Strategies of data processing

Many utilities allow saving of their current parameter sets. We call such named sets strategies. They were developed long ago as a mean to organize work of big operator teams.

Whatever detail instructions are given, notorious human element remains all the same, and someone inevitably becomes confused...

Use of strategies enables operators to select understandable names like «Optimization of river lines» and so on instead of input of numerous parameters.

Besides, new projects inherit all strategies of all utilities at prototype-based project creation. It means that after the most experienced operator has vectorized one map sheet (a trial project), all other members of the team may use adjusted utility settings.

As one utility may process different objects, it may have many strategies. For example, different parameter sets may be saved for processing of roads, rivers, lakes, boundaries, etc. Thus, one should be able to deal with them, i.e. to select, create, rename, and delete. Besides, strategies may be taken (read) from another project. Why to input settings again if it was already done earlier?

Above all, remember that strategies are nothing more than sets of utilities' parameters, saved for your convenience.

Strategy control in utilities comes to one pulldown list and four buttons. The list field contains the name of the current strategy and allows selection of another, if it exists in the project.

Current strategy - the current set of the utility parameters will be saved with this name. It will be easy later to select and use this set.

 ***New strategy*** - creates a new strategy.

 ***Delete strategy*** - deletes the current strategy.

 ***Save strategy*** - saves current settings with the name of the current strategy.

 ***Load strategy*** - imports strategies from another ET project. New strategies will be added to existing ones, and strategies of the same name will be overwritten (changed for imported).

Autotrace Lines utility

This utility serves as a bridge between image and vector. It forms vector skeleton of the current black-and-white image (raster layer). The skeleton consists of polylines with high density of vertices - about one vertex per one pixel of the image.

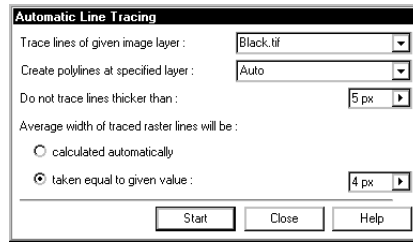
The skeleton formed by the utility is an arc-and-node data model. All joints of 3 and more polylines are nodes. Besides, there may pseudo-nodes in the model caused by vertex number constraint in Easy Trace polylines.

Name of the utility indicates that it is focused on line processing. Contours around filled areas should be formed with the help of the Outline Contours utility.

Vector skeleton quality will be better if you fulfill Image Thinning before vectorizing.

The utility is susceptible to small holes in lines. That's why it is recommended to apply Diffusion at final stages of subject layer preparing.

Dialog box of the Autotrace Lines utility



Parameters of the utility

Trace lines of given raster layer - meant for selection of the black-and-white image to be vectorized.

Create polylines on specified layer - meant for vector layer selection. New-created skeletons of vector lines will be attributed to this layer. You may select an existing layer or input any name to create a new one automatically.

Do not trace lines thicker than - helps to avoid automatic tracing of filled areas, symbols, etc. Line width is measured in pixels.

Average width of traced raster lines will be - meant for input of line width in the source image, in pixels.

The thicker are original lines, the longer are their incorrectly oriented segments near gaps usually formed at sites where they are obliquely cut by lines of other subject layers. The program calculates discrepancy of segment directions considering line width. But the width can not be determined automatically if the image was thinned; in that case it should be specified explicitly.

There are two ways to input average width of lines in the source image:

- *calculated automatically* - if on, the program calculates the average width of lines in the image.
- *taken equal to given value* - if on, the program applies the user-specified value as the average width of raster lines.

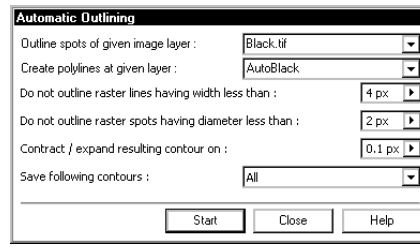
Outline Contours utility

This utility outlines filled areas in subject black-and-white images.

Similar to the Autotrace Lines utility, this one generates «dense» polylines with a great number of vertices, but unlike the previous case, these lines are closed contours around objects.

Contours with vertex number exceeding 8192 are an exception as they are not closed. The program breaks them with pseudo-node forming because of vertex number constraint in ET format.

Dialog box of the Outline Contours utility



Parameters of the utility

Outline spots of given raster layer - meant for selection of the black-and-white image to be vectorized.

Create polylines on given layer - meant for vector layer selection. Vectorized borders of filled areas will be attributed to this layer. You may select an existing layer or input any name to create a new one automatically.

Do not outline raster lines having width less than- width of raster lines (measured in pixels of the image) to be excluded from vectorizing. It is intended for screening of linear objects.

Do not outline raster lines having diameter less than - serves for screening of small noise spots. «Diameter» is understood as the largest side of a rectangle circumscribing the spot (measured in pixels of the image).

Contract / expand resulting contour on - serves for contracting or expanding of vector contours (measured in pixels of the image). If specified value is negative, the resulting contour will be contracted, otherwise it will be expanded.

The option is intended for correct vectorizing of small linear contours (tend to collapse at centerline tracing) and large hatched areas.

This option may be also used at vectorizing of unfilled contours on the inside. For example, These may be contours of buildings with many linear objects adjoining to them on the outside.

The option may notably increase operation time because of high vertex density in contours.

This vectorizing method lost its attraction after autodetection utilities had been elaborated for lakes, ortho-objects, and circles.

Save following contours - serves for selection of contour screening parameter. The following options are provided:

- *All* - all generated contours will be saved.
- *Only external* - only external contours of filled areas will be saved.
- *Only without holes* - all areas with holes will be ignored. For example, circles of topographic symbols will be discarded.
- *Only internal* - only inner contours (holes) of vectorized areas will be saved. For example, this option may be used in combination with the Autodetect Circles utility to vectorize and save all symbols of trees and bushes. They may be later substituted for corresponding point objects.

Raw Line Filtering utility

Besides useful vector line skeletons, there are a lot of vector «rubbish» in the project after automatic vectorizing. These may be both irrelevant objects (slope indicators, filling remnants, topographical signs, depth marks in polygonal water bodies, etc.), and vectorized defects of the subject layer (line «adhesions», «loops», «branches», etc.).

It would require a lot of editing to form the final vector model out of such material, but the *Raw Line Filtering* utility radically diminishes the scope of manual labour.

Typically, it repairs several thousands defects per one map sheet at processing of relief and hydrographic network.

Effectiveness of local defect recognition becomes notably better if *Breakup Joining* is fulfilled immediately after automatic tracing. The joining should be «cautious» - with a small length value for gaps to be repaired (search radius) and strong restrictions of convergence angle admissible for segments to be jointed. As a result, the operation joins segments that are WITH HIGH PROBABILITY parts of the same line.

Raw Line Filtering utility is an extremely effective tool but it requires some experience.

Preview option of the utility allows one to estimate correctness of parameter selection beforehand.

The utility ensures:

- Visual control at input of defect selection parameters – you just click samples of artifacts you want to include into filtering or exclude from it;
- Data correction – defects will be deleted and line segments sewed together in a user-specified way;
- Automatic shift of the working window to revealed defects with the help of F and V hot-keys. This feature accelerates selection of filtering parameters in large images;

- Inheritance and import of once adjusted parameters from other projects for their repeated use.

Method of application

Filtering procedure comprises:

- preliminary calculation (utility forms the graph of vector data);
- precise definition of defect types, processing order, and parameters of search and correction;
- filtering execution.

