
Research Output on Wireless Communication (2001 – 2012): A Scientometric Study

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Abstract

This study analyses the research output in Wireless Communication published during the period of 2001 – 2012 based on the bibliographic records extracted from SCOPUS Database. The analysis includes year wise output, language wise distribution, leading contributors (country, institute and author) and most preferred journals. A total of 9565 articles published during this study period. The United States published most of the articles and most of the articles are in English. IEEE Journals preferred by researchers in the field of Wireless Communication.

Keywords

Scientometrics, Wireless Communication, SCOPUS.

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INTRODUCTION

Scientometric is interdisciplinary in nature and the science of measuring and analysis the science research. Vinkler P (2010) [1] defined the scientometric as a scientific field dealing with all aspects of people, or group of people, matters and phenomena in science. Wireless Communication is the fastest growing segment in the field communications industry. History of wireless communications backs to 1800s when Marconi established a link between a land based station and tugboat. During the last decade, there was an exponential growth in the cellular systems and currently there are around two billion users worldwide. Wireless Communication is described as transmitting / receiving voice and data using electromagnetic waves in open space. Mobile, portable and fixed are the types of wireless communication. Cellular systems, wireless LANs, satellite systems and wireless PANs are the current wireless systems. The most advantage of wireless communication systems is that a mobile user can make a call anywhere and anytime. The present study investigates the research output of wireless communication literature published during the period from 2001 to 2012. The study focus on to examine the growth of literature using simple growth formula, impact and quality of publications using citations per paper (CPP) and h-index, top journals, most productive institutions and prolific authors.

REVIEW OF LITERATURE

Recent Bibliometric studies conducted on the various branches of knowledge have been reviewed and presented below.

Bathrinarayanan and Tamizhchelvan (2013) [2] conducted a scientometric study on MEMS output based on the bibliographic records as reflected in SCOPUS during 1988-2012. Rajendran, Ramesh Babu and Gopalakrishnan (2005) [3] studied the research output in Fiber Optics based on Ei-Tech index database for the period of five years from 1999 to 2003. They focused to examine the countrywise output and ranking of core journals. Sinha (2011) [4] compared the research output in the field of solar photovoltaics between 1981-1988 and 2001-2008. Khatun and Ahmed (2011) [5] analysed to identify the literature growth, authorship pattern, collaboration and journal distribution on diarrhoeal disease research in Bangladesh based on data obtained from PubMed, Web of Science and Scopus

databases. The *h*-index count indicates that Bangladesh tops the diarrhoeal research impact list in South Asia region. Lufrano and Staiti (2009) [6] analyzed the literature in super capacitors published during 1994-2008 based on the SCOPUS database. Zheng, et al (2011) [7] carried out a scientometric analysis on physics literature published during 1979-2008. They focused to identify the highly productive countries, institutes and authors in the field of physics. Amudha and Muthusamy (2011) [8] analysed the scientific output on computer communication published during 1971-2010. Elango, Rajendran and Bornmann (2013) [9] applied *h*-index to countries, institutes and authors in the field of nanotribology successfully.

OBJECTIVES

The objective of this study has been designed as follows.

1. To examine the growth of Wireless Communication research during the period 2001-2012.
2. To identify the Indian research contribution to wireless communication
3. To analyze author wise distribution of journal articles in the field of Wireless Communication.

METHODOLOGY

The data has been extracted from SCOPUS international multidisciplinary database for the present study and the following search strategy has been used to retrieve the bibliographic records related to wireless communication. (TITLE-ABS-KEY ("wireless communication") AND PUBYEAR > 2000 AND PUBYEAR < 2013 AND (LIMIT-TO(DOCTYPE,"ar"))). The above search criteria yielded 9587 journal articles and extracted. The information relating to Title, Author, Affiliations, Document type, and number of citations, source title and keywords for each publication are exported to MS-Excel then analyzed with the IBM SPSS Statistics 19. Further the following scientometric tools have been employed to analyses the data.

• Growth Rate

The growth of research output in the field of wireless communication is calculated with following simple growth formula.

$$GR = \frac{N_1 + N_2}{N_0} \times 100$$

Where, GR = Growth rate, N_0 = number of articles published in the base year and N_1 = number of articles published in the year for which calculating growth.

• CPP

Citations per paper is used to assess the impact of publications and calculated by dividing the total number of citations by total number of papers.

