International Journal of
INTELLIGENT SYSTEMS AND APPLICATIONS IN ENGINEERING
ISSN:2147-6799 www.ijisae.org Original Research Paper

AI for 5G networking- A Bibliometric Analysis

Smita Mahajan[1*], Shivali Amit Wagle[2], Sunil M Sangve[3], Aryani Gangadhara[4]

Submitted: 21/12/2023 **Revised:** 27/01/2024 **Accepted:** 09/02/2024

Abstract: The merging of 5G networking with artificial intelligence (AI) has become a game-changing paradigm, completely overwhelming the landscape of communication systems. A thorough bibliometric analysis is presented in this work to help comprehend the developments, patterns, and significant research areas at the nexus of artificial intelligence (AI) and fifth-generation(5G). Through an extensive assessment of conference papers, patents, and academic literature, this investigation delves into the complex interactions that arise between artificial intelligence and 5G technology. This bibliometric analysis is a valuable tool for scholars, policymakers, and industry experts trying to understand the intricacies of AI-enabled 5G networks, as it offers a broad perspective of the scholarly scene. In this dynamic and quickly developing sector, it provides insights into the current level of knowledge, points out research gaps, and lays-out a plan for future studies.

Keyword*: bibliometric analysis, 5G network, data analysis, artificial intelligence*

1 Introduction

The fusion of Artificial Intelligence (AI) and the fifth-generation (5G) of wire- less technology has marked a revolutionary paradigm shift in the landscape of telecommunications [1]. As the world witnesses an unprecedented surge in data consumption, there is an escalating demand for fast, reliable, intelligent, and adaptive networks. Integrating AI techniques within the framework of 5G net- working promises to address these demands, presenting a spectrum of opportunities for optimizing network performance, enhancing user experience, and revolutionizing various industry verticals. The marriage of AI and 5G technology encompasses various applications, from autonomous vehicles and smart cities to healthcare and industrial automation. Leveraging AI algorithms for network optimization, predictive maintenance, and resource allocation has the potential to improve the efficiency and reliability of 5G networks significantly. Machine learning, deep learning [21], and other AI methodologies enable networks to dynamically adapt to changing conditions, predict traffic patterns, and proactively manage network resources [2]. Moreover, as the landscape of AI-driven 5G networking continually evolves, this paper intends to highlight the current state and the potential research gaps, challenges, and opportunities for further exploration. By illuminating these aspects, our analysis aims to serve as

a guiding compass for researchers, industry professionals, and policymakers, steering them towards collaborative innovation and propelling advancements in the dynamic realm of AI-powered 5G networking. 5G represents the latest evolution in wireless network technology, succeeding the fourth generation (4G). As the succeeding global wireless standard, 5G introduces a revolutionary net- work architecture aimed at providing enhanced data speeds, reduced latency, and increased capacity to accommodate a greater number of users, devices, and services. This advancement in technology is geared towards optimizing network efficiency and ushering in a new era of connectivity [3].

5G accommodates applications across three primary use-case categories.

1. "Enhanced Mobile Broadband (eMBB) — High bandwidth services for wireless connectivity."
2. "Ultra-Reliable Low Latency Communication (URLLC) — Ultra reliable and low latency communication for critical requirements."
3. "Massive Machine Type Communication (mMTC) — Reliable communication for billions of sensors and monitoring devices."

5G boasts impressive downlink peak data rates that can soar up to 20 Gbps, a substantial leap compared to the 1 Gbps peak speed of its predecessor, 4G LTE.

1,2Artificial Intelligence and Machine Learning Department, Symbiosis Institute of Technology, (Pune campus), Lavale, Pune-412115, Maharashtra, India.
3Department of Artificial Intelligence and Data Science, Vishwakarma Institute of Technology, Pune-411037, Maharashtra, India
4JSPMs Rajarshi Shahu College of Engineering, Tathawade, Pune-411033, Maharashtra, India
rajansmita@gmail.com
kulkarnishivali@yahoo.co.in
sunil.sangve@vit.edu
aryanimaths@gmail.com
**Corresponding author: rajansmita@gmail.com;*

Anticipated to yield a remarkable 10- to 100-fold surge in user experience data rates, 5G is set to accommodate an unprecedented volume of connected devices—10 to 100 times more than the capacity of 4G—while showcasing an exceptionally low latency of approximately 1 millisecond (ms).

Beyond its outstanding network performance and speed enhancements, the 5G era promises a paradigm shift in connected experiences. This groundbreaking technology is set to enhance the performance of business applications and introduce inventive user experiences and services in various domains, including augmented, virtual, and mixed reality applications (AR, VR, and MR), video-conferencing, industrial automation, autonomous vehicles [22], and interconnected medical devices. The advent of 5G heralds a new era where connectivity not only becomes faster but also facilitates a myriad of cutting-edge applications, redefining the way users interact with and experience digital technologies.

This paper aims to conduct a comprehensive bibliometric analysis that delves into the ever-expanding realm of AI applied to 5G networking. Through this analysis, we aim to unearth the trends, seminal contributions, and key focal points within the amalgamation of AI and 5G. By scrutinizing many scholarly articles, conference papers, and patents, this study seeks to identify influential authors, institutions, and countries at the forefront of this transformative field. AI refers to artificial intelligence, a technology that enables machines to simulate human intelligence. 5G technology is the fifth generation of mobile communication networks, allowing faster data transfer and improved connectivity [4, 5].

