Envision Toolbox Manual

Chapter 5

Extractor

Interactive
Region of Interest Extraction

Chapter 5 - Extractor

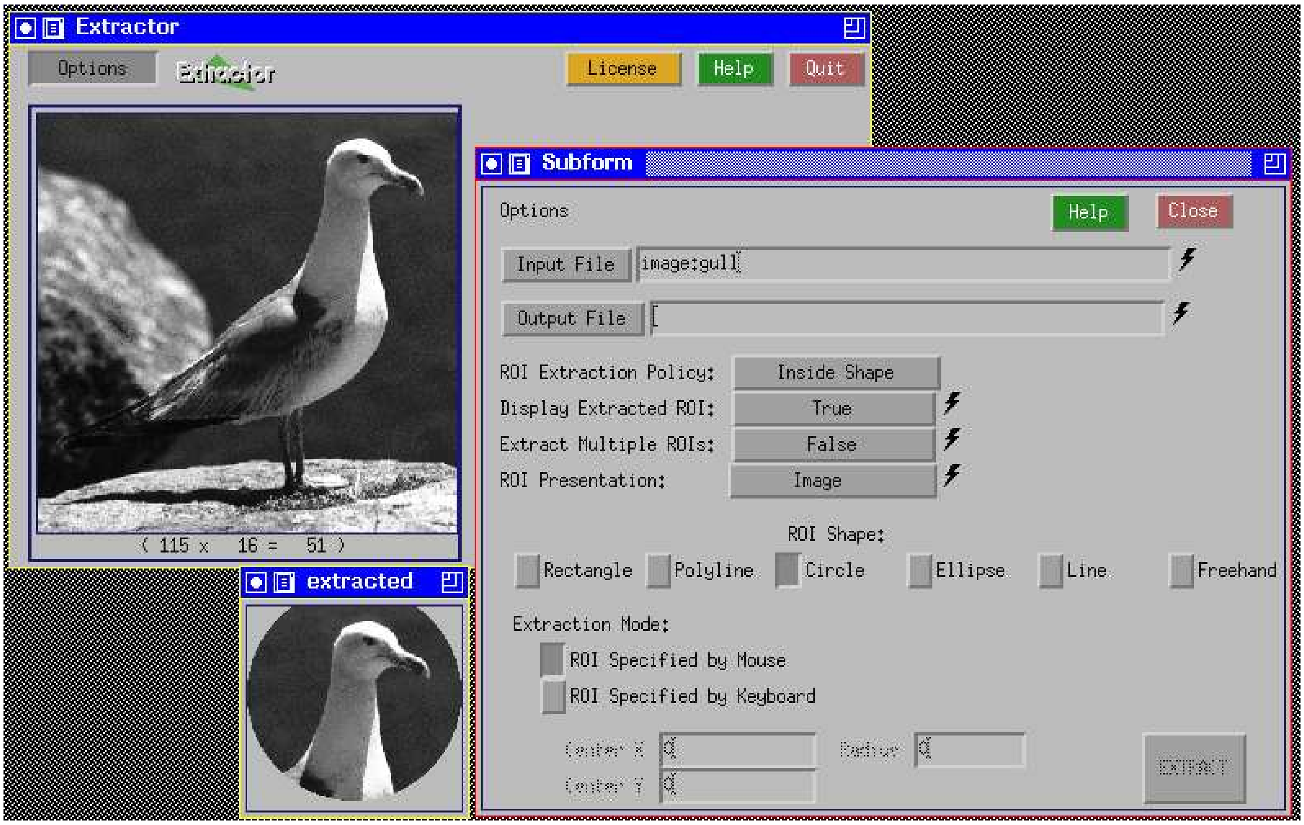

Figure 1: The extractor application allows interactive region of interest extraction. Here, a circular area of the "gull" image has been extracted ($SAMPLEDATA/data/images/gull.viff, shorthand "images:gull").

A. Introduction

Extractor is an interactive region of interest (ROI) extraction tool. The features supported by the region of interest extraction tool are:

ROI Shape
A wide variety of shapes with which to define the ROI. Supported shapes include rectangle, line, circle, ellipse, polyline, and freehand.

ROI Extraction Policy
The ROI Extraction policy provides control over whether the extracted ROI is defined by the area inside the shape, by the area outside the shape, or by the outline of the shape itself.

Display Extracted ROI
You may automatically display the extracted region of interest in a separate window, as well as writing it to an output file.

Extract Multiple ROIs
If desired, multiple ROI's may be extracted from the same image; the resulting data object output will have all specified ROI's combined into the same image.

ROI Presentation
The extracted ROI may be displayed as a signal (2D plot), an image, or a surface (3D plot).

