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Research Article

Analysis of the Relationship of Video Text and Urban Image Communication Based on the Calculation Method of Wedge Diffraction in Geometrical Optics

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City image reflects a city's comprehensive competitiveness and is also an important indicator of a city's spiritual civilization and urbanization process. A good city image is an intangible asset of a city, which can contribute to the political, economic, cultural, and social construction of a city and create more value for the city. This paper mainly discusses the research status and research methods of urban image at home and abroad. Based on the calculation method of wedge diffraction in geometrical optics, various heuristic uniform diffraction formulas of lossy wedge are compared and analyzed, and a better heuristic formula of uniform diffraction of lossy wedge is given. Finally, the selection of important channel parameters in the propagation channel is discussed, and a method for predicting the statistical parameters of the propagation channel of urban images based on the results of ray tracing is proposed. Then, the channel parameters are analyzed by using statistical parameters, and the channel parameters of the city image propagation model are analyzed.

1. Introduction

After my country entered the 21st century, science and technology continued to innovate and progress, and the era of intelligent media based on emerging technologies such as artificial intelligence, mobile Internet, and big data has finally arrived [1]. Technology authorization makes the whole process of information dissemination gradually open, and anyone can participate in the whole process of information production and release. News communication has shifted from professional groups to all groups, which makes information communication channels diversified and interwoven. The participants, media, and means of urban image are more diversified [2]. The research on urban image in the era of SMART media also shows a new trend of diversified and multidisciplinary development [3]. The connotation of urban image is continuously deepened, and the dissemination of urban image has received more and more attention [4].

Like people, each city has its own life, each city has its own development context and historical trajectory, and each city also has its own growth process and story [5]. As the foundation of human existence, cities constitute carriers and units, carrying all aspects of human life [6]. However, urban image, a vocabulary that reflects the panorama and appearance of a city, has undoubtedly become a hot issue discussed by journalism and communication scholars in recent years [7]. The competitiveness reflected in a city's politics, economy, and culture interprets the degree of development of a city's modernization, which is the inherent image of a city [8]. The construction of the city's buildings, environment, roads, etc., is the manifestation of a city's external image [9]. In recent years, there have been rankings that directly express the image of cities, such as national urban GDP rankings, national urban air quality rankings, and national urban comprehensive strength rankings [10]. With the opening of the 2008 Beijing Olympic Games and the 2010 Shanghai World Expo, the promotion of the city's image has become increasingly hot and necessary [11]. In

recent years, CCTV has interspersed the promotional films of various cities in prime time [12]. The pictures are rich, and the content is exquisite, which not only brings beauty to people but also increases the audience's understanding of cities across the country [13]. The production and dissemination of these propaganda films is based on the media as the means of dissemination, and the video text has become an important dissemination platform and carrier [14]. These contents showing the urban exterior scene comprehensively, objectively, and diversifiedly show the characteristics of each city, so as to better spread the city image [15]. Video text is a media carrier that can carry rich content and show emotion. Short videos on social platforms can effectively spread such rich objects as city images. City image is an important attraction for city tourism. The successful online promotion practices of cities can bring inspiration to other cities in China. Of course, online city image promotion is not just about creating temporary traffic. Instead, we should continue to dig deep into the connotation of the city image, combine with multiple media to carry out continuous communication, so as to form distinctive characteristics of the city to attract more investors and tourists. The communication of city image needs to build a professional communication subject, and then, its operation team studies the communication content. Then, choose the channel or platform where the current marketing audience gathers most to carry out communication, such as short video media and new media platform [16].

The relationship between communication and the city is an ancient proposition, dating back to ancient Greece [17]. Ancient Greece and other city-states were regarded as a "communication society" with a multifaceted communication as the social foundation. With the development and evolution of media, urban communication theories and their perspectives are constantly enriched and developed [18]. At present, new communication technology and the wave of globalization and urbanization are agitating each other, and the issue of constructing and disseminating the image of the city has become more prominent in the increasingly fierce competition [19]. In order to effectively recognize, understand, and deal with many urban communication problems such as changes in social relations, reorganization of communication forces, and changes in human existence due to the development and change of media technology in globalization and urbanization, there is an urgent need for more broad disciplinary perspective, more specific theoretical guidance, and more detailed media and audience research [20].

René Claire, a famous French director, said, "In a film, the picture is the only means of narration." Image is an art of telling a story with a lens. Therefore, in the narration of video texts, we must first consider the visual modeling of film and television. The relationship between image text and city image construction is actually how to express city image through lens language. So what is the image of the city? It should be composed of two parts: one is material, which is an intuitive image that can be seen by us; the other is spiritual, which is the core concept and unique culture of the city. The abstract things like ideas and spirits must be expressed with the help of certain material carriers. Symbols are the most direct carrier for expressing meaning, are visual, and are also an effective way to achieve rapid dissemination. How to better establish the image of a city through video text? The author believes that the key to the image construction of a city or region is the association of the audience. An important means of arousing associations is by means of specific symbols. Information is the unity of sign and meaning, sign is the external form or material carrier of information, and meaning is the spiritual content of information. Using distinctive and characteristic symbols to impress the audience and then establishing an association response is the key to building a city image.

2. State of the Art

2.1. Correlation between Image Text and City Image. With the theme of "City Image Communication," relevant journals and dissertations were searched and analyzed on Chaoxing Discovery System and CNKI. Various academic development trends are shown in Figure 1. Around 2008, urban image communication began to be valued by the academic community. After analyzing the content of relevant literature, it is found that the current research focuses mainly on urban culture, urban brand integrated marketing, urban image communication strategy, new media, and urban image communication.