Some critical notes. First, the utility usually should be run several times in a row. After some defects are corrected, it will find and correct others more successfully.

Second, vector filtering may alternate with joining of polyline segments across gaps. For example, «short-distance joining» -> «filtering» -> «long-distance joining» -> «final filtering».

In more details now:

1. Switch off all layers but the SOURCE image and the vector layer containing results of automatic tracing.

   Attention! Any black-and-white subject image is distorted by processing and does not fit for control of vector data correctness. Besides, filtering should be applied to non-optimized «dense» lines generated by a utility of automatic tracing / outlining.

2. Start the *Raw Line Filtering* utility, specify the vector layer to be filtered and predominant line width in the source image. The latter parameter is necessary for estimation of defect size and subsequent correct improvement of vector data;
3. Unselect all types of defects but one («branches» for example), and click the *Preview* button. After this, you may act in three ways:
4. you may be contented with the current defect search parameters taken from the current filtering strategy;
5. you may specify new parameters «by eye», on the base of your previous experience;
6. you may specify new parameters by defect pointing (left click) directly on the screen. If that is the case, click the R button first to discard current values. Then start to select samples of defects on the screen. Parameter values will change in the dialog box as condition range for defect search becomes wider.
7. It may happen that the next specified defect excessively extends the limits of selection. Click the mouse right button then to cancel the last specified condition, but you may do only one step back.

8. If you input parameter values manually, click *Preview* when ready. At screen selection of samples, the program automatically refreshes marks of future correction;
9. Successively add new defect types to the set of search conditions to specify data correction more exactly.
10. If the program recognizes defects incorrectly, click a sample first to find out its type and specify selection parameters for this type more exactly.
11. At recognition conflict for defects of two types (for example, these may be «X-Joints» and «Bridges»), change priority of their recognition. Move the defect you want to give preference to upwards in the list.
12. If recognition conflict remains, separate processing of these defect types. Specify the most high-priority defect first and fulfill filtering. Then run the utility again and select defects of other types.
13. To estimate the quality of defect search before correction, use the mechanism of navigation by error marks and marked objects accepted in Easy Trace - hot keys F (*Next object*) and V (*Previous object*).
14. When ready, click the *Apply* button to execute data correction.

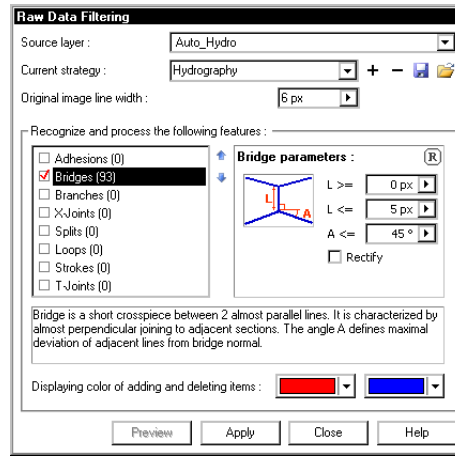
When you click Apply, adjusted parameters of filtering will be saved in the current strategy.

Parameters of the utility

The *Raw Line Filtering* dialog box contains:

- field for vector layer selection;
- strategy control parameters (allow one to input a new strategy name, to create, delete, save a strategy, and to load it from another project);
- field of line width in the source image;
- grouped parameters for defect search and processing;
- prompts at the bottom that describe selection parameters;
- color selection buttons for line segments that will be added and deleted;
- utility control buttons.

Dialog box of the Raw Line Filtering utility

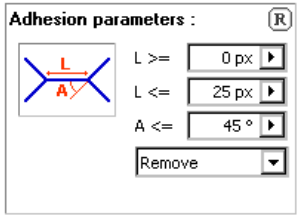


Source layer - meant for selection of the layer to be filtered.

Current strategy - see «Strategies of data processing».

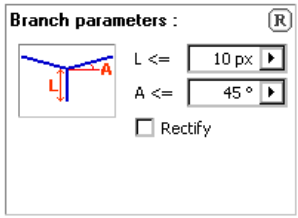
Original image line width - this information is necessary for defect search and correction. Default value is one automatically calculated at autotracing. If image thinning was applied before autotracing though, this parameter should be specifie manually.

Recognize and process the following features - as the utility filters «dense» lines (approximately one vertex per one pixel), all linear parameters are measured in pixels:

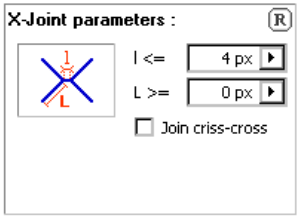


Adhesion is a section where 2 almost parallel neighboring lines are stuck together. The angle (A) defines maximal deviation of adjacent line segments from adhesion axis. Adhesion may be cut out together with adjacent line segments (with consequent automatic joining) or directly repaired at correction

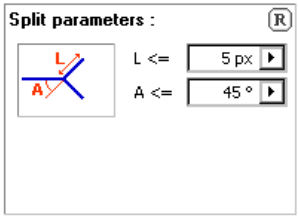
Bridge is a short crosspiece between 2 adjacent lines, which is almost perpendicular to them. The angle (A) defines maximal deviation of the lines from bridge normal. Bridges may occur as data elements (river rapids) and at sites of isoline pattern densening.



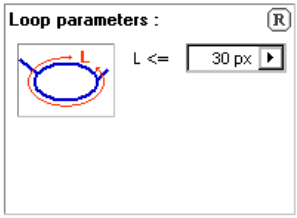
Branch is a short segment, transversal to adjacent line sections. The angle (A) defines maximal deviation of adjacent segments of the line from the branch normal. Branches may be caused both by the material itself (slope-indicating hachures) and by low quality of data («shaggy» lines in the image).



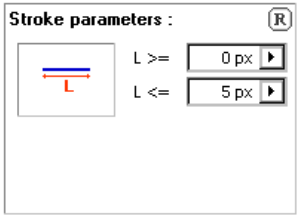
X-Joining occurs usually at line intersections. It is a short segment with 2 adjacent lines on each side. These defects are subject to contraction into points or transformation into crossing lines. X-joint is characterized by maximal length (l) of the bridge and minimal length (L) of adjacent line segments.



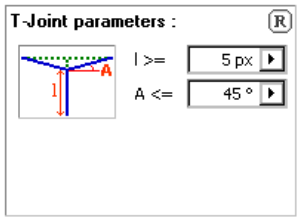
Split is a couple of short segments at the end of a longer line. Splits may cause serious difficulties at breakup joining. Besides the length (L), this defect is characterized by the maximal angle (A) defining deviation of the segments from the long line axis. Splits appear if Diffusion was not used at extraction of subject images.



Loop is a small closed contour consisting of one or two segments. The length (L) defines maximal total contour length. Loops inevitably appear around holes in thick raster lines and because of vectorizing of inscriptions. All the loops shorter than the specified L value will be deleted or «passed through» if there are two lines joined to them.



Stroke is a short isolated line segment. Stroke is characterized by its maximal length (L)



T-Joint is a 3-degree node. It looks like a branch but the transversal segment is not short. T-joints appear at sites of tributary emptying, coupling of polygon boundaries, etc. Correction moves the «dropped out» vertex of line joining. Filtering of this defect is of the lowest priority and should be done separately, after correction of other artifacts.

Priority up / down - meant for processing order control. The higher is a defect type in the list, the higher is priority of its search and correction.

Reset parameters - the button resets parameters of the current defect type to their minimal (most strict) values.

