:** Local variance increases with the increase in scale parameter as the homogeneity of objects in the scene increases. The highest values of LV just before successive levels along the curve indicate scales where objects reached meaningful levels of organization in terms of variation of their homogeneity. First peaks in LV are automated extracted within the three-scale approach, but the user can choose other values of LV for its specific purposes of a project. ROC of LV can be a real help in identifying them. Thus, the amount of change of LV from a level to another indicates how important is the respective scale level in structuring the information on objects variability relative to the whole scene (for details, see Drăguț *et al.*, (2010)).