International Journal of Computer Science and Information Technology
ISSN: 3005-9682 (Print), ISSN: 3005-7140 (Online) | Volume 3, Number 2, Year 2024
DOI: https://doi.org/10.62051/ijcsit.v3n2.15
Journal homepage: https://wepub.org/index.php/IJCSIT/index

A Bibliometrics-Based Review of Domestic Research in the Field of Artificial Intelligence

Chong Wang, Zixi Chen

Sichuan University of Science & Engineering, Zigong 643000, China

ABSTRACT

Artificial Intelligence (AI) is a technology that simulates human intelligence and has been rapidly developed in recent years. With the continuous development of the Internet and big data technology, AI technology has been widely applied and studied. In this paper, using "artificial intelligence" as the keyword, we searched the core journals on China Knowledge Network, selected 8913 effective documents from 2015-2023 as the research samples, and used the scientific bibliometric methods such as word frequency analysis, cluster analysis, and theme evolution analysis, and visualized and analyzed them with the help of COOC software, to synthesize the research hotspots in the field of artificial intelligence. The hotspots, development and evolution history of research in the field of artificial intelligence are sorted out, and the future research direction and application prospects are prospected.

KEYWORDS

Artificial intelligence; Bibliometrics; Visualization

1. INTRODUCTION

Artificial intelligence is a technology that simulates human intelligence, which allows computers to think, learn and make decisions like humans. In recent years, with the continuous progress of computer hardware and algorithms, AI technology has developed rapidly and has been widely used in various fields. Computer science has extensive interactions with a wide range of disciplines, and its knowledge structure spans a wide range of disciplines, including applied mathematics, decision sciences, statistics, social sciences, materials science, biochemistry, chemistry, genetics, and so on; machine learning and data science, which are built on the foundations of computer science and statistics, are becoming a major disciplinary field that is driving innovation in industry and science through the export of knowledge to other fields of study [1]; AI is widely used in critical decision-making in education, healthcare, transportation, finance, manufacturing, logistics, chemicals, and other fields, and has created clusters of disciplines with tight knowledge flows [2-8]; The significance of cross-disciplines lies in the development of new knowledge through the integration of multidisciplinary skills and perspectives of research, and the vigorous development of cross-disciplines is an inevitable requirement for the soundness of China's higher education disciplinary and professional system in the new era, and it is also an intrinsic demand of economic and social development; The cross-fertilization of AI with many disciplines will greatly contribute to the leapfrogging of many disciplines [9].

With the development of machine learning techniques, artificial intelligence technology is gradually shifting from rule-based to data-based approaches. As a subfield of applied computer science, AI partially realizes human intelligence by using machines as carriers, exhibits powerful learning, reasoning and planning capabilities, and provides transformative potential for enhancing and

replacing human tasks and activities, thus becoming a core strategic industry in the new round of global scientific and technological revolutions and industrial changes as well as a core technological element of the "Strengthening of National Strategic Scientific and Technological Forces". "Strengthening the national strategic scientific and technological power" [10]. Moreover, machine learning can train models with a large amount of data, thus giving computers the ability to learn and reason on their own. In the field of machine learning, deep learning is currently one of the most popular technologies. Deep learning realizes the learning and classification of data through multi-layer neural networks and has made significant breakthroughs in the fields of image recognition, speech recognition, natural language processing and so on. In addition, reinforcement learning is also an important machine learning technique, which guides computers to complete tasks through reward mechanisms, and has been widely used in gaming, robotics and other fields. In addition to machine learning techniques, artificial intelligence also involves natural language processing, computer vision, intelligent control and many other aspects. Natural language processing allows computers to understand and generate natural language, and has been applied to intelligent customer service, machine translation and other scenarios. Computer vision allows computers to recognize and understand images and videos, and has been applied to face recognition, drones, and other fields. Intelligent control allows computers to control physical systems for decision-making and control, and has been applied to automated production, smart cities, and other fields. Artificial intelligence technology has become one of the hotspots of technological development in today's world, and it will have a far-reaching impact on the future development of society and economy. In the future, AI technology will continue to develop and be applied in more fields.

