Journal of Computing and Electronic Information Management
ISSN: 2413-1660 | Vol. 12, No. 1, 2024

A comparative study of interactive animation and traditional animation

-- Scientific econometric analysis based on CiteSpace

Qiaojuan Shan, Yusrita binti Mohd Yusoff * and Ariffin bin Abdul Mutalib

School of Multimedia Technology and Communication, Universiti Utara Malaysia
* **Corresponding author**: Yusrita binti Mohd Yusoff

Abstract: The article conducted a comprehensive study on the development trends of animation. Through the collection of relevant literature on the subject, it examined the research's impact in various countries. The study utilized the CiteSpace analysis tool to conduct a detailed quantitative analysis of the evolution of the animation field in recent years, covering literature and academic publications from 1990 to 2022. In terms of analytical methods, the study employed various approaches, including visual network analysis, collaboration network analysis, keyword analysis, co-contribution network analysis, and co-citation network analysis. These methods were applied to detect visual networks within the animation field. Through these analytical techniques, the study showcased research hotspots, collaboration relationships, keyword trends, and academic contribution networks within the animation field. The findings revealed a steady increase in the number of publications and papers in the animation field in recent years, indicating that animation has become a highly researched topic. To delve deeper into the comparison between interactive animation and traditional animation, the study employed CiteSpace bibliometric technology and selected 4567 English-language and 1346 Chinese-language documents from the ScienceNet and China National Knowledge Infrastructure databases. Through a systematic evaluation, the study conducted a thorough analysis of the current status of interactive animation and traditional animation, highlighting their differences and projecting potential future trends for interactive animation. This comprehensive research provides a holistic perspective on academic studies in the animation field, contributing to a better understanding of the evolution and future directions of the animation industry.

Keywords: Interactive animation; Difference and Development trend; Bibliometric analysis CiteSpace.

1. Introduction

With the continuous advancement of computer network technology, animation development techniques are gradually improving. The expressive forms of animation are evolving from a singular form towards interactive formats. Against the backdrop of the rise of new media, animation is no longer confined to traditional platforms such as animated films, television, mobile phones, and digital TV. Currently, interactive animations place a greater emphasis on the audience's experience, including storylines, scene designs, and character portrayals. Creators strive to ascertain whether the audience can immerse themselves in the scenes and resonate with the work. The goal of interactive animation is to establish connections and bridges between humans and machines, as well as individuals. Most production teams are composed of young individuals who bring a unique perspective, focusing on current trends, entertainment elements, and fashion requirements. This is reflected in the works, encompassing aspects from character attire to language, dialogue, and character movements. On the other hand, during animation playback, creators provide a comment section for the audience. Viewers can leave comments, and the platform backend extracts exemplary comments based on audience feedback. This not only promptly informs creators of the audience's opinions on the work but also stimulates participant interest. These designs are based on the characteristics of young people, emphasizing interaction and feedback with the audience. With these trends, interactive animation is becoming a more enriched, innovative, and deeply interactive art form with the audience.

Interactive animation is a novel form of entertainment that involves aspects such as animation scenes, characters, composition, and color, similar to traditional animation. It shares intricate connections with traditional animation, continuing the fundamental concepts and formal standards of animation creation. Building upon the foundation of traditional animation, interactive animation introduces elements of populism, innovating in the form, production methods, and content of traditional animation. Emphasis is placed on the audience's emotions, with a heightened focus on audience engagement and immersion. The emphasis on audience interaction is a highlight of interactive animation and the most significant distinction from traditional animation. In summary, interactive animation, while inheriting the traditions of traditional animation, presents a more innovative and interactive form of entertainment by introducing new elements and ideas and emphasizing audience participation. This new animation experience allows the audience to directly immerse themselves in the animated narrative, creating a more immersive entertainment experience.

(1) The findings reveal that:

The number of papers in the Web of Science database is steadily rising, whereas the number of documents in the second China Knowledge Network (CNKI) is steadily decreasing. In comparison to other countries, China now has a big number of documents in the subject of interactive animation. Five of the top 15 institutions are Chinese, according to a review of the cooperative network of institutions. The most powerful countries are the United States, the United Kingdom, and China.

(2) The web of science database and the CNKI database have different emphasises, with CNKI having fewer study on Chinese interactive animation literature. Many studies on interactive animation may be found in the Web of Science database. They are complementary to one another.

(3) In the realm of animation, CNKI excels in traditional Chinese animation, animation production, new media, animation design, animation art, and animation virtual reality technology. The promise of multimedia learning, virtual reality, computer animation, authorized reality, and interactive animation, which are the keywords of interactive animation and traditional animation, are the top five in the web of science database. It will also be the primary research focus in the future.

Interactive animation, as a new art form, can be traced back to the mid-1980s when one of the founders of IDEO, Bill Moggridge, first introduced the term "interaction design." Brenda Laurel further explored the methods of building interactive design using script concepts in her book "Computers as Theatre." This art form has been widely applied and developed in various fields and industries. Interactive animation not only brings economic benefits to businesses but also provides visual enjoyment and educational inspiration for people. Its production involves a wealth of scientific and technological knowledge, spanning multiple disciplines such as design psychology and computer technology. In the field of medicine, interactive animation plays a crucial role. For instance, researchers at Shanghai Jiao Tong University conducted studies on the interactive experience of medical animation design. Additionally, a master's thesis by Sun Qian from Beijing University of Technology, titled "Interactive Design of Emergency Rescue Animation—A Case Study of Cardiopulmonary Resuscitation," extensively discusses the potential applications of interactive animation in the medical field. These studies aim to enhance people's awareness of sudden events in daily life and teach them how to effectively perform self-rescue. The application of interactive animation in critical moments before the arrival of professional rescuers can significantly reduce injuries and timely protect lives, making it highly reusable in the medical field. The interactivity generated by interactive animation facilitates easier retention of first aid knowledge, enhances engagement, and strengthens understanding of emergency response, thereby reinforcing the effectiveness of learning. Additionally, the audience gains the ability to think independently and experiences emotional engagement. Moreover, through social platforms, interpersonal interaction is further amplified, extending the powerful and widespread impact of interactive animation.

