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ORIGINAL

Computational experiments in Computer Science: A bibliometric study

Experimentos Computacionales en Ciencias de la Computación: Un estudio bibliométrico

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ABSTRACT

Introduction: computational Experiments are crucial in various fields, including biological sciences, engineering, social sciences, etc., and are a powerful tool for understanding complex systems, optimizing processes, and driving innovation. Their importance lies in their ability to integrate with experimental methods, facilitate simulation-based learning, and provide cost-effective, scalable, and flexible solutions for analyzing complex systems. The purpose of this study is to make a bibliometric analysis of the research related to Computational Experiments in Computer Science.
Methods: this bibliometric analysis was performed using information from 2013 and 2024 from the Scopus and Web of Science databases, with published articles This bibliometric study followed the guidelines proposed in the publication "How to conduct a bibliometric analysis: An overview and guidelines" by the author Gonthu N. To answer the research questions, the number of articles per year, number of articles per country, number of articles per subject area, list of main journals, and citation analysis were analyzed.
Results: the results show that Scopus has more publications on the subject, China is the country that publishes more on the subject, Mathematics is the predominant subject area, finally, a co-occurrence analysis was performed where a total of 27 clusters were found in Scopus and 10 clusters in WoS. From this, the 10 most relevant keywords in each of the databases were identified.
Conclusions: this review can be a basis in order that researchers to have a starting point for the current state of publications on Computational Experiments for future research.

Keywords: Computational Experiment; Computer Science; Operations Research; Optimization; Bibliometric Analysis.

RESUMEN

Introducción: los experimentos computacionales son cruciales en diversos campos, como las ciencias biológicas, la ingeniería, las ciencias sociales, etc., y constituyen una poderosa herramienta para comprender sistemas complejos, optimizar procesos e impulsar la innovación. Su importancia radica en su capacidad para integrarse con métodos experimentales, facilitar el aprendizaje basado en la simulación y ofrecer soluciones rentables, escalables y flexibles para analizar sistemas complejos. El propósito de este estudio es realizar un análisis bibliométrico de la investigación relacionada con los Experimentos Computacionales en Informática.
Método: este análisis bibliométrico se realizó utilizando artículos publicados entre 2013 y 2024 en las bases de datos Scopus y Web of Science. Este estudio bibliométrico siguió la guía propuesta en la publiación "How to conduct a bibliometric analysis: An overview and guidelines" del autor Gonthu N. Para responder a las

preguntas de la investigación, se analizaron el número de artículos por año, el número de artículos por país, el número de artículos por área temática, la lista de revistas principales y el análisis de citas.
Resultados: los resultados muestran que Scopus tiene más publicaciones sobre el tema, China es el país que más publica sobre el tema, Matemáticas es el área temática predominante, finalmente se realizó un análisis de co-ocurrencia donde se encontró un total de 27 clusters en Scopus y 10 clusters en WoS. A partir de esto, se identificó las 10 palabras clave más relevantes de cada una de las bases de datos.
Conclusiones: esta revisión puede ser base para que los investigadores tengan un punto de inicio para futuras investigaciones en el estado de las publicaciones en Experimentos Computaciones.

Palabras clave: experimento computacional, ciencias de la computación, investigación operativa, optimización, análisis bibliométrico.

INTRODUCTION

In the context of computational testing of an algorithm, an experiment consists of solving a series of problem instances using a computational implementation.[1] It requires determining the problem, implementing the algorithm, selecting the computational environment, selecting the performance measures, running the experiment, and reporting the results.[2] Computational experiments are very necessary nowadays and have been used for several years in many engineering simulations[3], especially in situations where physical experiments are difficult, costly, or impossible to perform.[4] Therefore, these computational experiments cannot follow the same principles that guide researchers in physical experiments.[5] Simulations require several steps:[6] Problem Definition (Scope), Model design, data collection, model validation, and System Improvement.[7] For the design step, a metamodel is required, which, from the mathematical point of view, is an explicit and relatively simple approximation of the input/output function implicitly defined by the simulation mode.[8] Select the correct parameters in fundamental so that the physical data are well approximated to the designed simulation model.[9] Model verification is required, which is the process of determining operational performance and that it is an accurate representation of the physical model or system.[10] In relation to model validation, aspects such as verifying points of error, combining several sources of information, etc., should be analyzed.[11] The researcher artifacts are documentation of the experimental settings[12] with the necessary details is crucial to achieving replication and comparison of computational experiments; these tasks are impossible without detailed steps.[13] Computational reproducibility[14] allows the reproduction of exactly the same results with the same data, unlike replication, which requires following the same steps but with different data in an independent experiment.[15] For both replication and reproducibility, research artifacts [16] must be well crafted, structured and zipped to be public and to support the principles of open science.