The main form of extractor displays the input image in a workspace. Above the workspace are "License", "Help", and "Quit" buttons, from which one may access the license agreement, display online help pages, and quit the program, respectively. In the upper left hand corner of the main form is the "Options" subform button. The "Options" subform button may be used to display the "Options" subform, which is used to set all the parameters relevant to ROI extraction.

B. Command Line Options

The syntax for executing extractor from the command line is as follows:

```
% extractor
  -i          (infile)  input image from which to extract ROI
  [-o]        (outfile) output image in which to save ROI
  [-policy]   (list)    ROI extraction policy
                1  "Inside Shape",
                2  "Shape Outline",
                3  "Outside Shape"
                [default: 1 "Inside Shape"]
  [-disp]     (boolean) display extracted ROI in separate window
  [-mult]    (boolean) extract multiple ROIs from the same window
  [-pres]    (list)    ROI presentation
                1  "Signal",
                2  "Image",
                3  "Surface"
                [default: 2 "Image"]
  [-shape]   (flag)    specifies desired shape for ROI
                1  (Rectangle),
                2  (Polyline),
                3  (Circle),
                4  (Ellipse),
                5  (Line),
                or 6  (Freehand)
          [default: 1]
```

Note that the standardized Khoros arguments [-V], [-U], [-usage], [-P], [-gui], [-form], [-x], [-y], [-A], [-a], and [-ap] are also supported by editimage.

-i {input image filename}
This is the input image to be displayed, from which the region(s) of interest will be extracted.

[-o {output image filename}]
This is the name of the file in which to save the extracted region of interest. Note that the extracted ROI can be saved in a file, displayed in a separate window, or both.

[-policy {1, 2, or 3}]
This option dictates the ROI Extraction Policy. When given a value of 1 ("Inside Shape"), the region of interest will be extracted from the area that is *inside* the shape that is drawn on the input image. When given a value of 3 ("Outside Shape"), the region of interest will be extracted from the area that is *outside* the shape that is drawn on the input image. When given a value of 2 ("Shape Outline"), the outline of the shape is used to define the region of interest.

[-disp]
Provide a value of TRUE (1) if you want the extracted region of interest to be displayed in a separate window. You can use this boolean argument to display the extracted region of interest, whether or not the [-o] argument is used to specify an output file.

[-mult]
If set to TRUE, multiple ROI extraction will be enabled.

[-pres]
The ROI presentation may be set to display a signal (2D plot), image, or surface (3D plot).

[-shape]"
This argument dictates the shape of the ROI to be extracted.

C. The Options Subform

The "Options" subform allows you to control all parameters which affect ROI extraction.

Input File
Enter a new input file to be displayed in the workspace; the new input file can now be used to extract regions of interest.

Output File
Provide the name of the output file to which the ROI is to be written. Note that the ROI does not *have* to be written to an output file; it may simply be displayed in a separate window (the ROI will be displayed in a separate window when "Display Extracted ROI" is set to "True"). Leave the filename as NULL if you do not want the ROI written to an output file.

ROI Extraction Policy
This list selection allows you to specify whether regions of interest will be defined by the area inside the shape, outside the shape, or by the outline of the shape.

Display Extracted ROI
Set this logical selection to TRUE if you want the extracted region of interest to be displayed in a separate window; change it to FALSE if you do not want to see the extracted ROI.

Extract Multiple ROI's
If desired, you may extract multiple regions of interest from the same image, and save them as a single data object.

ROI Presentation
The ROI Presentation dictates how the data object representing the extracted ROI is to be constructed. It may be output as a signal (2D plot), an image, or a surface (3D plot).

ROI Shape
This toggle is used to set the desired shape of the ROI. Supported ROI shapes include rectangle, line, polyline, circle, ellipse, and freehand.

Extraction Mode
The Extraction mode may be set to "Mouse" or "Keyboard". "Mouse" implies interactive extraction using the mouse, while "Keyboard" implies non-interactive extraction using the provided floating point selections to specify location & size coordinates.

C.1. ROI Shapes

The shapes supported for region of interest extraction include rectangle, line, polyline, circle, ellipse, and freehand. An ROI is defined both by the shape of the ROI, and by the ROI Extraction Policy. The ROI Extraction Policy may be one of "Inside Shape", "Shape Outline", or "Outside Shape". The following section summarizes the results of using the various ROI shapes with each of the ROI Extraction Policies.

Rectangle
The region of interest will be defined by a simple rectangle.

1. Inside Shape
The subimage defined by the rectangle is extracted.

2. Shape Outline
The bounding box of the rectangle is calculated, and all pixel values inside the bounding box but not on the outline of the rectangle are masked out.