This paper analyzes and reviews AI-related literature through bibliometric methods to objectively understand the current status and future development direction of AI research. Specifically, the research objectives of this paper include the following: to analyze the volume of AI-related publications to understand the development history and trends of AI research; to analyze the distribution of author institutions to understand the research centers in the field of AI; to analyze the subject keywords to explore the hotspots and fronts of AI research; to summarize the history of the development of AI, and to analyze the current status and future development trends of the field of AI . Through the bibliometric analysis and review in this paper, we can understand the current situation and future development direction of artificial intelligence research more objectively and provide reference for the development of artificial intelligence technology.

2. RESEARCH DATA SOURCES AND RESEARCH METHODOLOGY

(1) Data sources

Literature search using China Knowledge Network (CNN). When literature searching in China Knowledge Network, select the advanced search function, the search formula is "Topic=Artificial Intelligence, Time Span=2015-2023, Accurate Matching, Literature Type=Journal, Journal Source=CSI, CSSCI and Beida Core", and retrieve the literature of 10869 articles, after the data cleaning and de-weighting, after eliminating redundant information such as conferences, editorial language, character interviews, etc., we finally get the literature 8913 papers as the research samples

(2) Data processing

China Knowledge Network (CNN): Since the maximum number of documents exported from CNN is 500 at a time, the selected 10869 documents were exported in plain text format for 25 times, and the exported content included: title, abstract, keywords, authors, and other key information of the documents, and the documents were saved with the filename of DOWNLOAD.

(3) Research tools and methods

COOC software is mainly used for the metrological analysis of scientific literature data, identification and display of new trends and dynamics in scientific development, and visualization is presented

through the use of the knowledge mapping tool VOSviewer. COOC software was utilized to extract keywords, map keyword co-occurrence, and map the timeline of topic evolution in the field of artificial intelligence research.

Word frequency analysis method. This paper uses word frequency analysis to extract keywords in AI literature information, and through the high and low distribution of keywords, to study the development trend and research hotspots in the field.

Cluster analysis method. The goal of cluster analysis is to collect data to categorize on the basis of similarity. Clustering is a process of categorizing data into different classes or clusters so that objects in the same cluster have great similarity and objects between different clusters have great dissimilarity. In this paper, we mainly use Excel and COOC software to count the high-frequency keywords of domestic research papers in the field of artificial intelligence and establish a high-frequency keyword co-occurrence matrix, perform cluster analysis, organize and analyze the big research themes and hotspots in the field of artificial intelligence in China.

Theme evolution analysis method. The timeline view focuses on outlining the relationship between clusters and the historical span of literature in a particular cluster, which can clearly reflect the process of the rise, prosperity and decline of research in a particular cluster, and the timeline view of AI research using COOC can be used to analyze the research hotspots and trends in the field of artificial intelligence in China.

3. RESEARCH OVERVIEW

3.1. Statistics on the Number of Publications

In 2015-2023, the amount of literature related to the field of artificial intelligence research shows a rising trend of increasing year by year, in which the original of the number of articles issued in 2023 appears to have declined somewhat may be in the current statistics of only the first half of the year. After the introduction of Alpha Dog in 2016, which defeated the human Go champion Lee Sedol and other events, the global artificial intelligence boom has arrived. The United States released the National Strategic Plan for Artificial Intelligence Research and Development in 2016, and China released the New Generation Artificial Intelligence Development Plan in 2017, and these policies were introduced to promote academic research. The years 2016 and 2017 served as critical nodes for the publication of AI governance papers, and likewise for the release of AI policies. When in 2021 with the arrival of a large number of AI products, the number of related research results showed a faster rate of growth, the size and influence of the literature in the field of AI research were greatly improved, and the field has continued to rise in attention since then. Especially in 2022, the number of publications in the field of artificial intelligence surged, with a growth rate of 34.76%.