Due to the importance of computational experiments,[17] we have seen the need to carry out this research with the objective of performing a bibliometric analysis that will be a starting point for future research on the subject.

The remainder of the paper is presented as follows: The next section describes the methodology, dataset, and tools used in the development of this study. The following section shows the results and statistical tests obtained in the study. Below, we have described the threats to validity. The next section provides a discussion and comparison with other related research, and finally, conclusions and future research directions are presented.

METHOD

For the bibliometric analysis, we have followed the guide proposed by,[18] where an exhaustive study of this type of study is made, and a comparison is made with other similar analysis techniques such as meta-analysis[19] and systematic literature reviews. According to this publication, bibliometric studies and meta-analyses have a quantitative character,[20] while systematic literature reviews tend to have a qualitative character and may have deviations in the interpretation of the data.[21] According to the author, the type of analysis to perform is decided based on the research questions posed. For the present study, bibliometric analysis[22] has been decided because it is desired to analyze the relationships between data from previous publications such as authors, countries, institutions, topics, etc.

The steps for the bibliographic analysis are as proposed in the guide:[18]

Step 1: Define the aims and scope of the bibliometric study.

For the initial search of publications, the most representative databases such as Scopus and Web of Science (WoS) were selected.

Inclusion criteria

- Publications between January 2013 and October 2024.
- Publications in English.
- Peer-reviewed studies published in journals.
- Studies that propose computational experiments applied in Computer Science.

Exclusion criteria

- Studies that do not refer to Computer Science.
- Non-peer-reviewed studies, books, book chapters, or gray literature.
- Studies that are not in English.
- Conference publications.

Research questions

The following research questions have been posed:

- RQ1: How many publications are there in the Scopus and WoS databases related to the topic Computational Experiments in Computer Science?
- RQ2: From which countries do the authors who have written about Computational Experiments in Computer Science come from?
- RQ3: Besides Computer Science, what are the sub-areas of research in which you have been doing Computational Experiments in the stated time period?
- RQ4: Which are the journals where there are papers on Computational Experiments in Computer Science?
- RQ5: What are the most cited publications on Computational Experiments in Computer Science?

Step 2: Choose the techniques for bibliometric analysis

Based on guidance from,[18] the existing techniques are Performance Analysis and Science Mapping.

Performance Analysis

Examines the contributions and components of research in a specific field.[23] This technique was used to analyze the total number of publications and citations.

Science Mapping

Examines the relationships between the components of the research.[23] This technique used a co-authorship analysis to learn about the authors and their affiliations. A citation analysis was also performed to find the most influential publications and thus to determine which journals they have been published in.

Step 3: Collect the data for bibliometric analysis.

Searches were conducted in the selected databases (Scopus and WoS) following the abovementioned inclusion and exclusion criteria.

Scopus search

The initial search in the Scopus database without applying the inclusion criteria yielded a total of 299 papers with the following search string: “comput* experim*” AND “ computer science”. Applying the inclusion and exclusion criteria, the following search string was used:

TITLE-ABS-KEY (“comput* experim*” AND “ computer science”) AND PUBYEAR > 2012 AND PUBYEAR < 2025 AND (LIMIT-TO (SUBJAREA , “COMP”)) AND (LIMIT-TO (DOCTYPE , “ar”)) AND (LIMIT-TO (LANGUAGE , “English”)).

This resulted in a total of 54 papers.

WoS search

The initial search in the WoS database without applying the search criteria yielded a total of 61 papers with the following search string:

“comput* experim*” AND “ computer science”

Applying the inclusion and exclusion criteria, the following search string was used:

“comput* experim*” AND “ computer science” (Topic) and 2024 or 2023 or 2022 or 2021 or 2020 or 2019 or 2017 or 2018 or 2016 or 2015 or 2014 or 2013 (Publication Years) and Article (Document Types) and English (Languages) and Computer Science (Research Areas). This resulted in a total of 15 papers.

