5G and User Experience: A Bibliometric Approach

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Abstract—This paper aims to conduct a bibliometric analysis of research at the intersection of 5G and user experience in the last five years. The main purpose of the current study is to provide the current status and trends of this intersection research in one of the academic research databases, that is, Web of Science. From the results of our study of 116 collected articles, published from 2017 to 2021, we found a continuous growth in this area of intersection research. We highlight several leading affiliations, publication venues and supporting agencies and confirm that there are notable interests and improvements in this area.

Index Terms—5G, user experience, bibliometric analysis, Web of Science

I. Introduction

4G, the fourth generation of wireless and mobile communication technologies, has been mainly employed in presenting mobile data services for our society, while the fifth generation (5G) has rapidly suffused into various aspect of our society. With this diffusion of 5G, a number of services have newly emerged and have been provided to the commercial markets in several advanced countries (e.g. South Korea and United States) [1], [2].

Considering the fastest-growing effects of 5G and related emerging services, research on users' perspectives toward 5G and the services have become one of the hottest topics to successfully diffuse 5G infrastructure and to improve industrial competitiveness. Compared to a number of bibliometric approaches to technical and engineering research of 5G [3], only few studies have focused on the intersection between 5G and user experience (UX).

The general definition of bibliometric analysis is "*an approach for the statistical and quantitative analysis of research publications that can quantify the literature growth of specific subjects and the impact of individual research results*" [4]. Bibliometric studies can provide the trend of specific research topics with consideration of research outcomes. Also, they can present an overview of a specific research field, grouped by regions, researchers, research areas, sources and supporting agencies.

Thus, this study attempts to conduct a bibliometric analysis to provide an overall trend of recent intersection research of 5G and UX in the last five years. The study can lead to a better understanding of the emerging research topics on users' perspectives toward 5G and its services. The reminder of the current study is organized as follows: Section 2 presents the study methodology. Section 3 examines the key results and Section 4 makes a concluding remark based on the results from Section 3.

II. Study Methodology

A. Data Gathering

To collect the intersection articles of 5G and UX, we used Web of Science [5], a database for bibliometric studies. To retrieve our target data, we set the publication period to five years since 2017 (i.e,. Jan. 2017 to Aug. 2021) [6], [7]. Table I shows the search query in this study.

TABLE I: Search query and criteria.

Category	Description
Query Selection	(TS=("user experience" OR "UX")) AND (TS=(5G)) **Language**: English, **Index**: SSCI, SCIE, **Year**: 2017, 2018, 2019, 2020, 2021

We collected the authors, sources, supporting agencies, affiliations, nations and research areas. We used four publication types: articles, early access, proceeding papers and reviews.

B. Data Analytics

After collecting the dataset from Web of Science, we examined the trends of intersection research of 5G and UX with consideration of articles, areas, article venues, countries and supporting agencies.

III. Results of Bibliometric Analysis

We collected 116 publications from January 2017 to August 2021. First, we examined the trends of publications in 5G and UX. As presented in Table II, considering that only eight months in 2021 were considered in this analysis, the annual number of publications in the area of 5G and UX has consistently increased from 2017 (15 (12.9%)) to 2020 (41 (35.3%)). This means that the academic interests in UX and 5G have consistently developed.

Second, we examined the research areas of publications. Table III shows a summary of the research categories of 5G and UX articles. Because UX and 5G are generally considered as the main topics in computer science (76, 65.5%) and telecommunications (84, 72.4%), these categories rank high in the number of articles published. Moreover, the general engineering category ranks fairly high (81, 69.8%).

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TABLE II: The publication number in 5G and UX.

Year	Number of articles
2017	15 (12.9%)
2018	16 (13.8%)
2019	20 (17.2%)
2020	41 (35.3%)
2021	24 (20.7%; as of Aug. 2021)

TABLE III: Top five research categories in the intersection of 5G and UX. Multiple categorization is allowed.

Categories	Number of articles
Telecommunications	84 (72.4%)
Engineering	81 (69.8%)
Computer Science	76 (65.5%)
Chemistry	7 (6.0%)
Physics	5 (4.3%)

Third, we examined the top venues for articles of 5G and UX in Table IV. The most popular venue for 5G and UX was *IEEE Access* (29, 25.0%), one of the biggest open-access journals. The second popular venue was IEEE (*IEEE Communications Magazine*, 6 (5.2%), another journal provided by IEEE.

TABLE IV: Top venues for the intersection of 5G and UX

Venues	Number of articles
IEEE Access	29 (25.0%)
IEEE Communications Magazine	6 (5.2%)
Sensors	4 (3.4%)
Wireless Communications and Mobile Computing	4 (3.4%)
Others	73 (62.9%)

Fourth, we present the top research affiliations in Table V. Samsung (7, 6.03%), one of the global companies in telecommunications, was the top productive affiliation, followed by two Chinese affiliations (Huawei Technologies, 6, 5.17%; Chinese Academy of Sciences, 5, 4.31%).

TABLE V: Top affiliations for the research of 5G and UX

Affiliations	Number of articles
Samsung Electronics	7 (6.03%)
Huawei Technologies	6 (5.17%)
Chinese Academy of Sciences	5 (4.31%)
Aalto University	4 (3.45%)
Beijing University of Posts Telecommunications	4 (3.45%)
Tampere University	4 (3.45%)
University of Electronic Science Technology of China	4 (3.45%)
University of Oulu	4 (3.45%)
Xidian University	4 (3.45%)

Fifth, we examined both the top supporting programs and research nations (Tables VI and VII). Three research programs in China and two research agencies in Europe support 58 articles in research area of 5G and UX (50.0%). Correspondingly, China (59, 50.9%) was the most productive nation for research in 5G and UX, followed by Spain (14, 12.1%), Finland (12, 10.3%), United States (12, 10.3%) and South Korea (9, 7.8%).

IV. DISCUSSION AND CONCLUSION

Our study of bibliometric analysis showed that the intersection of 5G and UX has become one of the emerging academic

TABLE VI: Top supporting programs for the research of 5G and UX

Programs (or supporting agencies)	Number of articles
National Natural Science Foundation Of China	36 (31.0%)
Fundamental Research Funds for the Central Universities	9 (7.8%)
European Commission	5 (4.3%)
National Key R&D Program of China	5 (4.3%)
Spanish Ministry of Economy and Competitiveness	3 (2.6%)

TABLE VII: Top nations for the research of 5G and UX

Countries	Number of articles
China	59 (50.9%)
Spain	14 (12.1%)
Finland	12 (10.3%)
United States	12 (10.3%)
South Korea	9 (7.8%)

and practical topics, evidenced by the increasing number of publications in Web of Science. The majority of leading venues were organized by telecommunication and computer science (e.g. *IEEE Access*, *IEEE Communications Magazine*), while Samsung, South Korean company, and Huawei Technologies, Chinese company were considered to be the top affiliations in this area. Moreover, China was examined to be the leading nation in the intersection research of 5G and UX. Thus, we suggest future researchers to start their collaborative work and research with the leading affiliations presented in this study.

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