AI encompasses the technology allowing machines to replicate human intelligence, enabling them to execute tasks that traditionally demand human cognitive capabilities. On the other hand, 5G, denoting the fifth generation of wireless communication technology, surpasses its predecessors by providing accelerated speeds, reduced latency, and enhanced capacity [6].

AI enables machines to perform tasks that typically require human intelligence. 5G enhances mobile communication systems by delivering accelerated speeds, reduced latency, and expanded capacity [7, 8]. The article [9] provides a joint 3GPP and O-RAN perspective on AI adoption in mobile communication systems. It also identifies areas for future exploration towards 6G.

The outcome from [10] research is that, - Identified promising research directions for AI in 5G - Provided design paradigms for 5G network optimization.

2 Literature Review

The Analysis of hybrid non-linear autoregressive neural network and local smoothing technique for bandwidth slice forecast [11] proposes a hybrid model for forecasting bandwidth slice utilization in LTE networks. The model combines a non-linear autoregressive neural network (NNAR) with a local smoothing technique to improve forecasting accuracy. The authors evaluated the proposed model using several local smoothing techniques and found that the model with the least data loss performed the best. The model was also compared to other bandwidth slice forecasting models and was found to outperform them by more than 12.3%. The hybrid model can effectively forecast bandwidth slice utilization even in the presence of concept drifts, which are sudden changes in the underlying data distribution. This makes the model well-suited for use in dynamic network environments. The proposed model has several potential applications, such as resource allocation in virtualized software-defined networks (vSDN) and bandwidth management in LTE networks. The hybrid NNAR and local smoothing model proposed by Hassan et al. is a promising approach for forecasting bandwidth slice utilization in LTE networks. The model can out- perform other forecasting models and is well-suited for use in dynamic network environments [11].

The article delves into the practical utilization of AI in the context of optical communication networks and the 5G technology [12]. The article primarily introduces representative applications of AI technology, such as:

- Network optimization: AI can optimize the performance of optical and 5G networks by dynamically adjusting network parameters such as routing and resource allocation.
- Predictive maintenance: AI can predict network failures and perform preventive maintenance, which can help reduce network downtime and improve reliability.
- Self-organizing networks: AI can be used to develop self-organizing net- works that can automatically configure and optimize themselves. This can help to reduce the operational costs of networks.
- Traffic prediction: AI can be used to predict network traffic patterns, which can help to improve resource allocation and network performance.
- Security: AI can improve the security of optical networks and 5G networks by detecting and mitigating cyberattacks.

- Resource allocation: AI can allocate network resources more efficiently, which can help improve network performance and reduce costs.
- Network slicing: AI can slice networks into multiple virtual networks, each with its own dedicated resources. This can help improve networks' performance and reliability for specific applications.
- Edge computing: AI can bring computing and storage resources closer to the edge of the network, improving the performance and latency of applications.
- Interference management: AI can reduce user and device interference in 5G networks.
- Spectrum management: AI can be used to manage spectrum resources more efficiently, which can help to improve network performance.

The article delves into the potential hazards associated with AI technology failures resulting from vulnerabilities in optical communication networks. It puts forth various coping strategies to address these concerns, including: The article discusses the advancement of AI systems by adopting modularization and miniaturization techniques. It explores the synergy of AI with conventional classical network modeling and planning methods. Emphasis is placed on enhancing the efficacy and interpretability of AI technology. In essence, the article offers a thorough examination of the diverse applications of AI in optical communication networks and 5G. It also discusses the potential risks and coping strategies for AI technology failure.

The work discusses how AI /Machine Learning (ML), Edge Computing, and 5G networks can be used to increase industrial and personal productivity by 100X [7]. AI/ML, Edge Computing, and 5G can be used to improve industrial productivity in the following ways:

- Predictive Maintenance: AI/ML can be used to predict the need for ma- chine maintenance before failures occur. This can help to avoid downtime and improve the efficiency of manufacturing processes.
- Quality Control: AI/ML can automate quality control tasks, such as inspecting products for defects. This can help to improve product quality and reduce costs.
- Process Optimization: AI/ML can optimize industrial processes by identifying and eliminating bottlenecks. This can help to improve the efficiency of production and reduce costs.
- Robotics and Automation: AI/ML can be used to develop new and improved robotic and automation systems. This can help to reduce the need for human labor and improve the efficiency of manufacturing processes.
- Supply Chain Management: AI/ML can improve supply chain management by optimizing inventory levels, forecasting demand, and managing transportation. This can help to reduce costs and improve the efficiency of supply chains.
- Personal Productivity:
- Smart Homes and Offices: AI/ML can automate tasks in homes and offices, such as climate control, security, and lighting. This can free up people's time to focus on more important tasks.
- Personalized Education and Training: AI/ML can provide personalized education and training to students and employees. This can help people to learn more effectively and efficiently.
- Virtual Assistants and Chatbots: AI/ML can be used to develop virtual assistants and chatbots that can help people with tasks such as scheduling appointments, booking flights, and finding information. This can free up people's time to focus on more important tasks.
- Remote Work: AI/ML, Edge Computing, and 5G can enable remote work by providing the necessary infrastructure and support. This can help people to save time and money on commuting, and it can also give people more flexibility in where they work. in short, AI/ML, Edge Computing, and 5G have the potential to revolutionize industrial and personal productivity. By automating tasks, optimizing processes, and providing personalized assistance, these technologies can help people to be more productive and efficient.