3. Outside Shape
The pixel values within the rectangle are masked out, while the remainder of the image is preserved.

To extract a rectangular region of interest, rubberband the rectangle surrounding the region of interest in the input image. To rubberband the rectangle, click the mouse button on a corner of the desired region of interest. Holding the mouse button down, move the mouse to the opposite corner of the desired rectangle. The rectangle will refreshed as the mouse moves, or "rubber-banded" after the mouse. Release the mouse button when the rectangle appears as desired.

Polyline

The region of interest will be defined by a polyline. The first and last points of the polyline are joined in order to close the shape.

1. Inside Shape

The bounding box is calculated from the vertices of the polyline and all pixel values within the bounding box but not inside the polygon are masked out.

2. Shape Outline

The bounding box is calculated from the vertices of the polyline and all pixel values not on the polyline itself are masked out.

3. Outside Shape

All pixels within the polyline are masked out, while the rest of the image is preserved.

To extract a polyline region of interest, begin by clicking the mouse on one vertex of the desired polyline. As you move the mouse, a line will be rubberbanded after it. Continue to button click on each successive vertex, until the polyline appears as desired; double click to end the polyline. The first and last vertices of the polyline will be joined in order to define a closed region of interest.

Circle

The region of interest will be defined by a circle.

1. Inside Shape

The bounding box is calculated from the dimensions of the circle and all pixel values within the bounding box but not inside the circle are masked out.

2. Shape Outline

The bounding box is calculated from the vertices of the polyline and all pixel values not on the circle itself are masked out.

3. Outside Shape

All pixels within the circle are masked out, while the rest of the image is preserved.

To extract a circular region of interest, rubberband the circle defining the region of interest in the input image. To rubberband the circle, click the mouse button on the center of the desired region of interest. Holding the mouse button down, move the mouse until the circle has the desired radius; release the mouse button to finalize the circle.

Ellipse

The ellipse region of interest works similarly to that of a circle (see above).

To extract an ellipsoid region of interest, rubberband the ellipse defining the region of interest in the input image. Rubberbanding an ellipse is similar to rubberbanding a circle, except that the width and height of the ellipse will be changed with horizontal and vertical mouse movement.

Line

The region of interest will be defined by a line.

1. Inside Shape

The bounding box is calculated from the endpoints of the line; all pixel values within the bounding box but not on the line are masked out.

2. Shape Outline

Same as "Inside Shape" (see above).

3. Outside Shape

All pixels on the line itself are masked out, while the rest of the image is preserved.

To extract a line region of interest, rubberband the line defining the region of interest in the input image. To rubberband the line, click the mouse button on one endpoint of the desired region of interest. Holding the mouse button down, move the mouse to the other endpoint of the line. Release the mouse button when the line is of the desired length and direction.

Freehand

The region of interest will be defined by a freehand drawing. The begin and end points of the freehand drawing are joined in order to close the shape.

1. Inside Shape

The bounding box is calculated from the boundary of the drawing and all pixel values within the bounding box but not inside the freehand shape are masked out.

2. Shape Outline

The bounding box is calculated from the outline of the freehand drawing and all pixel values not on the outline itself are masked out.

3. Outside Shape

All pixels within the freehand drawing are masked out, while the rest of the image is preserved.

To extract a freehand region of interest, begin by clicking the mouse on an endpoint of the shape to be drawn. Holding the button down, move the mouse in the desired shape; a line will be drawn according to the movement of the mouse. Release the mouse button to end the freehand drawing. The beginning and ending point of the drawing will be joined in order to define a closed region of interest.

C.2. The ROI Extraction Policy

The ROI Extraction Policy can be set to "Inside Shape", "Shape Outline", or "Outside Shape"; this indicates whether regions of interest will be defined by the area inside the shape, outside the shape, or by the outline of the shape.

Masking is used to indicate which portions of the image are within the region of interest. Masked-out values will appear in black.

Since single or multiple ROI's can be extracted from the same image, the algorithm used for determining the mask value depends both on the ROI Extraction Policy, and on whether single or multiple regions of interest are being extracted from the image.

Inside/Single
When the ROI Extraction policy is set to "Inside Shape" and a single region of interest is extracted from the image, the mask values within the ROI are set to 1, while the mask values outside the ROI are set to 0.

Inside/Multiple
When the ROI Extraction policy is set to "Inside Shape" and multiple regions of interest are extracted from the image, the mask values within a ROI is set to the number indicating the order in which the ROI was created. For example, the mask values within the first ROI created are 1, the mask values within the second ROI created are 2, etc. The mask values outside the ROI are set to 0.

Outline/Single
When the ROI Extraction policy is set to "Shape Outline" and a single region of interest is extracted from the image, the mask values on the outline of the ROI shape are set to 1, while the mask values not on the ROI outline are set to 0.

Outline/Multiple
When the ROI Extraction policy is set to "Shape Outline" and multiple regions of interest are extracted from the image, the mask values on the outline of a ROI is set to the number indicating the order in which the ROI was created. For example, the mask values on the outline of the first ROI are 1, the mask values on the outline of the second ROI are 2, etc. The mask values not on the outline of any ROIs are set to 0.