Displaying color of adding and deleting items- allows selection of contrast colors indicating line parts that will be added and deleted.

Preview - meant for estimation of changes that will be caused by filtering. If the button is accessible, current parameter values were not yet used for defect search, and thus the button should be clicked.

Apply - executes filtering in accordance with the current parameter values .

Close - closes the dialog box without saving of vector data alterations and changes of the current strategy.

Help - displays relevant help information.

Breakup Joining utility

This utility is designed for joining of line segments generated by automatic vectorizing of black-and-white subject images.

Objects of these images have a lot of gaps at sites where lines of different color cross each other in the source color image. Besides, elements of dotted and dashed lines are separated by definition and their vectorizing results in a chain of vector objects.

The utility processes «dense» non-reduced lines immediately after automatic tracing. So, it fills the gaps with «dense» line fragments - 1 vertex per 1 pix of the image.

Note that adjacent map sheets should be merged with the help of another utility - Join Along Boundaries. It generates joining segments with the specified approximation precision instead of «dense» filling.

The *Breakup Joining* utility is focused on repair of nonintersecting lines. Its most typical application is breakup joining in relief contours. Processing of crossings (in communication schemes for example) should be done with the *Raw Line Filtering* utility AFTER breakup joining

The will be far less incorrect line junctions if you apply «barrier» vector layers. For example, you may prohibit isoline joining across other relief elements, or rive joining across lakes, etc. Barrier layers should be vectorized first of course.

The utility joins lines by a smooth arc consistent with the segments to be joined but it has also the *Merge by Straight Line* option developed for broken lines.

Line disintegration into chaotic strokes happens sometimes at vectorizing of low-quality images. These vector strokes may be directed even transversely to real line direction. To avoid S-shape kicks at joining of such objects along an arc, one may specify a threshold segment length. All segments shorter than this value will be treated as points

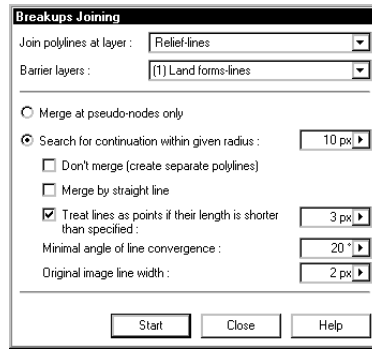
As a rule, breakup joining should be run twice: «cautious» joining before applying of the Raw Line Filtering utility and final joining after removal of local defects.

The «cautious» joining deletes small gaps between line segments that «look on each other». Strict limitations of admissible angle and distance between segments help to avoid adhesion of «rubbish» vector objects to useful lines.

Such joining makes segments of useful lines much longer than chaotically directed vector «rubbish» and thus improves effectiveness of vector data filtering a lot.

Parameters of the utility

Dialog box of the Breakup Joining utility



Join polylines at layer - meant for selection of the layer containing lines to be repaired.

Barrier layers - a list where you may select several vector layers at once. Polylines of these layers will serve as barriers at gap correction - they cannot be crossed at joining. It is recommended to include the layer of the project field's vector frame into the set of barrier layers.

Merge at pseudo-nodes only - when on, polyline segments will be united only at pseudo-nodes. It may be necessary after line form optimization. Long «dense» lines may consists of several segments forming pseudo-nodes because maximal number of vertices per polyline in Easy Trace is 8192.

Search for continuation within radius - this option enables joining of line segments across long gaps. It requires input of several parameters:

Radius - maximal distance of line continuation search. To be joined, line ends should be within this radius.

Don't merge (create separate polylines) - the option ensures compatibility with an old (free) version of Easy Trace. When on, the utility inserts segments into gaps in lines.

The option helped to delete false joints easily. It became obsolete after the Vector Eraser tool had received its line cut mode but we decided to keep it for data processing in free ET 7.99 version.

This approach implies execution of preliminary operations in a modern full-blown version and subsequent manual editing in free packages.

Final check, breakup joining, and optimization of results should be done in a modern version again.

When all false joints are deleted, switch on the *Merge at pseudo-nodes only* option and run the utility once again.

Merge by straight line - when on, the program joins lines by a straight segment rather than an arc. It may be useful at automatic tracing of strait and broken lines.

Treat lines as points if their length is shorter than specified - meant for correct joining of lines disintegrated into small segments. In that case, joining regardless segment direction generates a smooth curve well corresponding to the raster line. Another application of the option is joining of dotted lines.

Minimal angle of line convergence - limits from below the range of angles between segments within which joining is allowed. Permissible angles are from 180 deg. (segments belong to a strait line) to negative values (joining of divergent segments).

Original image line width - contains the average width of lines in the source image. This parameter helps to estimate «the zone of uncertainty» at polyline ends at search of continuation. The thicker is the line IN THE INITIAL IMAGE, the longer is the «dirty» zone at line end. If image thinning was applied before autotracing, specify this parameter necessarily.

Line Form Optimization utility

All operations related to automatic vectorizing in ET use «dense» lines as source data. Actually, dense lines are vector «skeletons» of lines in the image containing a lot of superfluous vertices, about one vertex per one pixel of the image.

Line form optimization is the final operation of automatic vectorizing. It should be done after position of line ends is fixed with the *Topology Correction* utility and GROSS distortions of line form are edited manually.

Excessive manual correction of line form before its optimization is a typical mistake of operators.

The utility does it AUTOMATICALLY together with deletion of superfluous vertices.

Time of manual editing defines duration of the entire automatic vectorizing cycle. Any manual manipulation takes much longer than an automatic utility.

It is easy to understand what kind of defects should be corrected manually. Run the Line Form Optimization utility and find defects it has not managed with. There will not be many. Use Undo\Redo (Ctrl-Z\Ctrl-Y) commands to compare vector lines before and after optimization.

Another typical mistake is utility application BEFORE manual correction of GROSS defects. One may think that it is easier to correct lines containing little vertices. That's wrong!

It is easy to «brush off» a jut in a dense line with one stroke of Vector Eraser but correction after optimization means transfer of individual vertices.

Line form correction after optimization is several times longer than editing of gross defects in dense lines.

Conventionally, line form optimization consists of two steps:

Stage 1. Line smoothing.

The stage comprises deletion of different spikes in lines and vestiges of segment joining. Select the *Smooth Lines* or *Winding Lines* filter for the process depending on line character: The first is designed for lines of relief contours in flat ground, roads, and rivers. The second suits better for relief lines in highlands and winding boundaries of water bodies.

Any filter «aims» to arc straightening. The longer is the filter, the more severe is filtering and the greater is arc deformation. It means facing of sharp turns in vector lines and «collapse» of closed contours, small especially. That is why the utility should be applied ONLY ONCE.

Optimal smoothing (filter length) depends on many reasons, DPI of the source image first of all. The higher is resolution, the greater is optimal length of the filter.

Length selection is always a search of compromise. A long filter remains fewer defects in straight line parts but may cut off sharp bends. A short filter ensures good correspondence to raster lines at bends but can not delete spikes in strait zones.

Optimal level of filtering should be found experimentally: Optimization -> view of results -> UNDO -> change of filter length -> Optimization... The utility is very fast and your tests will not take much time.

It is reasonable to use different filtering parameters for long and short lines to diminish scope of manual editing at the end. Small objects are usually more winding than long ones. You may separate lines by length and apply filters of different severity.

Example 1. Soft filtering of small and therefore more winding contour lines, severe clipping of spikes in long contours.

