

Application of Genetic Algorithm to Problem of Multicriterial Optimization in Land Use Planning

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Project timetable

○ 2004-2005/Dec-Jun, Sarajevo

Theoretical research:

- Field: Artificial Intelligence
- Field: Geoinformation Systems

Practical implementation:

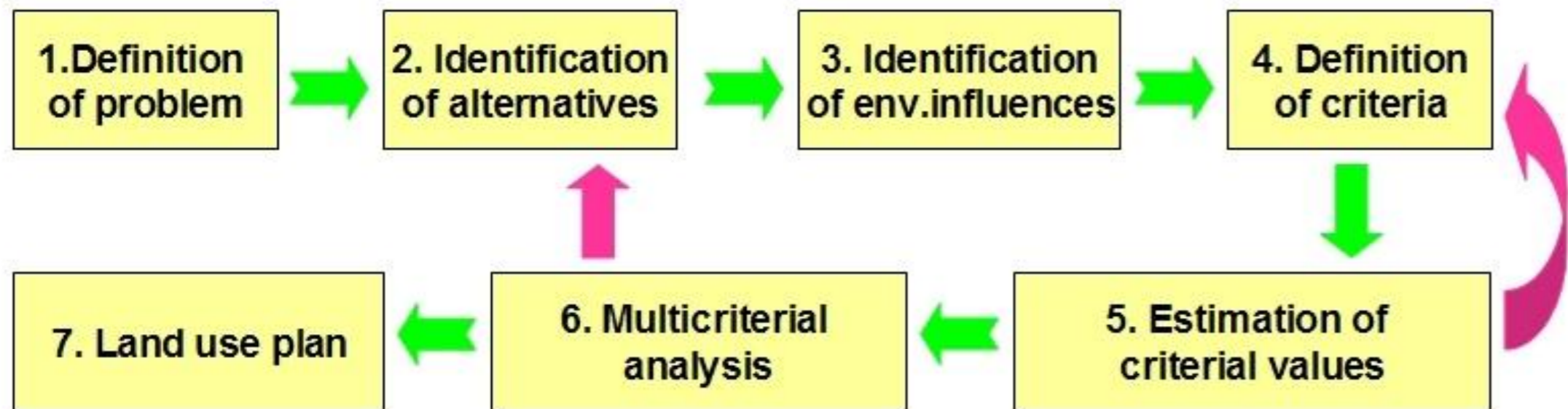
- MATLAB
- Fuzzy Logic Toolbox
- Genetic Algorithms Toolbox
- MapInfo Professional GIS
- Sybase Power Designer

This work researches for possibility of GA application in optimization of spatial validation multi-criterial model during the regional urban planning process. The matter exposed in the work describes both the problem of multi-criterial spatial validation from land use aspect and searching for optimal model methodology. The crucial points of the research are the following:

- multi-criterial valorization of the land from the GA use perspective,
- how to utilize the capacity of the GA optimization techniques in the frame of decision support system and with usage of the GIS tools and
- how to apply the GA in the field of genotype presentation in spatial modeling.

