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Research on Monitoring Technology and Analysis of Urban Green Space Ecology and Environment

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Abstract: Urban green land plays an active role in the process of improving urban ecological environment and the harmony between human and nature. With the economic development, industrial progress and the improvement of people's living standard, urban greenness as the regulator of urban environment has been generally concerned. The dynamic monitoring of urban green land is conducive to scientific and effective urban management, and provides scientific basis and evaluation criteria for urban green land system planning. In this paper, we use remote sensing as the observation means to systematically carry out the research of urban green land ecological environment monitoring technology and analysis. Firstly, it introduces the pre-processing techniques of remote sensing data for urban monitoring, and selects the area method, grid cell method, buffer zone method and moving window method as the key techniques for spatial measurement of urban greenness spaces, and finally evaluates the ecological effects of urban green land with the greenness environment index model of urban buildings. This paper provides the key techniques and evaluation process of urban green space remote sensing in a more systematic way, which will play an important role in garden city evaluation, ecological city evaluation, garden planning, smart city and ecological city support, urban building planning, and sponge map city construction.

Keywords: urban green land, remote sensing monitoring, ecological effects

1. Introduction

1.1. Relevant Concepts

The term “green land” is explained as “a green ground or area formed by planting trees, shrubs, flowers, herbs and ground cover plants to a certain extent” in Ci Hai. According to the usage nature, it can be divided into public green land, production green land and special green land, etc [1].

An urban greenness is an open space in a city used as a park or other greenness, and is defined by the World Health Organization as "any urban land covered with vegetation" that can be used for rest, ecology, beauty, health, and other purposes along with man-made facilities such as playgrounds, blue spaces (waters or waterways), or natural landscapes. Urban greenness are sometimes the land of individuals or institutions such as university grounds or community gardens, but are generally open to the public. State and national parks outside the city boundaries are not considered urban greenness. As early as the 1st century, ancient Rome had the concept of RUS (referring to the countryside of the

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city), to incorporate greenness into urban planning. Modern urban greenness can be traced back to the city squares in London, England in the 17th and 18th centuries. Meanwhile, scholars in China have also elaborated on urban greenness and its composition, structure and function from different perspectives. For example, the Urban Greening Planning and Construction Index classifies urban green lands into six categories according to their types: urban public green lands, residential green lands, unit affiliated green lands, protective green lands, production green lands and scenic forests [1].

Based on the definition of urban green land by domestic and foreign scholars, it can be considered that urban green space is an area covered by vegetation with certain ecological service benefits within the city, mainly including urban forest, urban grassland, street trees, parks and wetlands, etc., which has a positive impact on the urban environment, has convenient accessibility, and highlights its three-dimensional characteristics more than urban green land [2].

1.2. Research Significance and Application Value

Urban greenness is a subsystem of the urban ecosystem and the main natural factor of the city, where green plants are the only source of oxygen [3]. It is equivalent to a natural regulator that purifies pollutants through a series of ecological effects and integrally regulates the urban environment to meet the requirements of clean, comfortable, beautiful and safe urban environmental quality through a variety of feedback regulation effects. With the economic development, industrial progress and improvement of people's living standards, urban environment is deteriorating and urban greenness as a regulator of urban environment has received widespread attention. The monitoring and regulation of urban greenness has become an important topic of urban planning.

Urban greenness mitigates surface runoff and heat island effects, reduce air pollution, and positively affect the physical and mental health of residents in surrounding areas. Historically communities with predominantly disadvantaged populations have generally lacked greenness, and due to policies (such as the redlining system of past U.S. housing policies) and economic inequalities, recent greenness programs have begun to focus on environmental justice and community engagement. Cleaning up pollution and adding greenness can increase the value of surrounding homes, i.e., environmental red gentrification, but the process can also have negative impacts in that disadvantaged groups cannot afford housing prices and may be forced to relocate [3].

