A Scientometric Analysis of Global Animation Research by Web of Science Data

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ABSTRACT

The research paper is analyzing the global publication trends on animation research output based on the Web of Science database. During 2011-2020, the database contained 6,295 publications were published in the field. The average number of publications per year was 629.5 and the highest number of publications 744 was published in 2019. Lee, J is the most productive author with 44 (0.70%) followed by Zhang, J J with 27 (0.43%) publications and Jin, X G with 26 (0.41%) publications. RGR is decreased from 0.75 in 2011 to 0.20 in 2018 and the Doubling time of the publications gradually increased from 0.92 in 2011 to 3.47 in 2018. Major source of publications on animation research is journal articles with 5,310 publications (84.35%). Authors from China have contributed maximum number of publications compared to the other countries and India stood 7th rank in terms of productivity in this period. Publications on animation are spread over 17 languages.

KEYWORDS: Animation, Scientometrics, Annual growth rate, Relative growth rate and Doubling time.

1. INTRODUCTION

Animation heads the creation of photography and the cine camera by several decades. It is an art form in which a world of dynamic image and sound may be produced completely out of nothing but a thought. Animation is the most quick of mediums it has become an vital ingredient in multimedia content; it is imbedded in the control interface display of multi-million dollar jet fighter planes, it is essential to the computer games industry; it increasingly strengthens all special effects in motion picture production; and it has provided content in an ideal form to distribute across a bandwidth poor networked environment.

Animation is an art form which can come from everywhere and which can go to anyplace. Almost anything can be brought to life and be imbued with personality, twigs, clay, drawings, objects, computer meshes, and, of course, anything becomes possible in the world of animation. It can amuse, clarify and attract. In all its wondrous forms from the TV commercials, sophisticated description works and simulations, to experimental, digitally composited, special effects driven and art films, animation is a powerful vehicle for ideas. The present paper has been undertaken to know the growth and development of publications in the field of animation.

2. OBJECTIVES FOR THE STUDY

The objectives of the present study are as follows:

➢ Year wise document output

➢ Document type of publications

➢ Most prolific authors

➢ Highly productive countries

➢ Highly productive institutes

➢ Most preferred source titles

➢ Language-wise distribution of publications

➢ Subject wise distribution of articles

3. METHODOLOGY

The Web of Science database was used for retrieving data on animation during 2011-2020, using search terms namely 'animation' in 'topic filed'. Records pertaining to animation were received only from 2011 onwards. A total of 6295 records were received to these publications transferred to spread sheet application and analyzed the data as per objectives of the study.

4. DATA ANALYSIS AND INTERPRETATIONS

4.1 Form of publications

Table 1: Form of publications

S. No.	Form of publications	No. of publications	Percentage
1	Journal Articles	5310	84.35
2	Proceeding Papers	355	5.64
3	Review Articles	188	2.99
4	Meeting Abstracts	134	2.13
5	Book Reviews	123	1.95
6	Editorial Materials	115	1.83
7	Early Access	25	0.40
8	Book Chapters	19	0.30
9	Letters	15	0.24
10	News Items	11	0.17
Total		**6295**	**100.00**
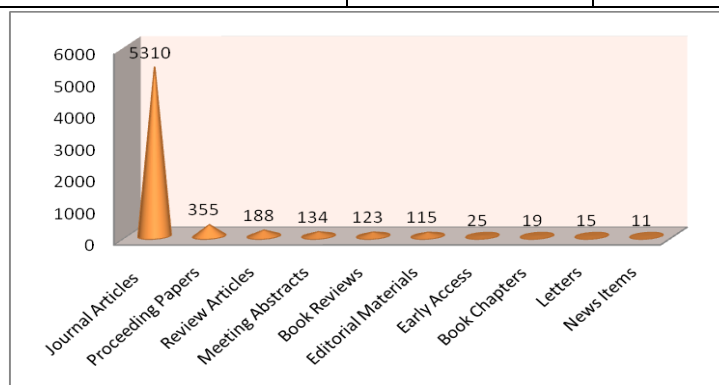
Figure 1: Form of publications