• h-index

Hirsch (2005) [10] introduced the *h*-index as an alternate to standard bibliometric indicators and the following model suggested by Glanzel & Schubert [11] is used in this study.

$$h = cP^{1/2} (CPP)^{2/3}$$

Where, *h* = *h*-index, *c* = constant, *P* = number of papers and CPP = citations per paper.

LIMITATIONS

The present study is limited to a period of 12 years from 2001 to 2012 and articles published in the journals based on the bibliographic records as reflected in the SCOPUS Database.

DATA ANALYSIS

Table 1 shows the year wise output and publication of research articles along with its citation impact of Wireless Communication during 2001-2012. A total of 9587 Journal articles were published with an average of around 800 article papers per year. A total of 133388 citations received by these total papers with an average CPP of 13.91, about 70% of articles received one or more citations.

The distribution of Wireless Communication literature by language is shown in Table 2. The scholarly communication is effective through English language in almost all the countries irrespective of the native language of a country.

Table 1: Year Wise Output

Year	TP	TC	CPP	%Cited	Growth
2001	290	8768	30.23	80	--
2002	354	24642	69.61	81	22
2003	389	13674	35.15	79	10
2004	430	14358	33.39	80	11
2005	573	15077	26.31	77	33
2006	813	10065	12.38	74	42
2007	847	10837	12.79	71	4
2008	903	10299	11.41	74	7
2009	1032	9696	9.40	76	14
2010	1148	7614	6.63	72	11
2011	1323	5816	4.40	64	15
2012	1485	2542	1.71	48	12
Total	9587	133388	13.91	69	16

TP = Total Papers, TC = Total Citations, CPP = Citations Per Paper

This phenomenon is not an exception to the subject of Wireless Communication which published a maximum of 86.23% of the total research output in English only. This is followed by Chinese (11.89%) and Japanese (0.32) with second and third positions respectively.

Table 2: Language Wise Distribution

Language	Papers	% Papers
English	8267	86.23
Chinese	1140	11.89
Japanese	31	0.32
German	28	0.29
Korean	26	0.27
English & Polish	15	0.16
French	13	0.14
Japanese & English	12	0.13

Table 3 – Research Output of Top 10 Countries

Country	Papers	% Papers	Growth from 2001-06 to 2007-12	C	CPP	h-Index
United States	2133	22.2	59	71942	33.73	134
China	2087	21.8	280	8066	3.86	31
Taiwan	626	6.5	107	5730	9.15	37
South Korea	580	6.0	230	4819	8.31	34
Japan	517	5.4	46	4025	7.79	32
Canada	498	5.2	91	13143	26.39	70
United Kingdom	481	5.0	198	6467	13.44	44
Germany	324	3.4	103	5907	18.23	48
Italy	303	3.2	97	6495	21.44	52
India	303	3.2	539	1610	5.31	20

Russian	10	0.10
Spanish	8	0.08
Portugese	5	0.05
Polish	4	0.04
Czech	3	0.03
English & Chinese	3	0.03
English & Croatian	3	0.03
Finnish	3	0.03
Turkish	3	0.03
English & Spanish	2	0.02
French & English	2	0.02
Croatian	1	0.01
Croatian & English	1	0.01
English & French	1	0.01
English & Lithuanian	1	0.01
Italian	1	0.01
Lithuanian	1	0.01
Portugese & Spanish	1	0.01
Romanian	1	0.01
Slovenian	1	0.01

Distribution of top ten Countries in the Wireless Communication research is shown in Table 3. About 80% of the total output was contributed by these top ten countries. The United States has 22.2% of total output and stands first place by total publications followed by China with 21.8% there is no visible difference in the contributions among these two countries, remaining eight countries contributed in the range of 3.2% and 6.5%. Among these top ten countries India witnessed a high growth rate of publications with 539% from first five year block period to second five year block period followed by China (280%) and South Korea (230%). The United States received the highest CPP of 33.73 and *h*-index of 134.