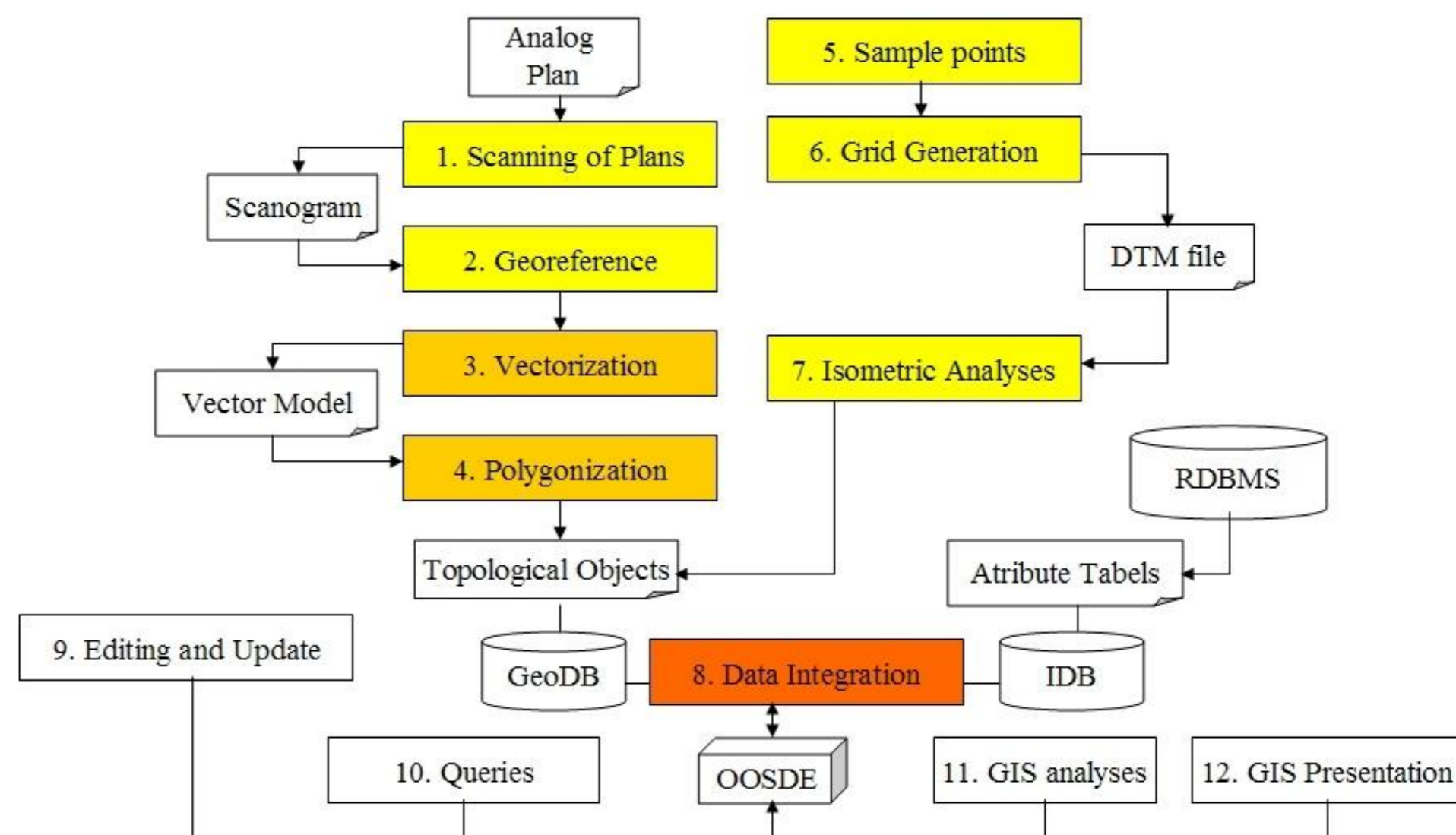
The study is illustrated by actual examples taken from the spatial planning area and available existing studies in this field.