Before analyzing video text and city image dissemination, we must first understand the relationship between video text and city image. There is a strong correlation between image text and city image. Using video text as the carrier and channel to disseminate the city image greatly enriches and improves the dissemination effect of the city image. Using the city image as the production material of the video text also expands the research field of the video text.

Video texts have played a variety of functions in the dissemination of city images. Analyzing the dissemination effects of city images from this aspect strengthens the audience's understanding of the relationship between video texts and city images. In different historical periods, the presentation and expression methods of video texts in the image of the city are also different. Nowadays, the research on video text is also becoming more and more full-fledged in the step-by-step development and expansion.

With the rapid development of today's economy and society, people's spiritual and cultural needs are also getting higher and higher. As the land where people live, the impact of cities on the entire society cannot be underestimated. This change brings about the common improvement of people's material life and spiritual life. The media is a tool for capturing new things, and the changes and development of cities are no exception and have become the objects of media communication. Video text belongs to the category of art and is the concrete expression of abstract art. What the city image is selectively extracted by the video text is the essence of the city image, that is, the content of spiritual connotation. In this way, the city image and the media have found a tacit understanding of symbiosis and coexistence. The media

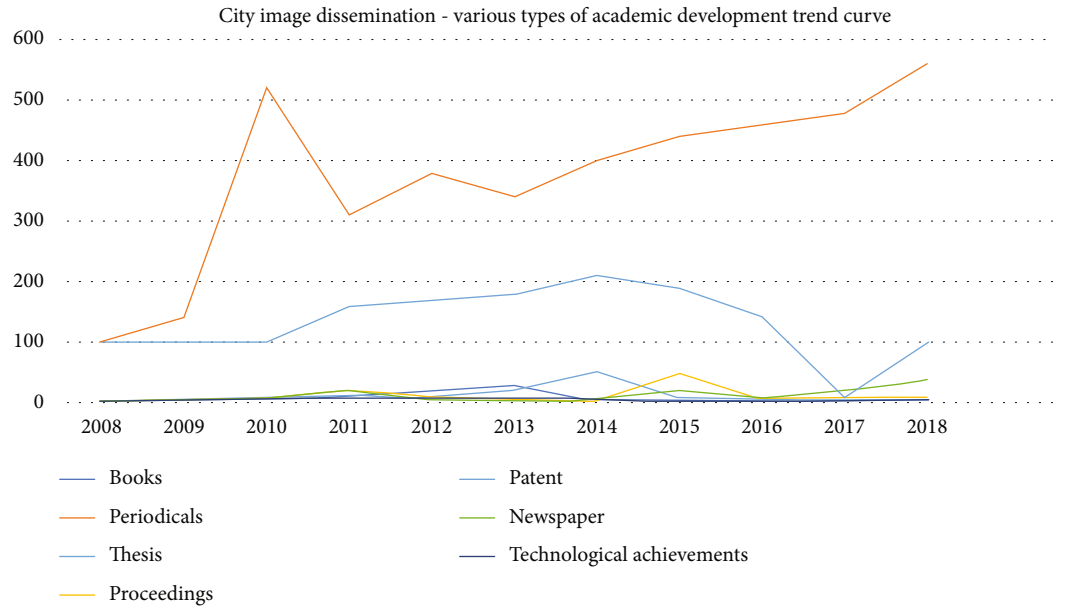

Figure 1: The academic development trend curve of urban image communication.

communication promotes and drives the expression of the city image, and the transmission of the city image also brings a larger and wider communication field to the media.

At the end of the 20th century, propaganda films related to the dissemination of urban images came out in my country. Afterwards, the government and citizens paid close attention to the information and content of the city's image. In order to open up the market for their own city image, cities also compete to research and design their own city image promotional films. With the acceleration of urbanization, more and more projects are now labeled as "urbanization." Through the urbanization seen by the media, the audience has a process from understanding to understanding of a city, thus achieving the purpose of media city image dissemination. Video text contains many levels of media (including pictures, promotional films, film and television dramas, and documentaries), which have become the most suitable carrier for disseminating the image of the city. Through the dissemination of these means, the audience can see the historical changes and real development of a city.

2.2. The Function of Image Text in the Dissemination of City Image. Media image dissemination has the characteristics of fast speed and wide range. As an effective carrier to promote the awareness of city image, video text includes propaganda films, documentaries, pictures, and other means of dissemination. There are many similarities between the means of communication and the wide range of communication channels, which has led to the promotion of the spread and effect of the entire city's image. The popularity and reputation of a city increases, and the audience has a deeper understanding and understanding of the city, which naturally enhances the city's influence. Therefore, the use of video text to spread the image of the city has a significant impact on the image of the city.

The content of the video text is mostly intuitive; the information is obvious to the audience. The picture information especially, after being processed for a short time, is quickly transmitted to the audience. In the vast sea of information, if a certain piece of information is to instantly occupy the audience's attention and catch the audience's attention, it requires the information to have a unique appeal, in order to stand out from the huge information content. Video text has the advantage in this respect, both in terms of visual perception and sound effect transmission, occupying an absolute advantage among many communication carriers. For example, in catastrophic reports such as the Wenchuan earthquake, a title summarizing a piece of text information in incisive language is obviously not as attractive to the audience as a picture that intuitively reflects the current situation of the disaster area and the conditions of the victims. The same is true in the dissemination of city images. Even if the city is written in hype, there is not a single eye-catching picture or video clip that leaves a deep impression. Therefore, in the era of all media, the rapid development of new media such as mobile phones and the Internet provides an important opportunity for the development of video texts.

