Journal Elektronik Sistem InformasI (JESII)
Volume 3 No 2 December 2025
DOI: xxxx.xxxx

E-ISSN: 2988-585X (Online)

Trends in AI-Generated Graphics Research: Bibliometric Analysis of Publication 2020-2025

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Article Info

Article history:

Received June 26,25
Revised Nov 23,25
Accepted Dec 18,25

Keywords:

Bibliometrics
VOSviewer
AI-generated graphics
Text-to-image
DALL·E
Midjourney
Stable Diffusion

ABSTRACT

This study aims to identify trends and developments in scientific research on AI-generated graphics during the period 2020–2025 using a bibliometric approach. The analysis focuses on publication trends, institutional and country collaborations, thematic distributions, and research network visualizations. Bibliometric data were collected from the Scopus database, resulting in 4,968 scientific documents retrieved using keywords such as "AI-generated graphics," "text-to-image," "DALL-E," "Stable Diffusion," and "Midjourney." The analysis was conducted using VOSviewer to examine keyword co-occurrence, co-authorship, co-citation, and bibliographic coupling. The results show a significant increase in publications, with a notable peak in 2024. China emerged as the leading contributor, followed by the United States, supported by major research funding institutions such as the National Natural Science Foundation of China (NSFC). Thematic analysis indicates a shift from GAN-based models toward diffusion-based text-to-image models, accompanied by growing attention to semantic, ethical, and social issues. Network visualization reveals ten major research clusters, including health, digital arts, and computer vision. Unlike previous bibliometric studies that primarily focus on general artificial intelligence or isolated generative models, this study provides a comprehensive and up-to-date mapping of AI-generated graphics research by integrating technological evolution, creative AI platforms, and ethical dimensions within a single analytical framework. These findings offer a holistic understanding of the research landscape and serve as a foundation for future technological development and interdisciplinary collaboration in AI-generated graphics.

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1. INTRODUCTION

The development of artificial intelligence (AI) technology in the field of computer graphics has driven a major transformation in the way humans create and manipulate digital visuals. One of the most notable

advances in the last decade has been the emergence of text-to-image synthesis models, which enable AI to generate images from text-based command alone. This technology has not only changed the way humans create visual content, but also accelerated the design process, expanded access to visual production, and created new opportunities in the fields of art, creative industries, and scientific research.

Varios studies have been conducted to examine the capabilities and applications of generative models such as DALL-E, Stable Diffusion, and Midjourney. The DALL-E 2 model developed by OpenAI is a generative AI system capable of generating images based on written descriptions [1], for product design, this technology creates design variations according to a concept, making it easier to select attractive designs [2]. Stable Diffusion 1.5, developed by Stability AI, uses the Latent Diffusion Model (LDM) approach to generate high-quality images form the text input [3]. Meanwhile, Midjourney is a text-to-image generator service that is increasingly popular among graphic designers. This model is used in real-time collaborative design processes, which encourages user communication creativity [4]. Even in a scientific context, Midjourney is used to create visualizations of complex phenomena such as tornado dynamics, combining scientific accuracy with artistic expression [5].

However, most existing studies on AI-generated graphics primarily focus on technical performance, visual quality, or specific application case studies. While these studies contribute valuable insights, they do not provide a systematic overview of how research in this field has evolved over time. A bibliometric analysis is therefore necessary to map publication growth, identify dominant research themes, examine collaboration patterns among countries and institutions, and reveal emerging research directions. Without such an analysis, researchers lack a comprehensive understanding of the research landscape, making it difficult to identify knowledge gaps, research opportunities, and long-term development trends in AI-generated graphics. The existing literature lacks a comprehensive bibliometric analysis that systematically examines publication trends, collaboration patterns, and thematic evolution in AI generated graphics research, despite the rapid growth of this field

This study aims to conduct a bibliometric analysis of scientific publications discussing AI-generated graphics from 2020 to 2025. The main focus of this study includes identifying publication trends, scientific collaboration, thematic distribution, and visualizing the resulting research network. The result of this study are expected to contribute significantly to formulating future research directions, encouraging cross-disciplinary collaborations, and helping stakeholders understand the evolving scientific landscape in the context of AI-based visualization.