In the article by Hassan et al [9]. discusses the importance of AI in the evolution of 5G and 6G networks. The authors argue that AI is essential for enabling new features and improving the performance of future mobile communication systems. The article provides a joint perspective from the 3GPP and O-RAN Alliance on the state of the art in AI adoption in mobile communication systems. The authors discuss the topics including:

1. Fundamentals of 5G architecture and its evolution towards openness and intelligence
2. AI for 5G-Advanced evolution
3. Case study on AI-enabled traffic steering

4. Areas for future exploration to accelerate AI adoption on the path towards 6G

The authors also discuss the challenges of adopting AI in mobile communication systems, such as the need for standardization and ensuring the trustworthiness of AI systems. Overall, the article provides a comprehensive overview of the importance of AI in the evolution of 5G and 6G networks. The authors argue that AI has the potential to revolutionize future mobile communication systems by enabling new features and improving performance. However, some challenges must be addressed before AI can be widely adopted in mobile communication systems. as per [9] AI is essential for enabling new features and improving the performance of future mobile communication systems. AI can be used to optimize network performance, predict network failures, develop self-organizing networks, predict network traffic patterns, improve security, allocate network re- sources more efficiently, slice networks, bring computing and storage resources closer to the edge of the network, reduce interference, and manage spectrum resources more efficiently. However, there are also challenges of adopting AI in mobile communication systems, such as standardization and the need to ensure the trustworthiness of AI systems.

The article by Hassan et al. discusses the potential of using artificial intelligence (AI) as a microservice over 5G networks. The authors argue that this approach has a number of advantages, including:

- Increased flexibility and scalability: AI microservices can be easily de- ployed and scaled on demand, which makes them well-suited for dynamic and resource-constrained environments such as 5G networks.
- Improved performance and efficiency: AI microservices can be offloaded to the network's edge, reducing latency and improving performance. Re- duced costs: AI microservices can be reused and shared across multiple applications, which can help to reduce costs.

The authors also discuss some challenges of using AI as a microservice over 5G networks, such as standardization and the need to ensure the security and privacy of AI microservices. The article provides a comprehensive overview of the potential and challenges of using AI over 5G networks as a microservice. The authors argue that this approach can potentially revolutionize how AI is used in various applications. AI as a microservice (AIMS) over 5G networks is a promising approach that can increase AI's flexibility and scalability, improve performance and efficiency, and reduce costs. However, some challenges need to be addressed before AIMS can be widely adopted, such as standardization and the need to ensure the security and privacy of AIMS.

The article by Xiaohu You et al. discusses the potential applications of artificial intelligence (AI) in fifth-generation (5G) mobile networks. The authors argue that AI can play a critical role in improving the performance and efficiency of 5G networks and enabling new features and services. The article identifies a number of promising research directions in AI for 5G, including:

- Network optimization: AI can optimize network performance by dynamically adjusting network parameters such as routing and resource allocation. This can help to improve network throughput, latency, and reliability.
- Radio resource management (RRM): AI can improve RRM by predicting network traffic patterns, detecting and mitigating interference, and optimizing spectrum utilization.
- Quality of service (QoS) management: AI can be used to improve QoS management by predicting user demand and allocating resources accordingly. This can help ensure that all users receive the needed QoS.
- Security: AI can improve network security by detecting and mitigating cyberattacks. AI can also be used to develop new security protocols and algorithms.
- New services: AI can enable new services such as augmented reality (AR) and virtual reality (VR). AI can also be used to develop new applications for 5G in areas such as healthcare, transportation, and manufacturing.

The article also discusses a number of challenges that need to be addressed before AI can be widely adopted in 5G networks. These challenges include:

- Standardization: There is a need to develop standards for AI-enabled 5G networks. This will ensure that AI systems can be interoperable and that they can be deployed and managed efficiently.
- Data privacy and security: AI systems must be designed to protect the privacy and security of user data. This is especially important in light of the increasing number of cyberattacks.
- Explainability: AI systems need to be designed to be explainable. This means that it should be

possible to understand how AI systems make decisions. This is important for building trust in AI systems and ensuring they are used responsibly.

Overall, the article provides a comprehensive overview of AI's potential ap- plications and challenges for 5G networks. The authors argue that AI has the potential to revolutionize 5G networks and enable new features and services. However, there are a number of challenges that need to be addressed before AI can be widely adopted in 5G networks.

AI has the potential to play a critical role in improving the performance and efficiency of 5G networks, as well as enabling new features and services. Promising research directions in AI for 5G include network optimization, RRM, QoS management, security, and new services. However, several challenges need to be addressed before AI can be widely adopted in 5G networks, including standardization, data privacy and security, and explainability.