Remote sensing technology can quickly and effectively provide macroscopic information on natural processes and phenomena on the ground surface, help reveal dynamic change patterns and predict development trends, and provide not only rich direct information and data quickly, but also scientific, accurate and timely analysis results. It not only provides detailed area information, but also insight into the overall situation. With the characteristics of macroscopic, multi-phase and multi-wavelength, remote sensing technology provides a new and effective method for monitoring and understanding cities, and provides scientific basis and technical support for urban ecological planning.

Remote sensing of urban greenness space provides new perspectives and research tools to explore the mechanism of human-greenness-buildings intra-interaction, helps new urbanization construction through scientific cognition of urban development in the field of spatial observation, and promotes the integration and intersection of remote sensing, urban environment, landscape, and ecology disciplines. The accurate measurement of urban green space provides support for intelligent urban planning and construction decisions, and the distribution of green space spatial structure allows evaluation, quantitative calculation and comparison of livability of different cities [4].

Urban greenness space is a product of urban planning and ecological field research, and practice sustainable development, and multi-source remote sensing data also provides new perspectives and research directions for large-scale spatial exploration. The study of urban greenness space remote sensing solves the problem of scientific and quantitative measurement of the contribution of urban

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green space to habitat quality, and forms a perfect urban green space remote sensing research and technology system. It becomes an important means of urban environmental monitoring and a reference basis for decision making, and has important research significance and practical value [4].

Remote sensing of urban greenness space has an important role in garden city evaluation, ecological city evaluation, garden planning, smart city, ecological city support, urban building planning, and sponge map city construction. It can evaluate the level of urban development and settlement, and has a wide range of applications in biomass and carbon estimation, urban landscape planning, residential evaluation, and assessment of urban vertical greening patterns [4].

1.3. Problems at the Present Stage

The studies on urban greenness domestic and foreign show that with the rapid development of cities, the existence value of urban greenness and the significance of scientific planning and management gradually become greater, but the following problems still exist in the current studies on urban greenness:

(1) Insufficient analysis of the interaction mechanisms between urban greenness and urban development trends and forms in urban greenness planning. Reasonable urban greenness system planning and management need to organize the interaction mechanism of urban greenness pattern-process-function to guide urban greenness planning and design and related policy formulation, so that the development of urban greenness system can adapt to rapid urbanization.

(2) There are more studies on urban greenness classification, focusing on urban vegetation area and distribution measurement, and studying the relationship between urban greenness and buildings, but there are still few studies on the multi-scale identification of urban greenness space from the perspective of urban living.

(3) The evaluation of urban vegetation takes the relatively large-scale urban greenness ecological effect and urban greenness area as the main indicators, and there are few studies on the environmental quality evaluation of urban greenness carried out from a three-dimensional perspective.

(4) LIDAR-based urban three-dimensional green volume information extraction, street-scale environmental investigation using street landscape data has just begun, and there is little research on urban green space remote sensing combining satellite data, LIDAR, street landscape and other data.

(5) Preliminary research on the ecological and economic effects of urban greenness has been conducted in China, and further in-depth research on the socio-economic functions of urban greenness is needed, but there is not much quantitative research on the psychological and social significance of urban greenness.

2. Literature Review

Habitat ecological philosophy in China has a history of more than 2000 years, but the establishment of modern landscape ecological planning theory is later than that of European and American countries, mainly focusing on the introduction and internalization of foreign research results. In respect of theoretical research, domestic research mainly summarizes and discusses the theoretical system of landscape ecological planning. At present, with the population growth and rapid economic development, most of Chinese cities are in the primary stage of urbanization, and the expansion of urban landscape is inevitable. Scholars from many related disciplines, urban landscape gardening and urban planning departments actively integrate the theories and ideas of landscape ecology into the planning field, and strive to find a landscape ecological planning method suitable for China's national conditions. For example, Feng li analyzed the current situation of urban green space construction and the natural geography of Beijing by applying the principles and methods of landscape ecology by Jim C.Y., and designed the vision of future green land planning in Beijing according to the actual ecological public needs combined with the "patch, corridor, substrate" of landscape ecology. From the viewpoint of landscape ecology, Che Shengquan et al. regarded urban greenness as an area where the city maintains natural landscape or restores natural landscape, a comprehensive embodiment of urban natural landscape and human landscape, the most ecological space in the city, and an important part of constituting urban landscape, including various parks, residential greenness areas, and units within urban areas [2]. Combined with keyword co-occurrence mapping and high-frequency keyword analysis, domestic research on the application of urban green land focuses mainly on landscape design, built environment, and landscape architecture.