It is important to clarify that once the inclusion and exclusion criteria were applied, all papers were manually

validated to ensure that they met the criteria applied.
The research artifacts from the study can be found in https://doi.org/10.5281/zenodo.12701189. The supplementary material contains:

- The .xlsx files of the dataset used to analyze the RQs.
- The .pdf files of the figures published in the paper.
- The .xlsx files of the tables published in the paper.

Step 4: Run the bibliometric analysis and report the findings.

Once the data was collected, VOSviewer version 1.6.20 was used to analyze information and obtain the Keyword analysis. In addition, the information was consolidated into a single dataset to produce the graphs using Microsoft PowerBI. The results are shown in the following section.

RESULTS

To answer RQ1, Figure 1 shows a comparison of number of articles per year in Scopus and WoS. Note that there is a higher number of publications in Scopus than in WoS, except in 2017 with 2 publications in each database. This is because Scopus offers more journals and citations.

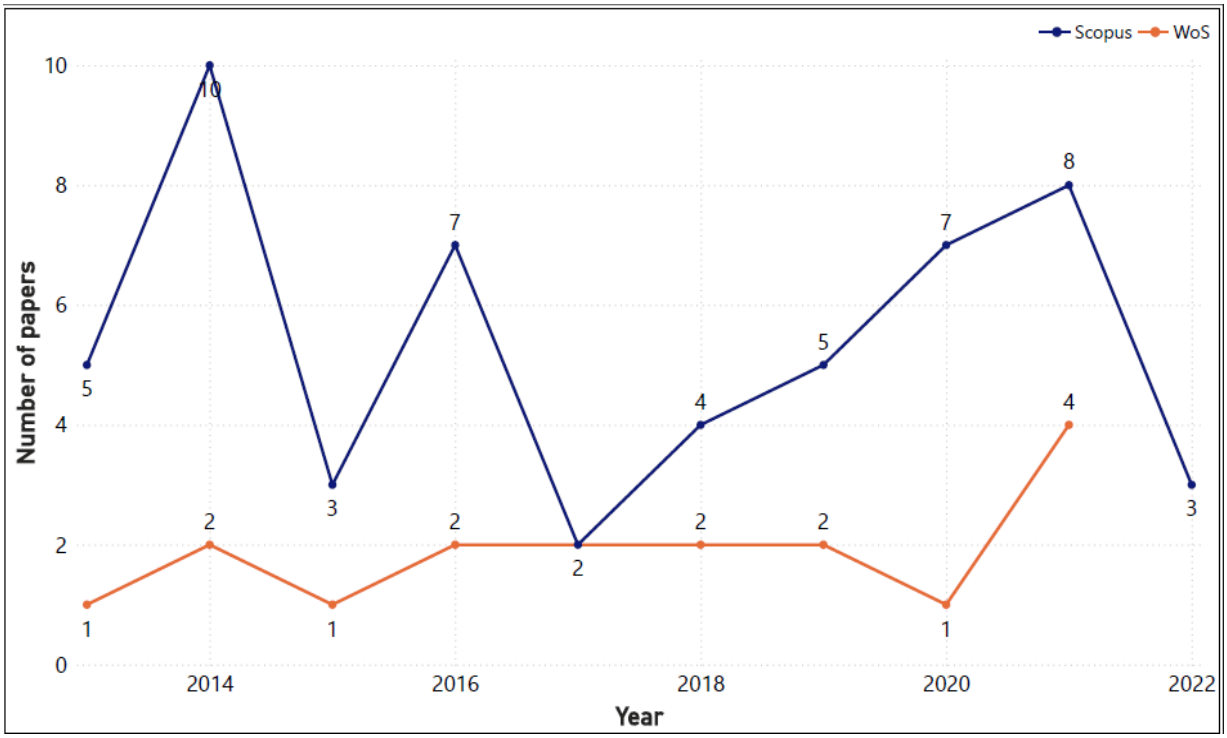

Figure 1. Comparison of number of articles per year in Scopus and WoS

To answer RQ2, figure 2 shows a comparison of the number of articles by country in Scopus and WoS. The results show that China and the United States lead the publications on Computational Experiments in Computer Science. This may be due to the high investment made by these countries in Research and Development; therefore, they have more papers to publish.