Example 2. The «Winding Line» filter for contours of small lakes (filter length is 10-15 pix to prevent «collapse»). The «Smooth Line» filter for large water bodies, with filter length 17-25 pix

It is convenient to save once adjusted parameters (including line division into short and long ones) as a strategy of line form optimization and repeatedly use them – for example, if your project consists of several map sheets.

Stage 2. Deletion of superfluous vertices.

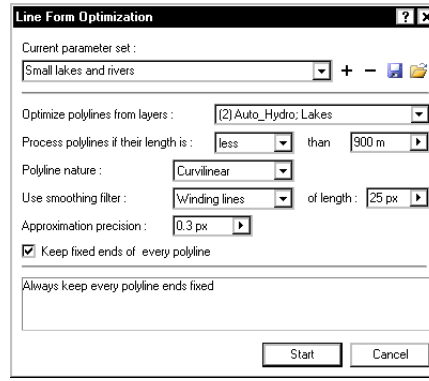
Dense lines knowingly contain superfluous vertices. For example, a straight line needs only two vertices of line ends. The number of necessary vertices in a curve depends on the required precision of image line representation.

Precision of image line representation is determined differently for lines of different type. For curves, it is maximal acceptable deviation of approximating segments from initial line after smoothing. For broken and ortho-lines, this parameter defines the length of minimal segment of the resulting line.

It is wishful to complete all operations of correction, line joining and editing before line form optimization. It enables the utility to form lines containing minimal possible number of vertices.

Parameters of the utility

Dialog box of the Line Form Optimization Utility



There are strategy control widgets in the top piece of the dialog box. Named sets of parameters (strategies) facilitate processing of one-type images and standardize its results.

Current parameter set - see Strategies of data processing.

Optimize polylines from layers - meant for selection of layers containing polylines to be optimized**.**

Process polylines if their length is - this condition allows selective optimization according to polyline length. For example, you may filter small (short) contour lines softly (without facing) and more severely delete spikes in long polylines.

Polyline nature - meant for selection of line type - *Curve, Broken*, or *Ortho.*

Use smoothing filter… of length - filter length to be used at smoothing. Its length controls the number of neighboring vertices in the dense line that will be used for line form averaging. The longer is the filter, the larger protuberances and corners in the line will be cut off.

Approximation precision - the smaller is this value, the more exact is representation of image line curvature. At the expense of greater number of vertices in the resulting line of course. Decrease of this value increases the number of vertices even in broken and ortho-lines.

Keep fixed ends of every polyline - if the layer of the lines you want to optimize is topologically linked with another layer (e.g., river lines connected with polygons of lakes), switch on the option to preserve the connectedness - but at line ends only! Only the *Topology Optimization* utility ensures full preservation of topological connectedness.

Autodetect Swamps utility

The *Autodetect Swamps* utility was somewhat tentative for a while but recently we used it for forming of more than 400,000 polygonal objects at vectorizing of complicated maps (Murmansk Region). Subsequent imprinting of swamp polygons into the source image simplified automatic tracing of other hydrographic objects greatly.

The utility forms polygonal objects around hatched areas representing swamps in maps. Polygon borders are smooth curves drawn via ends of strokes. There may be «holes» in polygons if there are unhatched zones within them.

Procedure

The utility uses vectorized strokes (that represent swamps in maps) as source data. It takes several steps to receive them:

1. It is necessary first to extract a thematic layer, i.e. an image containing swamp strokes. A special feature of the operation is the requirement of maximal continuity preservation (lack of gaps in the strokes) on any background (white, green, or dark-green).

   Preservation of stroke continuity inevitably causes noise in blue areas, and that's why the resulting image is unfit for vectorizing of other hydrographic objects. It is designed for vectorizing of swamps only. Subsequent use of the «Swamp Line Extraction» strategy at mask filtering purposefully destroys all objects but swamp strokes.

2. Automatic tracing of strokes. The object is to vectorize all lines thinner than 2 pixels. Thicker lines in the image are fragments of rivers and lake boundaries. The Autodetect Swamps utility will «sift» vectorized lines and form polygons of swamps. There will be defects in some of them of course as well as «phantom» polygons, but it is much easier to delete superfluous polygons than to form these complicated shapes manually.

   Quality of resulting polygons depends directly on quality of stroke extraction, so do not try to save time at subject layer creation.

The utility works in multi-step way. Several parameters should be specified at every step.:

Step 1. Stroke detection in source vector data.

1. Select the vector layer of vectorized swamp strokes.
2. Specify parameters of stroke selection. It may be done either explicitly or by the mean of screen selection.

   Screen selection comes to pointing at stroke samples. It is enough to click a stroke on the screen or click two points and thus to cross a group of strokes for sampling.

   The samples define the following parameters: minimal and maximal stroke length, slope angle of the stroke base line, spread of slope deviations from the base line.
3. Strokes that meet selection requirements change color when you click *Apply*. If selection is satisfactory, click *Next* to proceed to the next step, otherwise improve selection parameters and click *Apply* again.
4. Selected strokes lose indicating color when you change selection parameters and repeatedly click the *Apply* button. Strokes indicated on the screen become dotted.
5. To reset selection parameters (restore their minimal values), keep the Shift key pressed when you click a stroke.
6. To deselect a mistakenly selected «rubbish» object, click it again with the mouse right button.

   ATTENTION! Right-button Undo affects only the last change (stroke selection or crossing of a stroke group).

Step 2. Polygon forming

1. The procedure is extremely simple. You specify parameters -> click *Apply* -> view results -> edit parameters -> click *Apply*… an so on, until the result is satisfactory.

   At this stage, screen selection is provided only for minimal area of hole in polygon and minimal area of resulting polygon. You may select samples of polygons and holes after the *Apply* button was clicked for the first time.

   At this command, the utility forms all possible polygons but shows only ones meeting current parameters.
2. Use the mouse left button to change settings. Click a visible contour or an invisible presumptive one to change visibility.

   Pointing at a visible contour (polygon or a hole) is a command to change selection parameters so that this and similar contours were excluded from the resulting set. Correspondingly, pointing at an invisible contour changes parameters for inclusion of the contour into the set.

   Everything is clear for visible objects but how to find invisible ones? It is simple –

they are where they should be. Invisible contours are generated around strokes that are not enclosed by visible boundaries and around holes in hatching inside polygons.

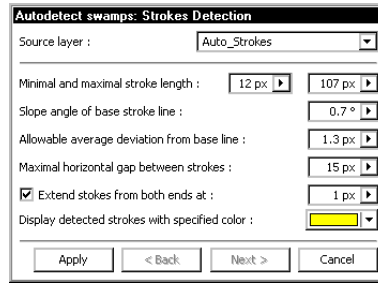
Change of selection parameters (polygon or hole area) does not require new contour forming (they are ready although invisible) and the result will be shown at once. Unfortunately, if the contour does not appear all the same, it is actually missing.

Step 3. Results

This is the final stage. Specify a layer to save polygons to, and optionally a layer for strokes. Click the *Save* button to write the results or *Cancel* to close the dialog box without saving. The *Back* button returns you to Step 2 – forming of polygons.

Parameters of the utility. Step 1. Stroke Detection

Dialog box of the Autodetect Swamp utility. Step 1. Stroke Detection



At the first stage, the utility discards vector lines that are not strokes or their fragments.

Source layer - meant for selection of the layer containing vectorized swamp strokes.