In foreign countries, research in urban green land is relatively adequate. As early as 1989, Singh et al. have made a rather detailed classification of urban remote sensing methods, which can be classified as post-classification comparison method, multi-temporal composite method, image difference/ratio method, vegetation index method, principal component analysis and transform vector analysis, etc. Hansen et al. have cross-referenced urban planning documents from Berlin, New York, Salzburg, Seattle and Stockholm to account for the various benefits of ecosystem services on planning urban landscapes. Sidle et al. proposed a DAIR (Design-Analysis-Implementation-Reassessment) framework to analyze the impacts of natural disasters on cities, which plays a very important role in guiding the process of urban planning [2]. Combined with keyword co-occurrence mapping, and high-frequency keyword analysis tools, foreign applications in urban green spaces focus mainly on health, physical activity, mental health, ecosystem services, air pollution, stress, and biodiversity.

It can be seen that domestic scholars express their understanding of urban greenness in the meticulous classification of it, with more emphasis on the description of urban plant structure and function. As for foreign scholars, they define the spatial connotation of urban greenness space differently, but emphasize more on its natural attributes in the basic connotation. In terms of spatial distribution characteristics, it reflects its landscape pattern and emphasizes its open characteristics. From the function, it mainly reflects the ecological service function, highlighting the function of improving the life of urban residents and the contribution to the livability of the city.

3. Remote Sensing Data Preprocessing Technology

In most applications, there are requirements for the source data from high-resolution remote sensing satellites. The data is typically a high-resolution multi-spectral image; that is, atmospheric correction and orthographic correction are performed first on a panchromatic image and then on a multi-spectral image, resulting in an image that fully combines the effective information of the two. However, there are other requirements for data in some applications. For example, high-resolution remote sensing images used in forest resource investigation applications should meet the requirements of "one map of forestry" and be spliced without obvious gaps. For example, some applications are interested in vegetation information, but under normal circumstances, affected by factors such as atmosphere and sensors, the spectral characteristics of vegetation in remote sensing images are not prominent. In order to meet more application requirements and generate better-quality remote sensing images, on the basis of image orthorectification, atmospheric correction, and image fusion, the base map is used for image registration to prepare for the mosaic of large-format images, and vegetation enhancement is carried out on the images to highlight the colour characteristics of vegetation and facilitate manual interpretation. It is also necessary to stretch the data so that it has a stable dynamic range of grayscale for subsequent calculation, interpretation, and processing. This paper mainly introduces the orthographic correction and splice technology of multi-spectral images, the registration technology of multi-source remote sensing data, the extraction technology of ground object height information based on LiDAR, and the ground object classification technology based on street view data [5].

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3.1. Orthographic Correction Technique

Orthographic correction is generally done by selecting some ground control points on the image and using the previously obtained digital elevation model (DEM) data within the scope of the image to simultaneously correct the tilt and projection difference of the image and resampling the image into orthographic image. It is a kind of geometric correction. It corrects the image of image point displacement caused by topographic relief and sensor error. Elevation point or DEM is needed, so the accuracy is higher in areas with large topographic relief. At present, the commonly used orthographic correction methods for remote sensing images include collinear equation correction, rational function model correction and polynomial correction. Generally speaking, according to different experimental areas, different basic control data and the characteristics of the data itself, a relatively appropriate calibration method can be adopted.

