

Scientometrics of Nonlinear Dynamics Research in India during 1989-2016

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Abstract

This paper highlight the different impact indicators such as Citation Score, Highly Cited papers, Self Citations, Average Citation Per Article, H-index of authors and H-type Index of Journals. An analysis of 3065 publications published by Indian scientists and indexed by web of science online database indicates that Nonlinear Dynamics in India picked up during 1989-2016. The Indian output in the field of laser research forms an integral part of the mainstream science as reflected by the pattern of publications and their citations in the international literature. The publication output is concentrated among few Institutions (IITs(785), IISc(286), Jadavpur University(84), Bharathidasan University(83), NITs(76) and Anna University(62)). The study indicates that the proportion of mega authored papers increased during 1989-2016 and the international collaboration is mainly with the USA, Germany, France, Italy, UK, Canada, Peoples R china, Japan and so on. It reveals upward trends in the number of articles published. Publications received 33273 citations with h-index of 68. The average citation per article is 10.86. 188 publications are from Open Access Journals out of 3065 publications.

Keywords: Citations; Self Citations, H-index, Nonlinear Dynamics, Scientometrics.

1. INTRODUCTION

Citations are count data, with an, as a rule, skewed distribution over the papers in a publication set: on the one hand there a few highly cited papers and on the other a large quantity of papers which are rarely, if ever, cited. Since the end of the 1990s, bibliometrics has been looking at this small group of highly cited papers particularly closely. There is a “shift from bibliometric impact scores based on average values such as the average impact of all papers published by some unit to be evaluated towards indicators reflecting the top of the citation distribution, such as the number of ‘highly cited’ or ‘top’ articles” (van Leeuwen, Visser, Moed, Nederhof, & van Raan, 2003, p. 257). Citation and referencing are important for academic writing. The purpose of a citation is to provide the reader with information to find the source of the author’s facts or ideas. The information in a citation includes, at the very least, the title, author, source of publication and date of publication.

2. ABOUT CNLD AT BHARATHIDASAN UNIVERSITY

The Centre for Nonlinear Dynamics was created in recognition of the excellent contributions made to the field of nonlinear dynamics at the international level and in recognition of the S. S. Bhatnagar prize (nation’s

highest science prize) in Physical Sciences awarded to Prof. M. Lakshmanan (at present Professor of Eminence in the Centre for Nonlinear Dynamics, School of Physics) in 1990 to promote research in that area. In the subsequent years, it was liberally supported by the Department of Science and Technology (DST) and the Department of Atomic Energy (DAE), Government of India towards the development of infrastructure, manpower, library and computational facilities. Today, the Centre is recognized as one of the top-ranking Centres of excellence in Nonlinear Dynamics at the National and International levels. About 33 research scholars have obtained their Ph.D. degree in Nonlinear Dynamics so far and at present 22 students are pursuing their research towards Ph.D degree. More than 25 post-doctoral fellows have worked at the Centre. In addition, the Centre receives a regular stream of visiting scholars and scientists from within India and abroad for collaborative research and for discussion.

3. OBJECTIVES

- i. To study the year wise distribution of publications and Citations
- ii. To study the author wise distribution of publications, Citations, H-index, Average Citations Per Article and Self citations.
- iii. To study the source wise distribution of Publications, Citations and H-type index.

- iv. To study the institution wise distribution of publications and Citations.
- v. To study the country wise collaboration of research (Publications and Citations)
- vi. To study the highly cited papers (Open Access Journals and Subscribed)

4. METHODOLOGY

All publications on Nonlinear Dynamics (keywords used: “Nonlinear Dynamics”) having ‘India’ in address field were downloaded from Science Citation Index. The data were exported and processed in the HistCite and VOSViewer to find out the contribution of Indian institutions, Authors, Citations in the field of Nonlinear Dynamics research during years 1989–2016. The year of publication, Citations, Self Citations, journals and authors were analyzed and displayed in tables using HistCite and visualize the citations using VOSViewer. The Global Citation Scores and Local Citation Scores are examined to identify the pattern of research contribution on Nonlinear Dynamics.

5. ANALYSIS AND INTERPRETATION

5.1 Year-wise Distribution of Publications

The below table represents the year-wise distribution of articles published in the field of Nonlinear Dynamics indexed in web of science online database. It shows that deals regarding the distribution of 3065 articles were published in 1989-2016. Maximum 324 (10.60%) was published in 2015 and minimum number of contribution i.e. 3 (0.1%) in the year 1989 and reveals an upward trends in the number of articles published. Publications received 33273 citations with h-index of 68. The average citation per article is 10.86. 188 publications are from Open Access Journals out of 3065 publications.

