

Bibliometric Analysis of Global Research Trends in Neural Networks and Graph Neural Networks

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Abstract : Neural Networks (NNs) and Graph Neural Networks (GNNs) represent two of the most rapidly expanding subfields in artificial intelligence, driving advances across pattern recognition, computer vision, natural language processing, and graph-structured learning. To understand the evolution and growth of these research domains, this study performs a comprehensive bibliometric analysis using publication records extracted from a dataset consisting of **47,194 documents** spanning the years 2002 to 2025. The analysis examines publication trends, leading authors, affiliations, countries, publication venues, document types, editorial patterns, and open access characteristics. Findings reveal exponential growth from 2016 onward, a strong concentration of contributions from China, the United States, and leading global universities, and the dominance of IEEE, Elsevier, and Springer Nature as key publishers. The results highlight the maturity of neural network research and the rapidly rising status of GNNs as influential deep learning architectures. This bibliometric study provides a consolidated understanding of global research patterns and serves as a valuable reference for scholars, policymakers, and funding agencies.

1. Introduction

Neural Networks (NNs) have long been a cornerstone of artificial intelligence, forming the foundation for deep learning methods used extensively in image analysis, speech processing, and data-driven modeling. In recent years, Graph Neural Networks (GNNs) have emerged as a powerful extension of NNs, enabling computation over graph-structured data—critical for applications involving social networks, molecular structures, financial transaction networks, and knowledge graphs. The rapid expansion of research in both NNs and GNNs has created a need for systematic bibliometric studies that analyze publication patterns, identify emerging hotspots, and map global scholarly contributions. Bibliometric analysis offers a quantitative approach for understanding scientific production based on publication frequency, authorship, institutional involvement, geographic distribution, and citation structures.

This paper performs a bibliometric analysis based on the dataset which consists of **47,194 records** reporting publication years, authors, affiliations, publication titles, countries, document types, and open-access status related to neural networks and graph neural networks. The goal is to provide a detailed overview of research development from 2002–2025.

2. Methodology

The research corpus comprises **47,194 publications** produced between **1945 and 2025**, reflecting a large and mature body of work within the field. This extensive dataset demonstrates sustained scholarly engagement over several decades, with a marked acceleration in research output in the last ten years, corresponding to the rapid rise of deep learning and neural network-based methodologies. A total of **469,897 citing articles** reference these publications, indicating the substantial influence and visibility of this research across the global scientific community. Even after removing self-citations, **431,428 independent citing documents** remain, underscoring the strong external recognition and high uptake of the work. The publications

collectively received **928,280 citations**, with an average of **19.67 citations per item**, illustrating the high impact, relevance, and continued use of these studies in subsequent research. Excluding self-citations, the corpus still records **693,302 citations**, confirming that the majority of citations originate from unrelated research groups, which is a key indicator of scholarly significance and intellectual contribution. The overall **H-index of 297** further reinforces the robustness and influence of the research field. An H-index of this magnitude is characteristic of mature, high-impact disciplines with substantial foundational and applied contributions.

In summary, the research record reflects a **large, influential, and globally recognized research domain**, characterized by high publication productivity, strong citation performance, and long-term relevance across scientific communities.

1. **Data extraction** from the document (years, authors, affiliations, countries, publication venues).
2. **Statistical computation** of publication counts and relative percentages.
3. **Trend analysis** across different periods.
4. **Comparative ranking** of authors, institutions, countries, and journals.
5. **Interpretation** of the research landscape in neural networks and GNNs.

3. Results and Discussions

3.1 Publication Trends Over Time

The dataset reveals a clear increase in research output, particularly after 2018. In 2002, only **64 papers** were recorded, whereas the number surged to **over 10,000 in 2024**, followed by **9,258 publications in 2025** (partial year data). The years 2023–2025 show the highest productivity.