3.2. Image Registration Technology

Image registration is a basic task in remote sensing image processing that is used to match two or more images taken at different times or with different sensors or perspectives. The significance of registration is to seek transformation models between images so that two or more images with overlapping areas taken at different times and from different viewpoints and sensors can be displayed in the same coordinate system. Remote sensing image registration methods can be divided into four categories: mixed model-based registration, region-based registration, physical model-based registration, and feature-based registration. Feature-based registration is the most widely used registration method at the present stage, which is generally divided into: feature detection, feature matching, mapping function design, image transformation, and resampling, among which feature detection is the key to image registration. Registration algorithms generally include matching based on grey correlation, matching based on transform domain, matching based on feature, matching based on model, and so on.

3.3. Ground Object Height Information Extraction Technology

A digital surface model (DSM) and a digital elevation model (DEM) can be extracted from LiDAR data. Lidar technology has a very high resolution and can obtain rich and comprehensive contour information. Its advantages include penetrating the tree canopy and being insensitive to light conditions. This system is capable of obtaining spatial information under clouds as well as at night in order to meet specific requirements and to be used as an auxiliary data source when combined with spectral images. Therefore, airborne Lidar technology has been applied in various fields such as digital terrain modelling (DTM), environmental monitoring, disaster assessment, and tree classification.

Research on the three-dimensional spatial structure of urban vegetation has become a scientific problem with important development prospects. Using high spatial resolution remote sensing data to extract tree parameters has been studied abroad for many years and achieved a lot of results, but it is still in the development stage in China, especially in the extraction of single wood parameters. In recent years, there has also been a lot of interest in extracting tree crown information from high spatial resolution images. The core problem is to detect the central point of the tree crown, define the boundary points of all the tree crowns, and then connect these boundary points to form the crown region. When these two core problems are solved, the tree crown can be extracted, and then other structural parameters can be extracted. The single tree crown identification hook is based on the radiation transfer model of the tree crown. The core idea is that the brightness value of the central point of the tree crown is high and that the brightness of the boundary point of the tree crown is low. The crowns of trees, especially those of conifers, have relatively regular geometric shapes, and their

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spectral reflectance also shows certain regularity. The spectral reflectance of the tree crown varies with the variation of the solar altitude angle, but there is always a local maximum reflectance point in the tree crown area. All trees, including conifers and broadleaved trees, have a local maximum brightness value point in the crown area, which represents the crown apex.

In recent years, the methods used in automatic crown extraction of single wood at home and abroad mainly include the local maximum method, the contour-based method, the template matching method, and the 3D model-based method. For example, Culvenor divides the automatic tree canopy recognition algorithm into a bottom-up algorithm, a top-down algorithm, and a template matching algorithm. The bottom-up algorithm uses the valley formed by the shadows between the trees as the boundary to distinguish the tree canopy. In the top-down algorithm, the canopy position is initially estimated from the maximum radiation value, and then the boundary is determined according to the characteristics of brightness reduction from the center to the edge of the canopy. The template matching algorithm uses a predefined template that describes the radiation characteristics of the canopy to detect the canopy in the image.

3.4. Remote Sensing Image Classification Technology

3.4.1. Remote Sensing Image Classification Technology Based on Street View

According to the typical urban environment, especially the main road and the streetscape on both sides, the basic urban features can be classified into roads, buildings, vegetation, and other scattered features. The road includes pavement, a traffic barrier, street lights, and traffic signs that are uniformly distributed at a certain interval. The buildings can be divided into wall parts and roof parts, and the vegetation can be divided into neatly arranged street trees and low shrubs in flower beds [6].

The point cloud data of the urban street environment includes both regular ground objects (ground, inside buildings, traffic signs) and irregular ground objects (flower beds, street trees, pedestrians, etc.). The vehicle-mounted laser scanning measurement system is a measurement system developed on the basis of the traditional LiDAR system, which uses the car as the platform to realize the integration of multiple sensors. Compared with the airborne laser scanning system, the vehicle-mounted system can obtain the building elevation data with higher accuracy. Compared with the single-station laser scanning system, the vehicle-mounted system can obtain the mosaic scanning data and image information of multiple measurement points on the vehicle route, which is a rapidly developing means of acquiring urban street view data [6].