The article by [13] discusses the potential applications and development prospects of 5G communication technology in aerobics sports. The author argues that 5G can revolutionize how aerobics sports are taught, trained, and competed.

Here are some of the specific applications of 5G in aerobics sports discussed in the article:

- Remote coaching and training: 5G can enable real-time remote coaching and training, allowing athletes to get feedback and instruction from experts regardless of their location. This can help improve the quality and efficiency of training and make aerobics sports more accessible to people in remote areas.
- Virtual competitions: 5G can be used to create immersive virtual competitions that allow athletes to compete against each other in real time, even if they are physically located in different places. This can make aerobics sports more exciting and engaging for both athletes and spectators.
- Data-driven performance analysis: 5G can be used to collect and analyze large amounts of data about athletes' performance. This data can be used to identify improvement areas and develop personalized training plans. This can help athletes to reach their full potential.

The author also discusses the development prospects of 5G in aerobics sports. The author believes 5G will become increasingly important in aerobics sports in the coming years. This is due to the fact that 5G offers a number of advantages over previous generations of mobile communication technology, including:

- High speed and low latency: 5G offers high data speeds and low latency, which is essential for real-time remote coaching and training, virtual competitions, and data-driven performance analysis.
- Massive connectivity: 5G can support many connected devices necessary for large-scale virtual competitions and data-driven performance analysis.
- Ultra-reliable low-latency communications (URLLC): 5G supports URLLC, which is essential for applications such as remote coaching and training, where even a small delay can significantly impact performance.

Overall, the article provides a comprehensive overview of the potential applications and development prospects of 5G communication technology in aerobics sports. The author argues that 5G has the potential to revolutionize the way aerobics sports are taught, trained, and competed. The article by [14] proposes a Digital Twin-Enabled Edge AI (DTE2AI) system to enhance the accuracy of AI tasks while meeting the constraints of energy saving and efficiency in smart critical infrastructures for 5G. A digital twin is a virtual representation of a physical system that can be used to simulate and analyze the system's behaviour. Edge AI is a distributed AI architecture that brings AI computation and inference closer to the network's edge, where data is generated and consumed.

The DTE2AI system works by first creating a digital twin of the physical infrastructure. The digital twin is then used to train AI models to perform various tasks, such as predicting demand, detecting anomalies, and optimizing operations. Once the AI models are trained, they are deployed to edge devices, which can be used to make real-time decisions and recommendations.

The DTE2AI system also includes an Energy-aware High Accuracy Strategy (EAHAS) algorithm to optimize the training accuracy of AI tasks under training time and energy consumption limits. The EAHAS algorithm dynamically adjusts the AI models' hyper-parameters during training. The authors evaluated the DTE2AI system using a real-world smart critical infrastructure dataset. The results showed that the DTE2AI system improved the accuracy of AI tasks by up to 12% while reducing energy consumption by up to 20%.

The DTE2AI system has several potential applications in smart critical infrastructures for 5G, such as:

- Demand prediction: The DTE2AI system can be

used to predict energy demand, which can help to reduce energy costs and improve reliability.

- Anomaly detection: The DTE2AI system can be used to detect anomalies in the infrastructure, such as equipment failures and cyberattacks. This can help to prevent outages and other disruptions.
- Operations optimization: The DTE2AI system can be used to optimize the operations of the infrastructure, such as scheduling maintenance and allocating resources.

This can help to improve efficiency and reduce costs. Overall, the DTE2AI system is a promising approach for enhancing the accuracy of AI tasks in smart critical infrastructures for 5G while meeting the constraints of energy saving and efficiency. The article by [15] proposes an architecture for edge-based predictive maintenance of machines using federated learning and multi-sensor platforms. Federated learning is a machine learning approach that enables multiple devices to collaboratively train a shared model without the necessity of exchanging or disclosing their data. This is important for predictive maintenance applications, where the data collected from machines is often sensitive and confidential. Multi-sensor platforms collect data from various sensors on a machine, such as vibration, temperature, and pressure sensors. This data can be used to train a predictive maintenance model to identify patterns and predict when a machine is likely to fail. The proposed architecture consists of three main components [15]. They can be enlisted as

1. Edge devices: Edge devices are devices that are located close to the ma- chines being monitored. They collect sensor data and train the predictive maintenance model using federated learning.
2. Aggregation server: The aggregation server collects the updated model parameters from the edge devices and aggregates them into a global model.

The global model is then sent back to the edge devices, which can use it to make predictions.

3. Maintenance platform: The maintenance platform provides a user inter- face for viewing the predictions made by the edge devices and scheduling maintenance tasks.

The proposed architecture has a number of advantages over traditional predictive maintenance approaches:

- Privacy-preserving: Federated learning allows edge devices to train the predictive maintenance model without sharing their data. This is important for applications where the data collected from machines is sensitive and confidential.
- Scalable: The proposed architecture is scalable to many edge devices. This makes it suitable for applications in large industrial settings.

The literature analysis concludes by highlighting the critical role that AI plays in the revolutionary landscape of 5G networks. The review of the literature emphasizes the important contributions, new directions, and difficulties in using AI to improve network performance, elevate user experiences, and stimulate innovation in a variety of sectors. This foundation of knowledge acts as a launchpad for future developments and cooperative efforts in this quickly expanding sector as we traverse the dynamic junction of AI and 5G.