Min/max stroke length - the length range of strokes that will be used at contour forming. The lower threshold cuts off fragments of river lines and lake boundaries, the upper one discards remains of horizontal lines of the grid.

Slope angle of base stroke line - swamp strokes in real maps are never strictly horizontal. Specify the averaged deviation of strokes from the horizontal line in this field (in degrees). Angle reading is counter-clockwise. Downward deviation of the stroke right end means a negative angle, upward deviation - a positive angle.

You may use *Ruler* to measure angles. Select the longest stroke (row of strokes) for this operation. The program calculates the angle automatically if you adjust parameters applying selection of stroke samples on the screen.

Allowable average deviation from base line- vector lines of strokes may be curved or they may have different slope angles. This parameter controls allowable scattering of slops relative to the base angle. Combination of the base angle and scattering forms a

«passage-way», with most of vector «rubbish» remaining outside it.

The program calculates scattering automatically if you adjust parameters applying selection of stroke samples on the screen. The easiest way to estimate correctness of this value is to inspect results of stroke selection.

Maximal horizontal gap between strokes - there may be gaps in strokes where they were crossed by lines of other colors. On the other hand, there may be «islands» inside swamp polygons, and they are also represented by gaps in strokes. This parameter controls maximal gap length to be considered as a stroke defect.

Extend strokes from both ends at... - this parameter elongates strokes and thus compensates for their shortening at extraction from the source image and automatic tracing.

Display detected strokes with specified color - color selection for recognized strokes.

Apply - selects strokes basing on specified parameters. If necessary, you may change parameters and click *Apply* again until desired result is reached.

Back - this command is inaccessible at this stage.

Next - allow you to proceed to polygon forming.

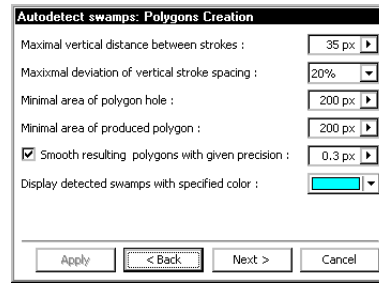
Cancel - closes the dialog box without saving. .

Parameters of the utility. Step 2. Polygon forming

At this stage, the utility generates polygons. It groups selected strokes and outlines the groups.

Every group comprises strokes with vertical distance between them, which does not exceed the specified value. Besides, horizontal projections of neighboring strokes should partly overlap.

Dialog box of the Autodetect Swamp utility. Step 2. Polygon Forming



Maximal vertical distance between strokes - controls stroke belonging to a group. If the distance exceeds the specified value this stroke belongs to another group (swamp contour).

Maximal deviation of vertical stroke spacing - controls vertical step of hatching and thus helps to discard stray strokes – remnants of rivers, lake boundaries, and the grid.

The larger is the value, the more are permissible variations of vertical distance between neighboring strokes belonging to one group.

Minimal area of polygon hole - minimal area that becomes an island in a polygon. Smaller islands will be ignored.

Minimal area of produced polygon - minimal contour area sufficient for the polygon to be saved.

Smooth result polygons with given precision - controls smoothness of polygon boundaries. It works similar to the «approximation precision» parameter of Tracers and *Line Form Optimization* utility. If the option is off, resulting contour will be a closed broken line joining points at stroke ends.

Display detected swamps with specified color - controls color of polygon displaying at selection of the utility's parameters.

Apply - displays polygons that correspond to specified parameters. Shows changes of polygons after parameter correction.

Back - returning to the previous step (stroke detection) for improvement of selection parameters.

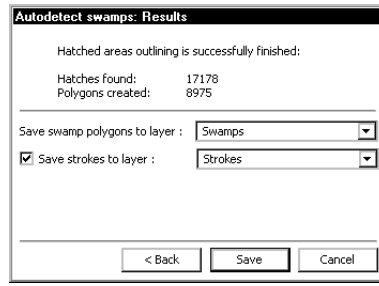
Next - allows you to proceed to result saving.

Cancel - closes the dialog box without saving.

Parameters of the utility. Step 3. Results

This stage is final. The dialog box contains the number of detected strokes and generated polygons. It also has fields for layers that will contain swamp polygons and (if required) idealized strokes.

Dialog box of the Autodetect Swamps utility. Step 3. Results



Save swamp polygons to layer - meant for selection of the layer that will contain generated polygons. You may select an existing layer or input any name to create a new one automatically.

Save strokes to layer -meant for selection of the layer that will contain recognized and

normalized strokes. You may select an existing layer or input any name to create a new one automatically.

Back - returning to the previous step (polygon forming).

Save - saves processing results.

Cancel - closes the dialog box without saving.

Autodetect Grid utility

Introduction

Almost all topographic maps of medium and small scale have a coordinate grid. On the one hand, it may be used for exact correction of geometrical distortions in the map based on position of all grid nodes. On the other hand, grid lines complicate vectorizing a lot, particularly in the automatic mode.

Numerous crossings of grid lines provide ideal conditions for exact correction but this operation is actually never done in practice. A typical topographic map sheet has up to 400 crossings and it is a laborious task to point at all of them. Image correction often comes to nothing more than indication of a dozen points on the frame. If that is the case, exact correction in the center of the sheet is out of the question.

Automatic recognition of the grid helps to achieve two objects. First, it gives accurate information about position of grid nodes in this particular image, and does it quickly. Second, recognized grid lines may be excluded from vectorizing for significant acceleration of the process.

Grid in the «black» subject image is indistinguishable from other black objects and there is no way to extract it individually. But it may cause serious problems in color images as well.

Iridescent (multicolored) halos appear near black lines of the grid at scanning. The effect is particularly strong when you open a compressed JPEG raster. These halos are usually purple-violet, with well expressed blue and red components. And these are exactly the colors often used in cartography. That's why usual methods seldom manage with grid deletion from subject images.

The problem may be solved in the following way:

Extract and vectorize the black raster layer, and then apply the *Autodetect Grid* utility. It separates grid lines from everything else and thus facilitates processing of remaining vector data.

Save idealized grid lines as an individual layer and then «subtract» them from a copy of the source image. This copy will be the source at extraction of other subject layers.

ATTENTION! Just as other utilities of autodetection, the Autodetect Grid utility processes «dense» vector lines created by autotracing instead of the image.

Procedure

Effectiveness of grid detection depends directly on quality of the «black» image. Do not try to save time at its extraction.

«Black» image extraction is described in Appendix (see «Lesson 1, Step 3 – Extraction of the black subject layer»). Application of the Autodetect Grid utility is also considered in Lesson 1 (Step 4 – Image vectorizing. Recognition of grid lines).

Here, we shall discuss several principle aspects of the operation:

Automatic vectorizing of the «black» subject layer generates input data for grid recognition. The area where the program searches for grid lines is inherited from the utility of automatic tracing.

Boundaries of the area may be changed similar to their input for automatic tracing. Click the Area button and specify any vector frame or form the border manually. As a rule, it is the vector frame of the map sheet.

The utility uses grid regularity (i.e. approximately same size of all the cells). To start grid detection, specify click 3 nodes of any cell of the grid.

It is recommended to use a cell somewhere in the center of the image for initialization and to select one with «clean» nodes without gaps or vector noise nearby.

Vary the «Allowable average deviation» parameter and specify incorrectly recognized nodes to detect grid position more precisely. The Rebuild button is meant for grid alteration after manual correction.

If you can not place the grid on all crossings nevertheless (it happens extremely rarely), process source vector data.

