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Fuzzy model in urban planning


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Abstract This paper presents application of a fuzzy logic in urban planning. Urban environment quality evaluation is an important part of environmental planning and management. Traditional theory does not give as good evaluation as the fuzzy set theory, which provides the basis for urban planning. Most information related to environmental evaluation has the spatial component, which is why GIS is widely used in the evaluation of the environment. Integration of the GIS and fuzzy set theory has been used lately in evaluation of urban environment quality. Fuzzy set theory is used in analysis of the environment because of its ability to manage imprecise, insecure and ambiguous data.

Introduction

Evaluation of the urban environment is very important part of urban planning process and it is inevitable part of decision process in urban planning.

The main problems of the urban planning could be identified throught evaluation of urban environment. Since conventional evaluation of the environment deal with numerous classification it result losing the results.

Fuzzy logic bring new light in urban plannig process, and evaluation.

GIS, geographic information sistem is also for last 15 years part of urban planning.

Integration of the GIS and fuzzy logic give the best results in evaluation of the urban environment.

Problem Formulation

Urban planning is the science of managing and directing city growth. Urban, city, or town planning is the discipline of land use planning which explores a very wide range of aspects of the built and social environments of urbanised municipalities and communities.

Planning is to predict possible number of people in space and fulfilling people needs for living, working and other activities, with providing needs for infrastructures (water, energy, traffic, etc). If one draw and colour all that in geodetic map there are no free space left.

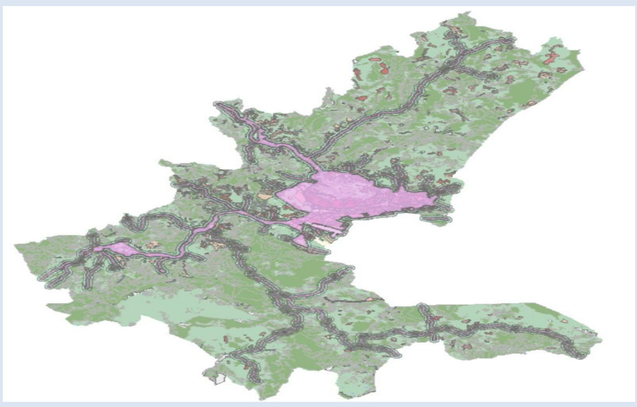
Problem Solution

Because of the data availabity the research was carried out in the area of the Sarajevo Canton, Bosnia and Herzegovina.

The criteria are used for the evaluation of the purpose of the problem decision-making. A valid evaluation is based on the criterion of rational evaluation. The way the evaluation criterion is selected will directly affect the reliability of evaluation results. A series of indicators measuring the quality of urban environment have been developed up to date. Some indicators are measured by the use of human perception of environmental quality.

Environmental indicators are created in order to measure the environment quality criterion. In general, the selection of indicators is based on following principles:

1. Indicator must reflect main aspects of the urban environment quality
2. Indicator must reflect the human response to the environment quality
3. Data required for indicators must be in such form to enable the researcher to collect them
4. Indicators must be comprehensive both to urban planners and wider population.



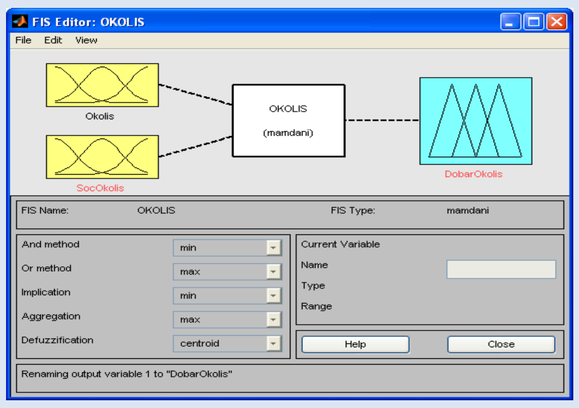
The data used in this paper were taken from analysis which had been carried out in the course of the creation of the Spatial Plan, as well as from relevant institutions which are part of this complex system: the Federation Meteorology Institute, the Cantonal Ministry of Spatial Planning (KEAP Study, Cantonal Plan of Sarajevo Canton Environment Protection), the Sarajevo Canton Development Planning Institute. The paper uses satellite images and ERDAS Software for classification of satellite images in order to obtain the green area coverage. ArcMap 9.1. Software was also used to process and display GIS data.

MATLAB- Fuzzy Toolbox Software was used for the analysis of final results.

There are 4 steps in the fuzzy logic:

- Design of entry variables
- Application of fuzzy operators
- Application of fuzzy method
- Aggregation of all outputs

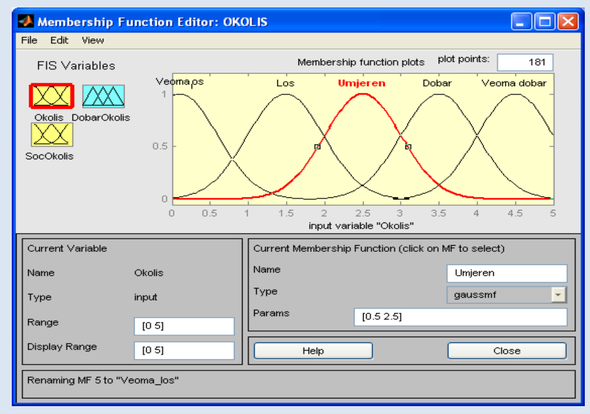
FIS editor (inputs and outputs are created in this form, operation methods and/or implication, aggregation).

