Textile and machine learning: A Bibliometric analysis

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ABSTRACT.

In the present research, a bibliometric analysis of scientific pub-lications in the area of textile sciences from the area of machine learning is carried out. The search equation identifies as keywords (i) textile and (ii) machine learning from the scopus database, obtaining as initial result 308 publications, being 281 the final publications to be studied from 1991 to 2022. The bibliometric analysis was carried out using bibliometrix and VOS Viewer, showing the growing interest of the scientific community and au-thors in this area of research.

Keywords: Textile machine learning, bibliometric analysis, bibliometrix, VosViewer.

Introduction

Machine learning techniques have made it possible to optimize the time and ac-curacy of operations in industrial, business and academic environments, among others. Bibliometric analysis evidences the growing interest in auto-mathematical learning in the textile industry [2] [3] [4–12], algorithms that study and detect fibers in images [13], among others.

This research is based on the bibliometric analysis methodology proposed by [1] for the analysis of bibliographic interest in the proposed topic of study. Section 2 presents the methodology consisting of the identification of key words, selection of publications to be analyzed that meet the key words to perform the respective bibliometric analysis, which allows establishing the main conclusions of the study.

2 Research methodology and Statistics

2.1 Key words

In this research, the following combination of keywords (i) textile, and (ii) machine learning TITLE-ABS-KEY ("textile" AND "machine learning") is selected

2.2 Initial results and selection results

The selected the scopus bibliographic database and selected the combination "ti-tle, abstract, keywords", the initial search considered the fields TITLE-ABS-KEY ("textile" AND "machine learning") obtaining 308 results. Of these, 27 records were eliminated as they did not correspond to articles but to summary information of the proceedings. Table 1 shows the details of the information obtained.

Table 1 Main information about data

Description	Initial Results	Final Results
MAIN INFORMATION ABOUT DATA		
Timespan	1991:2022	1991:2022
Sources (Journals, Books, etc)	217	209
Documents	308	281
Average years from publication	3.27	3.33
Average citations per documents	8.37	9.174
Average citations per year per doc	1.882	2.062
References	1	1
DOCUMENT TYPES		
article	146	146
book chapter	4	3
conference paper	112	112
conference review	26	0
editorial	1	1
letter	1	1
review	18	18
DOCUMENT CONTENTS		
Keywords Plus (ID)	0	0
Author's Keywords (DE)	0	0
AUTHORS		
Authors	1077	1076
Author Appearances	1274	1247
Authors of single-authored documents	10	9
Authors of multi-authored documents	1067	1067
AUTHORS COLLABORATION		
Single-authored documents	36	0.261
Documents per Author	0.286	3.83
Authors per Document	3.5	4.44
Co-Authors per Documents	4.14	3.92

Statistics data

The top 20 publications per year are identified. Table 2 presents the detail of publications by year (see Table 8 in the list of abbreviations).

Table 2 Top 20 publicaciones por año

Source	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total
LNCS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	1	1	3	0	9
SS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	2	0	0	7
CICAIS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	2	1	6
ACM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	1	0	5
AIISAC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	2	0	0	5
CPA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	2	5
S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	5
EAOAI	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	4
JOPCS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	1	4
IEEEJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	3
POS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	3
PIEEE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3
AEJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
ACH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
CS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
ESWA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
FATIEE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	2
ICMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2
IEEEA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	2
IEEEJO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2
IEEES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2

While the number of publications per year shows that there is an increase in interest from 1991 to 2022, and with greater and clearer interest from 2016 on-wards, with the highest year of publication being 2021. The Annual Scientific Pro-duction increase with a Growth Rate: 18.52% (See Table 3. and Figure 1).
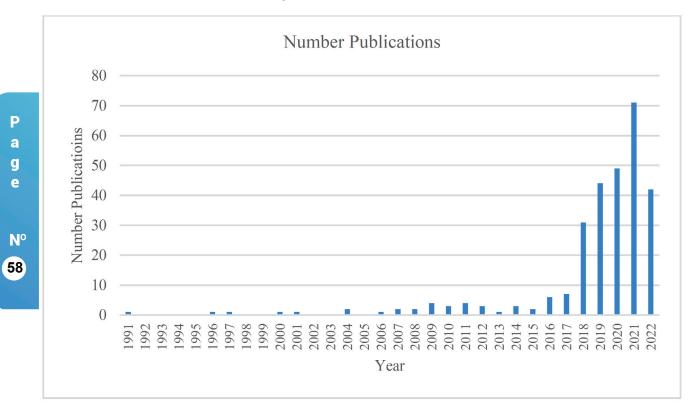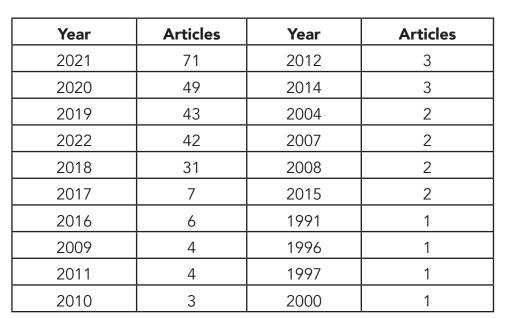
Figure 1 publications per year