This article utilizes the Web of Science, a scientific literature database that covers the most comprehensive and authoritative literature globally, for the collection and organization of relevant literature on interactive animation and traditional animation. Web of Science stands as one of the largest scientific literature databases in the world, making it the chosen data source. Through the analysis of literature from various countries and institutions, it is observed that China holds significant influence globally, ranking just below the United States and the United Kingdom. To gain a deeper understanding of the trends in the animation field, the study employs CiteSpace, a literature metric analysis software. A dataset consisting of 3,598 English-language articles and 960 Chinese-language articles collected from Scopus, Web of Science, and CNKI is used for the animated data study. The main focus is on exploring the correlations and comparative relationships between traditional animation and interactive animation in terms of annual publication quantity, disciplinary distribution, highly cited research, research institutions, literature keywords, authors, and national network analysis in the field. The research also places emphasis on national cooperation network analysis and research hotspots, providing a comprehensive overview of the current state of the animation field by comparing literature across the three databases. Lastly, building upon this foundation, the article further explores the frontiers and trends in traditional and interactive animation. This serves as a valuable reference for subsequent scholars and practitioners, facilitating a rapid and convenient understanding of the developments in the relevant field. Such insights contribute to enhancing national cultural strength and advancing cultural initiatives.

2. LITERATURE REVIEW

Art should align with the technology and development that is adapted to society. In the art world, artists have sought new expression media and carriers with the development of new media technology and the onset of the digital age. The article "Interaction Representation and Application of Flash Animation in Webpage Design" delves into the role of animation in web design. Another piece of research, titled "Research on interactive and animation elements of interaction picture book based on children's cognition," explores the innovative application of animation in children's picture books. In addition, there's a study on the reunderstanding of "from immersion to flow experience - immersive communication" of virtual reality images. The application of interactive images in film and television is also examined, along with research on animation lens language in a multi-dimensional context. The relationship between art works and viewing has evolved into a form of interactive communication, marking a departure from the traditional passive dynamic. The term "interaction" is derived from the literal meaning of "interaction" in English, referring to the interplay between two or more entities. In the realm of human-computer interaction and design, interactive design has gained widespread use, encompassing human-computer interaction and emotional interaction, such as the story design method. The emergence of interactive animation as a new art form is closely linked to the rapid development of the digital age, where interactive design finds extensive application in various fields. Interactive animation, as a cultural film and television product, has evolved in tandem with the rise of multimedia information, network technology, and interactive technology. It represents a new form of digital animation. Interactive animation, as defined, supports event response and interactive functions in the dissemination of animation works. It allows for author and audience participation, enabling control over animation playback and the storyline's direction. Consequently, audiences can shift from the passive role of traditional animation viewers to active participants, transforming the dynamic from the "narrator" and "viewer" identity in traditional animation to the "interactive" experience of identity exchange between "participant" and "other."

What is interactive animation? As the name suggests, the concept of interactive animation is the combination of interaction and animation. This is a combined noun. It

represents the beginning of emerging animation in the field of animation. At present, interactive animation is still in the primary development stage, and interactive animation is not yet mature in related fields and technical levels. Whether from the way of presentation, creative techniques, or technical means, there is no clear conclusion on interactive animation at the theoretical level. In terms of the nature of interactive animation itself, it is to let the audience experience, feel, complete and understand the profound connotation of art works through interactivity. The audience here is not only an ordinary audience, but also gives multiple identities such as participants, creators and viewers.

There are four main similarities and differences between interactive animation and traditional animation:

(1) Interactive animation is different from traditional animation in the way of artistic expression. It is a colorful non real and virtual real picture created by using the technology of computer, art and other disciplines. It provides a new world for displaying personal imagination and artistic talent. Compared with traditional animation, the virtual space constructed by interactive animation using digital analog technology has actually far exceeded the screen, which also includes the emotional sustenance of the audience and the emotional experience of the participants. Interactive animation needs a good narrative structure. Yu Shui, an associate professor at Beijing University of Aeronautics and Astronautics, abstracted the interactive narrative structure into three interactive narrative structure models in his article from nonlinear narrative film to interactive narrative film . In fact, interactive animation meets the audience's emotional experience to a great extent and can resonate with the audience in time and emotion.

