
Research Publications to International Journal of Robotics Research: A Bibliometric Analysis

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Abstract

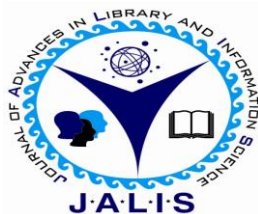
The present study is made an attempt to analyze research productivity of International Journal of Robotics Research from 2010-2019. This study discussed the year-wise distribution of publications output, Relative Growth Rate, Doubling time, Degree of collaboration, Authorship Pattern, Quantum of pages and also analysed highly cited publications. The maximum researchers preferred to publish their research papers in the form of Articles (82.32%) and majority (29%) of the publications from three authored. The degree of collaboration ranges between 0.92 to 0.99 and the mean value is 0.97. Majority (32.89%) of the research papers have published Sixteen to Twenty pages in the present study.

Keywords

Bibliometrics; Relative Growth Rate; Doubling time; Authorship pattern; International Journal of Robotics Research

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Introduction

International Journal of Robotics Research (IJRR) was the first scholarly publication on robotics research. The journal offered to incisive and thought-provoking original research papers and articles, perceptive reviews, and lively editorials on ground-breaking trends issues, technical developments, and theories in robotics by the outstanding scholars and practitioners in the field. The journal covers more than just narrow technical advances-it embraces a wide variety of topics. It consistently ranked in the top 3 in its category of the Thomson Scientific JCR, IJRR publishes scholarly articles that provides engineers, researchers, and scientists with the very best of current research on robotics research - from applied mathematics to artificial intelligence to computer science, to electrical and mechanical engineering. The journal also publishes high quality, peer reviewed datasets and multimedia extensions alongside articles and also member of the Committee on Publication Ethics (COPE). A single journal bibliometric studies helps to identify the research trends of a particular field of research. This study aims to ascertain the growth of literature, authorship pattern, trends of research collaboration, length of pages, break-up of single authorship vs. multiple authorship, highly cited papers etc. The present study attempts to measure the publication productivity of a journal namely, International Journal of Robotics Research from 2010 to 2019.

Background Works

A huge volume of literature has been approved in the field of library and information science in relation to the area of bibliometrics/scientometrics. A brief review of these studies is highlighted in the following paragraphs in order to examine the importance of the present study. The term bibliometrics was the application of statistical and mathematical methods to books and other media of communication (Pritchard, 1969). Vellaichamy and Jeyshankar (2020) conducted a bibliometric study on Journal of Ornithology. In their study examined the year-wise distribution of publications, Relative Growth Rate and Doubling time, authorship pattern, degree of collaboration, document-wise publication, language-wise publication, most productive authors and country-wise contributions etc. The study found that majority of papers were published in the form of articles and it share 87 percent in to the total output. The more distribution of publications was contributed from the

Germany was 359(26.53%). Though authors from the Germany were contributed highest number of papers.

Raza & Malik (2019) analysed bibliometric analysis of the journal of knowledge management during the period 2009-2016. A total of 1214 authors from 57 countries and 584 institutions published 508 papers in the journal from 2009 to 2016. USA & UK was the major contributions found to be 126 (24.8%) publications collectively. The two leading contributing institutions, i.e., Lakehead University and McMaster University were both from Canada and the top two most prolific authors also from these two universities. Vellaichamy & Jeyshankar (2015) investigated that a total of 158 papers were published in the Journal of Webology from 2004-2013. The degree of collaboration ranges from 0.182 to 0.693 and its mean value is found to be 0.44. Web analysis (24.68 %) and social media (15.82 %) papers are the top most publications in subject-wise analysis. India has contributed more number of articles compared to any other countries, such as Iran, UK, USA and Australia. Sujatha & Padmini (2015) examined annual growth of the articles, authorship pattern, collaborative measures like collaborative index, degree of collaboration, collaborative coefficient, modified collaborative coefficient, subject-wise distribution of articles, contribution of Indian authors, contribution of each country based on authors' nationality, number of references in each issue, year-wise references and citation analysis on the articles published in the journal of IEEE Transactions on Antennas and Propagation

Rao et al., (2014) analyzed bibliometric analysis of the Journal of Propulsion and Power during the period 1985-2013. A total of 4047 articles were published and it is observed that 523 (12.9%) were produced by single author, two authors 1330 (32.8 %) and 2194 (54.21%) articles published by multi and mega authors. Country-wise analysis shows that USA produced 61.24 %, Japan 6.92 %, Republic of China 3.8 %, Germany 3.25 %, UK 3.03 % and India 2.66 % of the total articles. Santhanakarthykeyan, Grace and Jeyshankar (2014) were studied the Indian journal of cancer and they were analysed 611 papers, 98.77 % of the papers were multi-authored. Out of 22 countries contributed 244 research papers during the study period. Of the 244 articles, 168 (68.85 per cent) were published from India. In another scientometric study done by Rajendran, Jeyshankar and Elango (2011) examined that the author productivity was 0.34 and the average number of authors per paper was 2.95 and the study also analysed majority (72.99%) of the contributions are by Indian authors.

