July 6, 2004

KISA Interface Tutorial

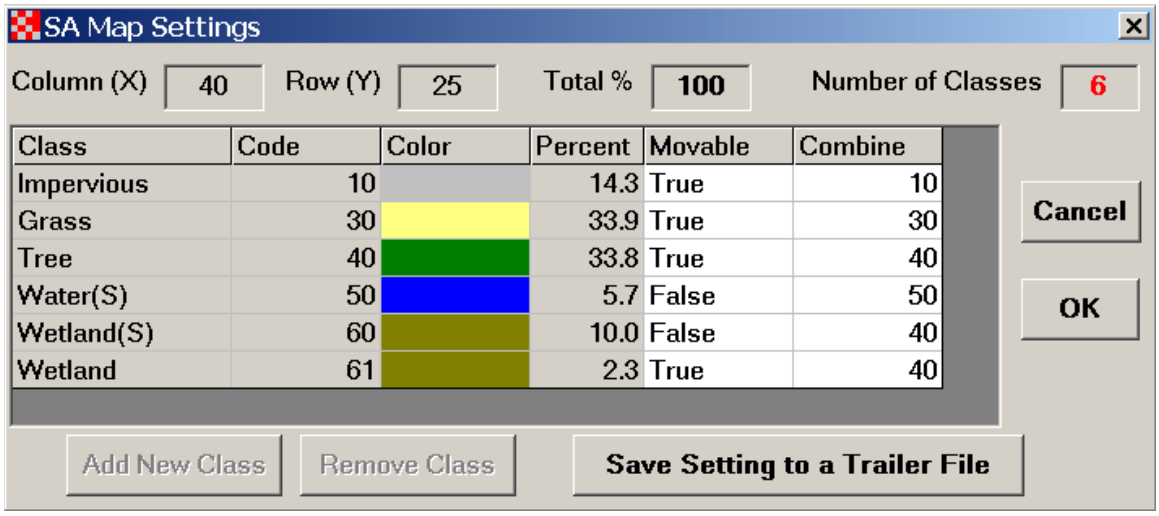
This document contains brief instructions for the following tasks:

1. Setting up data for KISA Interface.
2. Single-objective spatial pattern optimization.
3. Multi-objective spatial optimization.

1. Setting up data for KISA Interface

The KISA Interface only reads from and writes to ERDAS .lan or .gis files. To do spatial optimization in KISA Interface, you need to first read a land-cover file (or generate a random land-cover file) and, optionally, associate a zone file with the land-cover file. The zone file defines zones in which the land-cover proportions remain unchanged during the annealing process.

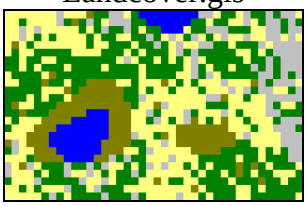
To load an existing land-cover file, select "Load existing land-cover map" from the "Map setup" pull-down menu and select the "landcover.gis" file. A map and a "SA Map Settings" dialog window will pop-up.



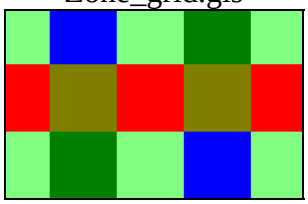
The "SA Map Setttings" window allows users to specify which land-cover classes are moveable and which classes are treated as the same cover type in the calculation of landscape metrics. In the example shown above, cover types 50 and 60 are not movable, because water (50) and existing wetland (60) are not subject to alteration in this particular application. However, designers are adding natural cover types, i.e., trees (40) and wetland (61), to promote the ecological function of the design site. The ecological function is measured as the compactness of landscape patches formed by these natural cover types. That is why tree, existing wetland, and wetland are combined to form an aggregated class. The settings can be modified by double-click individual cells in the table.

Click on the map window to make it the active window and select “Load zone map” from the “Map setup” pull-down menu. Select the “zone_grid.gis” file and click “Next” in the “Select inactive zones” dialog window. This will treat all zones in the zone map as active zones. Only the land-cover types of cells in an active zone can be reassigned to form a new map. User should make areas that cannot be managed as inactive zones.