(2) Another difference between interactive animation and traditional animation is that, for example, it is relatively "free" to play a "new role" Color "and may interact with other characters that do not exist in the original environment . In the process of narration, traditional animation conveys some content and information from the theme of narration, which is "one-way". In traditional animation, the audience is passive and can only infer or watch the animation according to the director or the plot of the story. The object of narration belongs to the passive receiver. As the receiver of narration, the audience accepts the content described by the main body of traditional animation, this is a kind of "one-way" nature. In the narrative process of interactive animation, the audience is no longer a simple "receiver" The audience can no longer control the beginning and end of the film based on their own preferences, and the audience can no longer make their own interactive narration based on their own preferences, adjust your own video clips and watch the interactive forms and contents selectively. beyond all doubt, Interactive animation breaks the original "one-way" of traditional animation "The way of narration makes the audience change from the recipient to the active one, so that the viewer has more discourse power and the audience can interact with it. It makes the narrative more open, comfortable and positive. In addition, the narrative mode of interactive animation does not necessarily refer to interpersonal relationship, but also human-computer relationship and machine-machine relationship, and there can also be more complex relationships, mutual influence and interaction .Let the audience participate in art, enjoy art, experience art, understand art, stimulate their interest in art, and even make some art lovers become real artists and animation designers.(3) The most significant disparity between interactive animation and traditional animation lies in their distinct design and production approaches. Notably, traditional animation exhibits disparities in understanding between the designer and the audience during the creation process. In this traditional paradigm, audiences lack insight into the designer's intended expression or conceptualization. Only upon completion of the animation design and the presentation of the final product can audiences comprehend or speculate on the intended meaning. Despite potential resonance between the audience and the creator, direct communication and integration across the gap between creation and appreciation remain challenging. The advent of interactive animation holds the promise of transforming this enduring situation. Interactive animation places a heightened emphasis on the taste and aesthetics of works during the creation process. This implies that, prior to initiating each project, creators must envisage from the standpoint of audience appreciation. Leveraging interaction and its distinctive forms, interactive animation seeks to construct a communicative bridge between designers and viewers, thereby ushering in a novel mode of expressive communication. In the realm of interactive animation creation, compared to its traditional counterpart, it is characterized by greater inclusivity, complexity, and creativity. A notable feature distinguishing interactive animation is its selective addition capability. However, this characteristic introduces a heightened level of difficulty for creators who must grapple with challenges in creative thinking. Creators are tasked not only with considering the interactivity of the work but also with ensuring the creativity of the story content, the appeal of the story plot, and the profound meaning of the content. Furthermore, creators must make nuanced choices catering to diverse audience segments with varying cultural backgrounds, psychological profiles, participation requirements, tastes, and aesthetics. The goal is to achieve a comprehensive approach—from passive to active—to meet the diverse aesthetic needs of the audience.

The distinction between interactive animation and traditional animation extends to variations in thinking and experience. Traditional animation relies on a closely linked plot structure where the audience, engrossed in the unfolding narrative, has minimal opportunity for rational contemplation. Viewers follow the predetermined sequence crafted by the designer, fearing the loss of crucial plot elements. Only upon completion of the entire cartoon can rational reflection on the story occur. In contrast, interactive animation provides audiences with the flexibility to control the timing of content consumption, allowing ample time for rational thought. Furthermore, interactive animation introduces customization options, enabling viewers to tailor music and sound effects based on personal preferences. This departure from fixed dynamic changes in traditional animation signifies a substantial shift, granting audiences the agency to alter sound effects for a personalized experience. The selection of background music can vary across animation scenes, enhancing user engagement. In terms of visual form, interactive animation seamlessly integrates elements from both traditional and modern animation technologies. The efficacy of visual form lies in its captivating ability, requiring the addition of interactive elements to visually stunning images while preserving traditional animation's essence. The introduced operability sets interactive animation apart, rendering its visual expression and content richness incomparable to traditional animation. Widely utilized across

various disciplines, interactive animation serves as a versatile tool for presenting teaching materials in the form of animation and games. It stimulates visual senses, elucidates the causality of image sequences, ensures visual coherence, and encourages imaginative engagement to bridge gaps in still images. Numerous studies have demonstrated that animation reduces cognitive load and enhances learners' comprehension. When used as a supplement in teaching, animation significantly improves learning effectiveness and motivation. Examining the broader landscape of animation studies, research methods are continually evolving. While there is a scarcity of papers utilizing bibliometrics, particularly CiteSpace, to study the animation domain, there is almost a complete absence of papers applying econometric analysis to relevant theories.

The existing literature primarily focuses on comparing and analyzing specific aspects of traditional animation and interactive animation, lacking a systematic and comprehensive analysis of the overall development of the animation field. This research, sourced from English databases such as Web of Science and Scopus, is augmented by the inclusion of CNKI for a more comprehensive study. To achieve a thorough understanding of the data development and research trends in interactive animation and traditional animation, this paper utilizes three databases—Web of Science, CNKI, and Scopus—as data sources for bibliometric analysis. This approach aims to provide a more holistic perspective on the evolution of animation by incorporating diverse sources and conducting a comprehensive exploration of the subject matter. DATA PROCESSING

To facilitate CiteSpace analysis, data collection involves a two-step process. The initial step is the identification of a suitable database for downloading data. It is imperative to select a comprehensive and high-quality database that encompasses a vast array of authoritative academic papers. This ensures the availability of extensive and reliable references. The data for this article was sourced from two primary databases: CNKI (China National Knowledge Infrastructure) and Web of Science. CNKI comprises various indices, including the Chinese Social Science Citation Index (CSSCI), Social Science Citation Index (SSCI), Engineering Index (EI), Science Citation Index Expanded (SCI Expanded), and Arts and Humanities Citation Index (AHCI). Covering nearly 13,000 leading journals globally, CNKI offers strong access channels. Examples of bibliometric analyses by professors Li Jie and Chen Meichao are accessible through this platform. Searching through subject words or keywords allows for the retrieval of articles, and refining the search using criteria such as "abstract," "keyword," "author," "organization," "first author," and "tutor" enables precise searches. The relevance of each article can then be assessed. The search was conducted using keywords "traditional animation" and "interactive animation," yielding a total of 760 articles related to traditional animation and 960 articles associated with interactive animation from 2013 to 2022. This period is chosen as the primary focus of the article because it witnessed the increasing involvement of interactive animation, with publications gradually rising. Simultaneously, traditional animation underwent noteworthy changes during this timeframe, transitioning from traditional hand-painted frame-by-frame animation to a format no longer confined to freeze-frame animation.