The degree of collaboration ranges from 0.90 to 0.94. The average degree of collaboration is 0.92 during the period 2005-2009.

Objectives

The objectives of the study are to understand the following regarding International Journal of Robotics Research:

- Year-wise published publications
- Year-wise authorship pattern
- Calculate relative growth rate and doubling time
- Collaborative measures
- Document-type
- Size of publications and
- Highly cited papers

Methods, Data Source and Limitations

The data for the present study were retrieved from SCOPUS multidisciplinary database. Scopus is the largest abstract and citation database of peer-reviewed literature: scientific journals, books and conference proceedings. It covers 24,600 titles and 5000 publishers. The bibliographic details of the published literature were collected using general search option of Scopus. The database searched under source title -'International Journal of Robotics Research' in the field of Search Box. The search was limited for a period of ten years (2011 to 2019) and 973 records were retrieved. The collected data were analysed using MS Excel and subjected to further analysis to meet the objectives and using some bibliometric indicators.

Analysis of Data and Interpretation

Table 1 illustrates that the productivity numbers differ from year to year and there is also steadily decrease in the number of articles from the year 2015 to 2018. Out of 983 publications, the maximum numbers of articles are contributing 125 papers in the year of 2019, which is 12.72% to the total publications. The minimum numbers of articles contributed in the year 2017 with 85 articles, which is 8.65% to the total publications. We can witness an increasing trend during 2010-2012 and decreasing the years from 2015 to 2018, while fluctuation is visible in other periods of study.

Table-1: Year-wise Research Output on IJRR

Year	No. of Papers	% age	Cumulative % age
2010	99	10.07	10.07
2011	105	10.68	20.75
2012	104	10.58	31.33
2013	96	9.77	41.10
2014	101	10.27	51.37
2015	93	9.46	60.83
2016	87	8.85	69.68
2017	85	8.65	78.33
2018	88	8.95	87.28
2019	125	12.72	100.00
Total	983	100.00	

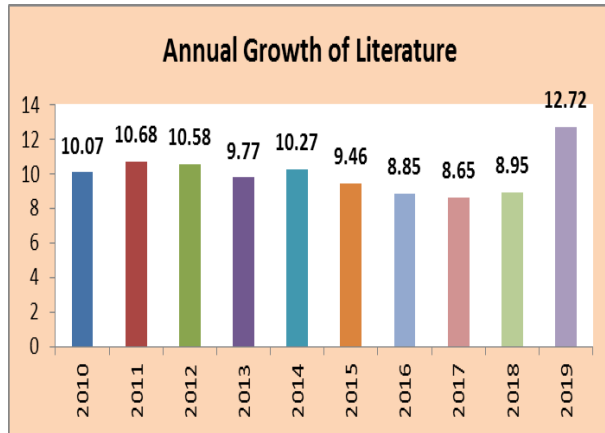


Figure-1: Annual Growth of Literature on IJRR

Relative Growth Rate & Doubling Time

The growth of publications was analysed by using two parameters Relative Growth Rate and Doubling time (Mahapatra 1985). RGR is a measure to study the increase in number of articles of time. It is calculated as,

Relative Growth Rate (RGR) =

$$\frac{\text{Log } e^{2W} - \text{Log } e^{1W}}{2T - 1T}$$

Doubling Time

Doubling time is the time required for each doubling of a Quantity in exponential growth. It has been directly related to Relative Growth Rate. It is the time required for articles to become double of the existing Amount.

$$Dt = \frac{0.693}{R}$$

Doubling time (DT):

New value=initial value*2^t/T double where
 T double=doubling time
 t=time elapsed since the initial value at time t=0

Table 2: Relative Growth Rate (RGR) and Doubling Time (Dt)

S. No	Year	No. of Publications	Cumulative	W1	W2	RGR	Doubling Time
1	2010	99	99	0	4.60	0	0
2	2011	105	204	4.60	5.32	0.72	0.96
3	2012	104	308	5.32	5.73	0.41	1.68
4	2013	96	404	5.73	6.00	0.27	2.55
5	2014	101	505	6.00	6.22	0.22	3.11
6	2015	93	598	6.22	6.39	0.17	4.10
7	2016	87	685	6.39	6.53	0.14	5.10
8	2017	85	770	6.53	6.65	0.12	5.92
9	2018	88	858	6.65	6.75	0.11	6.40
10	2019	125	983	6.75	6.89	0.14	5.10