Table 3 Articles per year

Year	Articles	Year	Articles
2021	71	2012	3
2020	49	2014	3
2019	43	2004	2
2022	42	2007	2
2018	31	2008	2
2017	7	2015	2
2016	6	1991	1
2009	4	1996	1
2011	4	1997	1
2010	3	2000	1

Data analysis

For the bibliometric analysis, the open source bibliometrix tool based on the R programming language with the biblioshiny package was selected to allow scien-tific mapping. [15] [16] [17]

Bibliometric analysis

Journal publications

The sources with the highest number of publications are (i) Lecture Notes In Computer Science (Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bioinformatics) with 13 publications, (ii) Advances In In-telligent Systems And Computing con with 8 publications, (iii) Communications In Computer And Information Science with 7 publications, (iv) Sensors (Switzerland) with 7 publications, (v) ACM International Conference Proceeding Series with 6 publications. (See Table 4)

Table 4 Journal publications

Sources	Articles
Lecture Notes In Computer Science (Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bioinformat-ics)	13
Advances In Intelligent Systems And Computing	8
Communications In Computer And Information Science	7
Sensors (Switzerland)	7
Acm International Conference Proceeding Series	6
Lecture Notes In Networks And Systems	6
Composites Part A: Applied Science And Manufacturing	5
Journal Of Physics: Conference Series	5

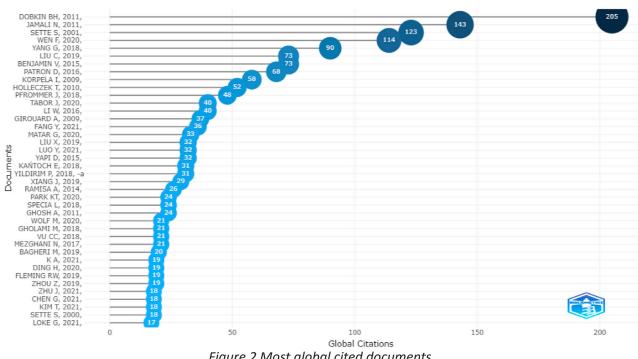|	
Sensors	5
Engineering Applications Of Artificial Intelligence	4
Ieee Journal Of Biomedical And Health Informatics	3
Ifip Advances In Information And Communication Technology	3
Lecture Notes In Electrical Engineering	3
Proceedings Of Spie - The International Society For Optical Engi-neering	3
Proceedings Of The Ieee Ras And Embs International Conference On Biomedical Robotics And Biomechatronics	3
Alexandria Engineering Journal	2
Analytical Chemistry	2
Composite Structures	2
Expert Systems With Applications	2
Fibres And Textiles In Eastern Europe	2
Icmi 2018 - Proceedings Of The 2018 International Conference On Multimodal Interaction	2
Ieee Access	2
Ieee Journal Of Translational Engineering In Health And Medicine	2
Ieee Sensors Journal	2
International Journal Of Clothing Science And Technology	2
Iop Conference Series: Materials Science And Engineering	2
Journal Of Ambient Intelligence And Humanized Computing	2
Journal Of Natural Fibers	2
Journal Of The Textile Institute	2
Lecture Notes In Mechanical Engineering	2
Materials	2
Mechatronic Systems And Control	2
Nano Energy	2
Procedia Manufacturing	2
Proceedings Of The Annual International Conference Of The Ieee Engineering In Medicine And Biology Society Embs	2
Research Journal Of Textile And Apparel	2
Science Of The Total Environment	2
Security And Communication Networks	2
Sensys 2021 - Proceedings Of The 2021 19th Acm Conference On Embedded Networked Sensor Systems	2
Textile Research Journal	2