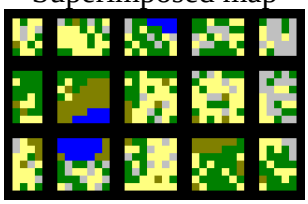
Landcover.gis



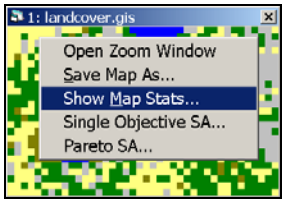
Zone_grid.gis

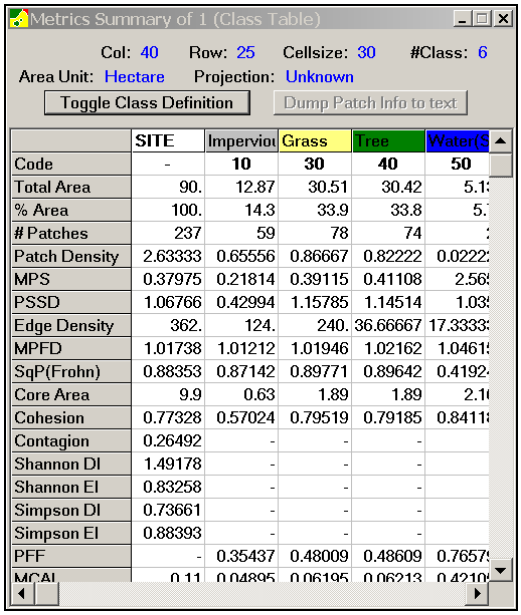


Superimposed map



To view the landscape metrics of the land-cover map, right-click on the “landcover.gis” window and select the “show map stats…” item. Users can click on the “toggle class definition” button in the metrics summary window to view the metrics of the “combined” land-cover classes.



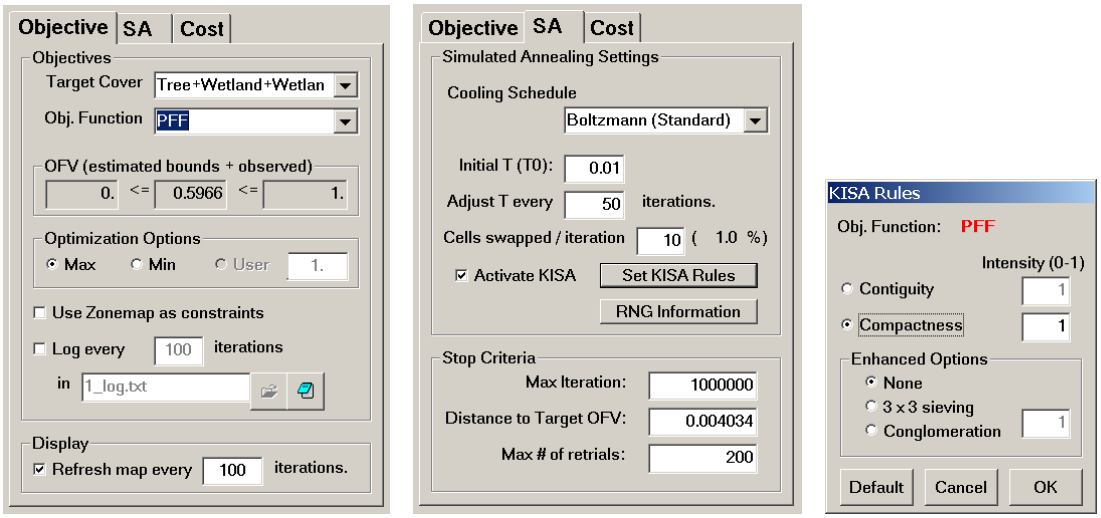


	SITE	Imperviou	Grass	Tree	Water(S
Code	-	10	30	40	50
Total Area	90.	12.87	30.51	30.42	5.1
% Area	100.	14.3	33.9	33.8	5.
# Patches	237	59	78	74	
Patch Density	2.63333	0.65556	0.86667	0.82222	0.0222
MPS	0.37975	0.21814	0.39115	0.41108	2.56
PSSD	1.06766	0.42994	1.15785	1.14514	1.03
Edge Density	362.	124.	240.	36.66667	17.3333
MPFD	1.01738	1.01212	1.01946	1.02162	1.0461
SqP(Frohn)	0.88353	0.87142	0.89771	0.89642	0.4192
Core Area	9.9	0.63	1.89	1.89	2.1
Cohesion	0.77328	0.57024	0.79519	0.79185	0.8411
Contagion	0.26492	-	-	-	
Shannon DI	1.49178	-	-	-	
Shannon EI	0.83258	-	-	-	
Simpson DI	0.73661	-	-	-	
Simpson EI	0.88393	-	-	-	
PFF	-	0.35437	0.48009	0.48609	0.7657
MCAI	0.11	0.04895	0.06195	0.06213	0.4210