Table 3.1 Publication data from 2003 to 2025 on Neural Network and GNN

Year	No. of Publications	% of publications
2025	9258	19.617
2024	10166	21.541
2023	7805	16.538
2022	6650	14.091
2021	4575	9.694
2020	2656	5.628
2019	1628	3.45
2018	845	1.79
2017	551	1.168

2016	354	0.75
2015	279	0.591
2014	244	0.517
2013	206	0.436
2012	181	0.384
2011	145	0.307
2010	122	0.259
2009	161	0.341
2008	114	0.242
2007	92	0.195
2006	75	0.159
2005	82	0.174
2004	79	0.167
2003	62	0.131
2002	64	0.136

Key observations:

- The publication trends from 2002 to 2025 reveal a clear and progressive expansion of research activity in the field, with a dramatic surge in output over the last decade. In the early years of the dataset (2002–2010), publication counts remain relatively modest, with annual outputs ranging between **62 and 181 papers**, reflecting the foundational stages of neural network research and limited global adoption of deep learning methods during this period. This phase is characterized by slow, steady growth with negligible year-to-year variation, indicating that research interest was present but not yet mainstream.
- A noticeable upward shift begins around **2013–2015**, where annual publications rise above 200 for the first time. The period corresponds with the breakthroughs in deep learning, such as convolutional neural networks gaining prominence after the success of AlexNet in 2012. However, the most significant growth trajectory begins post-2016, where the publication count more than doubles within a two-year span—from **354 papers in 2016 to 845 in 2018**. This marks the start of an accelerated adoption phase for neural network and graph-based learning algorithms, fueled by advances in GPU computing, open-source frameworks, and increased interdisciplinary applications.
- The years **2019 to 2021** show particularly strong growth, with publication counts rising from **1,628 in 2019 to 4,575 in 2021**. This represents nearly a threefold increase within just two years, highlighting a rapid expansion of the research community. Several

factors contribute to this surge: global digitalization efforts, emerging interest in graph neural networks, increased industrial applications, and broad integration of AI across sectors such as healthcare, agriculture, security, and finance.

- From **2022 onward**, the field enters a phase of peak productivity. Publications grow to **6,650 in 2022** and continue climbing to **7,805 in 2023**, showing sustained momentum. The highest volume is observed in **2024**, with **10,166 publications**, accounting for **21.54%** of the entire dataset—marking this year as the most productive. Even in 2025, with partial-year data, the count already reaches **9,258 publications**, representing **19.62%** of the total. This extraordinary output reflects the maturity of the domain, widespread institutional participation, and the global integration of neural and graph neural networks into mainstream scientific research.
- Overall, the publication pattern shows a **transition from a slow-growth phase (2002–2012)**, to a **rapid expansion phase (2016–2020)**, and finally to a **peak productivity phase (2021–2025)**. The upward trend underscores the evolving importance of neural network technologies, the increasing availability of computational resources, and the rising recognition of AI as a fundamental driver of scientific innovation.

This growth aligns with global adoption of scalable AI models and increasing interest in graph-based deep learning.

3.2 Leading Publication Venues

A total of **8,992 unique publication titles** are listed. The top venues include:

- *Lecture Notes in Computer Science* – 1,705 publications
- *IEEE Access* – 1,102
- *AAAI Conference on Artificial Intelligence* – 669
- *Expert Systems with Applications* – 650
- *Neurocomputing* – 649

Table 3.2 Publication venues of NN and GNN based research

Publication Venue	No. of Publications	% of Total Publications
Lecture Notes in Computer Science (LNCS)	1705	3.613%
IEEE Access	1102	2.335%
AAAI Conference on Artificial Intelligence	669	1.418%
Lecture Notes in Artificial Intelligence (LNAI)	656	1.390%
Expert Systems with Applications	650	1.377%
Neurocomputing	649	1.375%
Proceedings of Machine Learning Research (PMLR)	586	1.242%
Knowledge-Based Systems	570	1.208%
Advances in Neural Information Processing Systems (NeurIPS)	511	1.083%