The table 1 reveals that the major source of publications covered by web of science databases on animation research is Journal Articles with 5,310 publications (84.35%) followed by Proceedings papers with 355 publications (5.64%). Review Articles ranks the third position with 188 publications (2.99%), Meeting abstracts with 134 publications (2.13%), Book Reviews with 123 publications (1.95%), Editorial Materials with 115 publications (1.83%) and remaining forms are less than one percentage as seen in the table. The results indicate that the research outputs on the subject of the period covered by the study are mostly published in the form of journal articles.

4.2 Annual Growth Rate (AGR) of publications

Table 2 provides the AGR of the number of documents for period 2011 to 2020.

$$AGR = \frac{\text{End Value - First Value}}{\text{First Value}} \times 100$$

Table 2:   AGR of Publications

Year	No. of publications (%)	Cumulative total	Annual growth rate (AGR)
2011	555 (8.82%)	555	-
2012	569 (9.04%)	1124	102.52
2013	634 (10.07%)	1758	56.41
2014	586 (9.31%)	2344	33.33
2015	579 (9.20%)	2923	24.70
2016	564 (8.96%)	3487	19.30
2017	702 (11.15%)	4189	20.13
2018	677 (10.75%)	4866	16.16
2019	744 (11.82%)	5610	15.29
2020	685 (10.88%)	6295	12.21

During the period of 2011 to 2020, a total of 6,295 publications were published on data mining research. The highest number of publications are 6242 were published in 2020. The lowest publications of 2276 were published in 2012. The average number of publications published per year was 3575.4. Table 2 show that there has been a steady growth in research publications on data mining during the study period except in the year 2014.

The table 1 also provides that the annual growth rate of the total publications calculated year wise. AGR reveals that it has decreased from 158.35 in 2013 to 21.15 in 2020. There is a down ward trend in the growth rate as seen in the figure 2.
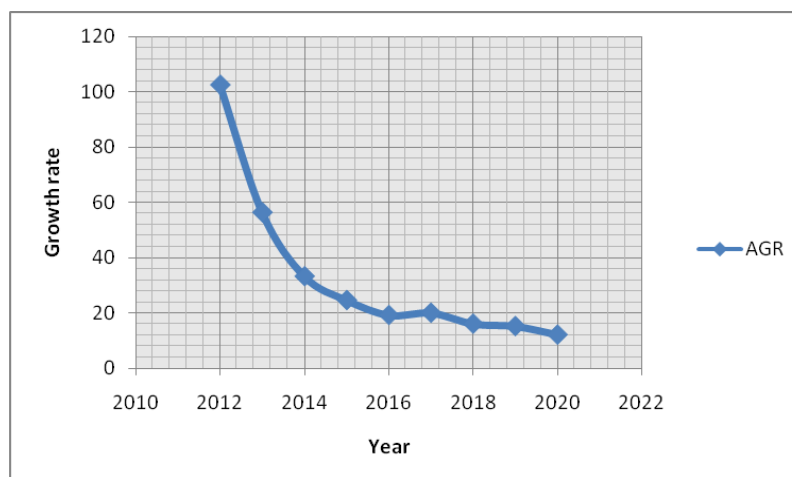
Figure 2: Annual growth rate of publications

4.3 Growth of publications – RGR and DT

The Relative Growth Rate (RGR) is the increase in a number of articles or pages per unit of time. This definition derived from the definition of relative growth rates in the study of growth analysis in the field of bioinformatics. The mean relative growth rate (R) over the specific period of the interval can be calculated from the following equation.

Relative Growth Rate (RGR)

$1 - 2R = \text{Log } W_2 - \text{Log } W_1 / T_2 - T_1$

Whereas

1-2 R- mean relative growth rate over the specific period of interval

$\text{Log}_e W_1$ - log of the initial number of articles

$\text{Log}_e W_2$ - log of the final number of articles after a specific period of interval

$T_2 - T_1$- the unit difference between the initial time and the final time

The year can be taken here as the unit of time.