To answer RQ3, figure 3 shows a comparison based on the number of articles per Subject area in Scopus and WoS. All the articles found belong to the Computer Science area according to the inclusion criteria, but some of the computational experiments described in the papers are applied to other subareas. The area of mathematics stands out because many of the computational experiments aim to improve the performance of different algorithms. Many of these algorithms are decision and search algorithms, especially in graphs, which is why the Decision Sciences area also stands out. And of course, computational experiments are very applicable to different areas in Engineering.

To answer RQ4, tables 1 y 2 are shown. Table 1 shows the list of Journals indexed in Scopus with publications on Computational Experiments in Computer Science. This table has been sorted by the number of papers published in the journals, which does not indicate the importance of the journal. The information on Cite Score and SJR applicable to the year 2022 has been obtained because Scopus does not yet have complete information for the year 2023. All this data shows the importance of journals in the scientific context. A column has also been added where the areas in which each journal publishes have been placed in the form of keys.

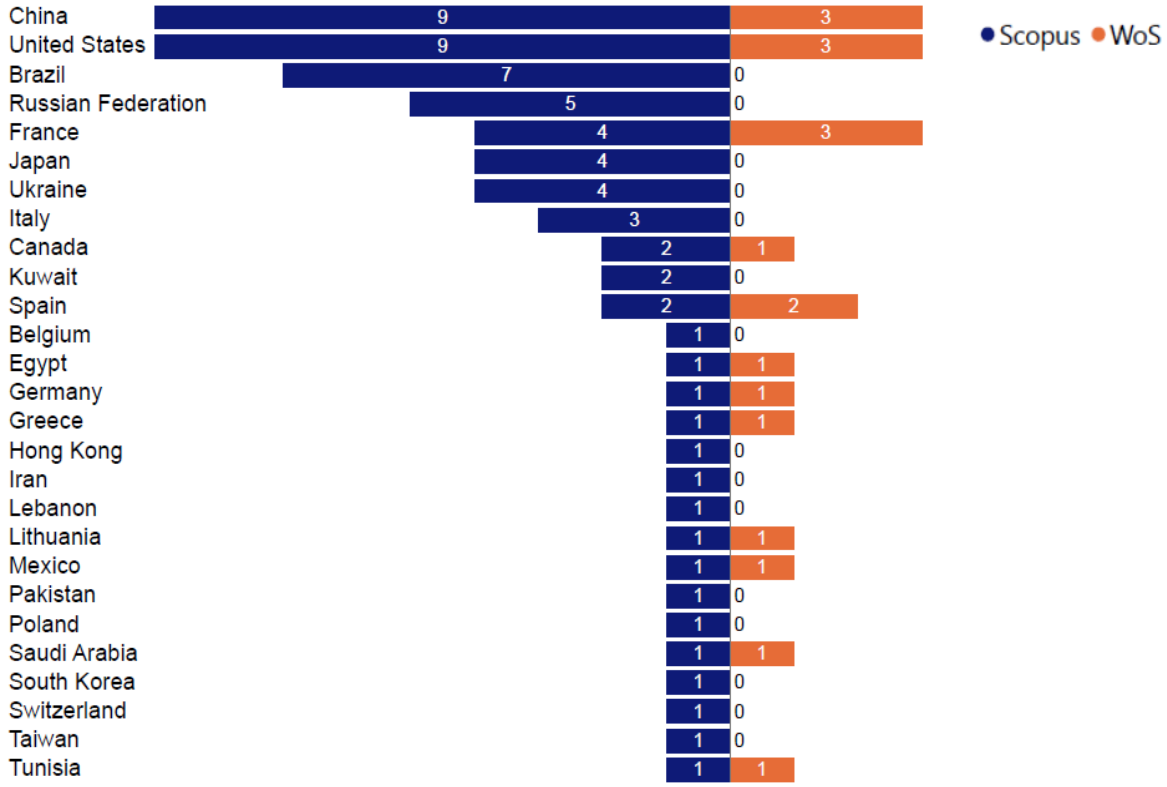

Figure 2. Comparison of number of articles by country in Scopus and WoS

Table 2 shows the journals indexed in WoS with papers related to Computational Experiments in Computer Science. In the same way as the previous table, the information has been ordered based on the number of papers published in each journal related to the topic in question. To know the quality of each of the journals, the columns Journal Citation Indicator and Journal Impact Factor for the year 2022 have been included, since WoS does not yet have information for the year 2023. To complement this, the column Quartile has also been created, which summarizes the previous data indicating in which quartile each journal is located. In general, it has been written in high impact journals. Once again, a column indicating the subject area of each journal has been included in the form of keys.