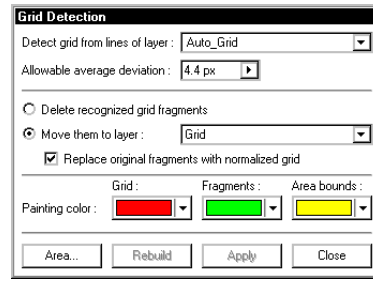
First, fulfill Breakup Joining with a small radius and a big convergence angle, i.e. sew segments of straight lines together across small gaps.

Second, apply line filtering with search and correction (contraction) of X-joints.

The recognized grid may be either deleted or saved to a user-specified layer. In the latter case, the program may save «idealized» grid lines with averaged node-to-node distance instead of real ones.

Parameters of the utility

Dialog box of the Autodetect Grid Utility



Detect grid from lines of layer - specify the layer of «dense» vector lines created by autotracing.

Allowable average deviation - controls sensitivity of the process to irregularity of the real grid. High values enable grid detection in badly distorted images (with traces of stretched creases for example), but risk of irrelevant line recognition increases as well.

Delete detected grid fragments - lines recognized as grid fragments will be deleted from source vector data.

Move them to layer - grid fragments deleted from source vector data will be attributed to the specified layer.

Replace original fragments with normalized grid - Grid segments moved to the specified layer will be idealized. The lines will have only vertices at grid nodes.

Painting color group of options

Grid - the color of idealized grid's lines and nodes.

Fragments - the color of recognized grid fragments.

Area bounds - the color of borders around the area of grid recognition.

Controls group:

Area - click to specify the area of grid detection. It coincides with the automatic tracing area by default.

Rebuild - repeats grid detection applying a new value of «*Allowable average deviation*» and additional grid nodes specified by the operator.

Apply - deletion of grid fragments or deletion with «idealized» grid generation.

Close - closes the dialog box without saving.

Autodetect Circles utility

Introduction

This utility is accessible from the menu *Utilities -> Auto Tracing*. It searches for approximately round objects and automatically detects them.

Value of the utility is rather doubtful at first sight - circles are seldom used in geographical information science as individual objects. On the other hand, a lot of topographic symbols turn out to be based on circles when examined with some imagination

The utility may be used in different ways. The simplest one is unloading of vector data received by automatic tracing. Deletion of circles helps to restore most lines that adjoined them previously.

Another application is automatic tracing of dotted lines. What do the point and the circle have in common? External boundary of any point is a circle. Thus, point outlining generates circles that may be transformed into strokes and sewed together (*Breakup Joining* utility processes only lines!) providing smooth and accurate lines.

One more example - automatic tracing of elevation marks. We outline the marks, autodetect them as circles, and transform the circles into points. Then we make the points «marked objects» and review them automatically with attribute data input (and deletion of objects recognized by mistake).

In short, the utility acts as following:

- It estimates distribution of circle diameters in rough vector data first. Diameter distribution is represented as a histogram;
- Directly in the histogram, you specify diameters of circles related to specific vector layers;
- The program saves diameter ranges in a table. They may be edited by sample selection on the screen;
- *Review* option shows objects that will be recognized at the current set of parameters. Click objects - samples on the screen to change selection parameters.
- *Apply* command substitutes selected vector objects for circles. Lines broken by the circles will be repaired automatically. The utility attributes the circles to the layers assigned for every diameter range.

Utility use procedure

The utility works with dense vector lines generated by the utilities *Outline Contours* or *Autotrace Lines*. It means that both circles and round filled objects of the image may be recognized.

Remember the following aspects of data preparing for automatic recognition of circles:

- Prepare TWO COPIES of your raster file before vectorizing of a black-and-white material or the «black» raster layer extracted from the color image. The first raster (let us call it «thick») is a black-and-white image with preserved line thickness and shape of filled objects. The second («thin») image is the same raster subjected to *Image Thinning*.

  «Thick» image is the best for tracing of filled objects' contours - elevation marks, topographic symbols, dots of dotted lines.

  «Thin» image is optimal for circle detection. At that, the circle may consist of tens vector fragments after automatic vectorizing (i.e., symbols of pits or barrows) but it will be automatically recognized by the utility all the same.

- Filled round objects will be recognized much better if you apply Diffuse + Admissible brightness range operations at image preparing. This combination deletes small «rubbish» well, both on borders and inside filled objects. For example, it can «tear away» points «stuck» to grid lines in the map.

- Apply the *Save the following contours* parameter of automatic outlining. For example, you may select the «*only without holes*» option and thus get rid of all inner contours in letters of inscriptions.

- It is reasonable to carry out Breakup Joining with a small radius value and weakly restricted convergence angle after vectorizing of the «thin» image. It helps to close faulty circles for subsequent recognition.

When the image is vectorized, start the utility and act as following:

1. Specify the layer of source vector data, the range of diameters of objects you want to recognize, and click the *Preview* button.

   Diameters may be estimated visually or measured with the *Ruler* tool. If some target objects are not highlighted, click them on the screen;

2. Specify diameter range for objects of every specific type.

   In the histogram, you may specify several «humps» that correspond to diameter ranges for objects of different types. Move sliders of the graph to capture the «hump» you need:

   – place the sliders on the left and right of the «hump» with some margins and click the *Stretch* button. The selected diameter range will occupy the entire histogram;

   – specify the range more exactly;

   – review the project in search of omitted objects. If found, click them for automatic change of the diameter range or allowable deviation from the ideal circularity.

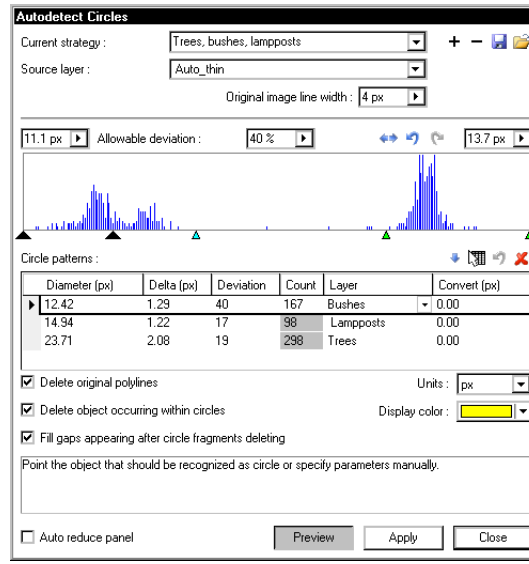
   – if superfluous objects are selected, decrease the range in the graph or just click them in the screen;

3. When selection parameters suit you, save them as a selection pattern. To do it, click the Create (pattern) button and specify two items in the generated row of the table:
   - the layer to attribute recognized circles of this type to;
   - if they all should be converted into circles of the same diameter. This diameter may be specified in the last cell of the table;
4. To recognize circles of several diameter ranges at once, repeat items 1-3, i.e. form selection patterns for other target diameters. When ready, click *Apply*.
5. Before start, decide additionally if you want:
   - to keep original vector lines or to delete them. We recommend deletion – the less vector lines remain in the project the easier is processing;
   - to delete objects within circles. As you like, usually - YES;
   - to sew up gaps that appear after deletion of circles' vector fragments. For example, a rectangle contour of a lawn touches round symbols of bushes. You may auto-detect the symbols, delete there original vector lines, sew up gaps and received a ready closed polygon of the lawn.
6. Finally, you may save parameters of the utility as a strategy and use them repeatedly at processing of one-type materials, as it is or with a small adjustment of diameter range boundaries.