2. Single-objective spatial pattern optimization.

Right-click on the “landcover.gis” window and select the “Single objective SA…” item to open the “simulated annealing” dialog window. Set the target cover type to “Tree+Wetland+Wetland(S)” and the objective function to “PFF”. Check the “refresh map every 100 iterations” checkbox. By maximizing the PFF of the natural land-cover types, the KISA Interface generates maps that have the most compact pattern of natural cover patches. Next, select the “SA” tab and set the initial T to 0.01 and check the “activate KISA” checkbox. Click the “Set KISA rules” button to open the KISA rules

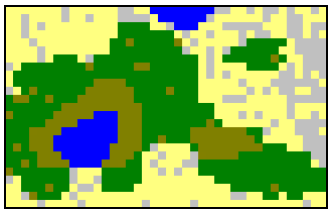
dialog window. Click on the “compactness” radio button and click “OK” to close the window. These simulated annealing parameters were derived from pilot experiments to ensure the most effective and efficient performance in maximizing PFF. Different initial T and KISA rules should be used for other objective functions.



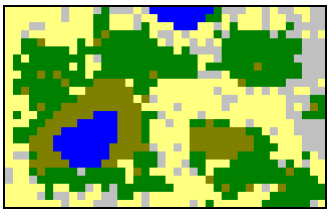
Press the ▶ button to run the optimization, “pause” to stop the optimization, and “Stop/Reset” to restart another run. One needs to press the “Stop/Reset” button to change the simulated annealing settings.

Now, stop and reset the run and check the “Use zonemap as constraints” check box in the objective tab. Press the ▶ button to run the optimization with zone constraints. The results from both runs are displayed below. One should note that simulated annealing is a meta-heuristic optimization algorithm. It doesn’t guarantee to find the optimal solution. Usually, if you let it run longer, it generates better solutions.