5.2 Ranking of Authors Based on Publications

Table 2 lists the top 10 most prolific authors in the field of Non linear dynamic. Heading the list based on number of appearances are the following top ten: Sharma, Ghosh, Lakshmanan, Porsezian, Sharma, Kavitha, Daniel, Sinha, Chatterjee and Ramaswamy. Among those Sharma from IIT Bombay has ranked at first with 64 publications and the author Ghosh from Vikram University has ranked at second with 50 publications and the third ranked by author Lakshmanan from Bharathidasan University shared with 46 publications and followed by scientists. Out of ten authors from the

table 2 shows that four authors from Tamilnadu and 3 authors from Bharathidasan University and affiliated college.

Table 1 Year-wise Distribution of Publications

Sl.No.	Year	Records	%	TLCS	TGCS
1	2015	324	10.6	17	232
2	2014	310	10.1	70	958
3	2013	252	8.2	50	1225
4	2012	218	7.1	86	1426
5	2011	198	6.5	73	1533
6	2009	184	6.0	113	2169
7	2010	184	6.0	71	1548
8	2008	172	5.6	121	2545
9	2007	139	4.5	75	2647
10	2006	135	4.4	87	2425
11	2016	123	4.0	0	16
12	2005	107	3.5	112	1409
13	2004	97	3.2	81	1681
14	2003	77	2.5	63	1518
15	2002	69	2.3	47	1250
16	2000	57	1.9	93	1626
17	1999	55	1.8	73	1355
18	1997	53	1.7	48	719
19	2001	51	1.7	58	939
20	1996	48	1.6	60	1143
21	1998	47	1.5	42	727
22	1995	46	1.5	40	914
23	1991	29	0.9	33	318
24	1994	29	0.9	30	564
25	1993	27	0.9	63	624
25	1993	27	0.9	63	624
26	1992	24	0.8	29	289
27	1990	7	0.2	18	130
28	1989	3	0.1	2	41

5.3 Ranking of Authors based on Citations

Table 3 counting the number of times cited by other works to measure the impact of a author. The analysis by citations found that Sharma accounted for 64 publications with 1995 citations followed next by Ghosh with 1111 citations for 3 publications, Pal with 1097 citations for 4 papers and Lakshmanan with 850 citations for 46 papers.

Table 2 Ranking of Authors based on Publications

Author	Institution	Records	TGCS	H-index	Average Citation Per Article	Self Citation
Sharma A	IIT Bombay	64	1805	22	28.20	141
Ghosh S	Vikram University	50	246	8	4.92	14
Lakshmanan M	Bharathidasan University	46	855	16	18.59	59
Porsezian K	Pondicherry University	44	489	11	11.11	29
Sharma RP	IIT Delhi	43	149	8	3.51	57
Kavitha L	Central University, TN	34	257	10	7.59	40
Daniel M	Bharathidasan University	27	398	12	14.78	38
Sinha S	CSIR	24	365	10	15.21	15
Chatterjee A	Jadavpur University	26	570	12	21.92	12
Ramaswamy R	Govt College for Women, Kumbakonam	26	543	11	20.88	26

Table 3 Ranking of Authors based on Citations

Author	Institution	Records	%	TLCS	TGCS
Sharma A	IIT Bombay	64	2.1	132	1795
Ghosh SK	Inst Phys Bhubaneswar	3	0.1	0	1111
Pal T	IIT Kharagpur	4	0.1	0	1097
Lakshmanan M	Bharathidasan University	46	1.5	111	850
Sen A	Inst Plasma Res Bhat, Gandhinagar	23	0.8	20	589
Prasad A	JNU, New Delhi	25	0.8	16	578
Kargupta K	IIT Kanpur	9	0.3	36	577
Ramaswamy R	Govt College for Women, Kumbakonam	26	0.8	39	539
Bhattacharyya S	Tata Institute of Fundamental Research	3	0.1	0	503
Minwalla S	Tata Institute of Fundamental Research	2	0.1	0	492

5.4 Source-wise Distribution of Publications

The study found that the total research output of the Nonlinear Dynamic for the study period published in various journals. As the major portion of the research publications 145 covered by highly impact factor journals and impact high h-type index also. The journal “Physical Review E” topped with 145 publications with the Global Citation Score of 2023, next to “Physics of Plasmas” 89 publications with the Global Citation Score of 624 and followed by Pramana, Physics Letters A and Nonlinear Dynamics.