Most relevant authors and Most Global Cited Documents

Among the authors with the most publications in the area are (i) Menon C with 9 publications, (ii) Kumar A. with 6 publications and Gholami M with 5 publications (See Table 5 and Figure 2).
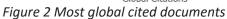
Table 5 Top 10 relevant authors

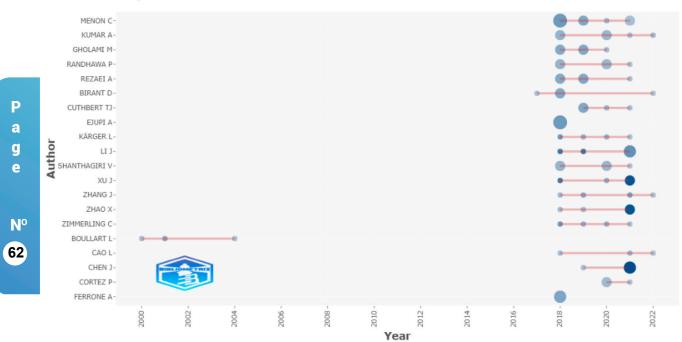| Authors	Articles	Articles Fracti-onalized
MENON C	9	2.42
KUMAR A	6	1.64
GHOLAMI M	5	1.05
RANDHAWA P	5	1.50
REZAEI A	5	1.18
BIRANT D	4	1.42
CUTHBERT TJ	4	0.85
EJUPI A	4	1.23
KÄRGER L	4	1.00
LI J	4	0.73
SHANTHAGIRI V	4	1.17
XU J	4	0.47
ZHANG J	4	0.76
ZHAO X	4	0.64
ZIMMERLING C	4	1.00
BOULLART L	3	1.33
CAO L	3	0.38
CHEN J	3	0.39
CORTEZ P	3	0.43

Most Global Cited Documents

Figure 2 Most global cited documents

Top authors production over time

Publications over time by author are shown in (Figure 3 and Table 6). there is evi-dence of a continuity of publications from 2018 to 2022 from the main authors (i) Menon C., (ii) Kumar A., (iii) Gholami M., (iv) Randhawa P.

Top-Authors' Production over Time

Figure 3 Top-Author Production over time

Table 6 Publication for year

Author	year	freq	TC	TCpY
BIRANT D	2017	1	3	0.5
0BIRANT D	2018	2	34	6.8
BIRANT D	2022	1	0	0
BOULLART L	2000	1	18	0.783
BOULLART L	2001	1	123	5.591
BOULLART L	2004	1	8	0.421
CAO L	2018	1	3	0.6
CAO L	2021	1	3	1.5
CAO L	2022	1	0	0
CHEN J	2019	1	1	0.25
CHEN J	2021	3	59	29.5
CORTEZ P	2020	2	6	2
CORTEZ P	2021	1	0	0
CUTHBERT TJ	2019	2	28	7
CUTHBERT TJ	2020	1	6	2
CUTHBERT TJ	2021	1	1	0.5
EJUPI A	2018	4	52	10.4
FERRONE A	2018	3	39	7.8
GHOLAMI M	2018	2	33	6.6
GHOLAMI M	2019	2	28	7

Author Local Impact

In terms of author local impact, the author, Menon leads the impact with an h-index 6, Gholami M h-index 5, as well as Ejupi A h-index 4 (See Figure 4 and Table 7).

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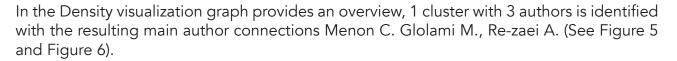

Figure 4 Author local impact
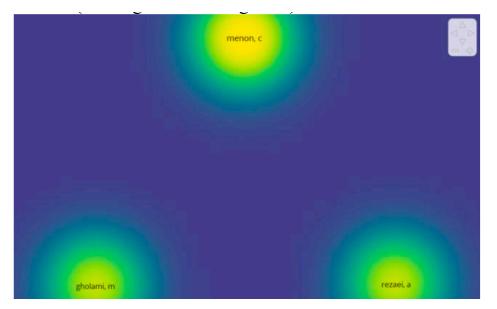
Table 7 Authors publication h-index g-index