2. METHOD

This study uses the bibliometric review method, which is a quantitative approach to analyzing scientific publications in order to understand the structure, development, and dynamics of a field of science [6]. The bibliometric method is often used to identify research trends, influential aythors, collaborations between researchers, and major topics that are developing in scientific literature [7]. To support the analysis, this study uses Bibliometric and VOSviewer tools, which have been proven effective in scientific mapping and collaboration network visualization, according to recent studies [8].

VOSviewer was selected as the main analytical tool due to its ability to construct and visualize bibliometric networks effectively, including keyword co-occurrence, co-authorship, co-citation, and bibliographic coupling analyses. This software enables the identification of research clusters, dominant themes, and collaboration patterns through network, overlay, and density visualizations. By using VOSviewer, this study is able to systematically reveal structural relationships within the AI-generated graphics research domain that are not easily observable through traditional literature reviews.

A. Data collection steps

Data collection was carried out direstly through the Scopus database with the following steps:

1. Log in to the Scopus website using an institutional account.
2. In the main search field, emter the following keywords: “AI-generated graphics”, “text-to-image”, “DALL-E”, “Stable Diffusion”, “Midjourney”.
3. The search filter wa set to search for data from 2020-2025.
4. After the search results appeared, the data was exported using the export feature in Scopus.
5. The data was exported in CSV format to facilitate the initial examination and organization of data using Microsoft Excel.

B. Data analysis

The exported data is imported into VOSviewer software for bibliometric analysis, using the following analysis techniques:

1. Keyword Co-occurrence Analysis: To identify the most frequently discussed research themes or focuses.
2. Co-authorship Analysis: To see the collaboration network between authors or institutions.
3. Co-citation Analysis: To find references or authors that are often cited together and considered influential.
4. Bibliographic Coupling: To group articles that have similar references, indicating a similarity influential.

C. Visualization and interpretation

VOSviewer generates network visualizations based on the above analyses. Each map is visualized in the form of clusters with different colors, which indicate the relationship between topics and entities. The visualization result are then analyzed descriptively to:

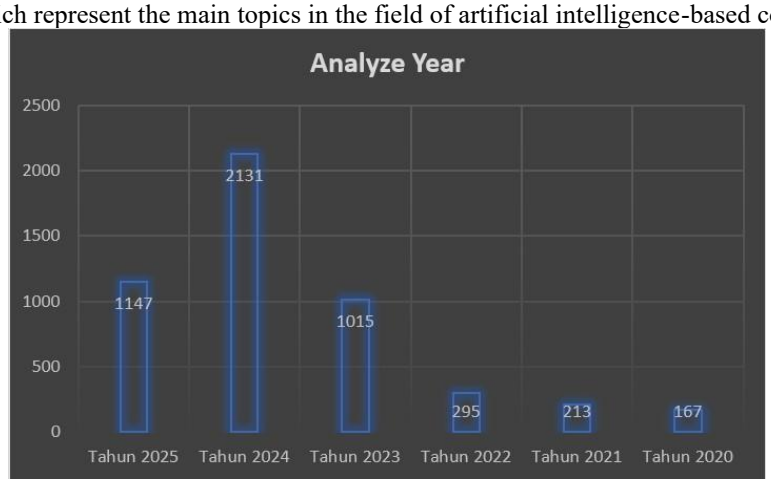
1. Identify dominant topics in the field.
2. Observe changes or research trends in the 2020-2025 time frame.
3. Analyze collaborative relationships between authors and institutions.

3. RESULT AND DISCUSSION

Global Publication Trends

Number of publications

Based on search result from the Scopus database, using the search criteria described in the research method, a total of 4,968 relevant scientific documents were obtained for the period 2020 to 2025. This search used a combination of keywords: "AI-generated graphics", "text-to-image", "DALL·E", "Stable Diffusion" and "Midjourney", which represent the main topics in the field of artificial intelligence-based computer graphics.



Source: Analysis Result

Figure 1. Growth in the Number of Scientific Publications per Year

The graph above shows that the number of scientific publications on the topic of AI-generated graphics increased significantly during the period 2020 to 2025. The highest spike occurred in 2024 with 2,131 documents, followed by 2025 (1,147 documents) and 2023 (1,015 documents). This shows that academic interest in artificial intelligence-based graphics technology has grown rapidly in the last five years.