CiteSpace software is a visual information analysis software . It is a Java application program for analyzing and visualizing the co-occurrence network developed by Professor Chen Chaomei of the school of information science and technology of Russell University . Some important steps are required before CiteSpace carries out graphic visualization. For example, before visualizing CNKI, first enter CNKI to download relevant data, select the format type as refwork format, and then rename it as download_ xx. Txt format must create a folder. The folder contains the following four parts: input, output, data and project. Then open the cite space software, click data, put the data downloaded from CNKI into data, convert the data (into wos format), and then click the "new" button to establish the project directory, which is project and data respectively. On the right side of the interface, you can select some types of graphics, such as author, country, institution, citation, etc. When the color of the "go" button is green. Click, and then the data starts calculation. Next, wait for the graph to stop and the visual analysis results are presented. It is relatively simple for web of science data to carry out graphic visual analysis in cite space. It only needs to establish a folder, which includes data and project, and then download the text downloaded in the web of science database. Text format into the data folder, and then establish a project between them (there are more types of co-occurrence analysis that Wos can choose than CNKI), select the corresponding type, click the button "go", and enter the interface to adjust the size, clustering, node, threshold, keyword node, etc. of the graph after the graph is generated.

3. METHODOLOGY

The research of this paper adopts the method of bibliometrics. For the collected data, CiteSpace is used for scientific and visual analysis . There are many methods for visual analysis with CiteSpace software, including author cooperation network analysis, national and regional cooperation network analysis, institutional cooperation network analysis, keyword co-occurrence analysis, keyword cluster analysis, co-occurrence analysis of subject keywords or wos classification, co-citation analysis of literature, co-citation analysis of authors and co citation analysis of journals,etc.

The main research method of this paper is to use the collected data for annual distribution and CiteSpace. Its main functions include analysis of the cooperative network of authors, institutions and countries, co-occurrence analysis of subject keywords or wos, co-citation analysis of literature, co-citation analysis of authors, co-citation analysis of journals, and coupling analysis of literature . Main research institutions: cooperation network analysis, national regional cooperation network, author, references, keyword co-occurrence, subject words. The size of nodes reflects the frequency of topics, keywords or fields. In the cooperative network analysis, the cooperative network analysis of authors, institutions or countries. The size of nodes in the network reflects the number of documents issued by authors, countries or institutions. Annual distribution helps to understand the development trend or trend of a discipline or field, and whether there is research value in this field. Through the analysis of major research institutions or their collaborators, we can know the distribution of research intensity in this field. Keyword co-occurrence analysis can reveal the theme and key topics of the paper. And the key factors and cutting-edge knowledge of the development of the whole animation field .

The threshold of city space is set to 1990-2022, and the time slice is 1 year. After the threshold is set, select the type

of visual analysis required in turn in the object analysis function panel, including organization, country, author, references, keywords, etc. Some types can also be selected for cluster analysis, and the function of CiteSpace can be used to draw the map of scientific knowledge. In the right control panel, you can adjust the threshold, the size of nodes and the color of graphics. Finally, we can also analyze the chart .

Table 1 lists the main topics related to the animation field. Among the 6033articles and papers, there are some newspapers, meetings, etc. It can be found that there are 1489 papers on Computer Science software engineering, accounting for 32.60% of the whole paper, and 867 papers on computer science theory methods, accounting for 18.980% of the whole paper; There are 644papers on electrical engineering, accounting for 14.10% of the total. These are an important research field of wos. Computer Science Interdisciplinary Applications、Computer Science Artificial Intelligence、Education Scientific Disciplines、 Computer science information systems, computer science cybernetics and imaging science photographic technology are also some important disciplines involved in the field of animation. It also plays an important role in the development of animation field.

Table 1. Topic10 distribution of studies on interactive animation from WOS

NO	Topic	Quantity	Proportion
1	Computer science software engineering	1489	32.60%
2	Computer science theory methods	867	18.98%
3	Engineering electrical electronic	644	14.10%
4	Computer science inerdisciplinary applications	636	13.91%
5	Education educational research	597	13.07%
6	Computer science artifical intelligence	580	12.70%
7	Computer science information systerms	492	10.11%
8	Education scientific disciplines	270	5.91%
9	Imaging science photographic technology	232	5.07%
10	Computer science cybernetics	226	4.90%

As can be seen from table 2, the international institutions with the highest frequency of publication are cited. Almost one third of the top 15 countries are Chinese institutions. And most of them are economically and culturally developed countries or countries with strong national soft power. These countries also pay very high attention to the field of animation. It can be seen from this table that the institutions with the highest document distribution rate in the United States are followed by China, South Korea and Japan. Among them, Carnegie Mellon Univ has the highest publishing rate, with 23 papers at the top of the list. Other universities with a high number of papers are Zhejiang Univ, aicfve Beijing Film Univ, Seoul Natl Univ, Univ Tokyo, Korea adv Inst Sci & Technol, Haiyang Univ and Univ British Columbia, And North Umbria Univ have published 11 papers. It can be concluded from the table that China is the largest contributor to the research in this field, including 5 institutions (Zhejiang University, Beijing Film Academy, Ocean University, Beijing University of Aeronautics and Astronautics and Nanjing University of science and technology, ranking No. 2, 3, 7, 10 and 14 respectively). Therefore, China has a great influence and plays a great role in this research field.

Table 2. Top 15 institutions for frequently published studies on interactive animation from WOS.