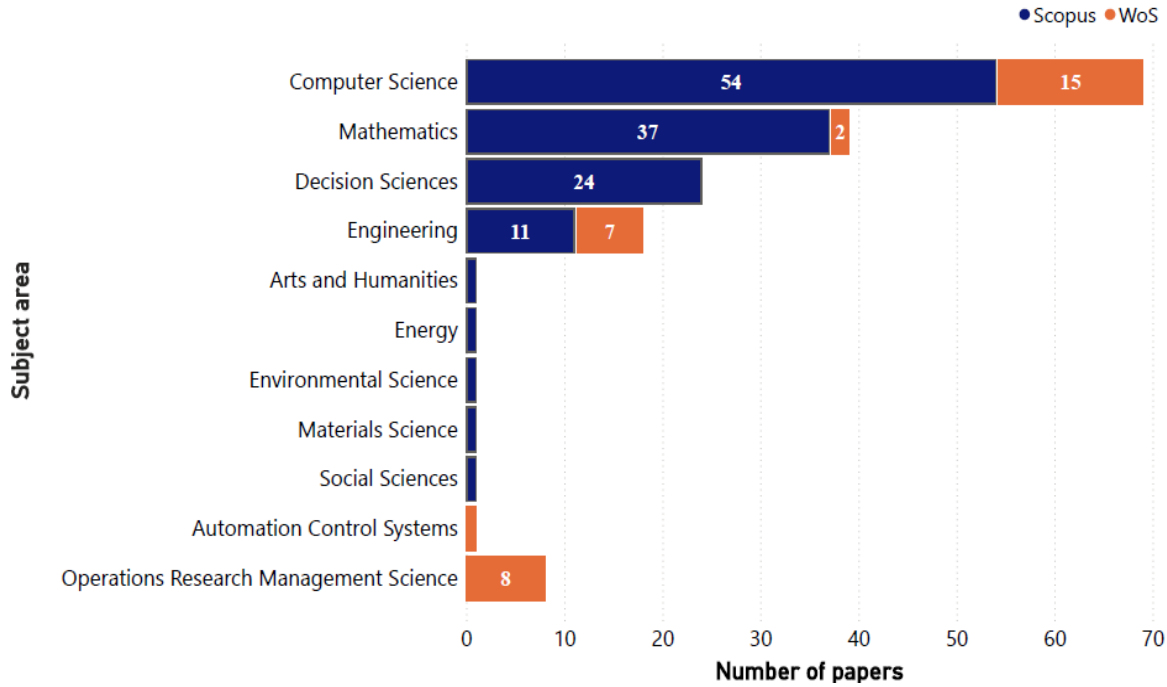

Figure 3. Comparison of number of articles by Subject area in Scopus and WoS

Table 1. Journals in Scopus

Journal	Papers	Subject Area	Cite Score 2022	SJR 2022
Computers and Operations Research	12	MMS, CSG, DSM	8,3	1,716
Informs Journal on Computing	6	DSM, CSA, CSI, CSS	3,4	1,441
RAIRO Operations Research	5	MTC, DSM, CSA	2,9	1,390
Cybernetics and Systems Analysis	4	CSG	1,5	0,290
Discrete Optimization	3	MAM, CSC, MTC	2,3	0,500
Journal of Computer and Systems Sciences International	3	MAM,ECS, CSN, CSI	1,5	0,325
Theoretical Computer Science	3	CSG, MTC	2,5	0,590
Computers and Industrial Engineering	2	EGE, CSG	11,9	1,760
International Journal of Computer Mathematics	2	MAM, CSC, CSA	3,5	0,526
Digital Scholarship in The Humanities	1	AHL, SSL, CSI, CSA	2,4	0,375
Expert Systems with Applications	1	EGE, CSA, CSR	12,6	1,873
IEEE Transactions on Evolutionary Computation	1	CSC, MTC, CSS	25,5	5,767
IEICE Transactions on Fundamentals of Electronics Communications and Computer Sciences	1	CSD, MAM, EEE, CSP	1,1	0,211
Informatica (Netherlands)	1	MAM, CSI	7,5	0,624
International Journal of Computational Intelligence Systems	1	MCM, CSG	4,8	0,554
International Journal of Systems Science	1	MTC, ECS, CSA	5,6	1,105
International Journal of Unconventional Computing	1	CSG	2,6	0,375
Journal of Combinatorial Optimization	1	MDM, MAM, MCO, CSC, CSA	2,4	0,497
Journal of Scientific Computing	1	MAM, MNA, CSC, MCM, EGE, MTC	4,1	1,171
Journal of Supercomputing	1	MTC, CSI, CSH, CSS	5,4	0,684
Lecture Notes In Computer Science	1	MDM, EGE, MCM, MCO, MMS	0,9	0,273
Optical Memory and Neural Networks Information Optics	1	CSG, EEE, MSE	2,0	0,222
Sustainable Operations and Computers	1	DSM, EIM, CSA, ESG, ERE	8,1	-

