Design and implementation of spatial decision-making system for determination of the user's desirable areas in terms of roughness

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Extended Abstract

Introduction

Earth roughness represents a fluctuation of the earth's surface, and it can be called the complexity of the earth (Wilson, 2012). Roughness calculation is of great importance and is the basis for lots of decision-making. There are various solutions for the roughness calculation.

The first description of roughness was presented by Kupers, in which the roughness surface is assumed to be a set of points (Kupers, 1957). According to this definition, the deviation from the height criterion of the points is considered as the roughness index.

The calculation of roughness in vast areas is possible only through satellite interpretation. The images used for this purpose should be of considerable power (Ghafouri, 1394). The main purpose of this paper is to automatically determine the parts of the area using the digital elevation model (DEM), which are desirable for the user in terms of roughness. To achieve this goal, a local decision-making support system is needed. In most of the mentioned methods, roughness is calculated as a variable in a region. But, the purpose of the paper is to calculate the roughness in different parts and to select the optimal area of the user. In previous methods, in order to achieve the goal, the roughness variable had to be calculated in each range and these ranges had to be compared one by one. This process is time-consuming and sometimes the desirable accuracy is not obtained. Therefore, there is a need for a method that reduces the time and increases the accuracy. For other purposes of this paper, we can refer to the calculation of roughness on a surface. In this research, a new method was developed for determining the areas with the user's desirable quality of roughness using a DEM and based on the fractal method and spatial decision-making support system and a system with robust tools was designed and implemented for estimating the roughness and it was tested by the digital elevation model of Iran. The results indicate that this method is very accurate.

Materials & Methods

Ground roughness is an important variable used in the sciences of the earth and astronomy. There is no unique definition for it. It can be defined as a variable to express the variability of the Earth's surface on a certain scale.
In this research, to determine the favorable areas of the user in terms of roughness, a number of methods including sigma T, sigma Z, fractal geometry and a developed method of fractal geometry were used to calculate the roughness. Various spatial analyses were also used in the system. Finally, the spatial decision-making support system was

developed for ranking and selecting the patches.

Results & Discussion

The system was implemented in the 'Visual Studio' environment using the 'C #' language and the 'arcengine' library. This system consists of several parts. First part, is the determination of the area whose roughness is to be determined. The second part, is the extraction of the patches of that area, the third part, which is done after the extraction of spatial complications and descriptive information of each patch, is similar to a filter which is based on roughness calculation methods. The four parts is, the ranking of these patches, and the fifth part, is their classification. The system is designed in such a way that the digital elevation model of any areas with any accuracy can be used. In this research, a 90 meter digital elevation model of Iran and the raster layer of its slope (produced in ArcGIS environment) were used. To display, Google maps were used.

This method has a high precision due to its pixel-to-pixel scanning capability of the area and it seems to be more accurate than the existing ones.

In most roughness determination methods, there is a method that calculates the roughness in the determined area. But, in this paper, using a spatial decision-making system and using the division of the region into smaller regions, the desired qualitative areas of the user are determined in terms of roughness, therefore, this method is able to decide automatically with regard to the user's needs.

Quality is different for various applications in terms of roughness. Sometimes high roughness and sometimes low roughness is favorable. However, other methods only calculate an amount of roughness of a region and we have to extract the values for each part of the earth and apply the analysis to it, and then compare them to determine their desirability. Several methods of calculating the roughness can also be used in the system simultaneously.

Conclusion

Earth roughness is a term used to describe the irregularities of an area. In most cases, determining the roughness of the earth is very complicated. There are many methods for calculating the roughness. The proposed method in this project is an innovative idea which is based on spatial analysis, spatial decision-making support system and roughness calculation methods and is calculated using the Digital Elevation Model. The results show that this method is a powerful tool for calculating roughness.

In order to improve and continue this work, the correlation of variables is suggested in the calculation and evaluation of the obtained results. In this paper, the values are also calculated at the surface of each patch and in rows regardless of the direction. Various models can be used to consider the order of cells in each patch and compare the results.

Keywords: Roughness, Decision support system, Ranking, Classification, Spatial analysis