Recognized circles may represent different raster objects – points, lines, symbols. Apply the Object Conversion utility for their further processing.

Parameters of the utility

Dialog box of the Autodetect Circles utility



Utility parameters are grouped in the following way:

- strategy control group (rename, create, delete, save, load from another project);
- fields for selection of the source vector layer and input of line width in the source image;
- distribution histogram of recognized circles' diameters, fields of minimal / maximal diameter value, field for selection of allowable shape deviation, and buttons for diameter range control;
- table of recognition patterns containing diameters, target layers of circles, etc. as well as a button for table editing.
- group of additional options of circle extraction from source vector data;
- prompt zone containing description of the current parameter;
- group of buttons for result preview, circle recognition, and rejection of all changes in the dialog box.

Source layer -layer of «dense» vector lines generated by automatic tracing or automatic outlining.

Original image line width - this parameter is necessary for assessment of the resulting contour's allowable deviation from the image.

Allowable deviation- controls how much the shape of source vector objects to be recognized may differ from the ideal circle.

Min / Max diameter value - Controls boundaries of the diameter range considered at histogram forming.

 ***Stretch*** - substitutes the current diameter range for the interval selected in the histogram, i.e. stretches this interval over the entire graph to increase accuracy of range specifying.

 ***Previous / next diameter range*** - move from a stretched range to the full one and conversely. Allows one to start input a new diameter range.

Histogram - shows distribution of circle diameters within the specified diameter range. Pairs of color sliders show borders of ranges written in the table of recognition patterns. Big sliders correspond to the current line of the table. If the table is empty, only big sliders are displayed.

Circle patterns - this table contains parameters selected for recognition of certain objects. It consists of the following columns:

Diameter - central value of the range of diameters for these objects.

Delta - spread in diameter values around the central value.

Deviation - allowable deviation of object shape from circle selected for the current recognition pattern.

Count - number of objects recognized under the current pattern.

Layer - vector layer of circles recognized under the pattern. You may select an existing layer or input any name to create a new one automatically.

Convert - diameter of all circles recognized under the current pattern will be changed for this value. There will be no diameter conversion if zero value is selected.

 ***Create (pattern) from histogram*** - adds a new recognition pattern to the table. It is based on the current value of admissible shape distortion and the diameter range marked with big sliders in the graph.

 ***Editing mode*** - when on (the button is pushed), move of histogram sliders changes parameter values in the current table line. The same happens at screen selection of samples. When the mode is off, move of the sliders and sample selection do not affect recognition patterns.

 ***Undo*** - stepwise cancel of changes made in recognition patterns.

 ***Delete*** - deletes the current element (selection pattern) of the table.

Delete original polylines - when on, source vector lines of recognized circle will be deleted. They will be also hidden in *Preview* mode.

Delete object occurring within circles - when on, vector lines inside recognized circles will be deleted.

Fill gaps appearing after circle fragments deleting - when on, gaps generated by deletion of lines - circle fragments will be sewn up.

Units - select the unit of diameter measurement in the table of patterns from the list: pixels, project units (meters usually), millimeters of paper map.

Display color - specify the color of detected circles.

Auto reduce panel - if on, the dialog box will be automatically minimized when the cursor is outside it.

Preview - switches on / off preliminary review of utility application results. Selection parameters may be corrected in this mode by direct specifying of objects on the screen. At that:

- pointing at a undetected object widens the current range of diameters and / or increases the allowable error of autodetection so that the object gets into the selection;
- pointing at a detected object deletes it from the selection and correspondingly narrows the range and \ or decreases the allowable error of autodetection;

Apply - generates circles and alters the source layer according to the specified parameter set. Parameter changes will be saved.

Close - closes the dialog box without saving of parameter changes.

Autodetect Orthogonal Shapes utility

Introduction

This utility is accessible from the *Utilities -> Auto Tracing* menu. It forms contours of orthogonal objects out of «dense» vector lines (1 vertex per 1 pix of the image) generated by the utilities *Outline Contours* or *Autotrace Lines*.

Automatic detection of orthogonal objects may be used for recognition of buildings in 1:500 and 1:2000 scale maps as well as blocks represented by filled areas in maps on the scales 1:100 000 and 1:200 000. An example of utility use is demonstrated in the «Vectorizing of small orthogonal objects» video.

Automatic detection of orthogonal objects comprises:

- Review of all closed contours within a user-specified range of line length. Contours may consist of one vector line or of numerous connected vector segments;
- Forming of orthogonal polygons on the base of detected contours. The polygons

correspond to user-specified conditions of accuracy, edge number, minimal edge length, etc.;

- Joint orthogonalization of contours with contiguous edges;
- Optional recognition of contours having non-orthogonal edges. Maximal share of such edges in the contour should be specified for this purpose;
- Optionally, the program brings contours generated around blocks and individual buildings to standard sizes adopted for such symbols.

We recommend to «subtract» lines of the coordinate grid and road network from the image intended for recognition of filled orthogonal objects otherwise numerous objects touching these lines will not be vectorized by the Outline Contours utility. It is advisable also to use the «only external» option of the Save following contours parameter to avoid vectorizing of inner contours in text inscriptions.

Attend to line connectedness at vectorizing of plans on the scale 1:500 - 1:2000 where they are not filled. To achieve it, fulfill «cautious» breakup joining with small radius value and big angle of segment convergence. Additionally, you may pull together «dangling» line ends with the Topology Correction utility.

Preliminary project unloading with the Autodetect Circles utility also has a goof effect. Do not forget to switch on the options Delete original polylines and Fill gaps appearing after circle fragments deleting.

Utility use procedure

Use the source image as a background at parameter selection as the «black» subject layer may notably differ from it.

Parameter selection comes to the following:

1. Specify the source vector layer and line thickness in the source image.
2. Specify *Maximal number of edges* in resulting ortho-objects. It is 4 if you want to recognize only rectangles but complex contours in city plans may be formed by several tens of edges. Click *Preview*.
3. Adjust the length range for the contours you want to recognize. Exclude small false contours from the operation and add non-recognized large contours. To include or exclude an object, click somewhere inside it.
4. Adjust the *Minimal length of resulting edge* parameter. Increase it to exclude small extraneous edges from the contours. Decrease the value on the contrary if the program ignores reliable edges.
5. Decrease the *Allowable deviation* value if contours differ from raster lines too much or evidently non-orthogonal lines are captured.

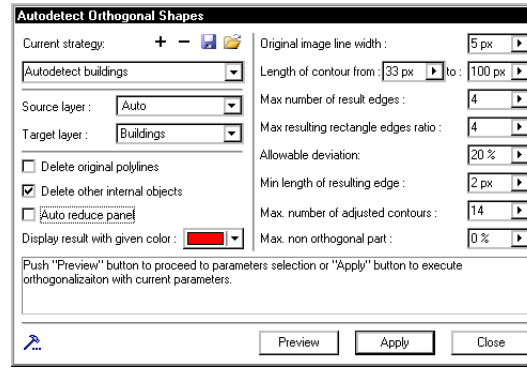
6. Specify *Target layer* which will contain recognized objects. Click *Apply*.

It is possible additionally:

- to eliminate overly elongated contours – vectorized strokes of dashed lines for example;
- to eliminate source polylines (recommended). This option facilitates processing and classification of remaining vector data;
- to eliminate vector lines inside recognized contours. Usually, these are remnants of vectorized inscriptions;
- to bring recognized rectangles (blocks and buildings in topo-maps) to fixed sizes applying a set of patterns.