3 Bibliometric Analysis

Bibliometric analysis involves utilizing statistical methods to examine and evaluate published research materials, such as articles, conference papers, and reviews. This analysis aims to provide insights into the broader impact and influence of publications within the global research domain [16]. On December 27th, 2023, data for Bibliometric analysis about the intersection of wireless networks and the application of Artificial Intelligence (AI) was gathered from Scopus. The search focused on key terms such as 'Wireless Network,' 'Applications of AI,' 'Routing,' 'Congestion,' 'Mesh Network,' and '5G.' This research initiative examines the global landscape of AI-driven Wireless Network studies. A total of 122 research papers have been identified across various publication types, including Journals, conferences, book chapters, books, and reviews. The distribution of these publications is summarized in the following Table 1. 40 papers are published in conference proceedings, 35 papers are published in Journals, and 27 review papers are published in this research area. So there is scope for further study and work in the area of wireless networks with AI.

The worldwide research work intensity in the area of wireless networks with AI is seen in Figure 1. India leads in publications, followed by China and Saudi Arabia, contributing 36, 30, and 21 research papers, respectively. Remarkably, these nations collectively represent around 43% of the prominent authors in this domain.

Table 1: Type of research publications for Wireless Networks with AI

Type of publications	Count of publications in last 5 years
Conference Paper	40
Article	35
Review	27
Book Chapter	16
Book	4

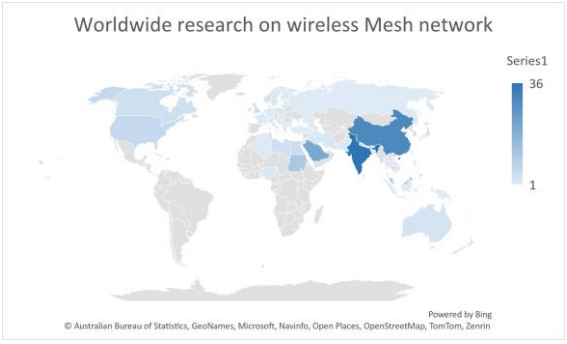

Fig 1: Prominent countries Worldwide doing research in Wireless Networks.

The trend of publication in this research domain is seen to increase and is shown in Figure 2. There was a drastic increase in the publication from 2021 to 2022.

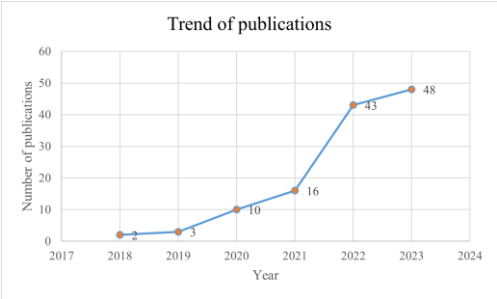

Fig 2: Trend of Publications over the years.

Table 2 shows the top ten authors working in the domain of wireless network with applications in AI. Saeed R. A. is the most influential author who published 12 research articles on wireless networks in last 5 years.

Table 2: Influential authors

Author name	Number of Publication in last 5 years
Saeed, R.A.	12
Ali, E.S.	10
Mokhtar, R.A.	8
Khalifa, O.O.	5
El-Sawy, A.A.	4
Khedr, A.M.	4
Osamy, W.	4
Salim, A.	4
Alatabani, L.E.	3
Belinskis, R.	3

The work highlights the pivotal role of energy efficiency in cloud computing, emphasizing its significance in reducing operational costs and achieving green computing objectives. It explores the integration of machine learning (ML) to optimize cloud communication and proposes energy-efficient solutions in the green cloud environment, addressing resource management and discussing trends, challenges, and the application of DeepMind AI in cloud data centers [17]. The critical role of energy efficiency in cloud computing due to its substantial energy consumption, focusing on cost reduction and green computing goals. It explores machine learning's application for optimizing cloud communication, proposing energy-efficient solutions and addressing resource management, along- side discussions on deep Mind AI, trends, and challenges in cloud data centers [18].

Amidst escalating network demands due to diverse applications and advanced technologies, the limitations of current networks like 4G and forthcoming 5G prompt exploration into 6G networks. Recent focus integrates Artificial Intelligence (AI) to design highly intelligent 6G networks, proposing an AI-based architecture for knowledge discovery, resource management, and service provisioning across four layers. This article explores AI's applications in optimizing network performance, emphasizing research directions such as computational efficiency, robust algorithms, hardware enhancement, and energy management for future AI-driven 6G networks [19].

The influential authors are working under the following affiliations shown in Table 3. The top author Saeed R.A is affiliated with Taif University, Saudi Arabia. The top authors have other collaborators working on a research problem from other Universities globally. The research becomes very strong when it's given a wide scope in terms of research expertise. The possible research collaborations between the researchers is shown in Figure 3

The combination of authors belongs to various research domains. The authors working in the top 10 research domains are shown in Figure 4. 35% of the researchers are from a Computer Science background, 27% are from an Engineering background and the rest of the researchers are from Mathematics, Energy, Decision Sciences, Materials Science, Medicine, Physics and Astronomy, Social Sciences, and Environmental Science domains.