Without zone constraints



With zone constraints

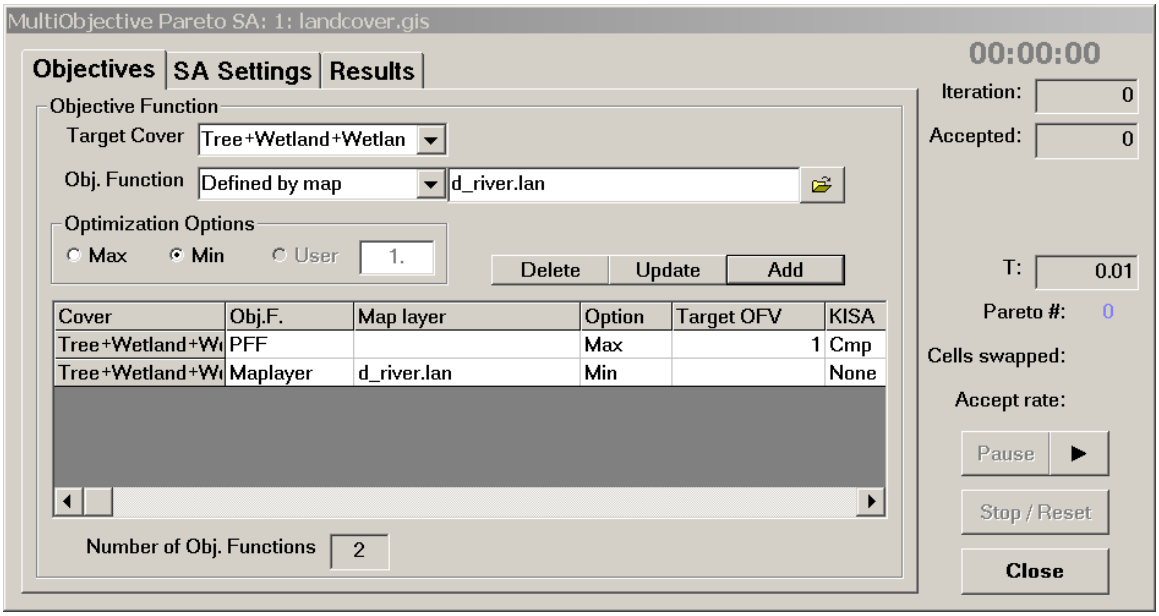


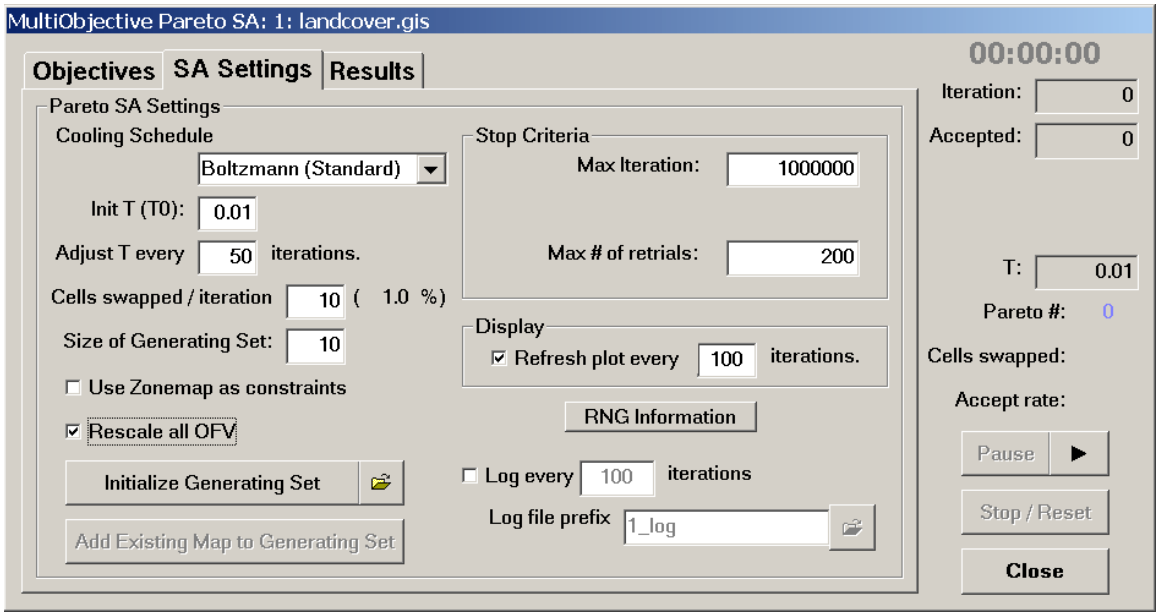
To save the maps just generated, right-click on the map and select the “save map as…” item. When done, press the “close” button in the simulated annealing dialog window to close the window.

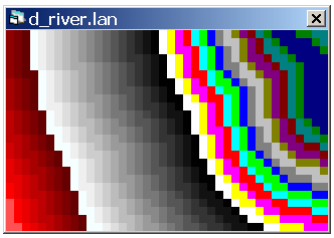
3. Multi-objective spatial optimization.

Right-click on the “landcover.gis” window and select the “Pareto SA…” item to open the “multi-objective Pareto SA” dialog window. Set the optimization objectives and SA settings as those shown in the pictures below. To set an objective whose objective

function is defined using a cost surface, select “defined by map” from the objective function pull-down list and click on the button to select the cost surface file. For this tutorial, select the “d_river.lan” file. d_river.lan is a raster map (see below) of the distance to a river on the upper-right corner in the study site. The objectives of this allocation problems are (1) maximizing the PFF (i.e., compactness) of the “tree+wetland+wetland(S)” cover type and (2) minimizing the distance of the combined cover type to a river.