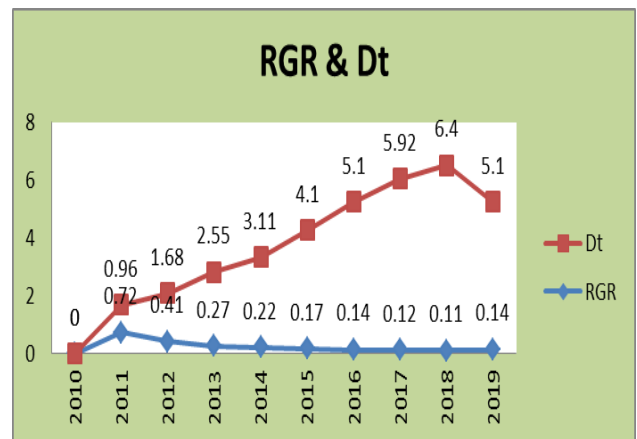


Figure-2: Relative Growth Rate & Doubling time

Authorship pattern

The pattern of authorship found in the publications output in International Journal of Robotics Research ranges from the single author to as many 21 authors in single terms. The research publications by three authors are found to be at a maximum with a score of 28.99 percent of the total output, closely followed by four authored publications forming 23.30 percent, making a much less difference between the two categories. Table 3 shows that among the single, double, three, four, five and more than five authored,

above five authored forms 11.29 % percent of the total research literature output registering an impressive majority while five authorship forms 10.78 percent. Single authored publications record a

score of 2.75 percent which is found to be smaller when compared to the other categories of authorship.

Table - 3: Year-wise Authorship Pattern

Year	Single	Joint	Three	Four	Five	More than Five	Total Papers
2010	2	27	27	26	10	7	99
2011	2	36	25	28	7	7	105
2012	1	22	32	25	10	14	104
2013	8	23	26	18	10	11	96
2014	4	25	33	19	7	13	101
2015	1	23	22	21	15	11	93
2016	2	26	33	14	7	5	87
2017	3	12	21	25	14	10	85
2018	1	11	26	25	13	12	88
2019	3	20	40	28	13	21	125
Total	27	225	285	229	106	111	983
% age	2.75	22.89	28.99	23.30	10.78	11.29	100.00

Document type

Table 4 displays the type of documents found in the collected records. It is evident that journal article is the most preferred medium of all the forms by the IJRR researchers. The largest number of the journal articles indicates a continued trend of relying primarily on this form of publications. Out of 972 publications, 82.32 percent is in the form of articles followed by 10.28 percent in the form of conference papers while other types are negligible.

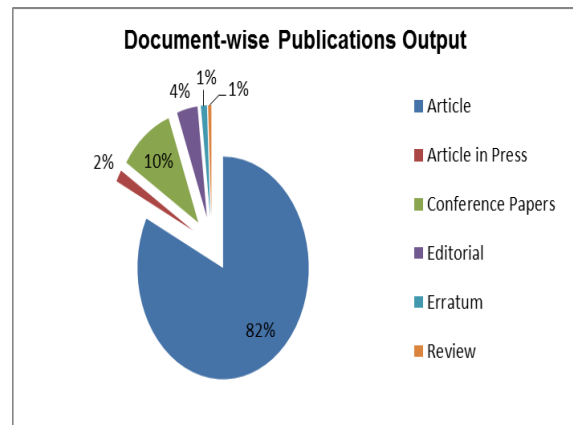


Figure 3: Distribution of document-wise publications

Table 4: Document-wise Publications

Sl. No	Type of Document	No. of Papers	% age	Cumulative % age
1	Article	801	82.32	82.32
2	Article in Press	17	1.75	84.07
3	Conference Papers	100	10.28	94.34
4	Editorial	38	3.91	98.25
5	Erratum	11	1.13	99.38
6	Review	6	0.62	100.00
Total		973	100.00	

Degree of Collaboration

The following formula Suggested by Subramanyam (1983) has been employed to degree of collaboration. The degree of collaboration in different years calculated as per the equation is presented in Table 5 and it shows that the degree of collaboration ranges from 0.92 to 0.99. The mean value is found to be 0.97.

$$C = \frac{Nm}{Nm + Ns}$$

Ns-Number of Single Authors; **Nm**- Number of Multi Authors; **C**-Degree of Collaboration; **MV**-Mean Value