Table 3: Affiliation of top authors in the domain of wireless networks with AI

University	Number of publications in last 5 years
Taif University	13
Sudan University of Science and Technology	9
Red Sea University	9
International Islamic University Malaysia	7
Atlas Skill Tech University	5
IIMT University, Meerut	5
Zagazig University	4
Al Qassim University	4
Benha University	4
University of Sharjah	4

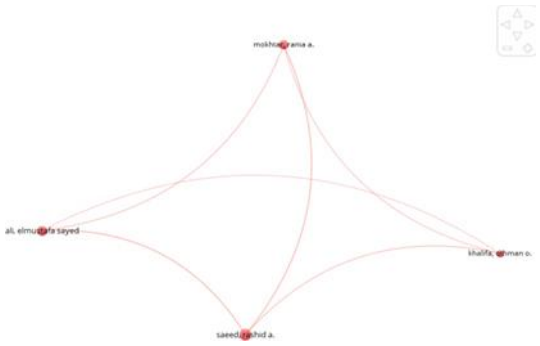

Fig 3: Top Research collaborations pair.

The domain area related to the wireless network where the researchers are working is shown in Table 4. The majority of the authors are from a Computer Science background and Engineering background. Researchers from other domains like Mathematics, Energy, and Decision Sciences are moving their re- search towards the application of wireless networks. and AI.

The publication is the outcome of the research work. Disseminating research findings to a wider audience for reading, adoption, or enhancement is an integral aspect of the research process. Figure 5 shows the connection of the author to the domain area where the author is currently doing research and the journal in which they have published their research. Electronics, IEEE Access, Sustain- ability, and Sensors are some of the top journals where influential authors are publishing their work. The new researchers can refer to the research articles published in these journals to get knowledge about the research work carried out. The research work when published in a peer-reviewed journal, then it be- comes authenticated to refer further to a research article from non peer reviewed journal.

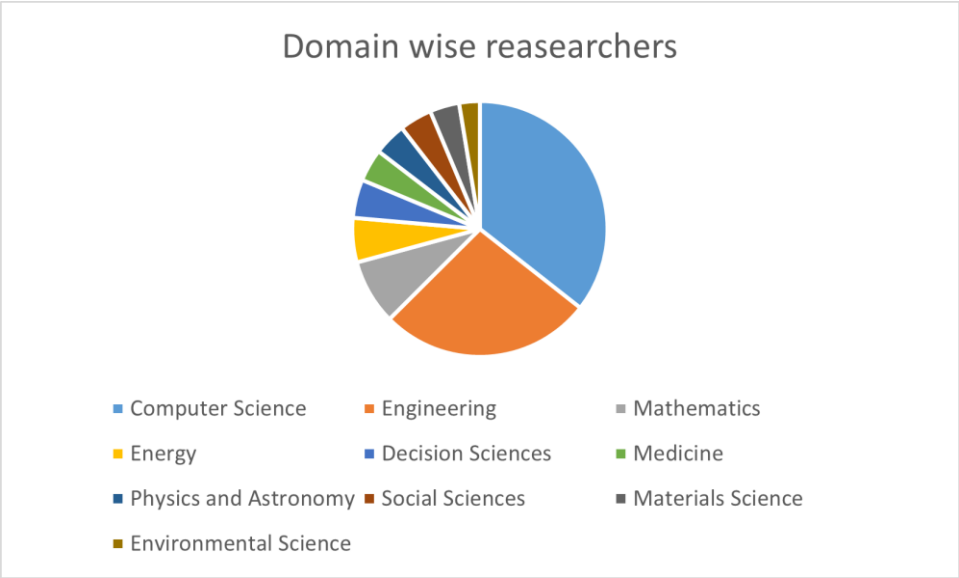

Fig 4: Research domain of Influential authors.

Table 4: Top Domain area

Domain Area	Number of publications in last 5 years
Computer Science	95
Engineering	72
Mathematics	22
Energy	15
Decision Sciences	13
Medicine	11
Physics and Astronomy	11

Social Sciences	11
Materials Science	10
Environmental Science	7

Funding is undeniably a pivotal aspect in the realm of research, serving as a driving force behind the advancement of knowledge and innovation. It provides the necessary resources and infrastructure essential for developing novel techniques and methodologies aimed at solving complex research problems. Specifically, within the domains of wireless networks and artificial intelligence (AI), the significance of funding becomes particularly apparent in catalyzing progress and facilitating breakthroughs.