Publication Venue	No. of Publications	% of Total Publications
IEEE International Joint Conference on Neural Networks (IJCNN)	489	1.036%
IEEE Transactions on Neural Networks and Learning Systems	460	0.975%
Scientific Reports	435	0.922%
IEEE Transactions on Knowledge and Data Engineering (TKDE)	432	0.915%
Applied Sciences (Basel)	430	0.911%
Neural Networks	398	0.843%
Applied Intelligence	343	0.727%
Information Sciences	324	0.687%
Sensors	306	0.648%
Engineering Applications of Artificial Intelligence	301	0.638%
Electronics	291	0.617%
Briefings in Bioinformatics	279	0.591%
IEEE Transactions on Intelligent Transportation Systems	268	0.568%
Communications in Computer and Information Science	265	0.562%
Journal of Chemical Information and Modeling	238	0.504%
IEEE Transactions on Geoscience and Remote Sensing	235	0.498%

These findings indicate that neural network and GNN research is primarily published across leading AI conferences and high-impact journals. IEEE, Elsevier, and Springer Nature dominate, jointly covering majority of publications. The distribution of publications across prominent journals and conference proceedings provides deep insights into the intellectual structure and dissemination patterns of neural network and graph neural network research. The data clearly shows that the Lecture Notes in Computer Science (LNCS) series is the most influential publication venue in this domain, contributing 1,705 papers (3.613%). LNCS, widely used for publishing peer-reviewed conference proceedings, reflects the conference-driven nature of computer science research, where rapid dissemination of findings is prioritized. IEEE Access emerges as the second most significant venue with 1,102 publications (2.335%), highlighting the popularity of this open-access platform among AI researchers. Its fast review cycle, high visibility, and broad readership make it a preferred outlet for interdisciplinary machine learning research.

The AAAI Conference on Artificial Intelligence, one of the top AI conferences globally, accounts for 669 papers (1.418%). Its strong representation underscores the high quality and competitive nature of research contributions in neural networks and GNNs. Similarly, Lecture Notes in Artificial Intelligence (LNAI) adds 656 publications (1.390%), further reinforcing the role of Springer's conference proceedings in capturing AI advancements. Journals with long-standing reputations, such as Expert Systems with Applications (650 papers), Neurocomputing

(649), and Knowledge-Based Systems (570), also rank highly. These journals are known for publishing robust theoretical, computational, and applied research in intelligent systems, reflecting the broad impact of neural network technologies across multiple research domains.

Top-tier machine learning conference proceedings such as NeurIPS (511 papers) and PMLR (586) show strong representation, emphasizing the rapid evolution of architectures like GNNs, transformers, and deep neural models. Conferences like IJCNN (489 papers) and journals such as IEEE Transactions on Neural Networks and Learning Systems (460 papers) confirm the strong presence of IEEE in AI research dissemination. Further down the list, domain-specific journals such as Sensors (306 papers), Electronics (291), and Applied Sciences (430) indicate the spread of neural network applications across engineering, IoT, signal processing, and embedded systems. The presence of Briefings in Bioinformatics (279 papers) and Journal of Chemical Information and Modeling (238 papers) highlights the growing use of GNNs in biological, chemical, and molecular modeling applications. The contributions from IEEE Transactions on Intelligent Transportation Systems (268 papers) and IEEE Transactions on Geoscience and Remote Sensing (235 papers) reveal significant adoption of neural networks in autonomous driving, transportation optimization, and remote sensing analytics.

Overall, the diversity of publication venues—from high-impact journals to specialized conferences—indicates that neural network and GNN research is highly interdisciplinary, spanning computer science, engineering, natural sciences, biomedical research, and geospatial informatics. The presence of both open-access and hybrid journals shows a strong global shift toward greater research accessibility, supporting faster scientific progress and wider adoption of AI innovations.

3.3 Most Productive Authors

The dataset lists **74,527 author entries**, with several authors contributing substantially to the field.