In the vast ocean of information, the audience is likely to be so immersed in it that it is difficult to prioritize. As a powerful media communication channel, video text can transfer the audience's attention to the spirit that the government needs to convey with its intuitive characteristics. The video text captures the audience's attention through rich and vivid content. This is not only conducive to government decision-making but also improves the efficiency and transparency of government decision-making and provides convenience for the audience to better participate in government decision-making and enhance the interaction between the audience and the government. In other words, the image of the city

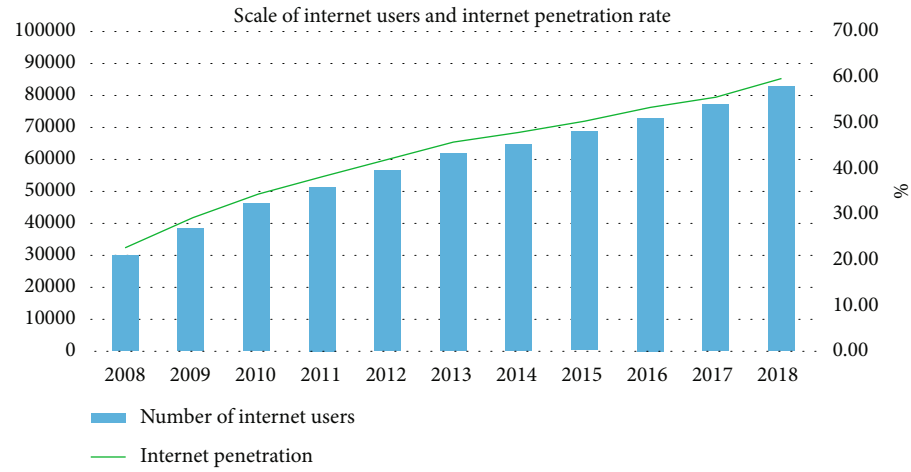

Figure 2: Scale of Internet users and Internet penetration rate in my country.

spread by video text builds a bridge between the government and the audience.

2.3. Public Communication under Smart Media. Intelligent media has the characteristics of no boundary and decentralization. From traditional media to new media, it has realized a multidimensional change from mass communication to mass communication, and from PC to mobile, it has realized the leap from portal website to social media. The time interval between technological iterative updates is shortening, media boundaries are disappearing, audience migration is intensifying, and communication channels are diversified. Various changes are rewriting the communication rules and reshaping the public communication landscape. According to "CNNIC: The 43rd Statistical Report on Internet Development in 2018" (hereinafter referred to as the report): as of December 2018, the number of netizens reached 829 million, and the Internet penetration rate was 59.6%, an increase of 3.8 percentage points compared with 2017. 56.53 million new netizens were added throughout the year. The scale of mobile netizens in my country reached 817 million, and the proportion of netizens accessing the Internet through mobile phones was as high as 98.6%. It provides an increasingly large user group and a deep audience base for the rise of mobile short video APPs. The specific data are shown in Figure 2.

In the past two years, short video consumption has experienced a rapid growth, according to the report, "As of December 2018, the number of short video users reached 648 million, and the utilization rate of netizens was 78.2%. In the second half of 2018, the user growth rate reached 9.1%." The short video thus covered nearly 80% of netizens. Combining the weekly time spent online by netizens in the report and the regular proportion of various APPs frequently used by mobile netizens, it can be estimated that the daily use of short video APPs by netizens is about 19.4 minutes (with two decimal points). Combined with the usage of Internet access devices in the report and daily experience, the actual duration of mobile Internet access will be higher than this value (see Figure 3 for details).

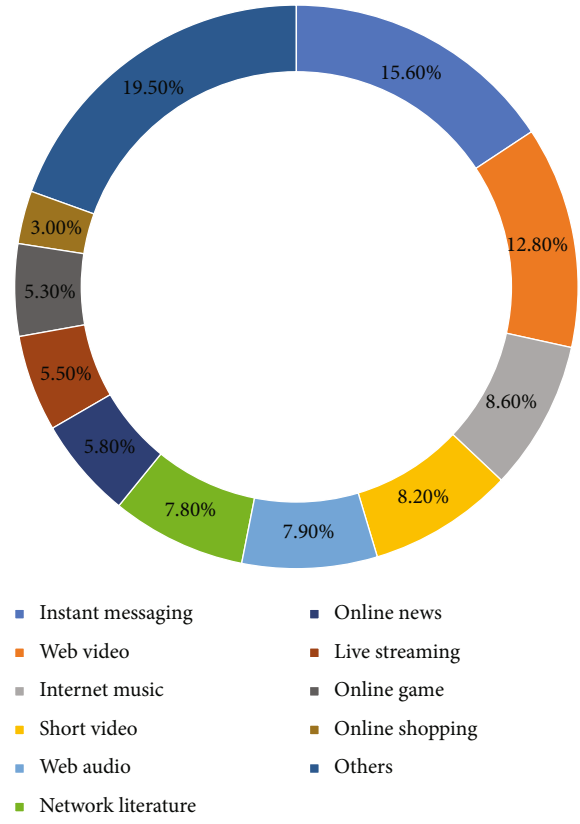

Figure 3: Proportion of usage time of various applications.