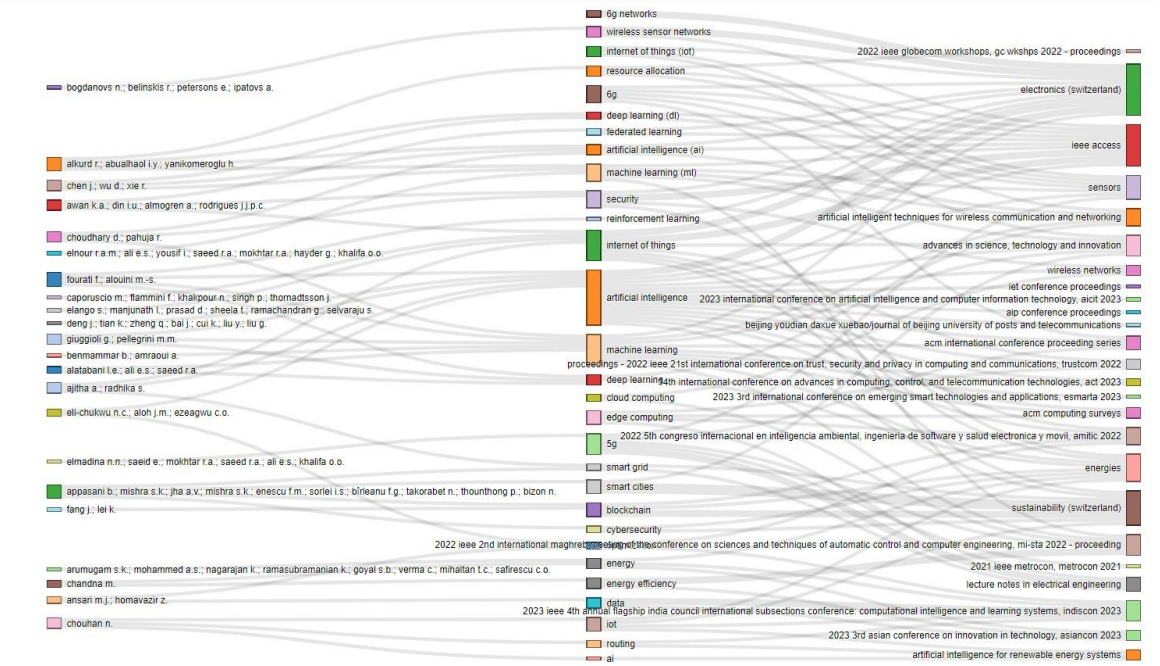

Fig 5: A combination of Author-domain-journal of paper publication on the topic wireless sensor with AI.

In the context of research related to wireless networks and AI, a comprehensive understanding of the top funding agencies involved in supporting such endeavors is imperative. Figure 6 illustrates the representation of the ten most prominent funding agencies contributing to this area of study. Notably, the National Natural Science Foundation of China emerges as the foremost funder, indicating a substantial commitment to advancing research in wireless networks and AI.

Among the top funding agencies depicted in the figure, the National Natural Science Foundation of China holds a position of prominence, channeling re- sources and support toward fostering advancements in this field. Furthermore, other significant contributors, such as the Fundamental Research Funds for the Central Universities, the Horizon 2020 Framework Program, the National Key Research and Development Program of China, And the China Postdoctoral Science Foundation underscore the collaborative efforts and diverse sources of funding that drive progress in wireless networks and AI research. It is seen that the majority of the research is funded by China followed by UK.

The acknowledgment of these top funding agencies not only emphasizes their pivotal role in supporting research endeavors but also sheds light on the concerted efforts and investments directed toward enhancing the understand- ing, development, and implementation of wireless network technologies and AI methodologies.

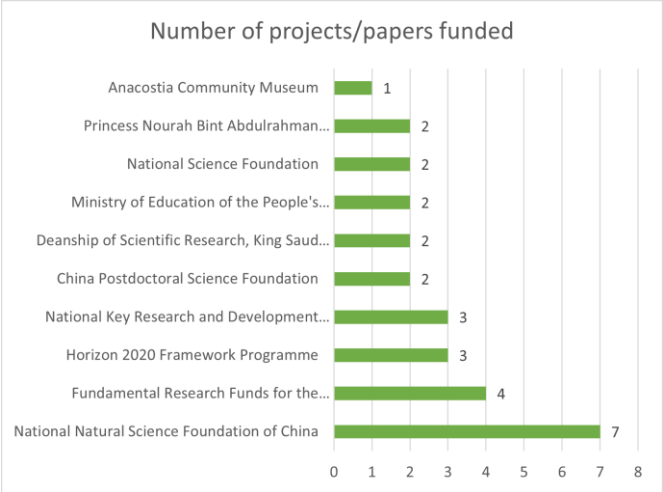

Fig 6: Top ten funding agencies for wireless networks domain.

4 Conclusion

This bibliometric review provides a broad picture of the changing environment at the nexus of 5G networking and artificial intelligence (AI). The results high- light the growing impact of AI on how communication networks will develop in the future, especially in the context of 5G technology. Emerging themes that are shown by the investigation include edge computing, AI-driven network optimization, and intelligent resource allocation. Moreover, it clarifies how AI may be used to tackle issues like network security, latency reduction, and effective spectrum utilization. There was a rise in the research from 2021 in the field of wireless networks and AI. Saeed R.A is the most influential author from Taif University who is doing research and many researchers are following to collaborate with him. Currently, most of the published research work is published in conferences that may not be peer-reviewed.

References

[1] Y. Ouyang, L. Wang, A. Yang, L. Su, D. Belanger, T. Gao, L. Wei, and Y. Zhang, "The next decade of telecommunications artificial intelligence," ArXiv, vol. abs/2101.09163, 2021.

[2] AI and G. A. P. P. for Transforming Industries Journal of Artificial Intel- ligence and Applications, vol. 1, no. 1, pp. 1–10, 2023.