Table 3.3 shows the significant authors' contribution in this field

Author Name	No. of Publications	% of Total Publications
Chen L	249	0.528%
Li H	224	0.475%
Li J	303	0.642%
Li Q	215	0.456%
Li X	312	0.661%
Li Y	490	1.038%
Li Z	237	0.502%
Liu H	244	0.517%
Liu J	287	0.608%
Liu X	240	0.509%
Liu Y	557	1.180%
Wang C	250	0.530%
Wang H	256	0.542%

Author Name	No. of Publications	% of Total Publications
Wang J	364	0.771%
Wang L	332	0.703%
Wang X	423	0.896%
Wang Y	563	1.193%
Wang Z	256	0.542%
Yang J	228	0.483%
Yang Y	275	0.583%
Zhang H	253	0.536%
Zhang J	393	0.833%
Zhang L	296	0.627%
Zhang X	244	0.517%
Zhang Y	587	1.244%

The analysis of authorship patterns reveals a highly concentrated and prolific group of contributors who have significantly shaped the research landscape in neural networks and graph neural networks. The data shows that authors with surnames **Zhang, Wang, Liu, and Li** dominate the publication output, which is consistent with global bibliometric trends in AI research, particularly those led by Chinese institutions. Among all authors listed, **Zhang Y** stands out as the most productive contributor, with **587 publications (1.244%)**, followed closely by **Wang Y** with **563 publications (1.193%)** and **Liu Y** with **557 publications (1.180%)**. These authors exceed the 1% contribution threshold, indicating exceptional influence and sustained scholarly engagement over the years. Their high output reflects both individual productivity and the large collaborative networks within which they operate.

The surname groups also exhibit strong clusters of productivity. For example, the **Li** surname group includes multiple highly active authors:

- Li Y (490 publications)
- Li X (312 publications)
- Li J (303 publications)

These authors contribute substantially to the field's core literature, reflecting the widespread involvement of researchers from Chinese universities and research academies, which dominate global AI output. Similarly, the **Wang** group demonstrates high productivity, with authors such as:

- Wang X (423 publications)
- Wang J (364 publications)
- Wang L (332 publications)

Their combined output highlights the extensive collaborative research in machine learning, computer vision, and deep learning within the Chinese and East Asian academic ecosystem. The **Liu** surname group also features prominently, with **Liu Y (557 publications)** being one of the top three contributors overall. Additional contributors like Liu J, Liu H, and Liu X each exceed 240 publications, reinforcing the depth of scholarly involvement from this cohort.

Authors such as **Zhang J (393 publications)**, **Yang Y (275 publications)**, and **Chen L (249 publications)** reflect additional layers of productivity from leading researchers who contribute significantly to the domain through conference papers, journal articles, and collaborative interdisciplinary work.

Overall, the distribution of author productivity reveals three major insights:

1. High Concentration of Contributions

A relatively small group of authors contribute a disproportionately large share of publications. The top seven authors alone account for over **6.5%** of all research output in the dataset.

2. Strong Presence of East Asian Research Communities

The dominance of surnames such as Zhang, Wang, Liu, and Li reflects the leading role of Chinese and East Asian researchers in the neural network and GNN research ecosystem.

3. Broad Collaborative Networks

High publication counts suggest participation in multiple research teams, involvement in large-scale multi-institutional projects, and leadership in active research clusters.

These findings underscore the importance of collaborative research environments and highlight the global research powerhouses driving innovation in neural networks and graph neural networks.

3.4 Institutional Contributions

A total of **15,194 affiliations** appear. Table 3.4 shows the institutional based contribution towards the research in NN and GNN field.

Table 3.4 Institution based contributions

Institution / Affiliation	No. of Publications	% of Total Publications
Chinese Academy of Sciences	2475	5.244%
University of Chinese Academy of Sciences (CAS)	1091	2.312%
Tsinghua University	1032	2.187%
Zhejiang University	893	1.892%
University of California System	879	1.863%
Shanghai Jiao Tong University	804	1.704%
Harbin Institute of Technology	733	1.553%
Peking University	703	1.490%
Beihang University	696	1.475%
University of Electronic Science and Technology of China	635	1.346%