Outside/Single
When the ROI Extraction policy is set to "Outside Shape" and a single region of interest is extracted from the image, the mask values within the shape are set to 0, while the mask values outside the ROI are set to 1.

Outside/Multiple
When the ROI Extraction policy is set to "Outside Shape" and multiple regions of interest are

extracted from the image, the mask values within the all the shapes drawn are set to 1. The mask values outside the shapes drawn are set to 0.

C.3. Multiple ROI Extraction

If desired, you may extract multiple regions of interest from the same image, and save them as a single data object. Set "Extract Multiple ROIs" to "True" to enable this capability. Then, begin the ROI extraction process normally. After a region of interest is specified, the shape drawn on the image to delineate the ROI will not be erased as it is when single ROI's are extracted. Instead, the shape will remain on the image, and the next ROI may be extracted. When all ROI's have been specified as desired, click the *right mouse button* or *double-click* to indicate that you are done. The resulting data object will have the multiple ROI's specified combined.

Note that extractor will allow you to change the ROI Shape during multiple ROI extraction, so that ROI's of different shapes can be extracted into the resulting image. Editimage, on the other hand, does not allow the ROI Shape to be changed.

C.4. The ROI Presentation

The extracted ROI should be output according to the way you intend to visualize it. It may be output as a signal (2D plot), an image, or a surface (3D plot).

Signal

When the ROI Presentation is set to signal, the value data defined by the *outline* of the ROI shape will be extracted and saved, regardless of the ROI Extraction Policy. Only the data on the outline of the ROI shape is output; no masking is used. The output file is expected to be visualized as a 2D plot. When the shape is a rectangle, the data on the outline is extracted beginning at the upper left hand corner, and the outline is traversed in a clockwise direction. When the shape is a polyline, the data on the outline is extracted beginning at the first vertex of the polyline; the extraction process then proceeds through the rest of the vertices and ends at the last vertex of the polyline. When the shape is a circle or an ellipse, the extraction process begins at the exact top of the circle or ellipse, and proceeds in a clockwise direction around the shape. When the shape is a line, the extraction process begins at the first point of the line and proceeds to the end of the line.

Image

When the ROI Presentation is set to image, the value data defined by the *inside, outline, or outside* of the ROI shape will be extracted and saved, depending on the ROI Extraction Policy. Regions excluded by the ROI will be masked out. See "ROI Shape" for more details. The output file is expected to be visualized as an image.

Surface

When the ROI Presentation is set to surface and the ROI Extraction Policy is set to "Inside Shape", the value data defined by the scanlines inside the ROI shape will be extracted and displayed as a 3D plot; values outside the ROI shape to the bounding box (if applicable), are set to the minimum value, or "floored". When the ROI Extraction Policy is set to "Shape Outline", the value data defined by the ROI shape will be extracted and displayed as a 3D plot; values inside and outside are "floored". When the ROI Extraction Policy is set to "Outside Shape", values inside the ROI shape are "floored". Note that depending on the size of the image, a 3D plot of the "Outside Shape" may be indistinguishable from a 3D plot of the entire image.

C.5. Extraction Mode

When set to "Mouse", ROI extraction is interactive; the mouse is used inside the image to do the extraction. When set to "Keyboard", ROI extraction is non-interactive; the appropriate floating point selections for location & size specification of the current ROI shape will be mapped at the bottom of the subform, and the "Extract" button used to extract the desired shape. For each ROI shape, the interactive or "Mouse" mode of extraction has already been described in the preceding section entitled "ROI Shapes" so that information will not be repeated here. The following is a description of noninteractive, or "Keyboard" extraction.

Rectangle
With keyboard extraction of a rectangle, the floating point selections "Upper Left X", "Upper Left Y", "Width", and "Height" will be mapped. Use these parameters to specify the upper left corner of the rectangle, as well as its width and height; click on "Extract" to extract the rectangle.

Polyline
Polylines cannot be extracted using the keyboard method.

Circle
For keyboard extraction of a circle, the floating point selections "Center X", "Center Y", and "Radius" will be mapped. Use these parameters to specify the center and radius of the circle; click on "Extract" to extract the circle.

Ellipse
For keyboard extraction of a circle, the floating point selections "Center X", "Center Y", and "A" and "B" will be mapped. Use these parameters to specify the center, a and b values of the ellipse; click on "Extract" to extract the ellipse.

Line
For keyboard extraction of a line, the floating point selections "Begin X", "Begin Y", and "End X" and "End Y" will be mapped. Use these parameters to specify the two end points of the line; click on "Extract" to extract the line.

Freehand
Freehand ROI shapes cannot be extracted using the keyboard method.

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