The abbreviations used in table 1 are: MMS - Mathematics: Modeling and Simulation, CSG - Computer Science: General Computer Science, DSM - Decision Sciences: Management Science and Operations Research, CSA - Computer Science: Computer Science Applications, CSI - Computer Science: Information Systems, CSS - Computer Science: Software, MAM - Mathematics: Applied Mathematics, CSC - Computer Science: Computational Theory and Mathematics, MTC - Mathematics: Theoretical Computer Science, ECS - Engineering: Control and Systems Engineering, CSN - Computer Science: Computer Networks and Communications, EGE - Engineering: General Engineering, CSR - Computer Science: Artificial Intelligence, MNA - Mathematics: Numerical Analysis, MDM - Mathematics: Discrete Mathematics and Combinatorics, MCM - Mathematics: Computational Mathematics, MCO - Mathematics: Control and Optimization, CSD - Computer Science: Computer Graphics and Computer-Aided Design, EEE - Engineering: Electrical and Electronic Engineering, CSP - Computer Science: Signal Processing, AHL - Arts and Humanities: Language and Linguistics, SSL - Social Sciences: Linguistics and Language, MSE - Materials Science: Electronic, Optical and Magnetic Materials, EIM - Engineering: Industrial and Manufacturing Engineering, ESG - Environmental Science: Global and Planetary Change, ERE - Energy: Renewable Energy, Sustainability and the Environment, CSH - Computer Science: Hardware and Architecture.

To answer RQ5, tables 3 and 4 have been created. The Top ten most cited papers in Scopus have been placed in table 3. In addition, the title of the paper, the authors and the year of publication have been included.

Table 4 shows the Top ten most cited papers in WoS. This table has been ordered by the number of citations that each paper has obtained. In addition, the title of the paper, the authors and the year of publication have been included.

Finally, co-occurrence analyses were performed on the two selected databases. Figure 4 and 5 show the results obtained from the VOSviewer software. It should be mentioned that the figures show different colors representing different 'clusters' or groups of terms. These clusters may represent subtopics or focus areas within the general field of study which is Computational Experiments in Computer Science. The size of each node (in the figure are the circles) represents the frequency with which the associated term appears in the database. The lines between the nodes indicate the co-occurrence of the terms, that is, the frequency with which two terms appear together in the same document.

For the co-occurrence analysis of the information collected from Scopus the co-occurrence has been configured with the parameter "All keywords", the field Minimum number of occurrences of a keyword has been set to 1 and the field Number of keywords to be selected has been set to 525. It has resulted in a total

of 27 clusters which can be seen in Figure 4. Based on these results it can be identified that the 10 most relevant keywords are: computer science, computational experiment, operations research, problem solving, optimization, integer programming, heuristics, programming, cybernetics and computational experiment.

Table 2. Journals in WoS

Journal	Number of Papers	Subject Area	Journal Citation Indicator 2022	Journal Impact Factor 2022	Quartile
Informs Journal on Computing	4	CSP, ORM	0,47	2,1	Q3
Computers and Operations Research	3	CSP, ENI, ORM	0,88	4,6	Q2
Computers and Industrial Engineering	2	CSP, ENI	1,31	7,9	Q1
Expert Systems with Applications	1	CSR, EEE, ORM	1,73	8,5	Q1
IEEE Transactions on Cybernetics	1	ACS, CSR, CSY	2,37	11,8	Q1
Informatica	1	CSI, MTA	0,72	2,9	Q2
International Journal of Unconventional Computing	1	CST	0,38	1,7	Q3
Journal of Combinatorial Optimization	1	CSP, MTA	0,4	1	Q4
Journal of Supercomputing	1	CSH, CST, EEE	0,72	3,3	Q2

The abbreviations used in table 2 are: CSP - Computer Science: Interdisciplinary Applications, ENI - Engineering: Industrial, ORM - Operations Research & Management Science, CSR - Computer Science: Artificial Intelligence, EEE - Engineering, Electrical & Electronic, ACS - Automation & Control Systems, CSY - Computer Science: Cybernetics, CSI - Computer Science: Information Systems, MTA - Mathematics: Applied, CST - Computer Science: Theory & Methods, CSH - Computer Science: Hardware & Architecture.