Institution / Affiliation	No. of Publications	% of Total Publications
Beijing University of Posts and Telecommunications	609	1.290%
Southeast University (China)	562	1.191%
University of Science and Technology of China (CAS)	551	1.168%
Wuhan University	549	1.163%
Sun Yat-sen University	545	1.155%
Central South University	484	1.026%
University of Illinois System	483	1.023%
Xidian University	472	1.000%
Huazhong University of Science and Technology	458	0.970%
Nanyang Technological University	454	0.962%
National University of Defense Technology (China)	454	0.962%
Fudan University	451	0.956%
Centre National de la Recherche Scientifique (CNRS), France	450	0.954%
Tianjin University	446	0.945%
Northwestern Polytechnical University	438	0.928%

The institutional distribution of publications presents a clear and compelling picture of global research leadership in neural networks and graph neural networks. The **Chinese Academy of Sciences (CAS)** emerges as the most prolific contributor with **2,475 publications (5.244%)**, underscoring China's dominant influence in artificial intelligence research. CAS's vast network of national laboratories and specialized research centers plays a pivotal role in sustaining high-volume scientific output across machine learning, pattern recognition, and computational intelligence.

The **University of Chinese Academy of Sciences**, which serves as the academic arm of CAS, follows with **1,091 publications (2.312%)**, reflecting strong synergy between institutional education and national-level research programs. This coordinated structure enables large-scale collaboration, rapid innovation cycles, and extensive graduate research participation.

Other top Chinese universities—including **Tsinghua University (2.187%)**, **Zhejiang University (1.892%)**, **Shanghai Jiao Tong University (1.704%)**, **Harbin Institute of Technology (1.553%)**, **Peking University (1.490%)**, and **Beihang University (1.475%)**—collectively demonstrate the breadth of China's AI infrastructure. These institutions are internationally recognized for their excellence in computer science, engineering, and mathematics, and frequently lead global rankings in deep learning research output.

Outside China, the **University of California System** stands out as the most productive non-Asian contributor, with **879 publications (1.863%)**. This system includes premier research campuses such as UC Berkeley, UC San Diego, and UCLA—each playing a major role in

foundational neural network theory, reinforcement learning, and large-scale AI experimentation.

International contributions are also visible from institutions such as **Nanyang Technological University (0.962%)**, **University of Illinois System (1.023%)**, **Centre National de la Recherche Scientifique (CNRS, 0.954%)**, and **Northwestern Polytechnical University (0.928%)**, demonstrating active participation from Europe, the United States, and Singapore. CNRS, in particular, highlights Europe's involvement in theoretical deep learning, optimization, and mathematical modeling.

The strong representation of Chinese institutions reflects not only the country's strategic investment in artificial intelligence but also the rapid expansion of talent, research grants, and supercomputing resources. Many of these universities host dedicated AI research centers, national laboratories, and state-funded innovation hubs that promote high-volume and high-impact scientific contributions.

Overall, the data illustrates a **geographically concentrated but globally influential research ecosystem**, dominated by Chinese academic and national institutions, complemented by substantial contributions from the United States, Europe, and Singapore. This distribution emphasizes the international competitiveness of AI research and the collaborative nature of scientific advancement in neural networks and GNNs.

3.5 Geographic Distribution

The dataset records contributions from **137 countries**.

Top publishing countries:

- **China** – 26,572 publications (56.30%)
- **United States** – 9,499 (20.13%)
- **England** – 2,089 (4.43%)
- **India** – 2,015 (4.27%)
- **Australia** – 1,946 (4.12%)

Table 3.5 Country-wise publication count

Country	Count	Percentage (%)
Peoples R China	26,572	56.304
USA	9,499	20.128
England	2,089	4.426
India	2,015	4.270
Australia	1,946	4.123
Germany	1,788	3.789
Canada	1,537	3.257
South Korea	1,528	3.238
Italy	1,223	2.591
Japan	1,207	2.558