MULTICRITERIAL ANALYSIS PROCESS

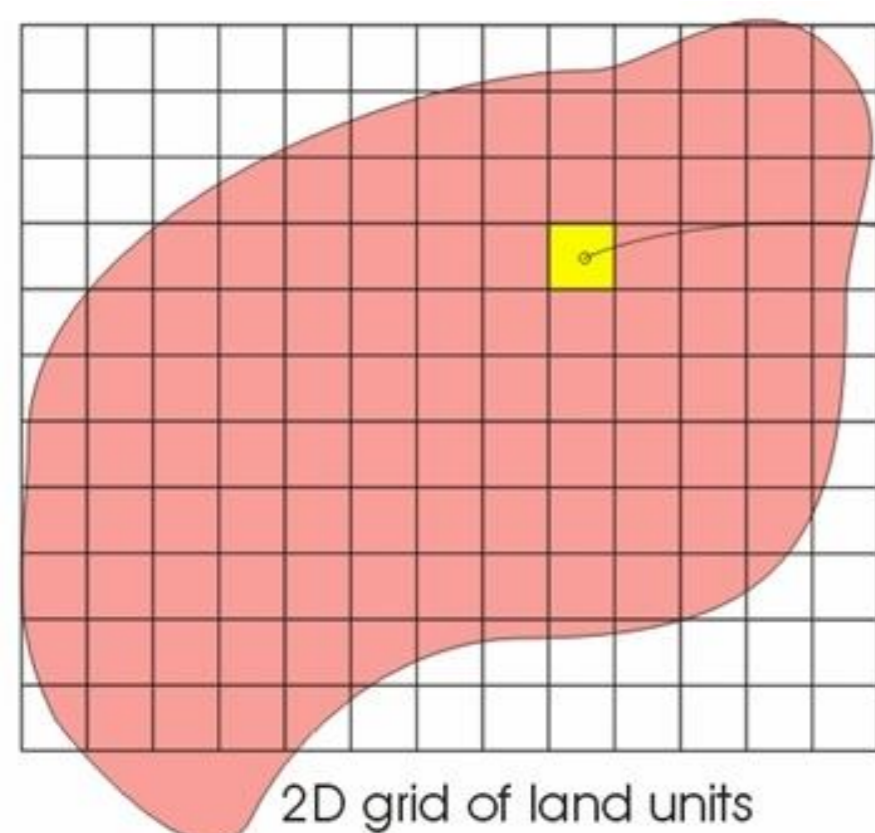


More alternatives - problem of multicriterial optimization – to find most suitable solution
 Alternatives – synthesis models (environmental, functional, neutral...)
 Adjusting criterial weights – simulation model variants – searching optimal solution

MULTICRITERIAL LAND VALORIZATION IN GIS



SPATIAL REPRESENTATION BY LAND UNITS



ID no.	Attribute 1	Attribute 2	Attribute n
235413	1aa	2aa	Naa
235414	1bb	2bb	Nbb
235415	1cc	2cc	Ncc
...	1...	2...	...
270124	1xx	2xx	Nxx

atribute table

Land use map generation:

$$M_{opt} = \{x_{yz}\}, y = 1...l, z = 1...r$$

where
 l – is no. of categories
 r – is no. of land units

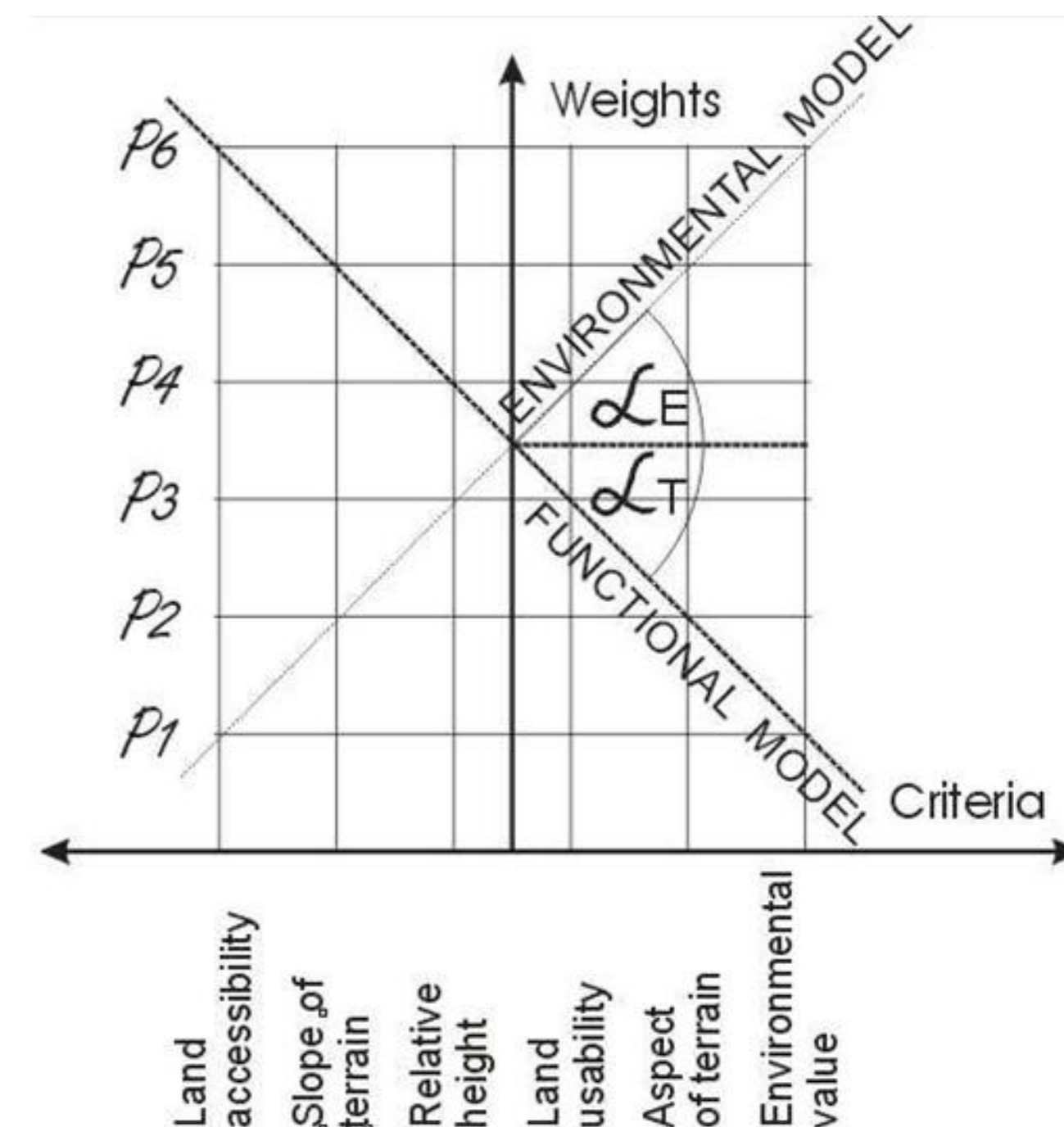
2D grid (GIS), resolution 100x100m, 2700 km²=270000 records