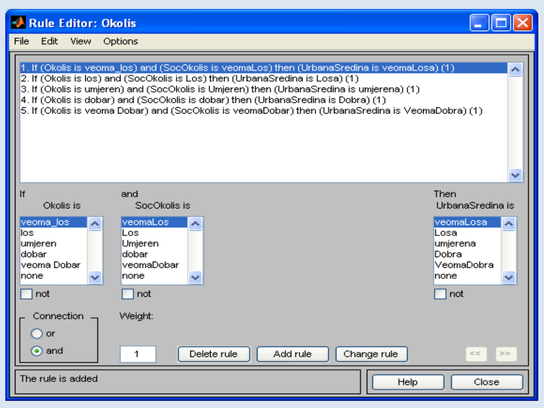


Membership function editor (sets title, operating volume, display range and parametres of each input and output, as well as function which describes each input and output).

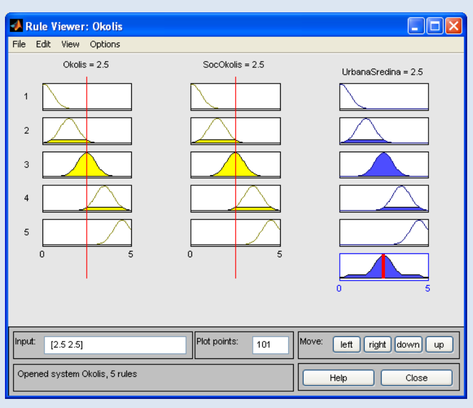
Membership function for Environment variable, Gauss membership function

Rule editor (form which provides input of if-then rule by selecting membership function for each variable and operation in use, result which follows in given case with capability to rank results by weight input).



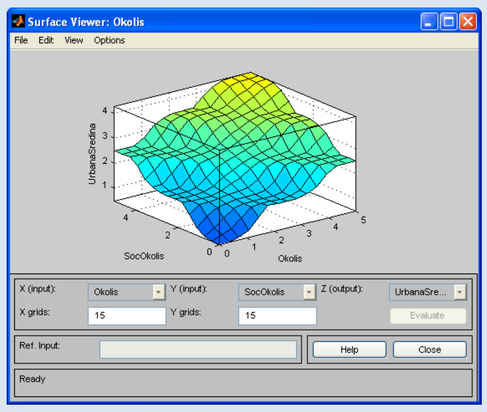


Rule results viewer (graphic display which shows how set operations over functions based on input values).



Rule Viewer for environment evaluation

Diagram Viewer (three-dimensional diagram of dependence of one output in function of two selected inputs).



FIS file serves to phase up two parameters. **Selected membership function is gaussmf.**

Gaussmf is Gauss ***curve*** with following syntax:

y = gaussmf (x, [sig c])

Symetric gauss function depends on two parameters σ and c, and it is given in following equation:

$$f(x; \sigma, c) = e^{\frac{-(x-c)^2}{2\sigma^2}}$$

For example:

```
x=0:0,1:10;
y=gaussmf(x,[2 5]);
plot(x,y)
xlabel('gaussmf, P=[2 5]')
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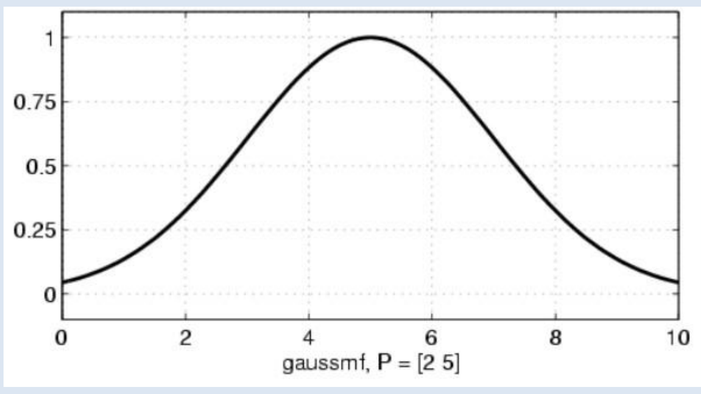
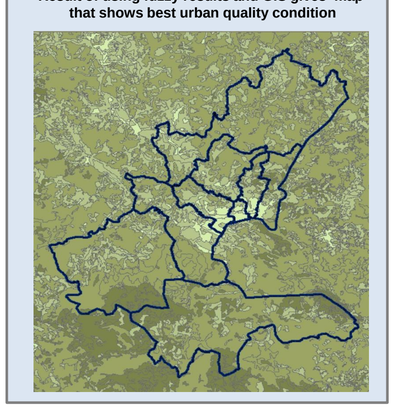


Result of using fuzzy results and GIS gives map that shows best urban quality condition



Conclusion

Better planning of urban environment is based on a complete and precise understanding of environment quality conditions and urban area.

Most researches focus only on some aspects of urban environment quality, for example, urban traffic environment, urban population environment and urban community environment.

Thanks to fuzzy set theory an ideal core for solving the fuzzy processes in the course of environment quality evaluation is secured.

However, major application of urban environment quality evaluation is focused only on quantity perception and not on spatial perception of urban environment quality.

The application of GIS and fuzzy set theory in environment quality evaluation is still scarce.

The application of new methods, such as fuzzy set theory, would give better and comprehensive results which would provide for more possibilities and space in processes which are part of cantons, towns and local communities development planning.

Literature

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[3] Spatial plan for Sarajevo Canton from 2003. – 2023, Sarajevo 2006.

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