No	research institute	frequency	centrality	year
1	Carnegie Mellon Univ	23	0.21	2013
2	Zhejiang Univ	17	0.13	2013
3	Seoul Natl Univ	15	0.01	2013
4	Univ Tokyo	14	0.03	2014
5	Korea Adv Inst Sci & Technol	12	0.00	2014
6	Hanyang Univ	12	0.07	2014
7	Beihang Univ	11	0.00	2013
8	Adobe Res	11	0.04	2014
9	Northumbria Univ	11	0.04	2013
10	Univ British Columbia	11	0.03	2014
11	Georgia Inst Technol	9	0.02	2013
12	Univ Edinburgh	9	0.04	2016
13	Bournemouth Univ	8	0.00	2013
14	Nanjing Univ Sci & Techno	8	0.00	2018
15	Disney Res	8	0.004	2013

From this table that the institutions with the highest document distribution rate in the United States are followed by China, South Korea and Japan. Among them, Carnegie Mellon Univ has the highest publishing rate, with 23 papers at the top of the list. Other universities with a high number of papers are Zhejiang Univ, aicfve Beijing Film Univ, Seoul

Natl Univ, Univ Tokyo, Korea adv Inst Sci & Technol, Haiyang Univ and Univ British Columbia, And North Umbria Univ have published 11 papers. It can be concluded from the table that China is the largest contributor to the research in this field, including 5 institutions (Zhejiang University, Beijing Film Academy, Ocean University, Beijing University of Aeronautics and Astronautics and Nanjing University of science and technology, ranking No. 2, 3, 7, 10 and 14 respectively). Therefore, China has a great influence and plays a great role in this research field.

The data presented in Table 3 is about the research of papers related to interactive animation. The title, year of publication, author and journal source of the top 10 articles cited. From the table, it can be found that the field of interactive animation is not only the field of art and humanities. Compared with traditional animation, the discipline field of traditional animation design is not extensive, that is, multimedia information technology Interactive animation such as film and television animation involves some engineering, computer graphics, medicine and so on. Thus, interactive animation is also one of the important research topics in the field of multimedia information animation. Among the 10 articles published on the platform of graphics, there are three most frequently cited articles in this journal, which can be seen from the table of graphics. Quantitative analysis of the studies on interactive animation from WOS.

Table 3. Top 10 most highly-cited studies on interactive animation from WOS

NO	Title	Author	journal	frequency	Year
1	A morphable model for the synthesis of 3D faces	Blanz, V	computer graphics	2039	1999
2	Animation: can it facilitate	Tversky, B	international journal of human-computerstudies	864	2002
3	Interactive evolutionary computation: Fusion of the capabilities of EC optimization and human evaluation	Busso, Carlos	language resources and evaluation	816	2008
4	interactive emotional dyadic motion capture database	Takagi, H	proceedings of the IEE	774	2001
5	Stable fluids	Stam, J	computer graphics	743	1999
6	Feature-based image metamorphosis	BEIER, T	computer graphics	459	1992
7	Interactive control of avatars animated with human motion data	Lee, JH	ACM transaction on graphics	361	2002
8	As-rigid-as-possible shape manipulation	Igarashi, T	ACM transaction on graphics	356	2005
9	Style-based inverse kinematics	Grochow, K	ACM transaction on graphics	354	2004
10	Physically based deformable models in computer graphics	Nealen, Andrew	computer graphics	347	2006

3.1. A review of the literature found on the web of science

Figure 1 shows that in 1990, web of science conducted a preliminary study on interactive animation for the first time. The research results show that the number of papers published during this period is small, indicating that interactive animation has not attracted extensive attention of scholars at home and abroad, and the number of publications per year is very small. From 1990 to 1997, more and more publications were published in the field of interactive animation, which shows that more and more experts and scholars began to pay great attention to interactive animation. During the 20 years from 1998 to 2017, the literature of web of science gradually increased and began to grow rapidly. The number of international papers on interactive animation has increased from 86 to 373. As of February 2022, 20 papers have been published in 2022. It is expected that more papers will be published in the future. The data presented in table4 are related to the research on interactive animation, the title of the 10 most cited articles, the author of the year of publication and the source of the journal. From the table, it can be found that the fields involved in interactive animation are not only the arts and humanities. Compared with traditional animation, the subject area of traditional animation design is not extensive, and interactive animation such as multimedia information technology, film and television animation involves some engineering, computer graphics, medicine, etc. It can be seen that interactive animation is also one of the important research topics in the field of multimedia information animation. It can be found from the table that 3 of the 10 most frequently cited papers were published on ACM transaction on graphics, and 3 were published on Computer graphics. It can be seen that these two journals are related to research. one of the most important platforms.

3.2. Research institutions

Table 4 shows the 15 international institutions with high publishing frequency. Among the top 15 international institutions, three are Chinese institutions, among which Zhejiang University ranks first in the number of publications. It can be seen that Chinese scholars have made outstanding contributions to the research of interactive animation. In addition, there are two institutions, namely Nanyang University of technology and China Academy of science. Among them, Zhejiang University and China Academy of

science The centrality values of are relatively high, 0.03 and 0.02 respectively, indicating that their research results are still worthy of reference for scholars. Figure 2 shows the cluster analysis diagram of research institutions published on the literature related to interactive animation and traditional animation. It can be concluded from the diagram that the intensity of lines between these institutions is relatively large, and the lines are relatively dense first, indicating that there is a cooperative relationship between them.