Doubling Time (DT) = 0.693/R

Table 3: Relative growth rate (RGR) and Doubling time (DT) of publications

Year	No. of Publications	Cumulative Total	W1	W2	RGR	DT
2011	555	555	-	6.32	-	**-**
2012	569	1124	6.32	7.02	0.70	0.99
2013	634	1758	7.02	7.47	0.45	1.54
2014	586	2344	7.47	7.76	0.29	2.39
2015	579	2923	7.76	7.98	0.22	3.15
2016	564	3487	7.98	8.16	0.18	3.85
2017	702	4189	8.16	8.34	0.18	3.85
2018	677	4866	8.34	8.49	0.15	4.62
2019	744	5610	8.49	8.63	0.14	4.95
2020	685	6295	8.63	8.75	0.12	5.78

Table 3 indicates that the RGR is decreased from 0.70 in 2011 to 0.12 in 2020. The highest value 0.70 corresponds to the year 2012, whereas the lowest value 0.12 for the year 2020. Correspondingly, the Doubling Time of the publications gradually increased from 0.99 in 2012 to 5.78 in 2020.
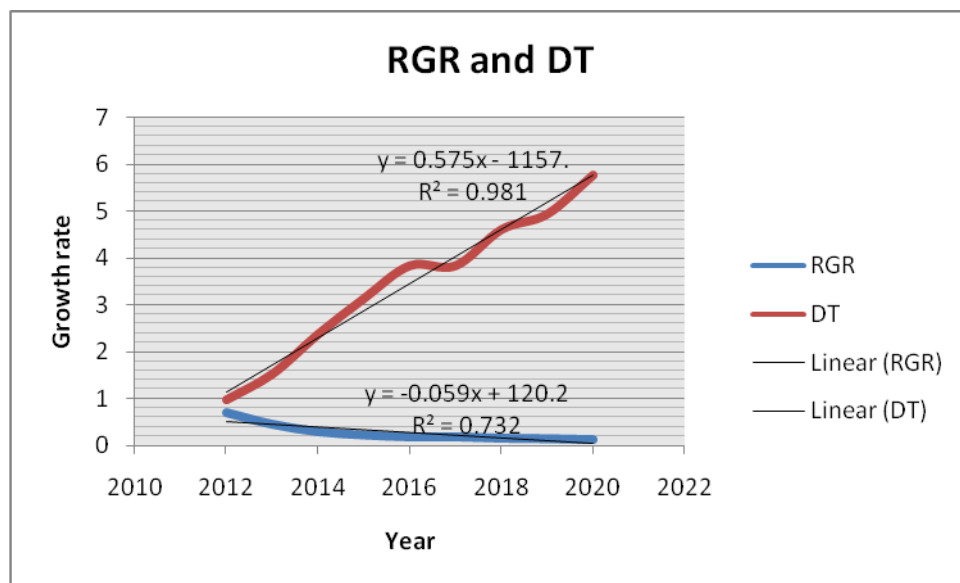

Figure 3: Relative growth rate and Doubling time

4.4 Most Productive Authors

Table 4: Most Productive Authors

S. No.	Author	No. of publications	Percentage
1	Lee, J	44	0.70
2	Zhang J J	27	0.43
3	Jin X G	26	0.41
4	Deng Z G	24	0.38
5	Komura T	22	0.35
6	Gross M	21	0.33
7	Kim J	20	0.32
8	Noh J	20	0.32
9	Paas F	20	0.32
10	Qin H	19	0.30
11	Schelter K	18	0.29