In 2016, the short video industry entered the "grassy era" of content and platform entrepreneurship. 2016 was called "the first year of short video," and many mobile short video apps such as Kuaishou, Miaopai, and Xiaokaxiu emerged rapidly, with Kuaishou as the representative. The first batch of short video platforms in China quickly seized the market and formed a super strong industry form. According to Aurora Big Data statistics, the market penetration rate of Kuaishou from January 2016 to January 2017 was higher than the sum of the market penetration rates of similar

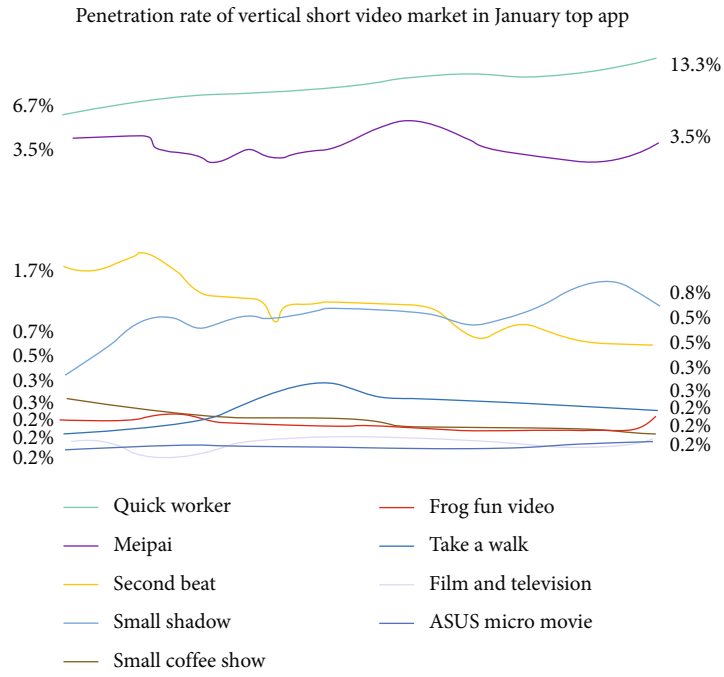

Figure 4: Laser big data 20 short video market penetration rate in January 2017.

products. It is worth noting that the "Douyin" APP incubated by Toutiao (now renamed ByteDance) was launched in a low-key manner on September 26, 2019, and quickly seized the short video APP users and market around February 2017, becoming a mobile short video app. A rising star in the video APP platform and a new force in the short video industry are shown in Figure 4.

With the development of new media technology, the boundaries of media are gradually disappearing, and media integration has become an inevitable trend. From large-screen to small-screen to multiscreen linkage, this kind of media transformation, which is constantly deconstructed and rapidly reconstructed, is providing infinite possibilities for media innovation. In this context, the means and concepts of urban image dissemination will also continue to develop.

3. Methodology

3.1. Forward Ray Urban Propagation Tracking Method. In the propagation problem of media, when the conditions of "high frequency" or "short wavelength" are satisfied, that is, when the characteristics of the medium and the parameters of the scatterers change very slowly over the distance of one wavelength, the propagation and scattering have "local" property; that is, the field in a given field of observation point does not need to be solved by the field distribution on the entire initial surface, but only by the field of a finite part of the surface. The forward algorithm is that ray tracing starts from the source point, emits a large number of ray beams uniformly to the surrounding space, traces the path of each ray beam separately, and uses the receiving sphere at the receiving point to determine whether the ray beam contributes to the field strength of the receiving point. The judging method is whether the distance between the ray beam and the receiving point is greater than the radius of the receiving sphere. If the distance is greater than the radius of the receiving sphere, it is judged that the ray beam has no contribution to the field point. The contribution of the ray beam adds to the total field at this field point. Then, continue to track the ray beam until its field strength decays to negligible. In this case, the tracking of the next ray beam is changed. Repeat the above process until all beams are traced. Its flow chart is shown in Figure 5.

One way to obtain beams of equiangular rays is to place an equi-icosahedron inside a unit sphere centered at the source point and then further divide its faces into much smaller equilateral triangles; Alternatively, the following circular column can be used to obtain beams of rays:

$$\begin{aligned} \theta &= i\delta, \\ \phi &= j\delta \csc \theta, \end{aligned} \tag{1}$$

where δ is the cone apex angle (included angle) of the ray beam and φ and θ are the included angles of each ray beam and the x-axis and z-axis, respectively.

3.2. Reverse Ray Urban Propagation Tracking Method. The reverse algorithm starts from the field point and, according to the principle of geometric optics, reversely traces every path that can reach the field point from the source point. Obviously, it is impossible to trace all the paths from the source point to the field point. Considering the attenuation of the field, with a certain precision, we can ignore those propagation paths that arrive at relatively small amplitudes. In this way, the propagation path between two points can be obtained. The model in this paper is mainly based on

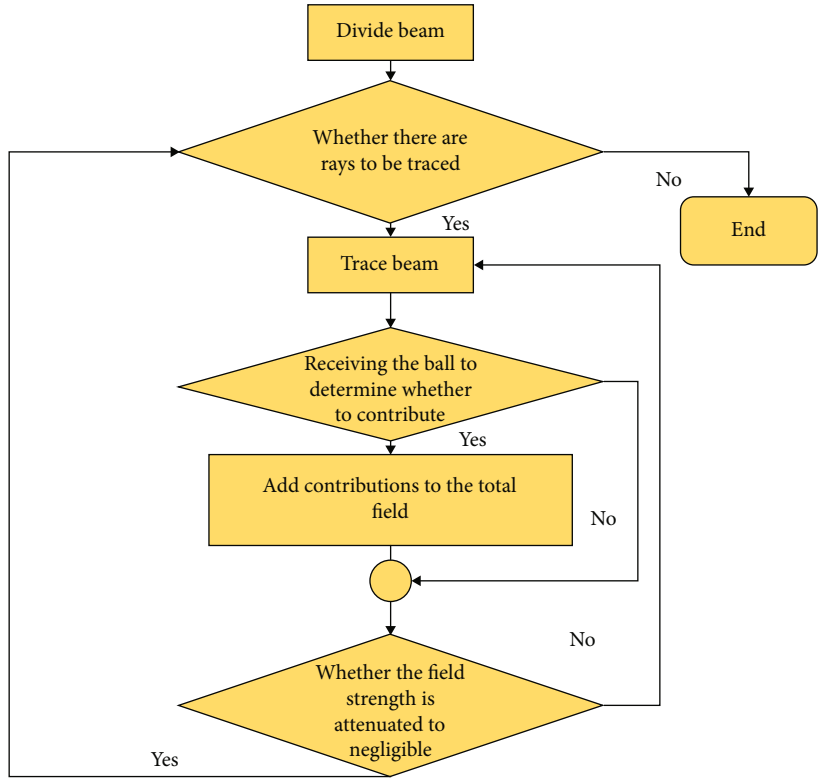

Figure 5: Flow chart of forward algorithm.