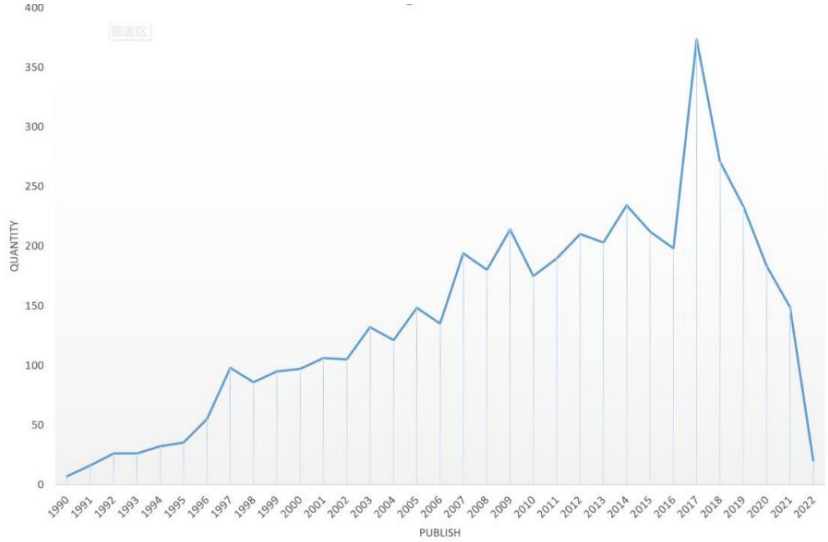


Fig. 1 Annual distribution of the studies on interactive animation from WOS

Table 4. Top 15 institutions for frequently published studies on interactive animation from WOS.

NO	Resaerch Institution	quantity	centrality	Year
1	Zhejiang Univ	53	0.03	2004
2	Nanyang Technol Univ	42	0.00	1997
3	Carnegie Mellon Univ	37	0.04	1999
4	Univ Tokyo	33	0.01	2001
5	Chinese Acad Sci	32	0.02	2001
6	Stanford Univ	27	0.02	2000
7	Univ British Columbia	27	0.01	2001
8	Univ Louisville	25	0.00	2007
9	Univ Washington	25	0.00	2002
10	Univ Toronto	24	0.02	2002
11	Arizona State Univ	24	0.00	1997
12	Seoul Natl Univ	22	0.00	2001
13	Purdue Univ	22	0.00	1997
14	Bournemouth Univ	22	0.02	2002
15	Swiss Fed Inst Technol	21	0.01	1999

Table 5. Top 10 most highly-cited studies on interactive animation from WOS

NO	Title	Author	journal	frequency	Year
1	A morphable model for the synthesis of 3D faces	Blanz, V	computer graphics	2039	1999
2	Animation: can it facilitate	Tversky, B	international journal of human-computerstudies	864	2002
3	Interactive evolutionary computation: Fusion of the capabilities of EC optimization and human evaluation	Busso, Carlos	language resources and evaluation	816	2008
4	interactive emotional dyadic motion capture database	Takagi, H	proceedings of the IEE	774	2001
5	Stable fluids	Stam, J	computer graphics	743	1999
6	Feature-based image metamorphosis	BEIER, T	computer graphics	459	1992
7	Interactive control of avatars animated with human motion data	Lee, JH	ACM transaction on graphics	361	2002
8	As-rigid-as-possible shape manipulation	Igarashi, T	ACM transaction on graphics	356	2005
9	Style-based inverse kinematics	Grochow, K	ACM transaction on graphics	354	2004
10	Physically based deformable models in computer graphics	Nealen, Andrew	computer graphics	347	2006



Fig.2 Institution cooperation network map of interactive animation from WOS

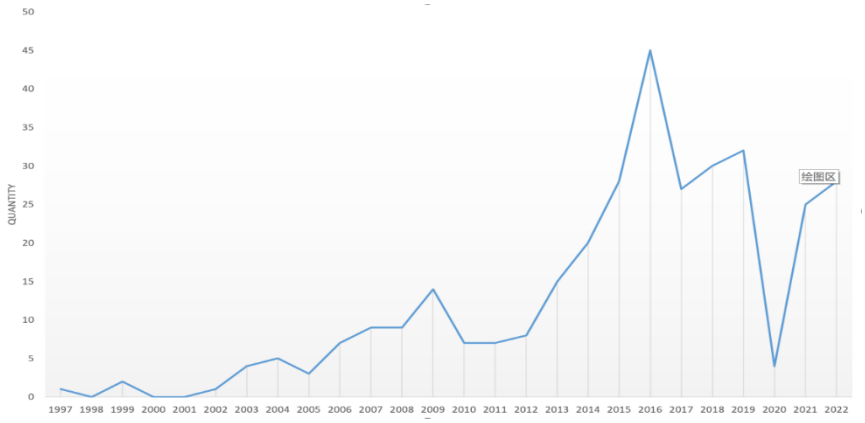


Fig.3 Annual distribution of studies on interactive animation from CNKI.

3.3. Analysis of the literature from CNKI

The scope of the paper set in this paper is from 1997. The first article published by CNKI, the method of developing three-dimensional interactive animation with Visual C + + published by sun Shaobin and Liu Changzheng of the technical office of Bengbu tank college, has become the first paper to study interactive animation on CNKI, which has great reference value. At that time, it received the attention of GF. The first CNKI article within the query scope set in this paper was published in 2012 and peaked in 2017, with 45 items. However, after 2014, the number of published studies began to decrease year by year, with 45 studies in 2016. There are 28 studies as of February 2022. Publications may continue to decrease in the future. In the past few years, the decline in the number of CNKI publications in this field is in sharp contrast to the steady growth of W & S.

Table 6 Discipline Distribution of China HowNet on sustainable urbanization research. Computer application technology is the main research topic in China. Of the 423 Chinese Studies in the sample, 38.98% involved related issues. Another 30% are related to education, industry and. The distribution of research directions can be seen by analyzing the literature cited most frequently in CNKI.