Artificial Intelligence domestic papers were published later than international papers, the total number of papers is also less than international papers, since the relevant departments have introduced policies related to Artificial Intelligence, and continue to strengthen the scientific and technological development of Artificial Intelligence, technical application of the importance of domestic scholars in the field of Artificial Intelligence research began to rise, from the annual cumulative number of papers gradually increased, it can be seen that the development of the field of domestic research in Artificial Intelligence is accelerating.

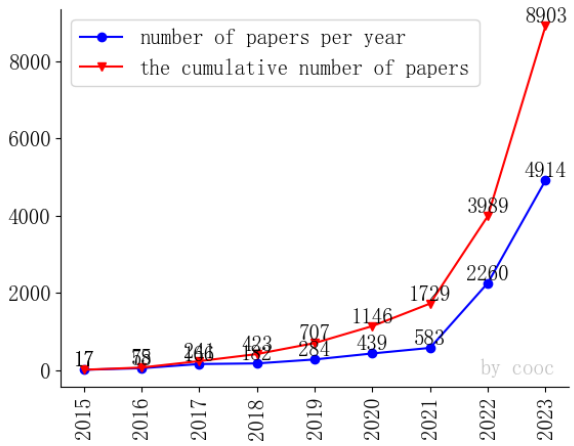

Figure 1. Number of Publications and Cumulative Publications in Artificial Intelligence, 2015-2023

3.2. Distribution of Organizations

Colleges and universities, research institutes, and companies and enterprises are different types of innovative research subjects, which all play a crucial role in the field of academic research. In the field of artificial intelligence, colleges and universities are the core institutions of academic output, and individual colleges and universities have the world's top level by analyzing the institutions of the authors of the published articles, we can grasp the distribution of the core research power in a certain field, which can help scholars to quickly understand the research perspectives and academic groups in this field. The COOC software is used to analyze the institutions of the issuing authors of 4898 documents, and the institutions with an issuing frequency greater than 10 are intercepted and displayed in the form of word cloud diagrams, as shown in Fig. 1, and the keywords with larger fonts represent the higher frequency of their issuing. From the data results, it can be seen that there are 106 institutions with more than 10 papers issued in China, with Tsinghua University as the institution with the highest number of articles issued. Next, Wuhan University, Nanjing University, Institute of Industrial Economics of Chinese Academy of Social Sciences, East China Normal University of Technology, Renmin University of China, Northwestern University, and Fudan University also accounted for a relatively high number of publications in this study. In the field of AI research, although there are many issuing institutions, except for a small number of institutions with more articles, the rest of the institutions are almost at the same level, with fewer articles and smaller gaps. In recent years, the rapid development of domestic AI research has initially formed a core group of authors and issuing institutions, in which, for example, Tsinghua University's artificial intelligence, an emerging research field, is continuing to develop.

4. ANALYSIS OF ARTIFICIAL INTELLIGENCE RESEARCH HOTSPOTS

4.1. Keyword Frequency Analysis

Identify the hotspots of artificial intelligence research by dissecting high-frequency keywords. Keywords refer to the nouns and terms or phrases that can reflect the theme and central content of the treatise. When a keyword appears with high frequency in the literature of the same field, it means that the word can reflect the research hotspot and development trend of this field. Utilizing the COOC software, through the keyword frequency statistics on the data of China Knowledge Network, the keywords are deleted and merged with synonyms beforehand, for example, "AI" and "artificial+intelligence" are merged with "artificial intelligence" and "artificial intelligence". For example, "AI" and "artificial+intelligence" are merged into "artificial intelligence", and meaningless words such as review, countermeasure, research and suggestion are deleted. The final keyword

frequency table is listed, and only the top 30 keywords are listed in this paper. From Table 1, it can be seen that the research mainly focuses on "artificial intelligence" to generate a series of keywords, of which the higher heat is "big data", "digital economy", "ChatGPT", "meta-universe", "algorithm", "machine learning", "Digital Transformation", "Digital Technology", "Quality Development", "Employment", "Robotics", etc. This is followed by "AIGC", "smart education", "human-machine collaboration", and "artificial intelligence education", "talent training", "algorithmic governance", "blockchain", "library" and so on. The content of domestic AI research hotspots can be roughly divided into two main categories: first, AI research on theory, mainly focusing on big data, algorithms, deep learning, machine learning and blockchain; second, AI research on practical applications, domestic applications on AI are embodied in robotics, intelligent education, intelligent libraries, legal and intellectual property rights.