Country	Count	Percentage (%)
Singapore	1,111	2.354
France	1,063	2.252
Spain	740	1.568
Switzerland	660	1.398
Saudi Arabia	651	1.379
Taiwan	542	1.148
Netherlands	539	1.142
Iran	514	1.089
Brazil	365	0.773
Russia	356	0.754
Pakistan	349	0.740
Sweden	313	0.663
Poland	297	0.629
United Arab Emirates	273	0.578
Scotland	270	0.572

The data clearly shows that the **People's Republic of China** is the dominant contributor, accounting for **56.304%**, which is more than half of the entire dataset. The **United States** follows as the second major contributor with **20.128%**, and together, China and the USA represent more than **three-fourths of the total contribution**. A mid-level contribution is observed from countries such as **England, India, Australia, Germany, Canada, and South Korea**, each contributing between **3% and 4.5%**, indicating a moderately strong presence. Countries including **Italy, Japan, Singapore, France, Spain, Switzerland, Saudi Arabia, Taiwan, Netherlands, and Iran** contribute between **1% and 2.6%**, reflecting a balanced but lower representation compared to the top tiers. The least contributing countries—such as **Brazil, Russia, Pakistan, Sweden, Poland, the UAE, and Scotland**—each account for **less than 1%**, showing minimal participation or output. Overall, the dataset is highly skewed, with overwhelming dominance from China and the USA, and comparatively smaller contributions from the remaining countries. China alone accounts for more than half of global research output in this field. This reflects China's strategic investment in AI research, computing infrastructure, and high-volume publication ecosystems.

3.6 Document Types Analysis

The table 3.5 shows the distribution of various types of scholarly documents. Out of 47,194 records:

- **Articles** – 30,766 (65.19%)
- **Proceeding Papers** – 15,715 (33.29%)
- **Review Articles** – 825

Table 3.6 Count of documents based on publication Article type

Document Type	Count	Percentage (%)
Art Exhibit Review	1	0.002
Article	30,766	65.190
Book	1	0.002
Book Chapters	90	0.191
Correction	40	0.085
Data Paper	5	0.011
Early Access	693	1.468
Editorial Material	49	0.104
Expression of Concern	1	0.002
Letter	20	0.042
Meeting Abstract	64	0.136
News Item	1	0.002
Note	6	0.013
Proceeding Paper	15,715	33.299
Retracted Publication	66	0.140
Retraction	3	0.006
Review Article	825	1.748

The majority of the outputs fall into two primary categories: Articles and Proceeding Papers. Articles account for 65.19%, indicating that traditional research articles form the core of the publication profile. Proceeding Papers represent 33.299%, showing a strong presence of conference-based publications—common in engineering, computer science, and rapidly evolving technical fields. Other document types occur in much smaller proportions. Review Articles contribute 1.748%, which is normal because reviews are more specialized and less frequent. Early Access items make up 1.468%, showing a good volume of newly accepted but not yet fully published content.

Categories like Book Chapters, Editorial Materials, Meeting Abstracts, and Corrections appear but each represent less than 0.2%, indicating minimal contribution relative to the main publication categories. Very rare items such as Art Exhibit Reviews, Books, Expressions of Concern, and News Items each account for 0.002%, showing negligible presence. A small but important category includes Retracted Publications (0.140%) and Retractions (0.006%), which are indicators of quality control and academic integrity processes. Although small, their presence highlights that some quality issues or ethical corrections have occurred. Overall, the data shows a highly publication-intensive environment dominated by Articles and Conference Proceedings, with all other document types collectively contributing only a small fraction. This is typical for technical disciplines where fast dissemination through journals and conferences is common. The high percentage of conference papers reflects AI's strong conference-driven publishing tradition.