Table 6. Discipline distribution of the studies on interactive animation from CNKI (top 10).

NO	Topic	quantity	proportion
1	Computer software and computer application	175	38.98%
2	Art, calligraphy, sculpture and photography	81	18.04%
3	Drama, film and Television Art	45	10.02%
4	Educational theory and educational management	26	5.79%
5	vocational education	21	4.68%
6	Higher Education	13	2.94%
7	Internet technology	11	2.45%
8	News and media	9	2.00%
9	General industrial technology and equipment	9	2.00%
10	secondary education	6	1.34%

Table 7 lists the 10 most cited studies. In terms of institutions, most of the institutions publishing relevant

literature in the field of interactive animation are well-known universities or research institutions, and most of the international organizations with the highest publishing frequency are from China. The institution with the largest number of papers and the strongest influence is the Chinese Academy of Sciences, which reflects the important global contribution of Chinese institutions to the field of interactive animation. Compared with CNKI research, the institutional cooperation of W&S research is relatively close and scattered, without aggregation effect and scale effect.

Table 7. Top 10 most highly-cited studies on interactive animation from CNKI.

NO	Title	Author	journal	frequency	Year
1	New aesthetic changes of interactive animation	Huang Benliang	cinematic literature	28	2011
2	Research on the application of interactive animation in interface design	Cao Huai	Packaging engineering	26	2009
3	Implementation of real-time interactive animation in VRML virtual scene	Gao jianhong	Packaging engineering Journal of Suzhou University	21	2009
4	Research on the art form of network interactive animation	Wang Ke	Decorate	21	2017
5	Complex modeling transformation and interactive animation under OpenGL	Liu Gang	Journal of Engineering Graphics	21	2005
6	Research on the development and application of visual communication dynamic design in new media environment	Ni Dan	Research on Art Education	19	2019
7	Complex modeling transformation and interactive animation under OpenGL	Qiu Meiling	Art and design (Theory) science and technology	18	2015
8	Research on interactive animation of flash network animation technology under digital media technology in the new era	Cheng Xiaojun	Popular literature and art	18	2013
9	Research on classification production and development trend of animation under New Media Art	Lin Xuefei	Art and design (Theory) science and technology	18	2010
10	Advanced application of ActionScript in making interactive animation in flash	Jian Wang	innovation guide	18	2008

In terms of institutions, most of the institutions that publish related literature in the field of interactive animation are well-known universities or research institutions, and most of the international organizations that publish the most frequently come from China. The institution with the largest number of papers and the strongest influence is the Chinese Academy of Sciences, reflecting the important global contribution of Chinese institutions to the field of interactive animation. Compared with CNKI research, the institutional cooperation of W&S research is relatively close and scattered, and there is no aggregation effect and scale effect

4. Conclusions

It has been a long time since the emergence of CiteSpace. Although bibliometric analysis is basically used in most fields, there are relatively few articles using CiteSpace for literature analysis in the field of animation. The research object of this study is the research on the development of animation in recent 10 years. Objectively evaluate the characteristics and development trend of animation at home and abroad. Through the understanding of the development trend and characteristics of animation at home and abroad, this study hopes to bring some useful references to scholars in the future. Starting from the data collection of web of science database, different search methods are used, including subject word search, journal type, author search, keyword search and so on. The study uses CiteSpace for data visualization research. The research results have certain reference value. Firstly, this paper selects the relevant papers on traditional animation and interactive animation in recent ten years for research. From 1990 to 2022, all the papers on this research are screened and analyzed. It is found that the publications of relevant papers in this field have increased since 2013, and the increasing trend is very significant. Using the combination of bibliometric analysis and visual analysis, this paper provides an updated bibliometric analysis method for the following researchers. The paper makes a scientific bibliometric analysis of the literature records of traditional animation and interactive animation based on cite space, which provides a unique and valuable research for the related fields of traditional animation and interactive animation. It can be concluded from the results. Firstly, the published data show that the number of researchers studying this animation field has increased significantly from 2013 to 2022, especially in the past five years. Traditional animation and interactive animation involve more and more fields of learning. From the perspective of the distribution of discipline classification, it has become an interdisciplinary research. Secondly, the research in the field of traditional animation and interactive

animation has spread all over the world, mainly led by some developed countries. For example, the United States and Britain. These countries are mostly countries with a large number of documents. Moreover, there are relatively many authors and institutions. These countries have played a great role in the cooperative relationship and pay more attention to this animation field. Such cooperative relationship is gradually established from 2018 to 2020. Although research in this field has become more comprehensive and critical, there is still a lot of space to fill . First of all, there are relatively few scams related to east ring in developing and less developed countries, which need urgent attention. So far, almost all research work in this field has focused on developed countries and regions. Such as the United States, Britain, South Korea, Japan and so on.

These results extend the previous bibliometric analysis of traditional animation and interactive animation. Because the scientific metrology software CiteSpace is used, it provides insights into the scientific structure and identifies potential relationships by visualizing them. However, in order to expand the breadth and scope of the study, further in-depth research can be carried out in the following aspects:

(1). More comparative analysis on the correlation between traditional animation and interactive animation can be analyzed, because the research in this area is relatively few and immature. There is almost no scientific econometric analysis of relevant theories found on the web of science and CNKI.

(2). We should use scientific metrology tools such as CiteSpace to explain and deal with self citation in order to get more accurate and reliable conclusions.

(3). Combined with visualization technologies in different disciplines, it can provide a comprehensive visualization map between traditional animation and interactive animation, such as analyzing the correlation, clustering coefficient and distribution degree between the two nodes.