SYNTHESES MODELS AND CRITERIAL WEIGHTS

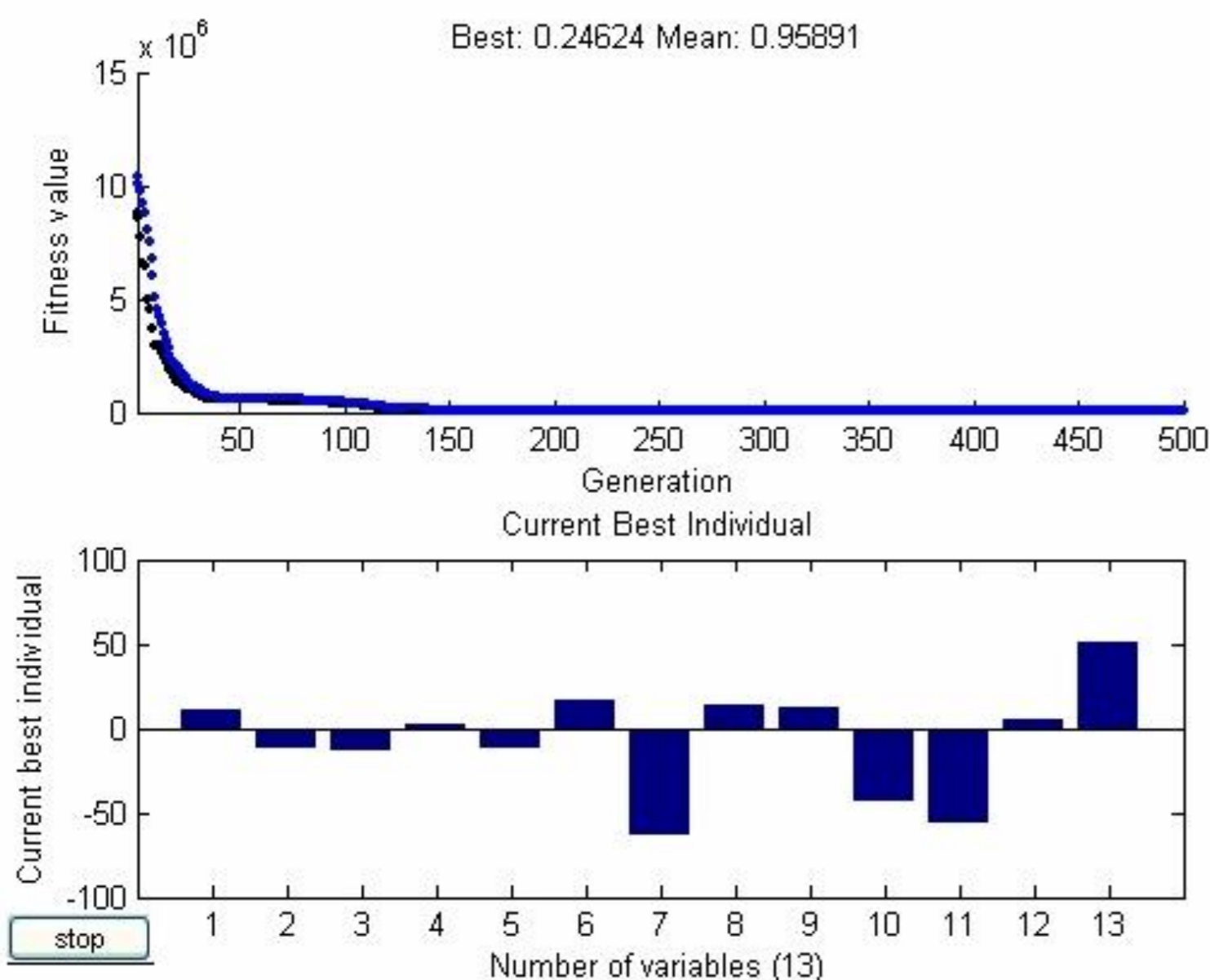
Synthesis model:

$$\begin{aligned}
 p1 &= -2,5 tga + 3,5 \\
 p2 &= -1,5 tga + 3,5 \\
 p3 &= -0,5 tga + 3,5 \\
 p4 &= 0,5 tga + 3,5 \\
 p5 &= 1,5 tga + 3,5 \\
 p6 &= 2,5 tga + 3,5
 \end{aligned}
 \quad (1)$$