5.5 Institution-wise Distribution of Publications

Table 5 indicates Institution-wise research productivity. It is noted that IIT ranks first in order by contributing 785(25.6%) and received 9442 citations

scores. Indian Institute of Science records the second place in order with 286 publications and received 3370 citations and followed by Jadavpur University with 84 Publications , Bharathidasan university with 83 publications and 6 Institutions from Tamilnadu among the listed top 20 Institutions.

5.6 Country-wise collaboration of Research

The global collaboration of most productive countries in Nonlinear Dynamics with Indian Scientists (Tables 6), with highest share 294 publications coming from USA, followed by Germany with 82 publications, France with 62 publications, Italy with 60 Publications and UK with 42 Publications. Indian has collaboration with more than 70 countries in the field of Nonlinear Dynamics and its shows strength of research.

Table 4 Source- wise Distribution of Publications

Sl.No.	Journal	Records	%	H-type Index	TGCS	TLCR
1	PHYSICAL REVIEW E	145	4.7	24	2023	104
2	PHYSICS OF PLASMAS	89	2.9	14	624	18
3	PRAMANA-JOURNAL OF PHYSICS	70	2.3	7	154	53
4	PHYSICS LETTERS A	48	1.6	12	460	39
5	NONLINEAR DYNAMICS	44	1.4	12	291	24
6	JOURNAL OF SOUND AND VIBRATION	43	1.4	18	734	14
7	PHYSICA SCRIPTA	41	1.3	10	169	19
8	COMMUNICATIONS IN NONLINEAR SCIENCE AND NUMERICAL SIMULATION	40	1.3	9	184	31
9	INDUSTRIAL & ENGINEERING CHEMISTRY RESEARCH	38	1.2	11	340	37
10	JOURNAL OF CHEMICAL PHYSICS	38	1.2	16	688	32

Table 5 Institution-wise Distribution of Publications

Sl.No.	Institution	Records	Rank	%	TLCR	TGCS
1	Indian Institute of Technology	785	1	25.6	479	9442
2	Indian Institute of Science	286	2	9.3	204	3370
3	Jadavpur University	84	3	2.7	43	1023
4	Bharathidasan University	83	4	2.7	165	1286
5	National Institute of Technology	76	5	2.5	15	351
6	Anna University	62	6	2.0	29	458
7	Indian Inst Technology Delhi	61	7	2.0	25	322
8	University Hyderabad	58	8	1.9	76	842
9	Jawaharlal Nehru University	54	9	1.8	55	907
10	Bhabha Atom Res Centre	52	10	1.7	19	559
11	Saha Inst Nucl Phys	46	11	1.5	3	226
12	Indian Assoc Cultivat Science	44	12	1.4	11	295
13	University Calcutta	44	12	1.4	4	271
14	Inst Plasma Res	43	13	1.4	24	696
15	University Delhi	40	14	1.3	5	951
16	Pondicherry University	39	15	1.3	19	294
17	Inst Math Science	36	16	1.2	16	510
18	Tata Inst Fundamental Res	36	16	1.2	25	1275
19	Visva Bharati University	34	17	1.1	7	252
20	Periyar University	33	18	1.1	29	150

Table 6 Country-wise Collaboration of Research in Nonlinear Dynamics

Country	Records	TLCS	TGCS	Country	Records	TLCS	TGCS
USA	294	138	4174	U Arab Emirates	5	0	61
Germany	82	30	792	Czech Republic	4	0	33
France	62	28	1200	Finland	4	1	72
Italy	60	27	540	Kazakhstan	4	16	81
UK	58	15	1535	Oman	4	1	30
Canada	42	13	431	Romania	4	1	58
Peoples R China	32	5	243	Bangladesh	3	4	30
Japan	30	16	534	Chile	3	0	43
South Korea	29	4	211	Hungary	3	0	28
Australia	25	2	260	Vietnam	3	0	3
Singapore	25	3	146	Armenia	2	0	18
Spain	22	2	187	Byelarus	2	0	21
Netherlands	18	12	188	Eritrea	2	2	11
Malaysia	17	4	96	Fiji	2	2	18
Saudi Arabia	17	3	90	Iraq	2	0	6
Unknown	17	12	199	Morocco	2	0	22
South Africa	15	0	106	New Zealand	2	0	1
Israel	14	2	97	Pakistan	2	0	7
Poland	13	1	84	Slovakia	2	0	18
Brazil	11	9	296	Thailand	2	0	34
Belgium	10	8	186	Argentina	1	0	17
Greece	10	0	73	Azerbaijan	1	0	17
Russia	10	3	116	Benin	1	0	0
Serbia	10	5	89	Bhutan	1	0	0
Mexico	9	6	106	Bulgaria	1	0	0
Austria	8	0	96	Colombia	1	0	17
Switzerland	8	0	69	Cyprus	1	0	0
Cameroon	7	1	19	Gabon	1	0	7
Sweden	7	0	64	Ireland	1	0	42
Denmark	6	0	172	Jordan	1	0	0
Iran	6	1	68	Kuwait	1	0	10
Taiwan	6	0	244	New Caledonia	1	0	9
Turkey	6	1	43	Rep of Georgia	1	0	17
Egypt	5	0	28	Slovenia	1	0	17
Norway	5	0	147	Sudan	1	3	15
Portugal	5	0	32	Tanzania	1	0	0