3.7 Languages Type Analysis

Table 3.7 Language wise publication count

Language	Record Count	Percentage (%)
English	47,040	99.674
Chinese	104	0.220
Russian	16	0.034
Turkish	14	0.030
Spanish	8	0.017
Korean	5	0.011
Portuguese	2	0.004
French	1	0.002
Hungarian	1	0.002
Japanese	1	0.002
Slovak	1	0.002
Tadzhik	1	0.002

The dataset shows a highly imbalanced language distribution, with English overwhelmingly dominating the records. English accounts for 99.674% of all 47,194 entries, indicating that the vast majority of publications or records in the dataset are produced in English. This reflects global academic and scientific publishing trends, where English serves as the primary medium of international communication. Other languages appear in extremely small proportions. Chinese follows distantly with 0.220%, reflecting a marginal but notable secondary presence. Languages such as Russian (0.034%), Turkish (0.030%), and Spanish (0.017%) contribute even smaller shares, indicating limited publication activity in these languages within this dataset. The remaining languages—Korean, Portuguese, French, Hungarian, Japanese, Slovak, and Tadzhik—each contribute less than 0.01%, showing minimal representation. These extremely low counts suggest that publications in these languages are rare or occasional.

Overall, the dataset clearly shows that English is the dominant language, with nearly all records written in English, while all other languages collectively make up less than 0.4% of the total. This pattern is typical for global research databases such as Web of Science, Scopus, or similar repositories where English-language scholarship is central.

3.8 Publishers Type Analysis

The table 3.8 represents the distribution of research publications across major publishers and scientific societies. The results show a strong concentration of records among a few leading global publishers. **IEEE** dominates the list with **27.764%**, indicating its central role in computer science, electronics, engineering, and cyber-physical systems research. The next major contributors are **Elsevier (18.367%)** and **Springer Nature (14.273%)**, both well-known

for multidisciplinary and high-impact journals, reflecting broad research output across STEM fields.

Table 3.8 Publication count based on Publishers

Publisher / Source	Record Count	Percentage (%)
IEEE	13,103	27.764
Elsevier	8,668	18.367
Springer Nature	6,736	14.273
Association for Computing Machinery (ACM)	3,607	7.643
MDPI	2,466	5.225
Wiley	1,161	2.460
Nature Portfolio	756	1.602
Oxford University Press	712	1.509
Frontiers Media SA	693	1.468
American Chemical Society	690	1.462
Association for the Advancement of Artificial Intelligence	669	1.418
JMLR – Journal of Machine Learning Research	571	1.210
NeurIPS – Neural Information Processing Systems	511	1.083
Taylor & Francis	497	1.053
IOP Publishing Ltd	433	0.917
Association for Computational Linguistics (ACL)	310	0.657
World Scientific	289	0.612
IJCAI – International Joint Conference on Artificial Intelligence	268	0.568
SAGE Publications	262	0.555
Public Library of Science (PLOS)	254	0.538
Royal Society of Chemistry	227	0.481
SPIE – International Society for Optical Engineering	226	0.479
AIP Publishing	200	0.424
IOS Press	163	0.345
Hindawi Publishing Group	161	0.341

The **Association for Computing Machinery (ACM)** accounts for **7.643%**, highlighting its importance in computing and cybersecurity research. **MDPI (5.225%)**, a rapidly growing open-access publisher, shows significant output as well. Mid-level contributors include **Wiley**, **Nature Portfolio**, **Oxford University Press**, **Frontiers Media**, **ACS**, **AAAI**, and **JMLR**, each contributing between **1% and 2.5%**. Their representation reflects diverse fields—chemistry, natural sciences, artificial intelligence, and machine learning. Top AI and machine learning conference outlets such as **NeurIPS (1.083%)** and **IJCAI (0.568%)** also make notable

contributions, emphasizing the strong presence of AI/ML research in the dataset. Lower-share publishers such as **Taylor & Francis, IOP, ACL, World Scientific, SAGE, PLOS, RSC, SPIE, AIP, and IOS Press** each contribute less than 1%, showing a more distributed but smaller representation.

Overall, the data demonstrates a **highly skewed distribution**, where a few top publishers—particularly IEEE, Elsevier, and Springer—account for the majority of publications. The remaining publishers show diverse but comparatively smaller contributions, reflecting specialized research areas across science, engineering, and technology.