Table 1. Table of high-frequency keywords for artificial intelligence, 2015-2023

High Frequency Keywords	frequency	High Frequency Keywords	frequency
AI	2361	AIGC	47
big data	168	intelligent education	47
digital economy	139	human-computer collaboration	45
ChatGPT	134	AI education	42
universe	120	intelligent technology	40
arithmetic	106	cultivation of talent	39
AI technology	85	Intelligent communication	38
Digital Transformation	70	Age of Intelligence	37
digital technology	64	blockchain	36
machine learning	62	blockchain	34
deep learning	62	library	33
High-quality development	58	intellectualize	31
start a career	51	knowledge map	31
mechanical person	50	legal regulation	31
age of AI	48	authorships	30

4.2. Keyword Cluster Analysis

In this paper, we used bibliometric software to map the Chinese artificial intelligence research hotspots from 2015-2023 using keywords as nodes. The basic principle is to use the point degree centrality, if a point has a connection with many nodes, then the node is in the center of the network, measured by the number of points that directly resound with the node. The size of the circle represents the size of the keyword point-degree centrality, the larger the point-degree centrality, the larger the circle; the lines indicate the connection between the keywords.

It can be seen that algorithm, big data digital economy, meta-universe, deep learning and machine learning are the most representative key common elements, and most problems in the field of artificial intelligence need to be analyzed and solved based on them; followed by keywords such as blockchain, robotics, human-machine collaboration, digital transformation, and intelligent education. The core issue of research concern in the field of artificial intelligence is still the issue of the basic theory of artificial intelligence, which is the most central framework and foundation of the field of artificial intelligence; finally, it is the issue of artificial intelligence application, which matches the distribution characteristics of the research hot words analyzed above.

According to the results of data analysis, the research hotspots in the field of artificial intelligence can be collectively divided into eight categories. 1) Machine learning and deep learning, involving neural networks, convolutional neural networks and other technologies, used in image recognition, natural language processing and other applications; 2) Intelligent education and intelligent education,

research on personalized learning and teaching, automated assessment, etc.; 3) Computer vision, research on image recognition, target detection, face recognition and image generation, etc., applied to medical, security, automatic driving, etc. 4) Human-computer interaction and intelligent hardware, developing smart speakers, intelligent assistants, etc., to make human-computer interaction more natural and intelligent. 5) Robotics, involving robot perception, decision-making, control, etc., applied to manufacturing, service industry, etc. 6) Digital libraries and intelligent publishing, focusing on researching the application of digital technology in libraries, including digital library construction, digital resource integration and management. As well as studying the field of intelligent publishing, such as the use of algorithms to generate content, intelligent authoring, etc.; 7) Data Mining and Big Data Analysis, mainly studying the use of big data technology, mining information and laws in data. 8) Artificial Intelligence Ethics and Law, mainly exploring the application and limitations of AI technology on the ethical and legal levels.

5. CONCLUSIONS AND RECOMMENDATIONS

Using the scientometric method, with the help of COOC software, the literature data about artificial intelligence in the China Knowledge Network database from 2015 to 2023 were analyzed and interpreted as well as visualized and mapped, and the time distribution mapping, the distribution map of institutions in the research field, and the evolution mapping were constructed, and the analysis led to the following conclusions.

The volume of relevant literature in the field of artificial intelligence research has shown a steady growth trend, especially since 2022, the scale and influence of the literature on artificial intelligence research have greatly increased, and the degree of attention has shown a sustained high growth in recent years. Artificial intelligence research is a multidisciplinary interdisciplinary academic research field, which contains computer science, mathematics, basic science, management and economics, etc., and borrowing interdisciplinary cross-theory to study artificial intelligence problems has become a major trend. However, the cross-disciplinary breadth of AI research in China is weak and more inclined to social sciences. The application of AI in education and publishing industry has been the longest hotspot in China, while ChatGPT, convolutional neural network, deep learning, computer vision and other related researches have only appeared in the past one or two years, in which deep learning research has an extremely far-reaching impact on the development of AI, and it is a promising direction of the future research, which is a promising development prospect that should not be underestimated.