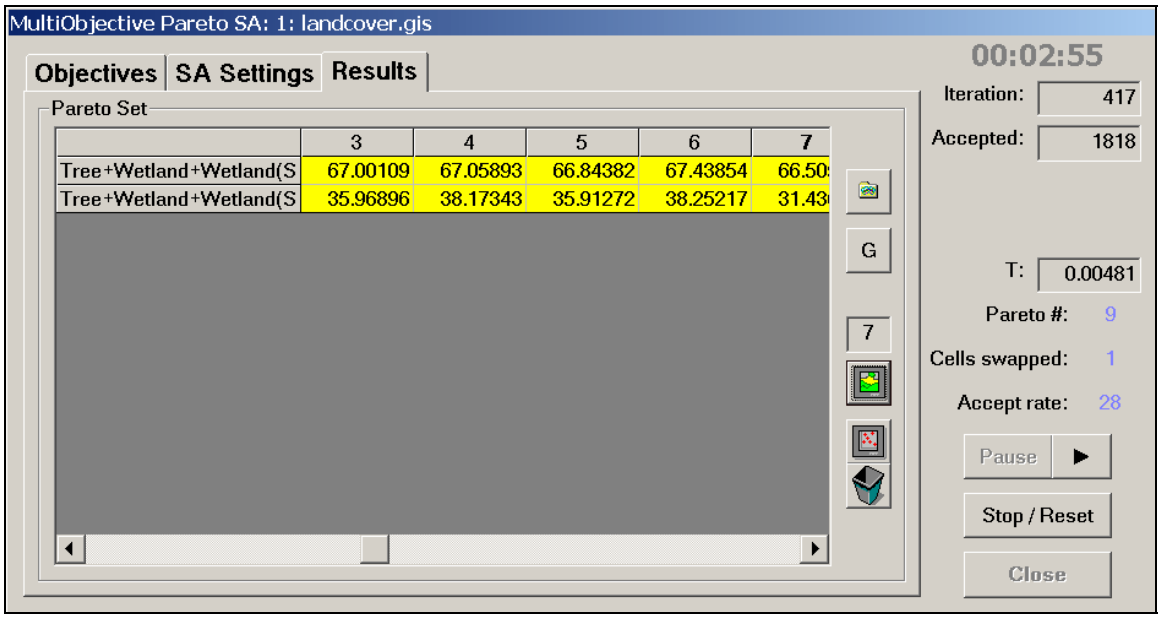


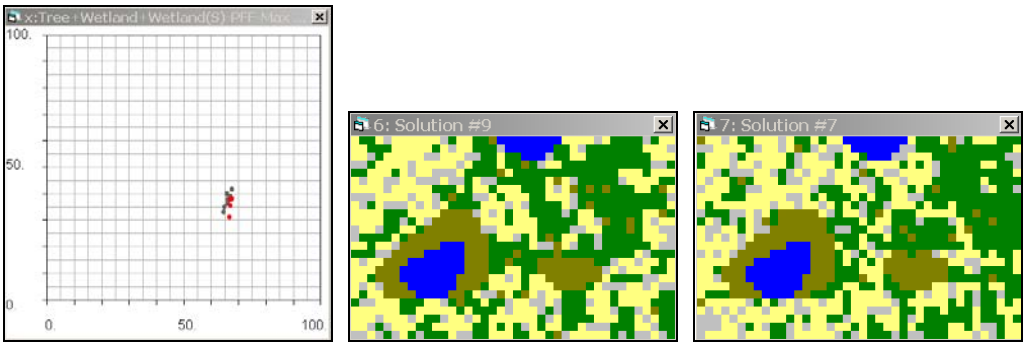




Press the ▶ button to run the optimization, “pause” to stop the optimization, and “Stop/Reset” to restart another run. One needs to press the “Stop/Reset” button to change the simulated annealing settings.

The Pareto simulated annealing generates a set of solutions that are Pareto optimal. Pareto optimality refers to the condition that one cannot improve the value of one objective without sacrificing the value of at least one other objective. To view the Pareto set, you must first pause/stop the run. Then, click on the “results” tab, select both objectives, and press the (scatter plot) button. Each point in the scatter plot corresponds to one entry in the Pareto set table shown in the “results” tab. You can click on the scatter plot or select an entry from the table and press the button to view the map.





To save individual maps, right-click on the map and select the “save map as…” item. You can also save the whole Pareto set into a map-pool file by pressing the button and selecting an output file name. The map-pool file can be viewed using the “GIS Map Pool Viewer” function found in the “tool” pull-down menu of the main window of KISA Interface. When done, press the “close” button to close the window.