3.4.2. Remote Sensing Image Classification Based on Neural Network

An artificial neural network (ANN) is a dynamic system composed of artificially directed graph topology that can fully approximate any complex nonlinear relationship through continuous or discontinuous operation at the neuron level. It can adapt to the problems of pattern recognition and signal processing and has been widely used in remote sensing image classification. In the experiment, ANNs were trained by the BP algorithm, and the classification rules were defined. The ground objects were divided into water bodies, artificial buildings, woodland, grassland, and bare land. The classification accuracy of the experimental results is better than that of the maximum likelihood classification and is comparable with that of optical remote sensing images.

When a single LiDAR dataset is used for point cloud segmentation, the method of strictly dividing the LiDAR point cloud based on slope cannot be well adapted to the classification of complex ground objects. The LiDAR point cloud is transformed into a height image and a reflection intensity image, and the GLCM height texture of the height image is obtained. Four GLCM height textures, the ground roughness coefficient, the average height, and the average reflection intensity were used as the features of ground cover identification. The backpropagation neural network (BP-ANN) method was

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used to identify ground objects from LiDAR data. Experimental results show that this method can effectively classify ground objects from LiDAR independent data sources, and the experimental accuracy is greater than 90%. Compared with the traditional maximum likelihood method, the classification accuracy of BP-ANN is higher than that of the maximum likelihood method. When the preset ground type can be recognized by both optical image and LiDAR data, the consistency between LiDAR height texture classification and optical image classification results can reach 76.5% [7].

3.4.3. Remote Sensing Image Classification Based on Gray Co-occurrence Matrix

Since the classification accuracy of traditional remote sensing image classification methods is not high, the texture features based on the grey co-occurrence matrix can be applied to the classification of ground objects on the basis of the analysis of the spectral information of images. The first two principal components of the original image after principal component analysis can be used to extract texture features of different measures based on the grey scale co-occurrence matrix method through programming operations. The extracted texture features are taken as the new band and combined with the original band. Then the combined image is supervised and classified to explore the feasibility of using texture features to classify ground objects. The classification results were compared qualitatively and quantitatively with those of the maximum likelihood method. The results show that the feature classification method combining texture and spectral features can effectively improve the accuracy of feature classification, which proves the validity of remote sensing image classification based on texture features [8].

On the basis of the slope threshold segmentation point cloud, a ground roughness coefficient can be constructed as a kind of height texture. Together with GLCM texture and reflection intensity, the feature space is used for the classification of multiple features. In the aspect of an intelligent algorithm, a backpropagation neural network (BP-ANN) can be introduced for LiDAR high-texture feature recognition [8].

4. Spatial Measurement of Urban Greenness

4.1. Urban Greenness Measurement Based on Area Method

The area method measures the probability of residents' accessing green space by calculating the proportion of green space in the whole city, or the per capita green space. Calculate the urban green coverage area based on the urban remote sensing image and obtain the urban remote sensing image. Then, the urban green land rate is calculated based on the urban green land coverage area. The calculation formula for the urban green land rate is as follows: Rgl = [SDC-SSTC +LstWst+Spw+Spl/2+Spf]/Sub, where Rgl stands for urban green land rate (see "A Method for Estimating Urban Green Land Rate Based on Urban Green Land Coverage Area" for more information). The area method is simple to understand and operate, but it cannot describe the specific spatial distribution of urban greenness.

4.2. Urban Greenness Measurement Based on Grid Element Method

The grid method is to divide the research area into uniform grids of fixed size, calculate the parameters of urban green space in the grid cells, or make a simple numerical combination. Grids are generally divided into simple grids and complex grids. The simple grid method is a simple calculation or numerical combination of urban green space parameters in grid cells, while the complex grid method adds building density, height, and adjacency distance with green space as the urban greenness measurement results of the whole grid cell, that is, the probability that urban residents in the whole grid cell contact urban green space. Although the grid method considers the distribution of green

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space, it takes the grid as a unit and does not consider the mutual influence of adjacent grids. The edge effect seriously affects the measurement accuracy, so it cannot accurately indicate the probability of residents' contact with urban green space.