p1, ..., p6 – criterial weights
 a – angle of model gravitation



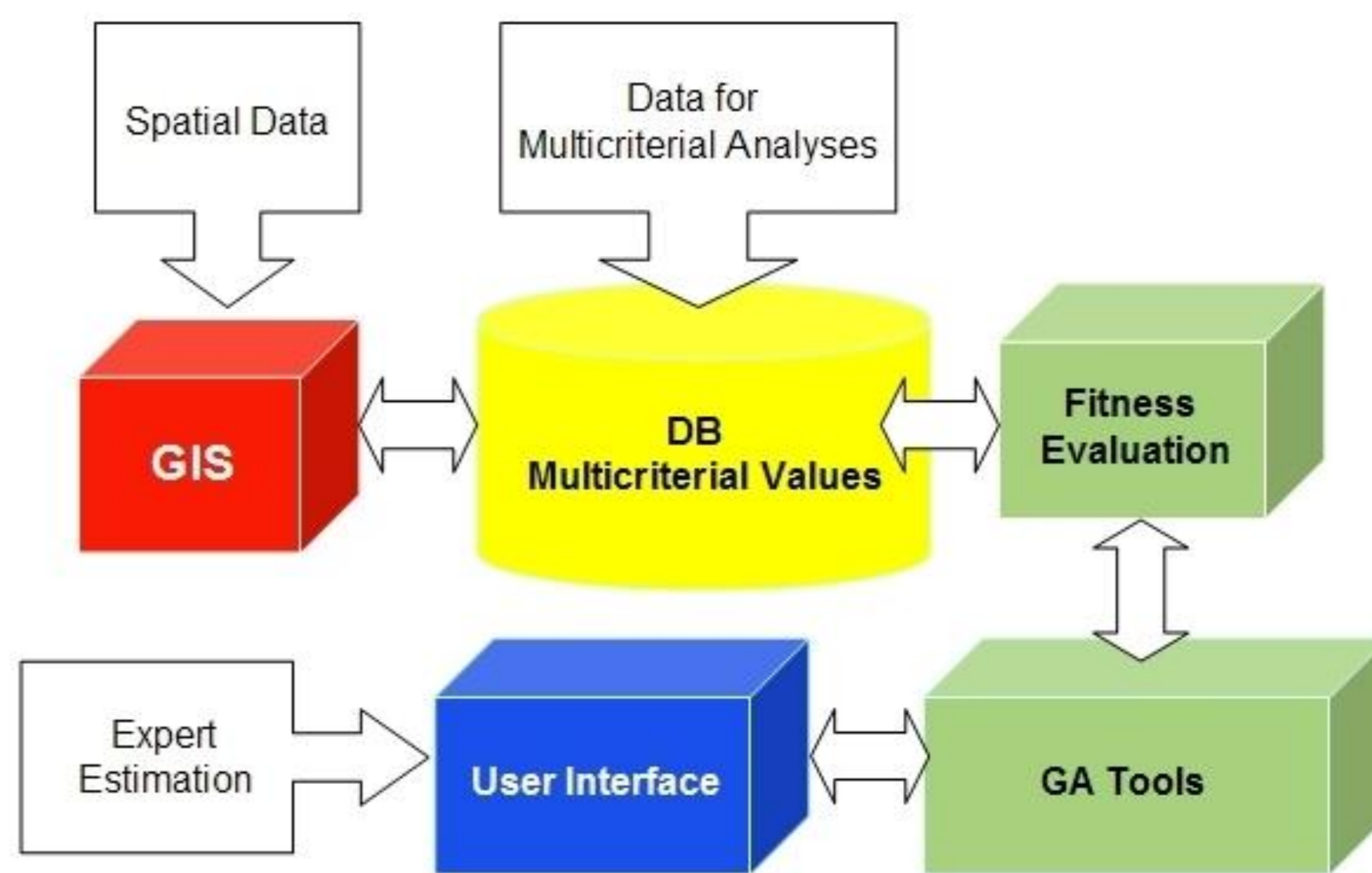
PARAMETERIZATION OF GENETIC ALGORITHM



n. test

- No. of variables: 13
- Selection: Roulette Wheel
- Population size: 100 chromosomes
- Reproduction:
 - elite count 2,
 - crossover fraction 0.8
- Mutation: Gaussian
 - scale: 1.0
 - shrink: 1.0
- Crossover: single point
- Stopping criterion: 500 generation

LAND USE MULTICRITERIAL ANALYSES AND DSS STRUCTURE



CONCLUDING REMARKS

Methodology for optimization of validation model consists:

- definition of syntheses models (alternatives),
- definition criteria and criterial values,
- design of multicriterial database in GIS,
- application of GA in multicriterial optimization and
- presentation of land use plan in GIS.

By the applied methodology and description of DSS it is enabled:

- interactive searching the alternatives of spatial organization
- finding the optimum alternative for various given parameters (objectives)
- development of a DSS for spatial multicriterial analysis by GA approach which is capable to handle with discrete values