This increase is inseparable from advances in generative AI technology, particularly in the fields of visualization and digital art. Since 2020, various models such as DALL-E, StyleGAN2, and Stable Diffusion have encouraged scientific exploration in automatic image creation [9], [10], [11]. The ability of these models to instantly generate original visual content has opened up opportunities for interdisciplinary research, from graphic design and digital media to education and technology ethics [12], [13].

In addition, attention to social and policy aspects has also contributed to an increase in the number of publications. Several recent studies have begun to discuss the impact of AI-generated images on public trust, visual disinformation, and copyright issues in the digital age [14], [15]. The surge in publications in 2024 can

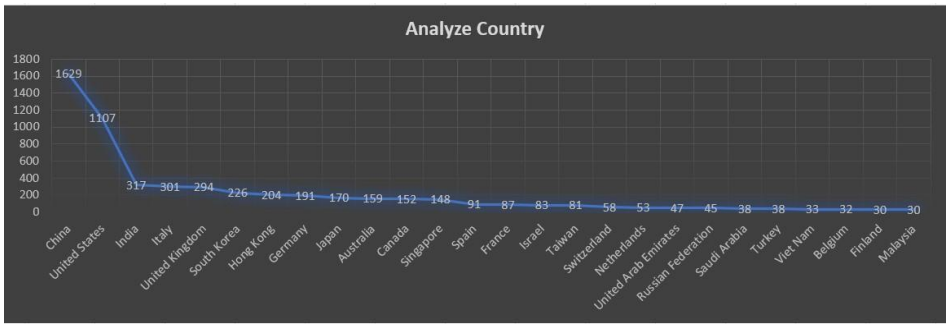
be attributed to the widespread adoption of this technology in various sectors, including higher education, the creative industry, and social media platforms.

This analysis is based on bibliometric data obtained from the Scopus database, which indicates that AI-generated graphics have become one of the most rapidly developing fields of research in the realm of artificial intelligence from 2020 to 2025.

Country Contributions

China is the largest contributor to scientific publications on AI-generated graphics during 2020 to 2025, with a total of 1,629 documents. It is followed by the United States with 1,107 documents, India with 317 documents, Italy with 301 documents, and the United Kingdom with 294 documents. Other countries that also made significant contributions include South Korea with 226 documents, Hong Kong with 204 documents, Germany with 191 documents, Japan with 170 documents, and Australia with 159 documents. The large contributions of these countries show that research on artificial intelligence-based graphics has become a major global concern and involves many institutions from various parts of the world.

The dominance of countries such as China and the United States in AI-generated graphics research can be attributed to several structural and strategic factors. First, both countries have placed artificial intelligence as a national research priority, supported by substantial government funding through institutions such as the National Natural Science Foundation of China (NSFC) and the National Science Foundation (NSF) in the United States. Second, the strong collaboration between universities, research institutes, and technology companies accelerates innovation and publication productivity. In addition, the availability of large-scale computational resources and open-source AI frameworks further supports intensive research activities. These factors collectively strengthen the research ecosystem and explain why these countries consistently dominate scientific publications in this field.



Source: Analysis Results

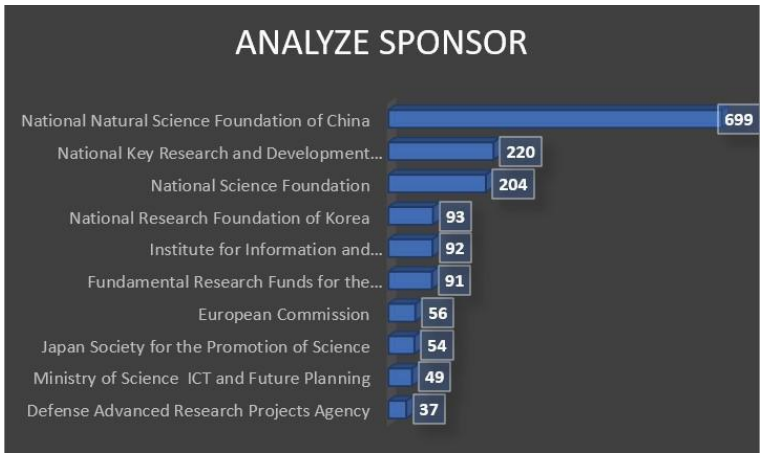
Figure 2. Number of Documents by Country