outdoor coverage prediction and channel analysis, so the transmitted rays are not considered, but only direct radiation, reflection, and diffraction are considered. When tracing a diffracted ray, first read out the common visible wedge table about the source point and the field point and then solve each wedge in turn.

$$\left(x_3', y_3', z_1' + \left(z_2' - z_1'\right) \frac{\sqrt{\left(x_1' - x_3'\right)^2 + \left(y_1' - y_3'\right)^2}}{\sqrt{\left(x_1' - x_3'\right)^2 + \left(y_1' - y_3'\right)^2} + \sqrt{\left(x_2' - x_3'\right)^2 + \left(y_2' - y_3'\right)^2}}\right). \tag{2}$$

Then, the coordinates of the diffraction point in the original coordinate system are obtained by coordinate transformation. Similarly, the diffraction point also needs to be judged to determine whether it is located within a straight edge of finite length. For the effective diffraction points, the connection and intersection judgments are made. For one reflection and one diffraction, the visible surface table of the source point and the visible wedge table of the field point should be read out, respectively. For a combination of a face and a split, the mirror point of the source point with respect to the face is first required. Then, find the diffraction point of the mirror image point and the field point about the wedge to judge its validity. If it is valid, find the intersection of the line connecting the mirror point and the diffraction point with the surface, that is, the reflection point, to judge its validity. If it is valid, the connection and intersection judgment can be performed. For the first-order diffraction and the first-reflection, the solution is similar to the solution of the first-reflection and the first-order diffraction. For a combination of a split and a surface, first find the mirror image of the field point on the surface, and then find the diffraction point of the mirror image and the source point on the split. The rest of the judgments are equivalent to the solution of one reflection and one diffraction. Although the reflection algorithm does not need to use the receiver sphere to judge the diffraction, the phase and polarization information of each ray can be calculated more accurately. But the reverse algorithm has its own drawbacks. The first is the judgment of visible faces and visible splits. The second is how to determine the order of ray tracing.

3.3. Introduction to the Acceleration Technology of Existing Ray Urban Propagation Tracking. Methods to reduce the ray beam without reducing the calculation accuracy are also

introduced in some literatures. But this method is not suitable for urban ray tracing; it is the application of ray tracing method in other aspects. In phase, less than half the ray beam is required for conventional ray tracing. In this method, the electric field of the source is set to

$$\vec{E}\left(\vec{r}\right) = \vec{E}(0) \cdot \sqrt{\frac{Q_p(z)}{Q_p(0)}} \cdot e^{j \cdot k \cdot \left(z + (1/2) \cdot [xy] \cdot Q_p(z) \cdot \begin{bmatrix} x \\ y \end{bmatrix} \right)}, \tag{3}$$

where $Q_p(z)$ and $Q_a(z)$ are the variable matrices of the phase and amplitude of the GRBF in the z-axis propagation direction, respectively, and the requirements are met:

$$Q_p^{-1}(z) = Q_p^{-1}(0) + z \cdot \begin{bmatrix} 10 \\ 01 \end{bmatrix},$$
$$Q_p^{-1}(z) \cdot Q_a(z) \cdot Q_p^{-1}(z) = Q_p^{-1}(0) \cdot Q_a(0) \cdot Q_p^{-1}(0). \tag{4}$$

The reflected rays are either in the form of GRBF. However, only reflection is considered in the calculation, and diffraction, which is a very important propagation mechanism in urban propagation, is not considered, so it is not suitable for urban propagation prediction. Spatial partitioning technology, as the name suggests, is to divide the entire area into many urban domains, and the number of faces and splits in these urban domains will be relatively small. And split to perform occlusion inspection, which greatly reduces the number of occlusion inspections. Because in the densely built urban area, the number of inner faces and splits in a microcity is quite large. If some tricks are not used, each ray will be judged to intersect with each face and each chopping in the city, and the calculation of intersection will be done, which is a huge amount of calculation. Assuming that the number of rays is N_0, the number of faces is N, and the number of splits is M; the required number of intersections is

$$\begin{aligned} &N_0(N+M)N, \\ &N_0(N+M)^2N, \\ &N_0(N+M)^3N. \end{aligned} \tag{5}$$

Obviously, such a large amount of calculation is unbearable. Therefore, it is necessary to adopt effective techniques to reduce the amount of computation. The generation of partition technology stems from this.

3.4. Research on the Calculation Method of Urban Image Dissemination Characteristics. It is well known that the problem of media propagation in arbitrary environments can be reduced to the solution of Maxwell's equations under given boundary conditions. Equations (6)–(9) give the differential form of Maxwell's equation.

$$\nabla \times \vec{H} = \frac{\partial \vec{D}}{\partial t} + \vec{J}, \tag{6}$$

$$\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}, \tag{7}$$

$$\nabla \cdot \vec{B} = 0, \tag{8}$$

$$\nabla \cdot \vec{D} = \rho, \tag{9}$$

where E and H are the propagation field strength and magnetic field strength, respectively, and their units are V/m and A/m, respectively; J is the current density; p is the charge density; D and B are the electric flux density and magnetic flux density, respectively, and their units are C/m^2 and Wb/m, respectively, which satisfy

$$\vec{D} = \varepsilon \vec{E} = \varepsilon_r \varepsilon_0 \vec{E}, \tag{10}$$

$$\vec{B} = \mu \vec{H} = \mu_r \mu_0 \vec{H}, \tag{11}$$

where ε and μ are the dielectric constant and magnetic permeability of the medium, respectively; ε ε r μ and Ho are the relative permeability of the medium and the permeability of free space, respectively. When studying the wireless propagation of city image, it can be approximated that $c \approx 3 \times 108$ m/s. The calculation of such reflection and refraction coefficients already includes the calculation of reflection and refraction of lossy media. And although such reflection and diffraction coefficients are derived from the case of plane wave propagation, they can also be used to approximate the reflection and refraction of cylindrical and spherical waves due to the local nature of high-frequency problems.