The data on animation research publication during 10 years between 2011 and 2020 reveals that 81,109 authors contributed to the publishing of the 6295 publications. The authors having 18 or more publications during 2011-2020 are shown in Table 4. Lee, J is the most productive author with 44 (0.70%) followed by Zhang, J J with 27 (0.43%) publications, Jin, X G with 26 (0.41%) publications, Deng, Z G with 24 (0.38%) publications, Komura, T with 22 (0.35%) publications, Gross, M with 21 (0.33%) publications, Kim, J, Noh, J and Paas, F each with 20 (0.32%) publications and Qin, H with 19 (0.30%) publications, respectively.
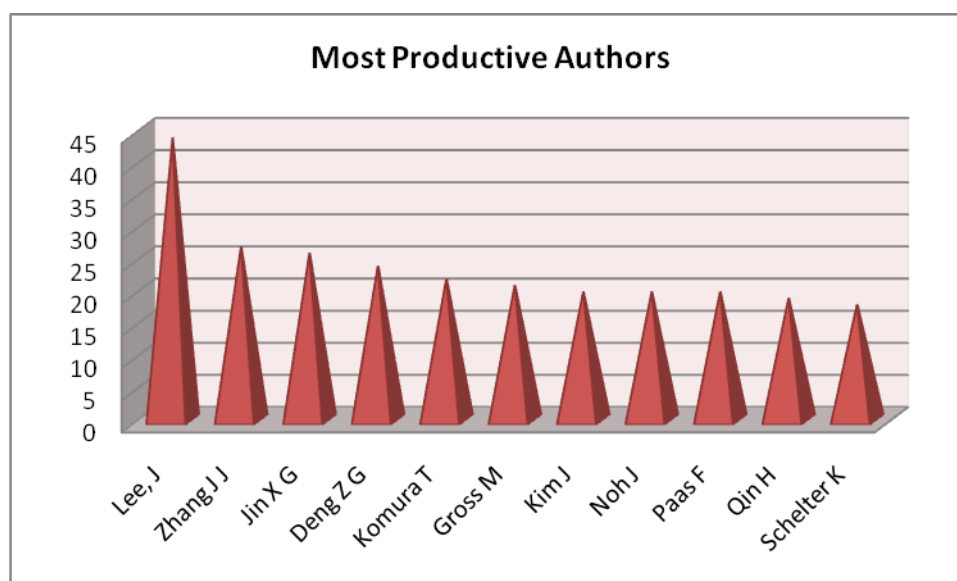
Figure 4: Most productive authors

4.5 Highly Productive institutions
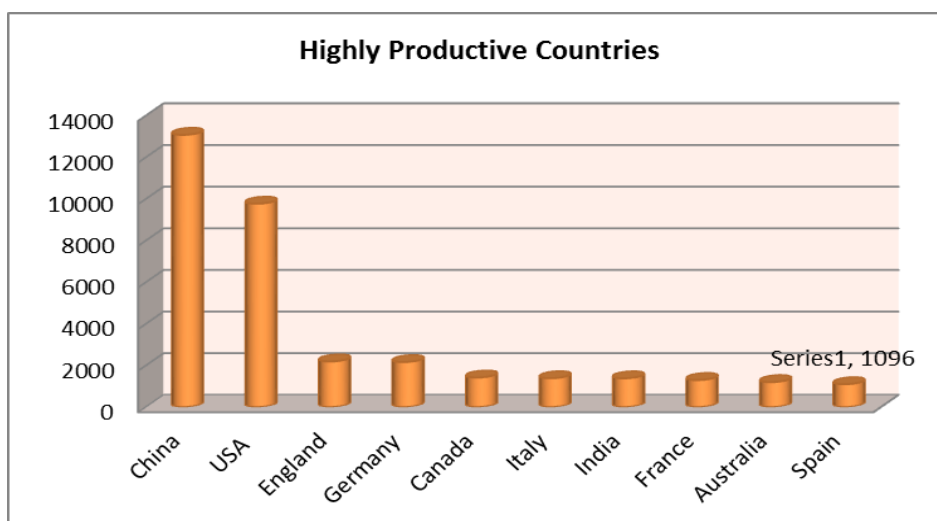
Table 5: Highly Productive institutions

S. No.	Institutions	Country	No. of Publications
1	University of California System	USA	196 (3.11%)
2	Chinese Academy of Science	China	134 (2.13%)
3	Centre National De La Recherche Scientifique CNRS	France	125 (1.99%)
4	Zhejiang University	China	119 (1.89%)
5	University of London	UK	110 (1.75%)
6	Harvard University	USA	68 (1.08%)
7	ETH Zurich		66 (1.05%)
8	Stanford University	USA	63 (1.00%)
9	University of North Corolina		58 (0.92%)
10	University of British Columbia	Canada	55 (0.87%)