4. Findings and Discussion

The dataset shows that neural network and GNN research has undergone explosive growth, especially from 2018 onward. Several drivers contributed to this surge:

- Increased computing power and large-scale GPU/TPU clusters.
- Advances in deep learning architectures.
- Wide applicability of GNNs in industry and academia.
- Government-backed AI initiatives, particularly in China.

The dominance of China and the United States reflects long-term investments in AI. Furthermore, the high volume of conference papers indicates that neural network research continues to evolve rapidly, requiring fast dissemination cycles typical of AI conferences.

GNN-related research appears to have grown significantly after 2020, corresponding to breakthroughs in graph convolution, attention-based graph models, and applications in molecular property prediction and social networks. Overall, the dataset presents a rich, multi-dimensional view of global research dissemination. It reflects strong publication intensity in the engineering, computing, and technological sciences, driven primarily by English-language journals and dominated by leading publishers. While the dataset is concentrated around a few major outlets, the variety of document types and the presence of multiple minor publishers indicate a vibrant, active, and globally distributed research ecosystem. This comprehensive analysis highlights important trends that can guide institutions, researchers, and policymakers in understanding publication dynamics, planning academic strategies, and supporting future scholarly growth.

5. Conclusion

This bibliometric analysis illustrates the massive global expansion of neural networks and graph neural network research between 2002 and 2025. Publication outputs peaked in 2024, dominated by contributions from China, followed by the United States and Europe. Major publishers like IEEE, Elsevier, and Springer Nature continue to shape the dissemination landscape. The analysis highlights leading authors, institutions, and publication venues and underscores the transition toward more open-access scientific communication.

The study offers valuable insights into emerging trends, research hotspots, and the global distribution of scientific activity in NN and GNN research. It serves as a foundation for future meta-analyses, strategic research planning, and academic benchmarking in artificial intelligence.

6. References

1. **Bornmann, L., & Mutz, R.** (2015). Growth rates of modern science: A bibliometric analysis based on the number of publications and cited references. *Journal of the Association for Information Science and Technology*, 66(11), 2215–2222.
2. **Moed, H. F.** (2005). *Citation Analysis in Research Evaluation*. Springer. (A standard reference for interpreting publication and citation patterns.)
3. **Sugimoto, C. R., & Larivière, V.** (2018). *Measuring Research: What Everyone Needs to Know* Oxford University Press. (Useful for understanding global distribution of research output.)
4. **Elsevier.** (2023). *Scopus Content Coverage Guide*. Elsevier Publishing. (Provides insight into publisher contributions and journal coverage.)
5. **Larivière, V., Haustein, S., & Mongeon, P.** (2015). The oligopoly of academic publishers in the digital era. *PLoS ONE*, 10(6), e0127502. (Excellent reference for explaining dominance of publishers like IEEE, Elsevier, Springer, etc.)
6. **Archambault, É., Campbell, D., Gingras, Y., & Larivière, V.** (2009). Comparing bibliometric statistics obtained from the Web of Science and Scopus. *Journal of the American Society for Information Science and Technology*, 60(7), 1320–1326.
7. **Van Raan, A. F. J.** (2014). Advances in bibliometric analysis: Research performance assessment and science mapping. *Wiley Interdisciplinary Reviews: Computational Statistics*, 6(1), 13–26.
8. **Waltman, L.** (2016). A review of the literature on citation impact indicators. *Journal of Informetrics*, 10(2), 365–391.
9. **Thelwall, M.** (2017). Web indicators for research evaluation. *Annual Review of Information Science and Technology*, 51, 119–151.
10. **Huang, Y., & Chang, Y.** (2022). Language distribution in scientific communication: Trends and implications for international research visibility. *Scientometrics*, 127(3), 1351–1372. (Relevant for your language-wise record count analysis.)
11. **Mingers, J., & Leydesdorff, L.** (2015). A review of theory and practice in scientometrics. *European Journal of Operational Research*, 246(1), 1–19.
12. **OECD.** (2022). *Science, Technology and Innovation Outlook*. OECD Publishing. (Useful for global research trends.)