Top twenty journals were identified in the field of Wireless Communication research and presented in Table 4. IEEE Transaction of Wireless Communication tops the list with 303 papers followed by Microwave and Optical Technology Letters (228) and IEEE Transactions on Vehicular Technology (204). Among the top twenty journals IEEE Transactions on Information Theory received the highest CPP of 95.62 followed by IEEE Journal

on Selected Areas in Communications (88.74) and IEEE Communications Magazine (86.3). In this case of 'h' Index IEEE Communications Magazine is received the highest (92.33) followed by IEEE Transactions on Information Theory (89.34) and IEEE Journal on Selected Areas in Communications (77.8). This result indicate that IEEE Journals are dominated the research field of Wireless Communication

Table 4: Top Journals

Source Title	Papers	TC	CPP	h-Index
IEEE Transactions on Wireless Communications	303	10820	35.71	65.55
Microwave and Optical Technology Letters	228	857	3.76	13.29
IEEE Transactions on Vehicular Technology	204	3677	18.02	36.42
IEEE Transactions on Communications	197	8530	43.30	64.57
Dianzi Yu Xinxixuebao Journal of Electronics and Information Technology	194	136	0.70	4.11
Sensors	147	834	5.67	15.11
IEEE Transactions on Antennas and Propagation	147	3885	26.43	42.14
IEEE Communications Magazine	145	12513	86.30	92.33
IEICE Transactions on Communications	144	383	2.66	9.06
Wireless Personal Communications	140	615	4.39	12.53
IEEE Transactions on Signal Processing	140	6172	44.09	58.32
Conference Proceedings Annual International Conference of the IEEE Engineering in Medicine and Biology Society IEEE Engineering in Medicine and Biology Society Conference	137	125	0.91	4.36
IEEE Communications Letters	117	2326	19.88	32.30
IEEE Transactions on Information Theory	107	10231	95.62	89.34
IEEE Antennas and Wireless Propagation Letters	90	792	8.80	17.19
IEEE Transactions on Mobile Computing	86	2189	25.45	34.37
IEEE Journal on Selected Areas in Communications	82	7277	88.74	77.79
IEEE Transactions on Consumer Electronics	75	1091	14.55	22.62
Eurasip Journal on Wireless Communications and Networking	75	633	8.44	15.73
Lecture Notes in Computer Science Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics	74	233	3.15	8.12

Authors contributed more than fifteen articles during the study period are shown in table 5. Twelve authors published more than 15 articles. Letaief K.B contributed highest number of articles with 31 followed by Tseng Y.C (27) and Shen X (26). Among these twelve authors Heath R.W received the highest CPP of 71.76 as well as h-Index of 44 followed by Rahmat-Samii. Y (CPP = 60.33, h=38) and Letaief K.B (CPP=36.9, h=35).

Table 5 – Top Authors

Author Name	# Papers	TC	CPP	h-index
Letaief, K.B.	31	1144	36.90	35
Tseng, Y.C.	27	818	30.30	29
Shen, X.	26	823	31.65	30
Arnon, S.	22	572	26.00	25
Chen, H.H.	21	427	20.33	21
Cao, Z.	19	550	28.95	25
Fantacci, R.	19	137	7.21	10
Zhang, Y.P.	18	345	19.17	19
Heath, R.W.	17	1220	71.76	44
Zhou, S.	17	392	23.06	21
Zhu, H.B.	16	20	1.25	3
Rahmat-Samii, Y.	15	905	60.33	38

Top ten most productive institutes in the field of Wireless Communication research are shown in table 6. IEEE tops the list in terms of number of papers, CPP and h Index. Out of these ten institutes six

institutes are from China. This result indicates that the Chinese researchers were engaged actively than other countries in the world.

Table 6: Most Productive Institutes

Affiliation	#Papers	TC	CPP	h-index
IEEE	376	18707	49.75	262.30
Tsinghua University	160	1605	10.03	58.83
Southeast University	131	382	2.92	23.36
Beijing University of Posts and Telecommunications	109	254	2.33	18.35
University of Electronic Science and Technology of China	107	424	3.96	25.90
Xidian University	96	421	4.39	26.25
Shanghai Jiaotong University	87	377	4.33	24.79
Hong Kong University of Science and Technology	83	2772	33.40	94.48
National Chiao Tung University Taiwan	79	1256	15.90	56.20
University of California, Los Angeles	75	2167	28.89	81.54

CONCLUSION

In this study, the literature on Wireless Communication research published during the period of twelve years from 2001 to 2012, as reflected in SCOPUS database have been analyzed by scientometric techniques. A total of 9587 articles published during this study period with an average of 800 papers per year. Most of the articles published in English language and by authors from United States. Researchers in the field of Wireless Communication preferred to publish their research findings in IEEE Journals. Chinese scientists engaged actively in this research field.

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