The scientometric profile of top 10 institutions is presented in table 5. Findings revealed that University of California System, USA with 196 (3.11%) publications is the most productive institutions in the field of animation research followed by Chinese Academy of Science, China with 134 (2.13%) publications, Centre National De La Recherche Scientifique CNR, France with 125 (1.99%) publications, Zhejiang University with 119 (1.89%) publications, University of London, UK with 110 (1.75%) publications, Harvard University, USA with 68 (1.08%) publications, ETH Zurich with 66 (1.05%) publications and Stanford University with 63 (1.00%) publications.

4.6 Highly Productive Countries

Table 6: Highly Productive Countries

S. No.	Country	Total Publications (%)
1	China	13073 (36.71%)
2	USA	9765 (27.42%)
3	England	2188 (6.14%)
4	Germany	2158 (6.06%)
5	Canada	1416 (3.98%)
6	Italy	1382 (3.88%)
7	India	1378 (3.87%)
8	France	1295 (3.64%)
9	Australia	1196 (3.36%)
10	Spain	1096 (3.08%)

Figure 5: Highly productive countries

The publication share of highly productive countries (≥1000 publications) on animation is given in Table 6. In all, there were 148 countries involved in the research in animation; however, China topped the list with highest share (36.71%) of publications. USA ranked second with 27.42% share of publications followed by England 6.14% share of publications, Germany with 6.06% share of publications, Canada with 3.98% share of publications, Italy with 3.88% share of publications and India with 3.87% share of publications and France with 3.64% share of publications.
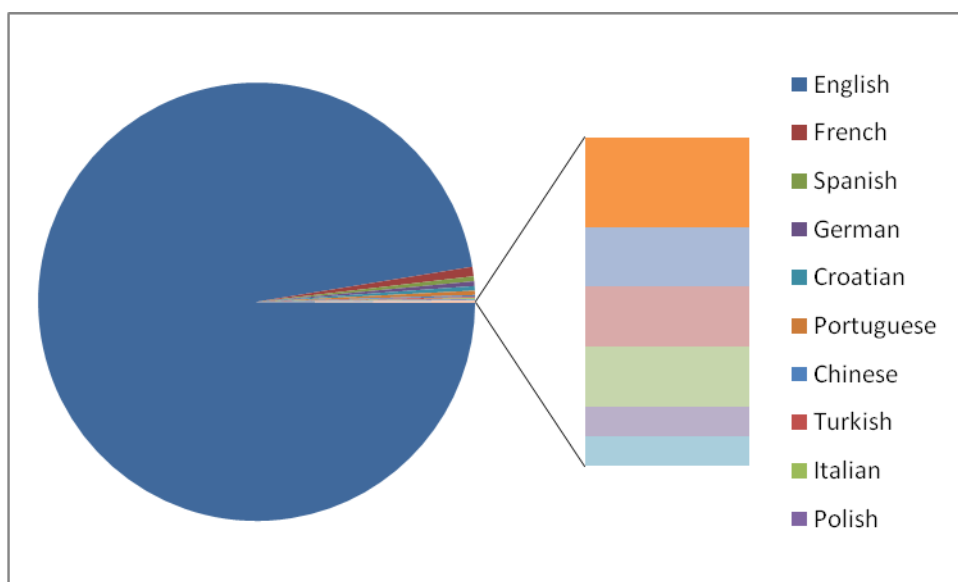
4.7 Language-wise Distribution