Table 5: Degree of collaboration among Authors

Year	No. of Authors			Other than these three authors	Degree of Collaboration	Total
	Single	Double	Three			
2010	2	27	27	43	0.98	99
2011	2	36	25	42	0.98	105
2012	1	22	32	49	0.99	104
2013	8	23	26	39	0.92	96
2014	4	25	33	39	0.96	101
2015	1	23	22	47	0.99	93
2016	2	26	33	26	0.98	87
2017	3	12	21	49	0.96	85
2018	1	11	26	50	0.99	88
2019	3	20	40	62	0.98	125
Total	27	225	285	446	MV = 0.97	983

Length of Pages

Page count provides another measure for a quantitative approach. Table 6 presents a quantified data of pages counts. Table 6 reveals the distribution of quantum of pages output of the Publications. The research literature output in various forms of documents has been categorized into different ranges From 1 to 30 pages category, then the last category is marked as “more than 30 pages”. The analysis shows that majority (32.89%) of the research papers have published Sixteen to Twenty pages.

Table 6: Size of Publications

Sl. No	Size of Publication in Pages	No. of Publications	% age	Cumulative % age
1	One - Five	53	5.45	5.45
2	Six - Ten	40	4.11	9.56
3	Eleven - Fifteen	204	20.97	30.53
4	Sixteen - Twenty	320	32.89	63.42
5	Twenty one – Twenty Five	231	23.74	87.16
6	Twenty Six - Thirty	79	8.12	95.28
7	Above Thirty	46	4.73	100.00
Total		973	100.00	

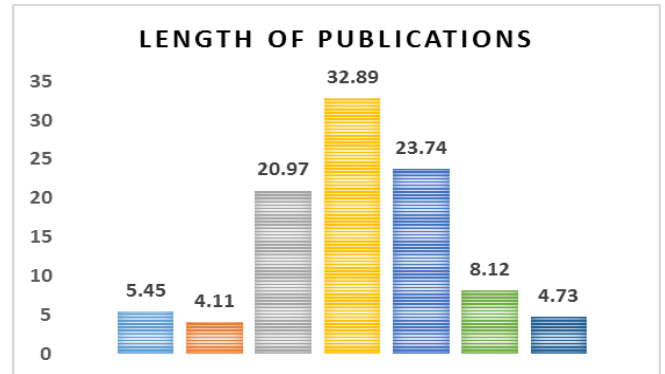


Figure 4: Length of Publications

Highly Cited Papers

Table-7: Highly Cited Publications of IJRR

Name of Authors	Title of the Research Paper	Year of Publication	Times Cited
Geiger A., Lenz P., Stiller C., Urtasun R.	Vision meets robotics: The KITTI dataset	2013	1290
Karaman S., Frazzoli E.	Sampling-based algorithms for optimal motion planning	2011	1257
Henry P., Krainin M., Herbst E., Ren X., Fox D.	RGB-D mapping: Using Kinect-style depth cameras for dense 3D modeling of indoor environments	2012	749
Webster III R.J., Jones B.A.	Design and kinematic modeling of constant curvature continuum robots: A review	2010	638
Kober J., Bagnell J.A., Peters J.	Reinforcement learning in robotics: A survey	2013	559
Kaess M., Johannsson H., Roberts R., Ila V., Leonard J.J., Dellaert F.	ISAM2: Incremental smoothing and mapping using the Bayes tree	2012	422
Leutenegger S., Lynen S., Bosse M., Siegwart R., Furgale P.	Keyframe-based visual-inertial odometry using nonlinear optimization	2015	419
Mellinger D., Michael N., Kumar V.	Trajectory generation and control for precise aggressive maneuvers with quadrotors	2012	396

Lenz I., Lee H., Saxena A.	Deep learning for detecting robotic grasps	2015	353
Cummins M., Newman P.	Appearance-only SLAM at large scale with FAB-MAP 2.0	2011	327

Conclusion

The publishing trend totally depends on the output of contributors, patterns of contributions and the quality of research. Out total of 983 publications, the maximum numbers (125 papers, 12.72% per cent) of papers were contributed in the year of 2019 and minimum number (85 articles, 8.65 per cent) of articles contributed in the year 2017. Authorship pattern provides, maximum number of (11.29) papers published by more than five authors and five authored papers were registered 10.78 percent and two percent of research papers registered with single authored in total publications. The degree of collaboration ranges from 0.92 to 0.99 and the mean value was found to be 0.97. Length of publication analysis shows that majority (32.89%) of the research papers have published Sixteen to Twenty pages and minimum number (4.11%) of research papers have published Six – Ten pages respectively.

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