China's position as the largest contributor to scientific publications on AI-generated graphics is quite reasonable, considering that the country has strategically placed artificial intelligence as a national priority in technology development. The Chinese government provides significant support for AI-based research, including the development of graphics and digital visualization, which are now widely used in the creative, manufacturing, and defense industries. Meanwhile, the United States, as a pioneer in the development of generative models such as DALL-E and StyleGAN, also plays a dominant role in publications. The excellence of the research ecosystem in universities and large technology companies such as OpenAI, NVIDIA, and Google has also encouraged the acceleration of innovation and dissemination of knowledge. With the high number of publications from these major countries, it is clear that research on AI-generated graphics is not just a temporary trend, but has become an important part of global digital transformation and a major focus in the development of visual technology in the future.

On the other hand, data on sponsoring institutions shows that the largest sponsor of scientific publications on AI-generated graphics is the National Natural Science Foundation of China (NSFC), a major Chinese government funding agency. This institution has funded 699 documents during the period 2020 to 2025. This is followed by the National Key Research and Development Program of China with 220 documents, and the National Science Foundation (NSF) of the United States with 204 documents. Other institutions that also contributed significantly are the National Research Foundation of Korea (93 documents), the Institute for

Information and Communications Technology (92 documents), and the Fundamental Research Funds for the Central Universities (91 documents).

Outside Asia, the European Commission contributed 56 documents, followed by the Japan Society for the Promotion of Science (54 documents), the Ministry of Science and ICT Korea (49 documents), and the Defense Advanced Research Projects Agency (DARPA) from the United States with 37 documents.



Source: Analysis Result

Figure 3. Number of Documents by Sponsor

The significant support from NNSFC reflects the Chinese government's seriousness in making artificial intelligence a national priority. Based on analysis by [16], NNSFC funded 256,526 of the 355,068 AI articles written by Chinese researchers (with a median share of 19.3%) and accounted for 75% of all AI publications that received funding in China. This places NNSFC as the largest and most dominant funding agency globally in supporting AI research.

The visualization in Figure 3 supports this dominant role, where NNSFC ranks first in the number of documents recorded in the Scopus database, with a total of 699 documents, based on the results of the bibliometric analysis conducted in this study. The data in this study only covers scientific publications in the 2020-2025, time frame, with the following keyword criteria: “AI-generated graphics,” “text-to-image,” “DALL-E,” “Stable Diffusion,” and “Midjourney.” Meanwhile, Rahkovsky's study covers AI publications across a wide range of disciplines and large databases. These two data sets complement each other and together show that NNSFC plays a central role in driving the growth of AI research.

Among the influential scientific publications from China is a study by [17] that explores the use of diffusion models to generate realistic images in the medical and educational fields. [18] developed a transformer-based diffusion model to generate realistic 2D medical images. The results not only demonstrated high visual quality, but also improved the accuracy of disease classification, such as COVID-19, when synthetic data was used to supplement the original data.

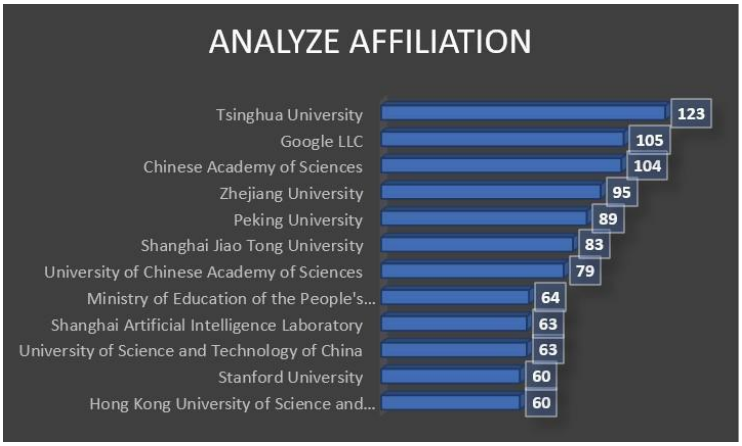
Meanwhile, the NSF continues to play an important role in the United States, albeit with a broader scope across various disciplines. Institutions from Europe and other East Asian countries such as Korea and Japan are also actively supporting the latest research, demonstrating that the development of AI-generated graphics is a global collaborative effort. One of the studies supported by the NSF is research [19] that highlights ethical challenges, data bias, and social responsibility in the application of generative technology.