In order to solve the discontinuity problem of the Keller diffraction theory in the boundary transition region, Kouyoumjian and Pathak proposed the ideal conductive wedge in the 1970s—the uniform geometric diffraction theory (UTD) r83, whose uniform diffraction coefficient is

$$D_{s,h} = \frac{-e^{j(\pi/4)}}{2n\sqrt{2\pi k}\sin\beta_1}, \tag{12}$$

where $F(x)$ is the transition function used to correct Keller's inconsistency, which is defined as

$$F(x) = 2j\sqrt{x}\exp(jx)\int_x^{\infty} \exp\left(-j\tau^2\right)d\tau. \tag{13}$$

Figure 6 shows a schematic diagram of the function change curve of the transition function $F(x)$, which includes the change curve of its amplitude and phase.

4. Result Analysis and Discussion

4.1. Visual Display of the Prediction Model of Urban Image Dissemination. One of the basic problems in ray propagation tracing of city image is the establishment of 3D model of city. To develop the urban propagation prediction calculation software module, it is necessary to visualize the urban image propagation model and ray tracing results. Now there are many popular graphics modeling software, the

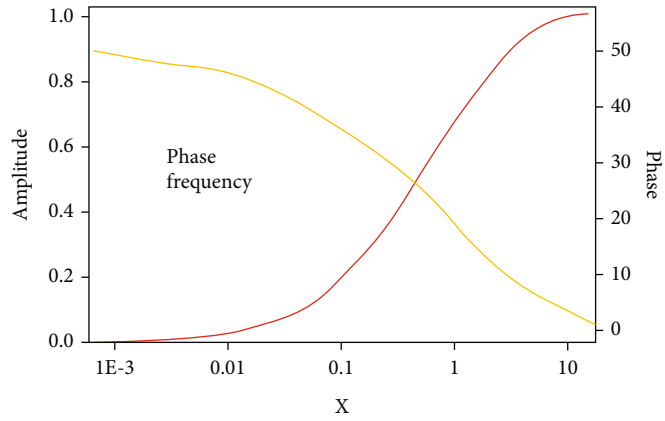

Figure 6: Propagation transition function.

description of the target mainly includes surface element, tetrahedron, and hexahedron. Different description methods address the needs of different application domains. The object of our research is mainly outdoor ray tracing, and the information to be obtained is the appearance parameters of the buildings in the city, so that our model can be built using the surface element method (pathc). In practice, we use 3Dface and 3DMax software of AutoCAD 14 for modeling.

In the visual display of the model, we use the OpenGL software. The development software uses V6C.O, which can realize the integration of the system. In this way, we use the 3Dface of AutoCAD 14 to model, output the DXF file, and the OpenGL software reads the DXF file and displays it. Graphics exchange file (DXF) is generally ASlCl code text file, a complete file consists of five segments as follows:

Header section (HEADE) R: it stores general graphic information of the DXF file, including variable names and corresponding data.

Table segment (TABLE) S: it contains the definition of command items and stores a series of tables, including line type (LTYP) E, layer table (LAYER), text text table (STYLE), view table (VIEW), user coordinate system table (UCS), window configuration table (VPORT), dimension table (DIMSTYLE), and application identification table (APPID).

Block table (BLocKS): it stores block definition entities.

Entity segment (ENTITIE) S: it stores graphic entities, including insert entities.

End of file (ENDOFFILE): it indicates the end of the file. Knowing the group code format of the DXF file can read the data in it. For our software module, just read the 3Dface data. When the ray tracing ends, the display of rays is actually the display of line segments. After the data of the model is obtained and displayed, the problem is ray tracing, which needs to extract the data useful for calculation from the known model, which requires analyzing the data structure of urban ray propagation prediction calculation. The model is composed of patches, and when we calculate the propagation, reflection, and diffraction of rays, we need not only the data of the faces but also the data of the splits and vertices, which requires the establishment of the faces containing the corresponding information.

4.2. Experimental Results and Analysis. Undoubtedly, in the urban image propagation prediction algorithm based on ray tracing, the quality of the ray tracing results determines the quality of various calculations in the future. To obtain reliable calculation results, it is necessary to have relatively accurate ray tracing results. Therefore, it is very necessary to improve the accuracy of ray tracing. The accuracy of the city image propagation model is inversely proportional to the time spent in ray tracing. In order to improve the efficiency of ray tracing, there are many high-rise buildings in the central area of the city. When the base station is located very low, a two-dimensional model is generally used. The accuracy of this model is of course not high. And when encountering the situation of high base station, this kind of model cannot be used. Therefore, in order to take into account the model accuracy and ray tracing efficiency, there are some quasi-3D models. As a verification, we use a TmPa urban area, along the street from point A to point B to compare the measurement results with the ray tracing results. The comparison between the calculated results at the same calculation level and the measured values is shown in Figure 7. Among them, the ray method 1 refers to the result of calculating only one diffraction and one reflection, and the ray method 2 refers to the result of calculating one diffraction and six reflections. We see that calculating multiple reflections can effectively improve the strength of the propagated signal, and, in general, calculating one diffraction plus six reflections is sufficient. In this way, not only the accuracy of the ray tracing algorithm is effectively improved, but also it is ensured that there is no need to spend too much computing time on the ray tracing.