4.3. City Greenness Measurement Based on Buffer Zone Method

The buffer zone method is based on the urban buildings as the research object, with a certain buffer radius to the outside of the building object buffer. The urban green space or building parameters are calculated in the buffer zone to measure the greenness of the building, that is, the probability that the urban buildings contact the urban green space. The buffer method based on the building as the object takes the building as the center and needs to accurately extract the edge of the building. The operation process is relatively complicated, and the implementation efficiency is low. As a result, the urban greenness of any point in the region cannot be measured due to the spatial discontinuity.

4.4. Urban Greenness Measurement Based on Moving Window

In view of the shortcomings of the above traditional methods, based on the advantages of multi-spectral remote sensing data and laser radar data (LiDAR), the high spatial resolution of remote sensing data is fully used to describe the spatial distribution of urban vegetation. Based on the high precision extraction of urban green space and building plane information, a remote sensing method of urban greenness measurement based on moving window is proposed. The urban greenness measurement method based on moving window is based on the distribution map of urban green space. With each pixel as the center, the moving window of N pixel ×N pixel (N is odd) is constructed. The ratio of the total green space area inside the window to the total window area is calculated and assigned to the central pixel of the window. Urban Green Index (UGI), as the central pixel of the window, refers to the probability that urban residents touch the surrounding urban green space in the area covered by the central pixel of the window. The moving window method can describe the spatial distribution of urban vegetation in detail and effectively analyze the contact probability between any point of the city and the surrounding green space, and avoid the edge effect produced by the grid method.

5. Techniques for Evaluating the Ecological Effects of Urban Green Lands

5.1. Study of Urban Greenness Landscape Pattern

As an important part of urban ecosystem, urban green space landscape plays an important role in the structure, function and changes of urban landscape. The analysis of urban green landscape structure and pattern is to analyze the number, spatial structure and pattern of the basic units constituting urban green landscape including green space patches and corridors and their interaction relationships. At the same time, urban green landscape should be combined with urban ecological environment for relevant analysis, such as exploring the relationship between urban green space and urban atmospheric quality, water quality, biodiversity, urban heat island and urban ecologically sensitive areas to provide a basis for urban green space ecological layout planning.

Landscape pattern indices are mostly used at home and abroad to carry out research on land use and landscape ecology, and to assess the effects of space-based configuration patterns, modes and states of built and non-built land on ecological processes, land cover changes, etc [9]. Yanjiao Wang proposed that in studying the relationship between urban green space and urban heat field, urban vegetation index and surface albedo can be used to study the relationship between urban landscape and urban heat island spatial patterns in conjunction with contemporaneous precipitation, which has important applications for mitigating the effects of urban heat island effect and urban planning [10].

Mackey et al. studied the relationship between urban vegetation and urban heat island by observing the LANDSAT images of Chicago city at a certain time of vegetation and reflective surfaces, they found that the reflective surfaces generated by urban green spaces were effective in mitigating the urban heat island effect [11].

5.2. Comprehensive Evaluation of Ecological Benefits of Urban Green Land

Conducting urban green space ecological benefit evaluation is an important basis for urban green land ecological environment planning. The evaluation indexes of ecological benefits of green land occupy a dominant position in the evaluation system, therefore, it is crucial to select the evaluation system indexes scientifically and reasonably. The ecological benefits of green land are not only related to the area but also have a great relationship with the three-dimensional green volume, the structure of green land, spatial distribution, plant species, urbanization, etc.