Encouragingly, Indonesia is also included in the list of the top 10 countries as contributors to scientific publications on AI-generated graphics. With a total of 30 documents, Indonesia is the only developing country in Southeast Asia that contributes significantly. This is in line with the increasing adoption of AI technology in the education sector, creative industries, and digital media.

Institutional Contributions

The results show that there are 10 top institutions that have contributed to global scientific publications on AI-generated graphics (see Figure 4). The institution that has published the most is Tsinghua University with 123 documents, followed by Google LLC (105 documents), the Chinese Academy of Sciences (104 documents), Zhejiang University (95 documents), and Peking University (89 documents). Other institutions in the top rankings are Shanghai Jiao Tong University (83 documents), University of Chinese Academy of

Sciences (79 documents), Ministry of Education of China (64 documents), Shanghai Artificial Intelligence Laboratory (63 documents), and University of Science and Technology of China and Stanford University, each with 60 documents.



Source: Research Results

Figure 4. Number of Documents by Publishing Institutions

The above data shows that 6 of the top 10 institutions are from China, confirming China's role as a centre for generative AI research. This dominance reflects the strong national funding structure and research focus at elite universities such as Tsinghua and CAS. The presence of non-academic institutions such as Google LLC (US) and Stanford (US) also indicates cross-academic and industrial collaboration, as well as a shift in research models that include the application of AI to industry. The presence of institutions such as the Shanghai AI Lab and MOE China also demonstrates the support of government agencies and applied research in China.

Overall, the contributions of these institutions reflect the distribution of AI-generated graphics research, which is dominated by China but still supported by global collaboration, especially from the US technology and academic sectors.

Co-Occurrence with Overlay Visualization

The purpose of co-occurrence analysis is to identify the directions and topics that are receiving attention from researchers around the world. This method has been widely used to track developments in research and science [20] Using VOSviewer.

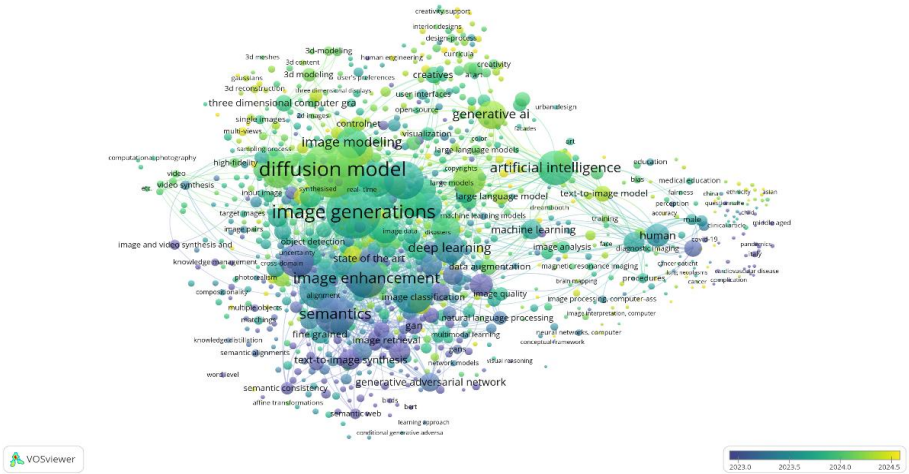


Figure 5: Co-occurrence analysis with visual overlay visualization

Figure 5 shows the results of co-occurrence analysis using visual overlay visualization in VOSviewer software. The colors on the points represent the average year of appearance of keywords in scientific publications. Purple indicates topics discussed in early 2023, while blue to green identifies keywords that are popular and frequently appear in publications from mid-2023 to early 2024. Light green to yellow indicates that the topic is relatively new and trending in scientific literature until 2025. The following table shows topics classified by year group:

Table 1. Topic Categories by Year

No	Year	Topic
1	2023.0 - 2023.5	Computer vision, semantic segmentation, image retrieval, text-to-image synthesis, gan, embedding, semantic consistency, image classification, semantic image, semantic consistency, generative adversarial network, learning systems, image processing, image synthesis
2	2023.5 - 2024.0	Deep learning, language mode, natural languages, natural language processing, image enhancement, performance, semantic information, text-to-image model, learning systems, visual semantics, textual description, text-to-image generation, human, machine learning
3	2024.0 - 2024.5	Diffusion model, stable diffusion, generative AI, image generations, visualization, stable diffusion, image modeling, generative adversarial network, state of the art, high quality images, synthetic image, text encoder, image-based, latent space, prompt, large language model
4	2024-2025	1s1Image coding, generative AI, midjourney, text-to-image, AI-generated, creatives, artificial intelligence, generative artificial intellig, fairness, gender bias lage language models, blackbox, medical imaging, photo interpretation, image denoising, image compression

Source: Analysis Results

Table 1 shows a trend in the development of research topics related to AI-generated graphics from 2020 to 2025, with a focus shifting from technical foundations to social and ethical implications. Although visual data is more dominant in the 2023-2025 period, the emerging trend reflects the overall dynamics over the past five years.

In the early phase, around 2023, research was largely dominated by discussions of basic AI-based image synthesis techniques. Topics such as computer vision, semantic segmentation, image retrieval, semantic images, embedding, and text-to-image synthesis appeared frequently, indicating that researchers' main focus was on developing visual systems capable of understanding and reconstructing information from text-based inputs. The presence of keywords such as GAN, embedding, and semantic consistency indicates that although much research has now shifted to diffusion-based models, the GAN (Generative Adversarial Network)-based approach remains relevant and is often referred to as the initial foundation in the development of generative text-to-image systems.

Entering the period from 2023.5 to 2024.0, the focus began to shift towards strengthening system performance and integration between natural language processing and image generation. Topics such as deep learning, language models, natural language processing, semantic information, and visual semantics show that research is focused on how systems can understand and convert meaning from text to visual form more accurately. Research in this phase aims not only to generate images from text, but also to ensure that the semantic relationship between text and images is more precise and contextual. This can be seen from the emergence of keywords such as text-to-image model, textual description, and learning systems.

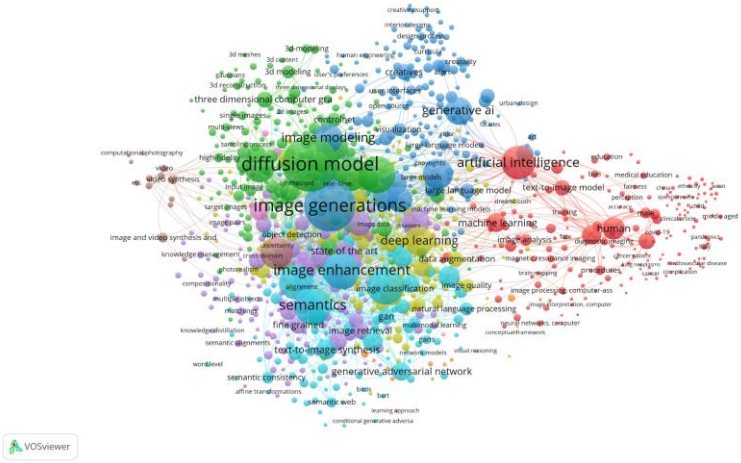
In the period from 2024.0 to 2024.5, research shows a significant surge in the adoption of diffusion and stable diffusion technologies as cutting-edge approaches that offer more realistic and sharp results than previous models. The emergence of keywords such as image generations, synthetic image, latent space, and prompt indicates that researchers are increasingly deepening technical aspects to maximize quality and control in the generative process. In addition, the emergence of large language models, generative AI, and state of the art signifies a deeper integration between visual generative systems and large-scale language models.