Parameters of the utility

Dialog box of the Autodetect Orthogonal Shapes utility



Utility parameters are grouped in the following way:

- strategy control group (rename, create, delete, save, load from another project);
- fields of the source and target vector layers;
- parameters of changes in the source vector layer;
- parameters of ortho-object recognition;
- prompt zone containing description of the current parameter;
- buttons for result preview, ortho-object recognition, and rejection of all changes;
- group of options for recognition pattern control.

Source layer - layer of «dense» vector lines generated by automatic tracing or automatic outlining.

Target layer - vector layer of recognized orthogonal objects. You may select an existing layer or input any name to create a new one automatically.

Delete original polylines - in *Preview* mode, hides source vector lines – components of recognized ortho-objects. The lines will be deleted from the source layer when you finally execute the utility.

Delete other internal objects - «cleans» internal area of recognized ortho-objects.

Auto reduce panel - if on, the dialog box will be automatically minimized when the cursor is outside it.

Original image line width - line width in the original (not thinned) image. It is necessary for assessment of admissible deviation between the image and the resulting vector object. If this value is too low, the utility will not be able to recognize some objects; if it is too high - orientation of resulting contours may be somewhat incorrect.

Length of contour from ... to - contour length measured in pixels of the image. As the utility recognizes objects made of «dense» vector lines, the length is actually equal to vertex number in the contour. A pop-up list of contour parameters appears when you place the cursor inside a recognized or supposed object. It helps to estimate limits of length range for contours to be recognized.

Max number of result edges - limit on sides in the resulting object. A building of complex shape may have 2-3 tens of edges. On the other hand, blocks in topographic maps are rectangular and thus have only 4 edges.

Max resulting rectangle edges ratio - applicable to small rectangles only. This protective parameter allows you to discard very long rectangles that may be generated by automatic tracing of long strokes in intermittent lines.

Allowable deviation - maximal allowable deviation of resulting contours from corresponding raster lines. Recommended values are 10-20%.

Min length of resulting edge - protection from small false edges in long ortho-objects (in pixels).

Max number of adjusted contours - groups of ortho-objects with common edges widespread in city plans (a long row of garages for example) should be processed together as mutual orthogonality of such objects in source materials is often insufficiently accurate. This parameter limits number of objects that will be orthogonalized conjointly.

Max non orthogonal part - resulting contours may comprise edges non-orthogonal with respect to other sides (a semicircular wall of a building, etc.). It is necessary to specify the share of edges that will not be reduced to base direction for recognition of such objects. The share is measured in percents of total contour length.

Display result with given color - screen output color of recognized objects.

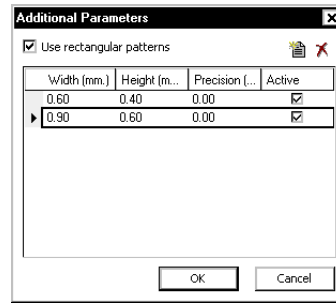
Preview - switches on / off preliminary review of utility application results. Enables you to see the source image uncovered with recognized objects. Screen selection of samples in this mode enables you to specify utility parameters more exactly. Click mistakenly recognized objects (too small for example) to change selection parameters and thus to exclude them from the operation. Pointing at unrecognized objects widens parameter ranges so that such objects become selected. This way of parameter adjustment is provided for the range of contour length, allowable deviation, maximal number of edges, and minimal edge length.

Apply - generates orthogonal shapes, deletes source lines, and clean inner areas according to the specified parameter set.

Close - closes the dialog box.

Rectangle patterns - opens the *Additional Parameters* dialog box meant for adjustment of rectangle generation patterns. The patterns are provided for standardization of small contours corresponding to topographical symbols in the map.

Dialog box for rectangle pattern adjustment



Use rectangular patterns - activate use of patterns.

New - creates a new standardization pattern.

Delete - deletes the current standardization pattern.

Width / Height - standardization pattern parameters measured in millimeters of paper.

Precision - allowable deviation of recognized objects' sizes from the pattern. Objects that do not correspond to any pattern with the specified accuracy will not be standardized and remain «as they are».

Active - indicates if the pattern will be used or not.

Autodetect Lakes utility

Introduction

This utility is accessible from the *Utilities -> Auto Tracing menu*. It forms polygonal objects after automatic tracing of the Hydrographic Network subject layer. The utility generates maximal polygons out of vector line segments connected by nodes or common vertices.

Necessity of this utility became clear at vectorizing of materials with numerous hydrographic objects. The way of their representation (filling of inner areas with blue points) makes it actually impossible to separate blue lines of lake contours from black grid lines. Lakes in the «blue» subject layer are either parted by grid lines or contain remnants of these lines in inner areas.

The *Autodetect Lakes* utility ignores inner lines that cut the polygon but generates its integrated outer contour. It also assembles parted inner contours (islands).

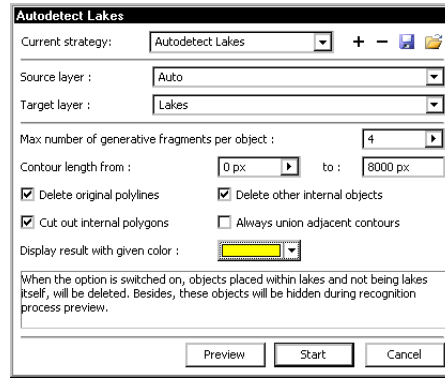
At data processing after automatic vectorizing of a complicated river net, the utility was able to detect and restore up to several thousands lakes in every map sheet.

Adjustment of the contour length range for lake recognition is supported by screen selection in *Preview* mode. Left click on mistakenly recognized objects changes selection parameters and thus excludes them from the operation. Pointing at unrecognized objects widens parameter range so that such objects become selected. To point at a polygon, click somewhere inside it.

Additionally, the utility can cut out embedded polygons (islands) and delete vector «rubbish» inside objects (vectorized remnants of inscriptions inside lakes for example).

Parameters of the utility

Dialog box of the Autodetect Lakes utility



Utility parameters are grouped in the following way:

- strategy control group (rename, create, delete, save, load from another project);
- fields of the source and target vector layers;
- parameters of lake recognition (maximal number of line segments that form the contour and the range of contour length);
- parameters of changes in the source vector layer and cutting-out of embedded islands;
- prompt zone containing description of the current parameter;
- buttons for result preview, ortho-object recognition, and rejection of all changes.

Current strategy - name of the current strategy and strategy control buttons.

Source layer - layer of «dense» vector lines generated by automatic tracing.

Target layer - vector layer of recognized polygons. You may select an existing layer or input any name to create a new one automatically.

Max number of generative fragments per object - limits maximal number of line segments to be used at polygon forming.

Contour length from...to - admissible range of contour length for recognized polygons.

Delete original polylines - deletes line segments used for polygon forming from the source vector layer. Remaining lines may be used to restore the river network.

Delete other internal objects- «cleans» internal area of recognized lakes.

Cut out internal polygons - cuts out nested contours (islands) from new-created polygons.

Always union adjacent contours - combines adjacent contours into one even if their overall length exceeds the maximal allowable length value. This option is useful for recognition of rivers represented by polygons.

Display result with given color - screen output color of recognized lakes in *Preview* mode.

Preview - switches on / off preliminary review of utility application results. Screen selection of samples in this mode enables you to specify the contour length range more exactly.

Start - generates polygons according to the specified parameter set.

Cancel - closes the dialog box.