In 1996, the American Forests Organization proposed an urban ecological evaluation method and developed the CITYgreen model, an extension of ESRI's ArcView software based on 3S technology, to evaluate the ecological benefits of urban green spaces and guide urban planning. On the one hand, the ecological benefits of green land analyzed by CITYgreen model include carbon storage/absorption, air pollutant removal, storm water mitigation, energy saving, tree growth prediction, ecological benefit evaluation of land planning scheme, wildlife protection, etc. The above ecological benefits are converted into intuitive economic values according to the shadow engineering method, alternative value method and other accounting methods. On the other hand, CITYgreen model can analyze and evaluate the ecological benefits of green areas at two scales, large scale and small scale respectively. The model works better in land use planning [12]. In addition, the US Forest Service developed the i-Tree model in 2006, which is widely used in urban forestry research in North American countries. It provides urban and community forestry analysis and benefit assessment tools, including eight urban forest analysis tools and applications, such as i-tree Vue, which provides free access to satellite imagery from the National Land Cover Database (NLCD) to assess community land cover [13]. This includes tree canopy and some of the ecosystem services currently provided by urban forests, and it can also simulate the impact of planting scenarios on future benefits [14].

Domestic scholars carried out a comprehensive evaluation of the ecological benefits of urban green spaces. Li Manchun et al. used GIS technology to establish an evaluation and prediction model for the ecological benefits of urban green areas, and established a unified and comprehensive evaluation system for the ecological benefits of green areas in the evaluation processes [15], which takes into account factors such as urban green area coverage, per capita green area, and pollutant emissions. At the same time, it combines the technical means of "3S", using remote sensing (RS) information as the main data source, with other field monitoring and statistical data, and GIS technology for data analysis and processing, to establish the evaluation and prediction model of urban green space ecological benefits [16].

5.3. Environmental Index Model for Greenness of Urban Buildings

In the process of building the remote sensing evaluation model of urban greenness environment, in order to represent the position relationship between urban greenery and buildings in detail, it is possible to integrate the two-dimensional coverage degree and three-dimensional aggregation degree of urban vegetation and buildings, establish evaluation criteria and assign weight superposition, and build a remote sensing evaluation model of urban building greenness environment based on moving windows.

Domestic and foreign scholars have carried out evaluation based on vegetation coverage, greenness adjacency, building coverage, high building coverage and other indicators, and conducted

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building scale urban green space index modeling. At the same time, three-dimensional spatial information of urban vegetation and buildings is used to measure urban vegetation coverage, vegetation aggregation, building coverage and building aggregation based on the moving window method. Then, an evaluation system is established by using the analytic hierarchy process (AHP) to evaluate the green environment of urban buildings [2].

After the establishment of the impact factors and evaluation criteria, weight overlay can be applied for analysis and building mask can be carried out according to the multidimensional evaluation results of vegetation and buildings. The remote sensing environmental evaluation index of urban buildings' greenness can be obtained by constructing a mathematical model. Next, a model construction method is proposed according to the method of constructing BGEI.

Urban building green environment index (BGEI) refers to the two-dimensional and three-dimensional spatial distribution characteristics of urban vegetation and buildings in a certain area around buildings. BGEI can be constructed by combining the grading standard of analytic hierarchy process.

$$BGEI = \sum_{i=1,j=1}^{i=n,j=4} w_j \times p_{ij}$$

p_j to target building as the center of moving window of vegetation coverage, concentration, building coverage and concentration values; w_j is vegetation coverage, aggregation degree, the weight of building coverage and aggregation degree; j represents four factors; i represents n building research objects.

6. Conclusion

It is crucial to collect greenery information of the city. Based on the remote sensing image data, remote sensing and GIS technology, combined with visual interpretation and field survey methods, remote sensing image for feature classification and green space information extraction, can accurately collect urban green space information in a timely and convenient manner, providing a basis for the formulation of reasonable and scientific urban planning.

This paper systematically introduces the process of urban green space remote sensing technology, and on the basis of introducing the connotation, scientific and application values of urban green space, focuses on urban vegetation extraction technology, urban green space multi-dimensional measurement technology and multi-scale perception technology, and also discusses the urban green space remote sensing evaluation method, which has practical significance for discipline research and industry application.

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