And, in the actual calculation, it is also found that not all the blocks need to calculate so many layers. For nonrear blocks with direct rays, only one diffraction and one reflection need to be taken into account to meet the requirements. The reason is simple; the ray intensity of the lower level is too small relative to the direct ray, so it can be ignored. In the calculation, only one diffraction and one reflection are

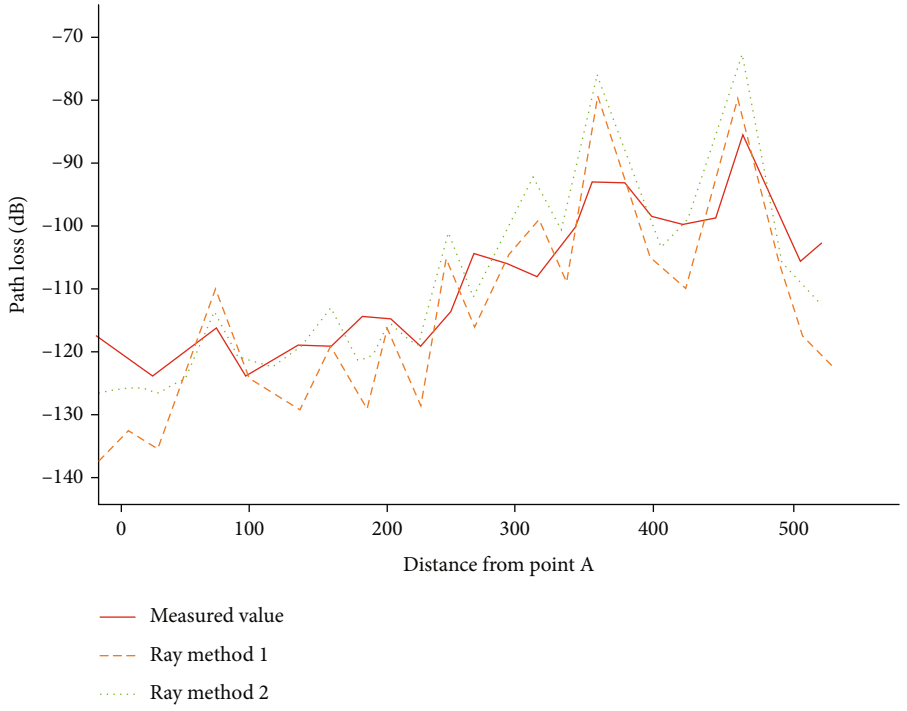

Figure 7: Comparison of ray tracing results at different levels with the measured values.

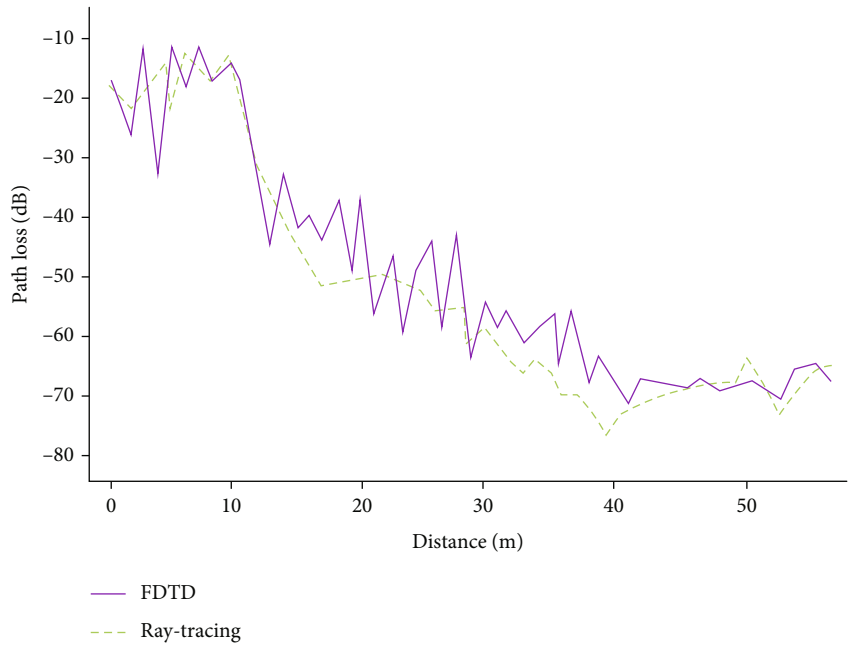

Figure 8: Propagation path loss of A-B.

calculated, and the results are compared with the calculation results of FDDT. The results are shown in Figure 8. It can be seen that this can well meet the accuracy requirements. Different blocks are calculated separately. For nonrear blocks with direct rays, only one diffraction and one reflection can be calculated, while for back blocks, one diffraction and six reflections need to be calculated. In this way, not only the efficiency of the reverse algorithm can be improved, but also the accuracy of its calculation can be guaranteed.