5.7 Highly Cited Paper from Open Access Journals

Citations, in which one paper refers to earlier works, are the standard means by which authors acknowledge the source of their methods, ideas and findings, and are often used as a rough measure of a paper's importance.

Fifty years ago, Eugene Garfield published the Science Citation Index (SCI), the first systematic effort to track citations in the scientific literature. By total number of citations, the top paper is "Excitonic transitions and off-resonant optical limiting in CdS quantum dots stabilized in a synthetic glue matrix", cited 41 times and published in 2007 (Author: Kurian from IIT Madras and other from RRI Bangalore; Source: Nanoscale Research Letters) and other papers are listed in the below table. The i10 index is 17 and it mean 17 publications are received 10 and above citations.

5.8 Highly cited Paper from Non Open Access Journals

By total number of citations, the top paper is "Interparticle coupling effect on the surface plasmon resonance of gold nanoparticles: From theory to applications", cited 1047 times (1067 Citations from Web of Science, 142 Citations from BIOSIS and 28 Citations from Chinese Science Citation Index) and published in 2007 (Author: Ghose from Raidigi College, Raidigi and Pal from IIT Kharagpur; Source: Chemical Reviews) and remaining papers are listed in the below table. The i10 index is 887.

Table 7 Highly Cited Papers from Open Access Journals

1.	Excitonic transitions and off-resonant optical limiting in CdS quantum dots stabilized in a synthetic glue matrix By: Kurian, Pushpa Ann; Vijayan, C.; Sathiyamoorthy, K.; et al. NANOSCALE RESEARCH LETTERS Volume: 2 Issue: 11 Pages: 561-568 Published: NOV 2007	Times Cited: 41 (from Web of Science Core Collection)
	Full Text from Publisher View Abstract	Usage Count
2.	Forcing Versus Feedback: Epidemic Malaria and Monsoon Rains in Northwest India By: Laneri, Karina; Bhadra, Anindya; Ionides, Edward L.; et al. PLOS COMPUTATIONAL BIOLOGY Volume: 6 Issue: 9 Article Number: e1000898 Published: SEP 2010	Times Cited: 38 (from Web of Science Core Collection)
	Full Text from Publisher View Abstract	Usage Count
3.	Application of optimisation techniques in groundwater quantity and quality management By: Das, A.; Datta, B. SADHANA-ACADEMY PROCEEDINGS IN ENGINEERING SCIENCES Volume: 26 Pages: 293-316 Part: 4 Published: AUG 2001	Times Cited: 31 (from Web of Science Core Collection)
	Full Text from Publisher View Abstract	Usage Count
4.	Anomalous width variation of rarefactive ion acoustic solitary waves in the context of auroral plasmas By: Ghosh, S.S.; Lakhina, G.S. NONLINEAR PROCESSES IN GEOPHYSICS Volume: 11 Issue: 2 Pages: 219-228 Published: 2004	Times Cited: 25 (from Web of Science Core Collection)
	Full Text from Publisher View Abstract	Usage Count
5.	Nonlinear optical properties of 2,4,5-Trimethoxy-4'-nitrochalcone: observation of two-photon-induced excited-state nonlinearities By: Gu, Bing; Ji, Wei; Huang, Xiao-Qin; et al. OPTICS EXPRESS Volume: 17 Issue: 2 Pages: 1126-1135 Published: JAN 19 2009	Times Cited: 22 (from Web of Science Core Collection)
	Full Text from Publisher View Abstract	Usage Count