Table 7 Language-wise Distribution

S. No.	Languages	Total Publications (%)
1	English	6113 (97.11%)
2	French	44 (0.70%)
3	Spanish	23 (0.37%)

4	German	22 (0.35%)
5	Croatian	21 (0.33%)
6	Portuguese	20 (0.32%)
7	Chinese	8 (0.13%)
8	Turkish	6 (0.10%)
9	Italian	4 (0.06%)
10	Polish	4 (0.06%)
11	Russian	4 (0.06%)
12	Lithuanian	3 (0.05%)
13	Czech	2 (0.03%)
14	Hungarian	2 (0.03%)
15	Slovak	2 (0.03%)
16	Japanese	1 (0.02%)
17	Malay	1 (0.02%)

Publications on animation are spread over 17 languages. The study reveals that the maximum number of publications have been published in the English language with 6113 (97.11%) publications, followed by French language with 44 (0.70%) publications, Spanish language ranks third position with 23 (0.37%) publications, German language with 22 (0.35%) publications, Croatian language with 21 (0.33%) publications. And the remaining languages such as Portuguese, Chinese, Turkish and other languages are constituted in negligible percentage. The English language superiority was found in every year in total productivity on the subject during the study period.

Figure 6: Language wise distributions

4.8 Major Source Title of Publications

Table 8: Source Title of Publications

S. No.	Source Title	No. of Publications	Percentage
1	ACM transactions on graphics	394	6.26
2	Computer graphics forum	263	4.18
3	Computer animation and virtual worlds	197	3.13
4	IEEE transactions on visualization and computer graphics	192	3.05
5	Animation an interdisciplinary journal	179	2.84
6	Visual computer	121	1.92
7	Computer graphics UK	103	1.64
8	Multimedia Tools and Applications	83	1.32
9	Computers in human behavior	68	1.08
10	Computers education	52	0.83

The publication share of most productive source titles (≥50 publications) on animation is given in Table 8. It reveals that ACM transactions on graphics the list with the highest number of publications 394 (6.26%) followed by Computer graphics forum with a share of 263 (4.18%) publications. Computer animation and virtual worlds occupies the third position with 197 (3.137%) publications. The fourth highest source title is IEEE transactions on visualization and computer graphics with 192 (3.05%) publications, Animation an interdisciplinary journal with 179 (2.84%) publications and Visual computer with 121 (1.92%) publications.

4.9 High Productivity Subject Areas

Table 9: High Productivity Subject Areas

S. No.	Subject	No. of Articles	Percentage
1	Computer science	2262	35.93
2	Engineering	676	10.74
3	Educational research	655	10.41
4	Psychology	482	7.66
5	Film radio television	314	4.99
6	Surgery	226	3.59
7	Chemistry	161	2.56
8	Science and technology	155	2.46
9	Neurosciences neurology	145	2.30
10	Physics	112	1.78

Table 9 shows high productivity subjects which are contributing more than 110 articles. It is found that Computer science has the highest number of articles with 2262 (35.93%) followed by Engineering contributing 676 (10.74%) articles. Educational research occupies the third position with 655 (10.41%) articles. The fourth highest articles belonged to the subject Psychology with 482 (7.66%), Film radio television with 314 (4.99%) and Surgery with 226 (3.59%) articles respectively.

CONCLUSION

The study reveals that there is a quantum of information literature output available in the subject of agriculture, medicine, microbial genetics,and plant science. A number of research works are being carried out all over the world in this field. A total of 6295 publications were published on animation research during a 2011-2020 and average number of publications per year was 629.5. The density of the research output during the year 2019 with 744 publications. University of California System, USA with 196 (3.11%) publications is the most productive institutions in the field of animation research followed by Chinese Academy of Science, China with 134 (2.13%) publications. Among 168 countries, China topped the list with highest share (36.71%) of publications followed by USA with 27.42% share of publications and England 6.14% share of publications. Among source titles, ACM transactions on graphics the list with the highest number of publications 394 (6.26%) followed by Computer graphics forum with a share of 263 (4.18%) publications. Publications on bioinformatics are spread over 17 languages. The maximum number of publications has been published in the English language with 6113 (97.11%) publications.

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