Overall, the trend in AI-generated graphics research shows a shift in focus from technical exploration to real-world applications in various sectors, as well as opening up critical discussions about the ethical and social impacts of using AI-based visual technology. This evolution reflects the maturity of a discipline that is not only oriented towards technological achievements, but also towards social responsibility and sustainable application.

The Relationship Between Studies on AI-generated Graphics and Other Concepts

Network visualization for the keywords AI-generated graphics, text-to-image, DALL-E, Stable Diffusion, Midjourney in Figure 6 with other concepts studied by researchers from around the world.

There are 1000 different terms found in the database. In this visualization, 10 clusters were found, categorized into 10 different colors and illustrated as follows:



Source: Analysis Results Using VOSviewer

Figure 6. Co-occurrence analysis with Network Visualization display

Cluster 1 contains 189 concepts in red, represents research at the intersection of health, medical imaging, computer vision, and data protection. This cluster covers applications of artificial intelligence in clinical diagnosis, medical image analysis, public health, and healthcare decision-making, with particular emphasis on diagnostic imaging, disease classification, privacy preservation, fairness, and bias. The presence of concepts related to demographics, ethics, and data privacy indicates growing attention to responsible and inclusive AI deployment in healthcare contexts.

Cluster 2 contains 186 concepts in red, focuses on image, video, and 3D content generation, emphasizing technical developments in diffusion-based generative models and their applications in computer graphics. Key themes include text-to-image and text-to-video generation, 3D reconstruction, rendering, image enhancement, controllability, and optimization, highlighting ongoing efforts to improve visual fidelity, efficiency, and controllable generation in generative systems.

Cluster 3 contains 169 concepts colored blue, captures research related to generative AI for art, design, and digital creativity. This cluster encompasses topics such as AI-generated content, creative design, human–AI interaction, ethical considerations, copyright issues, and creative processes. The prominence of tools like DALL·E, Midjourney, and Stable Diffusion reflects the increasing adoption of generative AI in artistic production, design education, and creative industries.

Cluster 4 contains 160 concepts colored yellow, centers on computer vision and deep learning methods for image analysis and generation. Major themes include image segmentation, object detection, photorealism, deepfake detection, dataset construction, and supervised and self-supervised learning. This cluster highlights the role of advanced vision models in improving image quality, interpretability, and robustness across diverse application domains.

Cluster 5 contains 144 purple concepts, represents research on multimodal artificial intelligence, integrating natural language processing, computer vision, and machine learning. Core topics include vision–language models, image–text retrieval, multimodal representation learning, cross-modal alignment, and large-scale pretraining, indicating a strong research focus on unified models capable of understanding and generating content across multiple modalities.

Cluster 6 contains 108 blue concepts is primarily associated with generative adversarial networks (GANs) and early approaches to text-to-image synthesis. This cluster emphasizes photorealistic image

generation, semantic consistency, evaluation metrics, and network architectures, reflecting foundational research that underpins subsequent advances in diffusion-based generative models.

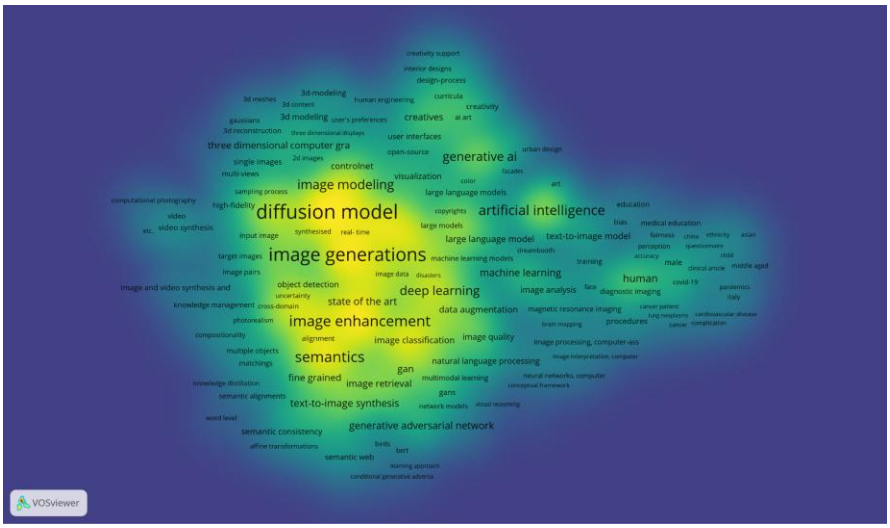
Cluster 7 contains 17 orange concepts. This cluster discusses topics related to multimodal reasoning and visualization question answering (VQA) with a contextual learning approach and mathematical models. The concepts in this cluster include: adversarial learning, autoregressive modelling, comprehensive analysis, conceptual framework, context learning, embedding, in contexts, information processing, learning, mathematical analysis, mathematical model, morphology, multi-modal fusion, question answering, research areas, visual question answering, visual reasoning.