[3] T. G. T. S. Group, "5g: The fifth generation of wireless technology," 2023.

[4] D. Long and B. Magerko, "What is ai literacy? competencies and design considerations," in Proceedings of the 2020 CHI conference on human fac- tors in computing systems, pp. 1–16, 2020.

[5] Ozkaya, "What is really different in engineering ai-enabled systems?," IEEE software, vol. 37, no. 4, pp. 3–6, 2020.

[6] M. Z. Chowdhury, M. Shahjalal, M. K. Hasan, and Y. M. Jang, "The role of optical wireless communication technologies in 5g/6g and iot solutions: Prospects, directions, and challenges," Applied Sciences, vol. 9, no. 20, p. 4367, 2019.

[7] B. Patra, "100x increase in industrial and personal productivity augmenting the state-of-the-art technologies ai/ml, edge computing, and 5g network," in Emerging Electronic Devices, Circuits and Systems: Select Proceedings of EEDCS Workshop Held in Conjunction with ISDCS 2022, pp. 463–472, Springer, 2023.

[8] G. M. Lee, T.-W. Um, and J. K. Choi, "Ai as a microservice (aims) over 5g networks," in 2018 ITU Kaleidoscope: Machine Learning for a 5G Future (ITU K), pp. 1–7, IEEE, 2018.

[9] X. Lin, L. Kundu, C. Dick, and S. Velayutham, "Embracing ai in 5g- advanced towards 6g: A joint 3gpp and o-ran perspective," arXiv preprint arXiv:2209.04987, 2022.

[10] X. You, C. Zhang, X. Tan, S. Jin, and H. Wu, "Ai for 5g: Research directions and paradigms," Science China Information Sciences, vol. 62, pp. 1– 13, 2019.

[11] M. K. Hassan, S. H. Ariffin, S. K. Syed-Yusof, N. E. Ghazali, and M. E. Kanona, "Analysis of hybrid non-linear autoregressive neural network and local smoothing technique for bandwidth slice forecast," TELKOMNIKA (Telecommunication Computing Electronics and Control), vol. 19, no. 4, pp. 1078–1089, 2021.

[12] Q. Zhang and Q. Zhang, "Study of optical networks, 5g, artificial intelligence and their applications," arXiv preprint arXiv:2301.13396, 2023.

[13] L. Feng, “Application and development prospects of 5 g communication technology in aerobics sports,” Microprocessors and Microsystems, vol. 82, p. 103945, 2021.

[14] K. Gai, Q. Xiao, M. Qiu, G. Zhang, J. Chen, Y. Wei, and Y. Zhang, “Digital twin-enabled ai enhancement in smart critical infrastructures for 5g,” ACM Transactions on Sensor Networks (TOSN), vol. 18, no. 3, pp. 1–20, 2022.

[15] P. Mohanram, A. Gilerson, R. Schmitt, et al., “Architecture for edge-based predictive maintenance of machines using federated learning and multi sensor platforms,” 2023.

[16] S. A. Wagle and R. Harikrishnan, “Bibliometric analysis of plant disease prediction using climatic condition,” Lib. Philos. Pract, pp. 1–22, 2021.

[17] M. B. Hassan, R. A. Saeed, O. Khalifa, E. S. Ali, R. A. Mokhtar, and A. A. Hashim, “Green machine learning for green cloud energy efficiency,” in 2022 IEEE 2nd International Maghreb Meeting of the Conference on Sciences and Techniques of Automatic Control and Computer Engineering (MI-STA), pp. 288–294, IEEE, 2022.

[18] M. M. Saeed, R. A. Saeed, M. A. Azim, E. S. Ali, R. A. Mokhtar, and O. Khalifa, “Green machine learning approach for qos improvement in cel- lular communications,” in 2022 IEEE 2nd International Maghreb Meeting of the Conference on Sciences and Techniques of Automatic Control and Computer Engineering (MI-STA), pp. 523–528, IEEE, 2022.

[19] H. Yang, A. Alphones, Z. Xiong, D. Niyato, J. Zhao, and K. Wu, “Artificial- intelligence-enabled intelligent 6g networks,” IEEE Network, vol. 34, no. 6,pp. 272–280, 2020.

[20] J. M. Khurpade, D. Rao and P. D. Sanghavi, "A Survey on IOT and 5G Network," 2018 International Conference on Smart City and Emerging Technology (ICSCET), Mumbai, India, 2018, pp. 1-3, doi: 10.1109/ICSCET.2018.8537340.

[21] Mane, D., Kumbharkar, P., Pawar, P., Katkar, K., Shah, S., Jamwal, K. (2023). Anomaly Detection from Video Surveillances Using Adaptive Convolutional Neural Network. In: Manchuri, A.R., Marla, D., Rao, V.V. (eds) Intelligent Manufacturing and Energy Sustainability. Smart Innovation, Systems and Technologies, vol 334. Springer, Singapore. https://doi.org/10.1007/978-981-19-8497-6_21

[22] Mane, Deepak, et al. "Traffic Density Classification for Multiclass Vehicles Using Customized Convolutional Neural Network for Smart City." Communication and Intelligent Systems: Proceedings of ICCIS 2021. Singapore: Springer Nature Singapore, 2022. 1015-1030.