Element	h_in-dex	g_in-dex	m_in-dex	TC	NP	PY_start
MENON C	6	9	1.2	88	9	2018
GHOLAMI M	5	5	1	67	5	2018
EJUPI A	4	4	0.8	52	4	2018
REZAEI A	4	5	0.8	62	5	2018
XU J	4	4	0.8	155	4	2018
ZHAO X	4	4	0.8	68	4	2018
BIRANT D	3	3	0.5	37	3	2017
BOULLART L	3	3	0.13	149	3	2000
CHEN J	3	3	1.5	59	3	2021
CUTHBERT TJ	3	4	0.75	35	4	2019
FERRONE A	3	3	0.6	39	3	2018
KÄRGER L	3	3	0.6	69	3	2018
KUMAR A	3	5	0.6	30	5	2018
LI J	3	3	0.6	168	3	2018
LI Y	3	3	1.5	55	3	2021
RANDHAWA P	3	4	0.6	28	4	2018
SETTE S	3	3	0.13	149	3	2000
SHANTHAGIRI V	3	4	06	28	4	2018
YILDIRIM P	3	3	05	37	3	2017
ZHANG J	3	3	0.6	41	3	2018

In the Density visualization graph provides an overview, 1 cluster with 3 authors is identified with the resulting main author connections Menon C. Glolami M., Re-zaei A. (See Figure 5 and Figure 6).

Figure 5 Density visualization

Figure 6 network authors.

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Conclusion

This bibliometric research presents an exploratory and quantitative analysis of the scientific production of the application of machine learning techniques in the textile industry from 1991 to 2022. The Bibliometric study describes the principal information about journals, authors, citations, networks, in order to identify the main authors who have contributed to this area as a first approach to this topic of study.

Appendix

Table 8 Events / journals Acronym

Acronym	Descriptions
LNCS	LECTURE NOTES IN COMPUTER SCIENC
SS	SENSORS (SWITZERLAND)
CICAIS	COMMUNICATIONS IN COMPUTER AND INFORMATION SCIENCE
ACM	ACM INTERNATIONAL CONFERENCE PROCEEDING SERIES
AIISAC	ADVANCES IN INTELLIGENT SYSTEMS AND COMPUTING
CPA	COMPOSITES PART A: APPLIED SCIENCE AND MANUFACTURING
S	SENSORS
EAOAI	ENGINEERING APPLICATIONS OF ARTIFICIAL INTELLIGENCE
JOPCS	JOURNAL OF PHYSICS: CONFERENCE SERIES
IEEEJ	IEEE JOURNAL OF BIOMEDICAL AND HEALTH INFORMATICS
POS	PROCEEDINGS OF SPIE - THE INTERNATIONAL SOCIETY FOR OPTICAL ENGINEERING
PIEEE	PROCEEDINGS OF THE IEEE RAS AND EMBS INTERNATIONAL CONFERENCE ON BIOMEDICAL ROBOTICS AND BIOMECHATRONICS
AEJ	ALEXANDRIA ENGINEERING JOURNAL
ACH	ANALYTICAL CHEMISTRY
CS	COMPOSITE STRUCTURES
ESWA	EXPERT SYSTEMS WITH APPLICATIONS
FATIEE	FIBRES AND TEXTILES IN EASTERN EUROPE
ICMI	ICMI 2018 - PROCEEDINGS OF THE 2018 INTERNATIONAL CONFERENCE ON MULTIMODAL INTERACTION
IEEEA	IEEE ACCESS
IEEEJO	IEEE JOURNAL OF TRANSLATIONAL ENGINEERING IN HEALTH AND MEDICINE
IEEES	IEEE SENSORS JOURNAL
IJOCSAT	INTERNATIONAL JOURNAL OF CLOTHING SCIENCE AND TECHNOLOGY
IOP	IOP CONFERENCE SERIES: MATERIALS SCIENCE AND ENGINEERING

JOAIAHC	JOURNAL OF AMBIENT INTELLIGENCE AND HUMANIZED COMPUTING
JONF	JOURNAL OF NATURAL FIBERS
JOTTI	JOURNAL OF THE TEXTILE INSTITUTE
LNIME	LECTURE NOTES IN MECHANICAL ENGINEERING
LNINAS	LECTURE NOTES IN NETWORKS AND SYSTEMS
M	MATERIALS
MSAC	MECHATRONIC SYSTEMS AND CONTROL
NE	NANO ENERGY

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