Actively introduce appropriate policies in the field of artificial intelligence to ensure the rapid development of research in the field of artificial intelligence. Artificial intelligence research is a field of continuous innovation, by encouraging researchers to conduct innovative research and practice. The government, academic institutions and industry can provide support such as innovation funds and award programs to motivate AI researchers to conduct cutting-edge exploration and experimentation.

Continuously improve algorithms and computing power. Accelerating the development of a new generation of artificial intelligence is an important strategic grip for China to win the initiative of global scientific and technological competition. Algorithms and computational power are the powerful driving force for the development of artificial intelligence, and in the future, the country should accelerate basic research in key areas such as algorithms, strive for technological breakthroughs and continuously improve computational power, in order to strive for the initiative of global scientific and technological competition.

Strengthen multidisciplinary cross-fertilization and emphasize basic science. The breakthrough development of artificial intelligence is not only limited to logical thinking, but also needs to consider image thinking, inspirational thinking, etc., and needs to rely on the theory of multidisciplinary cross-

fertilization, paying special attention to basic scientific research. Promoting cooperation between different disciplines is the key to promoting the development of AI research. Computer scientists are encouraged to cooperate with experts in other fields to jointly solve the challenges in AI research. Through interdisciplinary cooperation, the expertise and methods of each field can be fully utilized to promote the development of AI research.

Emphasize the ethical and social impact issues of AI, and actively explore AI ethical frameworks, norms and policy recommendations. Ensure that the development and application of AI technology conforms to ethical standards, respects privacy rights and interests, and promotes the benign development of AI so that it becomes a useful tool for the sustainable development of human society.

REFERENCES

[1] DEVARAKONDA S, KOROBSKIY D, WARNOW T, et al. Viewing computer science through citation analysis: Salton and Bergmark Redux [J]. Scientometrics, 2020, 125(1): 271-87.

[2] CHEN H S, ZHANG Y P, CAO Y R, et al. Security Issues and Defensive Approaches in Deep Learning Frameworks [J]. Tsinghua Science and Technology, 2021, 26(6): 894-905.

[3] GRIGORESCU S, TRASNEA B, COCIAS T, et al. A survey of deep learning techniques for autonomous driving [J]. Journal of Field Robotics, 2020, 37(3): 362-86.

[4] JAWAD J, HAWARI A H, ZAIDI S J. Artificial neural network modeling of wastewater treatment and desalination using membrane processes: A review [J]. Chemical Engineering Journal, 2021, 419.

[5] LI Y F, WU Q S, HUANG X, et al. Efficient Adaptive Matching for Real-Time City Express Delivery [J]. Ieee Transactions on Knowledge and Data Engineering, 2023, 35(6): 5767-79.

[6] LIANG G S, FAN W G, LUO H, et al. The emerging roles of artificial intelligence in cancer drug development and precision therapy [J]. Biomedicine & Pharmacotherapy, 2020, 128.

[7] VAKULCHUK R, OVERLAND I, SCHOLTEN D. Renewable energy and geopolitics: A review [J]. Renewable & Sustainable Energy Reviews, 2020, 122.

[8] ZHANG H T, PARK T J, ISLAM A, et al. Reconfigurable perovskite nickelate electronics for artificial intelligence [J]. Science, 2022, 375(6580): 533-+.

[9] ZHUANG Y T, CAI M, LI X L, et al. The Next Breakthroughs of Artificial Intelligence: The Interdisciplinary Nature of AI [J]. Engineering, 2020, 6(3): 245-7.

[10] WU F, LU C W, ZHU M J, et al. Towards a new generation of artificial intelligence in China [J]. Nature Machine Intelligence, 2020, 2(6): 312-6.