Figure 9 is a comparison of the diffraction results calculated by the method based on Muliuzhinets and the Pathak method. It can be seen that although the theoretical derivation is relatively strict, the calculation formula of the finite conductivity dielectric wedge diffraction field based on the

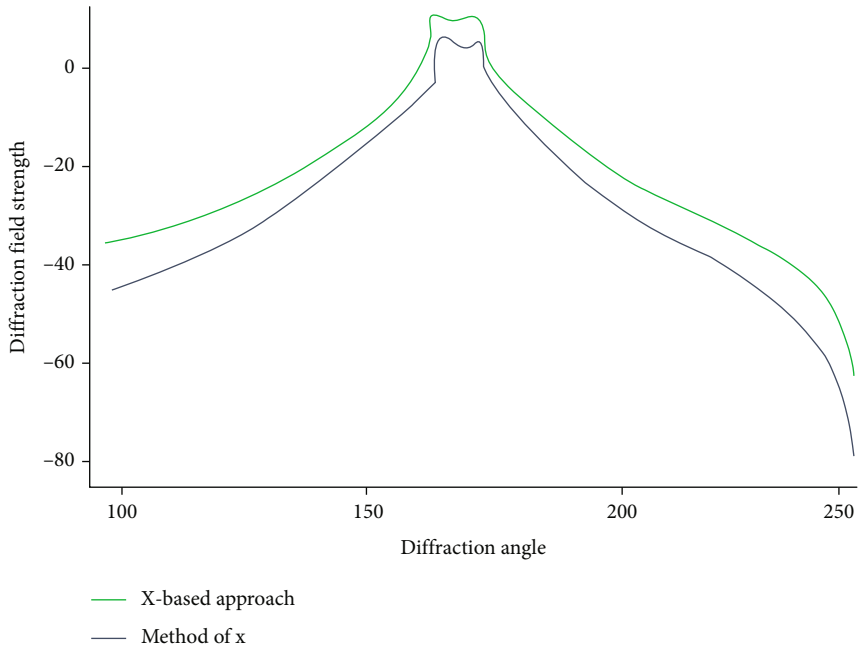

Figure 9: Comparison of diffraction results calculated by the method based on Muliuzhinets and the Pathak method.

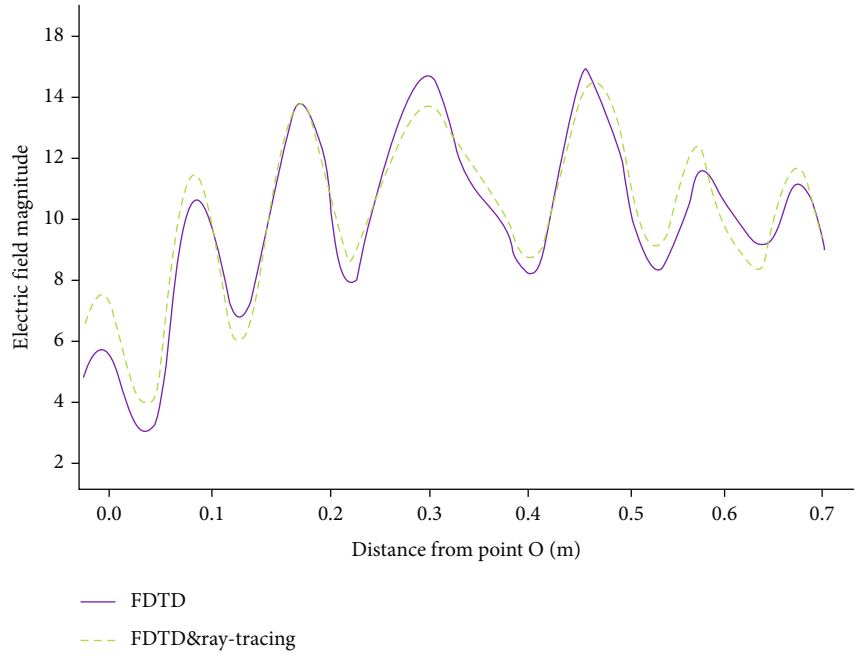

Figure 10: Comparison of mixed method and FDDT results.

Muliuzhinets method is very complicated and can only calculate the diffraction of some specific angle wedges, which is not widely applicable. For the calculation of the lossy medium wedge diffraction, another method with wider application range is the heuristic uniform diffraction coefficient formula. This heuristic uniform diffraction coefficient formula has no strict theoretical derivation, but a formula obtained by comparing the calculation results of the wedge diffraction.

The structures in the dashed box were calculated with FDTD using the recorded results as secondary sources. In the calculation, the grid size of FDDT is 20 grids per wavelength. The calculation results are compared with the calculation results of FDDT, and the results are shown in Figure 10. It can be seen from Figure 10 that the calculation results of the hybrid method are in good agreement with the results of FDTD. But it can be seen from the algorithm steps of the hybrid method that this method is only suitable for

the forward algorithm in ray tracing. For the reverse algorithm of ray tracing, this method is not applicable. The hybrid method is based on the forward algorithm of ray tracing, which also needs to introduce the receiver sphere in the calculation of the hybrid method, and also has the shortcomings of the forward algorithm such as the unclear ray path. In other words, the hybrid method cannot accurately calculate the phase and polarization information when the rays arrive at the field point.

5. Conclusion

This paper analyzes the five fields of city image communication from the perspective of video text, including promotional films, documentaries, film and television plays, communication, and marketing. Geometrical optics method, geometrical diffraction method, uniform diffraction coefficient, and heuristic wedge-shaped diffraction coefficient formula of finite conductive medium are adopted. The reverse ray tracing method is studied in detail, and a fast reverse ray tracing algorithm is given. Combined with computer graphics modeling technology and ray tracing technology, the image intelligence of the city is analyzed, and the prediction characteristics of media propagation characteristics are studied. A 3D ray tracing calculation model based on ray tracing octree method is proposed. Combining the ray tracing results with the traditional digital channel characteristic parameter analysis methods, a digital channel characteristic parameter analysis method based on ray tracing algorithm is studied. Various methods to improve ray tracing accuracy are comprehensively studied and analyzed, and the specific methods to improve the tracing accuracy of reverse algorithm are given. In short, a method for predicting the statistical parameters of urban image propagation channels based on ray tracing results is proposed. Then, the channel parameters are analyzed using statistical parameters, and the channel parameters of the urban image propagation model are analyzed.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares that there are no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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