The combination of bibliometrics and visual knowledge map provides scholars with a more reliable way of literature review to help them comprehensively and systematically understand the development process and evolution of hot spots in a certain field. Similarly, some studies use bibliometric methods to analyze the research literature of interactive animation, but the existing studies mainly analyze from the dimensions of evaluation indicators and urban environmental protection, and have not made a comprehensive analysis of the research status in the field of animation. With the help of visual measurement software, this study collects and analyzes the authors, research institutions, countries, keywords, citations and source journals of the literature in this field, which more intuitively and accurately reflects the current research hotspot and development trend. Provide ideas for future related research. At the same time, considering the prominent influence of Chinese scholars in this field, it does not cover the authoritative English literature, but further introduces the literature in the authoritative Chinese database to analyze the similarities and differences between the two, which covers the research of Chinese scholars more comprehensively than other literature analysis and research. The results show that the research trends of web of science and CNKI are related, but there are great differences in research institutions, discipline distribution and research hotspots. Therefore, it is necessary to integrate the literature in CNKI database and compare the literature in Chinese and English databases. Finally, for the future bibliometric research, if the research contribution and influence of non-English speaking countries in a certain field are particularly prominent, it is suggested that researchers also consider incorporating the authoritative literature in the local database, so as to better understand the global research frontier and development trend.

References

[1] Liu X, Tan Y. Functional development and research of interactive animation art in the context of new media. Western Leather. 2016(3818):64.

[2] Sun Q. Research on Interactive Design of Emergency Rescue Animation [dissertation]. Beijing University of Technology; 2016.

[3] Feng W. Research on Interactive Experience of Medical Animation Design [dissertation]. Shanghai Jiaotong University; 2011.

[4] Quan Y, Wang C. Interactive Art: New Audio Visual. Beijing: China Light Industry Press; 2007:16.

[5] Yang SS. Interaction Representation and Application of Flash Animation in Webpage Design. Applied Mechanics and Materials. 2014;3335.

[6] Xiang Z, Zhang L. Research on Interactive Animation Elements of Interaction Picture Book Based on Children's Cognition. In: Proceedings of 2014 IEEE International Conference on Progress in Informatics and Computing. IEEE Beijing Section; 2014:247-250.

[7] Kong S. From immersion to flow experience: Re-understanding of "immersive communication." Journal of Capital Normal University Society Science Edition. 2019;(04):74-83.

[8] Yang Y, Jia X. Research on visual guidance and line of sight interaction of virtual reality image. Contemporary Animation. 2019;(04):94-97.

[9] Ji Y. Application of Interactive Image in Film and Television [dissertation]. Shandong Normal University; 2019.

[10] Zhang Z. Research on Animation Lens Language of Multi-dimensional Language Environment [dissertation]. Veterinary Academy of Fine Arts; 2019.

[11] Shao Y. Interactive Animation Design and Application of Mobile Terminal App. Popular Literature and Art. 2017;24:52-53.

[12] Elleström, E. (2010). The modalities of media: A model for understanding intermedial relations. In L. Elleström (Ed.), Media borders, multimodality and intermediality; pp. 11–48.

[13] Lin L. Research on User Experience Design of Interactive Animation Based on Audio-Visual Language [doctoral dissertation]. Hubei University of Technology; 2020.

[14] Water. From Nonlinear Narrative Film to Interactive Narrative Film. Contemporary Film. 2012;2012(11):101-106.

[15] Bai X, Li Y. Innovative Thinking of Interactive Art. Beijing: China Light Industry Press; 2007:23-24.

[16] Meter P, Cui Y. Interactive Virtual Narrative Thinking of Interactive Animation in the Overall Aesthetic Field. J Chengdu Univ (Soc Sci Ed). 2015;2015(01):100-103.

[17] Geng S. Media and Audience Psychology of New Media Animation. Art Educ. 2015;2015(8):218.

[18] Li S. Introduction to Digital Media Art. Beijing: Tsinghua University Press; 2006:3.

[19] Cai M. Interactive Animation Design of Mobile Terminal Based on Story Design Method [doctoral dissertation]. Hubei University of Technology; 2012.

[20] Qi W. Research on Museum Exhibition Art of Mobile Terminal [doctoral dissertation]. Xi'an University of Engineering; 2018.

[21] Mo Y. Design and Implementation of Interactive Narrative Animation Based on Mobile Terminal [doctoral dissertation]. Wuhan Textile University; 2019.

[22] Chen C. CiteSpace: A Practical Guide for Mapping Scientific Literature. Hauppauge, NY, USA: Nova Science Publishers; 2016.

[23] Chen Y, Chen C, Hu Z, et al. Citation Spatial Analysis: Principles and Applications - A Practical Guide to CiteSpace. Beijing: Science Press; 2014.

[24] Chen Y, Chen C, Liu Z, et al. Methodological Function of CiteSpace Knowledge Graph. Scientific Research. 2015;2015(2).

[25] Li J, Chen CM. Citespace: Scientific Text Mining and Visualization. Capital University of Economics and Business Press; 2016.

[26] Chen C. CiteSpace II: Detecting and visualizing emerging trends and transient patterns in scientific literature. J Am Soc Inf Sci Technol. 2006;57(3):359-377.

[27] Zhao RY, Xu LM. The knowledge map of the evolution and research frontiers of Bibliometrics. J Libr Sci China. 2010;36(5):60-68.

[28] Zhang D, Xu J, Zhang Y, Wang J, He S, Zhou X. Study on sustainable urbanization literature based on Web of Science, Scopus, and China National Knowledge Infrastructure: A scientometric analysis in CiteSpace. J Clean Prod. 2020; 264:121537.