Table 8 Highly Cited Papers in Nonlinear Dynamics

1.	Interparticle coupling effect on the surface plasmon resonance of gold nanoparticles: From theory to applications By: Ghosh, Sujit Kumar; Pal, Tarasankar CHEMICAL REVIEWS Volume: 107 Issue: 11 Pages: 4797-4862 Published: NOV 2007	Times Cited: 1,067 (from Web of Science Core Collection)
	Full Text from Publisher	Usage Count
2.	Nonlinear fluid dynamics from gravity By: Bhatnagar, Sayantani; Minwalla, Shiraz; Hubeny, Veronika E.; et al. JOURNAL OF HIGH ENERGY PHYSICS Issue: 2 Article Number: 045 Published: FEB 2008	Times Cited: 426 (from Web of Science Core Collection)
	Full Text from Publisher View Abstract	Usage Count
3.	SOLUTION BEHAVIOR OF AEROSOL OT IN NONPOLAR-SOLVENTS By: DE, TK; MAITRA, A. ADVANCES IN COLLOID AND INTERFACE SCIENCE Volume: 59 Pages: 95-193 Published: AUG 31 1995	Times Cited: 389 (from Web of Science Core Collection)
	Full Text from Publisher View Abstract	Usage Count
4.	Instability of thin polymer films on coated substrates: Rupture, dewetting, and drop formation By: Sharma, A.; Reiter, G. JOURNAL OF COLLOID AND INTERFACE SCIENCE Volume: 178 Issue: 2 Pages: 380-399 Published: MAR 25 1996	Times Cited: 285 (from Web of Science Core Collection)
	Full Text from Publisher View Abstract	Usage Count
5.	Static and dynamic response of cluster glass in La_{0.55}Si_{0.5}CoO₃ By: Mukherjee, S.; Ranganathan, R.; Anilkumar, P.S.; et al. PHYSICAL REVIEW B Volume: 54 Issue: 13 Pages: 9267-9274 Published: OCT 1 1996	Times Cited: 232 (from Web of Science Core Collection)
	Full Text from Publisher View Abstract	Usage Count

6. FINDINGS AND CONCLUSION

It reveals upward trends in the number of articles published. Publications received 33273 citations with h-index of 68. The average citation per article is 10.86. 188 publications are from Open Access Journals out of 3065 publications. Out of top ten authors from the table 2 shows that 3 authors from Bharathidasan University and affiliated colleges.

Recognition of the excellent contributions made to the field of nonlinear dynamics at the international level and in recognition of the S. S. Bhatnagar prize (nation's highest science prize) in Physical Sciences awarded to Prof. M. Lakshmanan from Bharathidasan university (at present Professor of Eminence in the Centre for Nonlinear Dynamics, School of Physics) in 1990 to promote research in that area.

This study has highlighted quantitatively the contributions made by the researchers during 1989-2016 as reflected in Web of Science database. For a thorough analysis of the impact of an author or a publication, one needs to look in multiple databases to find all possible cited references. A number of resources are available that identify cited works including: Web of Science, Scopus, Google Scholar, and other databases with limited citation data. During 28 years period contributions in terms of number of publications is not significant. Though the records available in the Web of Science database reveal a small number, it is important to that the Web of Science covers only the peer-reviewed journals. Overall, at the global level collaboration of publications should be encouraged.

REFERENCES

- (1) V. Garousi and J.M. Fernandes, "Highly-cited Papers in Software Engineering: The top-100", *Information and Software Technology*, Vol.71, 2016, pp.108-128.
- (2) K. Ankasetty and M. Surulinathi, "Highly Cited papers from University of Mysore: A Citation Mapping", *Journal of Advances in Library and Information Science*. Vol.2, No. 2, 2013, pp.50-54.
- (3) R. Balasubramani, M. Surulinathi and Dr. M.Jayaprakash, "Mapping of Highly Cited Papers in Green Computing Research", *International Journal of Information Retrieval and Management*. Vol. 1. No.1, 2013, pp.16-25.
- (4) T. Rajagopal, G. Archunan, M. Surulinathi and P. Ponmanickam, "Research Output in Pheromone Biology: A Case Study of India", *Scientometrics*, Vol.94, No.2, 2013, pp.711-719.
- (5) K. Garg and P. Padhi, "Scientometrics of Laser Research in India during 1970-1994", *Scientometrics*, Vol.55, No.2, 2002, pp.215-241.