Cluster 8 contains 17 brown concepts. This cluster discusses topics related to image and video synthesis using generative models, which are increasingly developing in the integration of vision and natural language (vision-language modeling). The concepts in this cluster include: 3d, algorithms, applications, color photography, computational photography, computer vision, etc., generative model for image, generative models for image, image and video synthesis, image and video synthesis and generation, inverse problems, video, video synthesis, vision + language, vision + language and/or other modalities, vision + language and/or other modality.

Cluster 9 contains 6 pink concepts. This cluster contains topics on reinforcement learning applied in high-quality image synthesis and modeling. The concepts in this cluster include: cutting edges, deep reinforcement learning, high quality images, model images, reinforcement learning, reinforcement learnings.

Cluster 10 contains 4 gray concepts. This cluster contains topics related to continual learning, including challenges such as catastrophic forgetting, as well as conventional approaches and methods in designing adaptive learning systems. The concepts in this cluster include: catastrophic forgetting, continual learning, conventional methods, dan learning approach.

Identifying the most dominant and popular topics based on Density Visualization results



Source: Analysis Result Using VOSviewer

Figure 7. Co-occurrence analysis with Density Visualization display

Based on the results of bibliometric analysis using VOSviewer in Figure 7, the yellow areas indicate topics that are frequently discussed, such as “diffusion model,” “image generations,” and “image enhancement,” showing that current research focuses on developing diffusion models for image synthesis. In addition, keywords such as “semantics,” “text-to-image,” and “natural language processing” also appear quite dominantly, indicating that researchers' attention is not only focused on the technical aspects of image generation, but also on how models understand and interpret natural language. The shift from Adversarial Generative Models (GANs) to diffusion further emphasizes the direction of technological innovation towards more realistic visual quality and deeper semantics. This opens up new opportunities for interdisciplinary research between computational linguistics and computer graphics.

4. CONCLUSION

This study provides a comprehensive overview of the development of scientific publications in the field of AI-generated graphics from 2020 to 2025 through a bibliometric analysis approach. In general, publications on this topic have increased significantly from year to year, especially in 2024, indicating that AI-generated graphics have become one of the main focuses in artificial intelligence-based research. This trend indicates that research on AI-generated graphics has transitioned from an emerging topic to a rapidly expanding mainstream research area.

Geographically, China is the country with the most publications, followed by the United States and India, with support from research funding agencies such as NSFC and NSF. In addition, institutions such as Tsinghua University, Google LLC, and the Chinese Academy of Sciences are major players in the development of this research. An analysis of sponsors and institutions shows that AI-generated graphics research is not only growing quantitatively, but is also strategically supported by cross-country and cross-sector collaboration.

In terms of topics, research has shifted from early GAN-based technical development to the use of more advanced diffusion models, as well as beginning to touch on semantic, ethical, and social aspects. Keyword co-occurrence analysis shows that themes such as diffusion models, text-to-image, and natural language processing have become dominant in the last five years.

The findings indicate the dominance of China, the United States, and India in publication output, the prominence of diffusion based and text to image models, and a growing focus on ethical and application oriented themes. Thus, the results of this study contribute to scientific developments in understanding the direction, focus, and global scientific collaboration in the topic of AI-generated graphics. These findings can serve as a starting point for future researchers to expand their studies on technological development, social impact, and the integration of AI in the field of generative visual design in the future.

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