Table 3. Top ten most cited papers in Scopus

Title	Authors	Year	Citations
Reference Point Specification in Inverted Generational Distance for Triangular Linear Pareto Front.[24]	Ishibuchi, H., Imada, R., Setoguchi, Y., Nojima, Y.	2018	97
The r-interdiction median problem with probabilistic protection and its solution algorithm.[25]	Zhu, Y., Zheng, Z., Zhang, X., Cai, K.	2013	47
A redistricting problem applied to meter reading in power distribution networks.[26]	Assis, L.S.D., Franca, P.M., Usberti, F.L.	2014	39
A branch-and-price algorithm for the temporal bin packing problem.[27]	Dell'Amico, M., Furini, F., Iori, M.	2020	34
An efficient computational technique based on cubic trigonometric B-splines for time fractional Burgers' equation.[28]	Yaseen, M., Abbas, M.	2020	31
A hybrid Lagrangean heuristic with GRASP and path-relinking for set k-covering.[29]	Pessoa, L.S., Resende, M.G.C., Ribeiro, C.C.	2013	27
Multiple asymmetric traveling salesmen problem with and without precedence constraints: Performance comparison of alternative formulations.[30]	Sarin, S.C., Sherali, H.D., Judd, J.D., Tsai, P.-F.	2014	26
Verifying soundness of business processes: A decision process Petri nets approach.[31]	Clempner, J.	2014	24
A quantity flexibility contract model for a system with heterogeneous suppliers.[32]	Soo Kim, J., Il Park, S., Young Shin, K.	2014	22
Tabu search for the dynamic Bipartite Drawing Problem.[33]	Martí, R., Martínez-Gavara, A., Sánchez-Oro, J., Duarte, A.	2018	19

For the co-occurrence analysis of the information collected from WoS, the co-occurrence field has been configured with the parameter "All keywords", the Minimum number of occurrences of a keyword field has been set to 1 and the Number of keywords to be selected field has been set to 114. It has resulted in a total of 10 clusters which can be seen in Figure 5. Based on these results it can be identified that the 10 most relevant keywords are: heuristics, optimization, path relinking, network, algorithm, shortest path, grasp, cut, search, and sum.

Table 4. Top ten most cited papers in WoS

Title	Authors	Year	Citations
Tabu search for the dynamic Bipartite Drawing Problem.[33]	Martí, R; Martínez-Gavara, A; Sánchez-Oro, J; Duarte, A	2018	16
Verifying soundness of business processes: A decision process Petri nets approach.[31]	Clempner, J	2014	16
Using high performance computing for unrelated parallel machine scheduling with sequence-dependent setup times: Development and computational evaluation of a parallel branch-and-price algorithm.[34]	Rauchecker, G; Schryen, G	2019	14
Automated Multilateral Negotiation on Multiple Issues with Private Information.[35]	Zheng, RH; Dai, TL; Sycara, K; Chakraborty, N	2016	10
Efficient heuristic algorithms for maximum utility product pricing problems.[36]	Myklebust, TGJ; Sharpe, MA; Tunçel, L	2016	7
An Efficient Label-Correcting Algorithm for the Multiobjective Shortest Path Problem.[37]	Kergosien, Y; Giret, A; Neron, E; Sauvanet, G	2022	6
A New Scatter Search Design for Multiobjective Combinatorial Optimization with an Application to Facility Location.[38]	López-Sánchez, AD; Sánchez-Oro, J; Laguna, M	2021	6
Computational performances of a simple interchange heuristic for a scheduling problem with an availability constraint.[39]	Moncel, J; Thiery, J; Waserhole, A	2014	6
An efficient parallel strategy for high-cost prefix operation.[40]	Bahig, HM; Fathy, KA	2021	5
A Fast Bayesian Iterative Rule in Amoeba Algorithm.[41]	Cai, QX; Deng, Y	2019	5

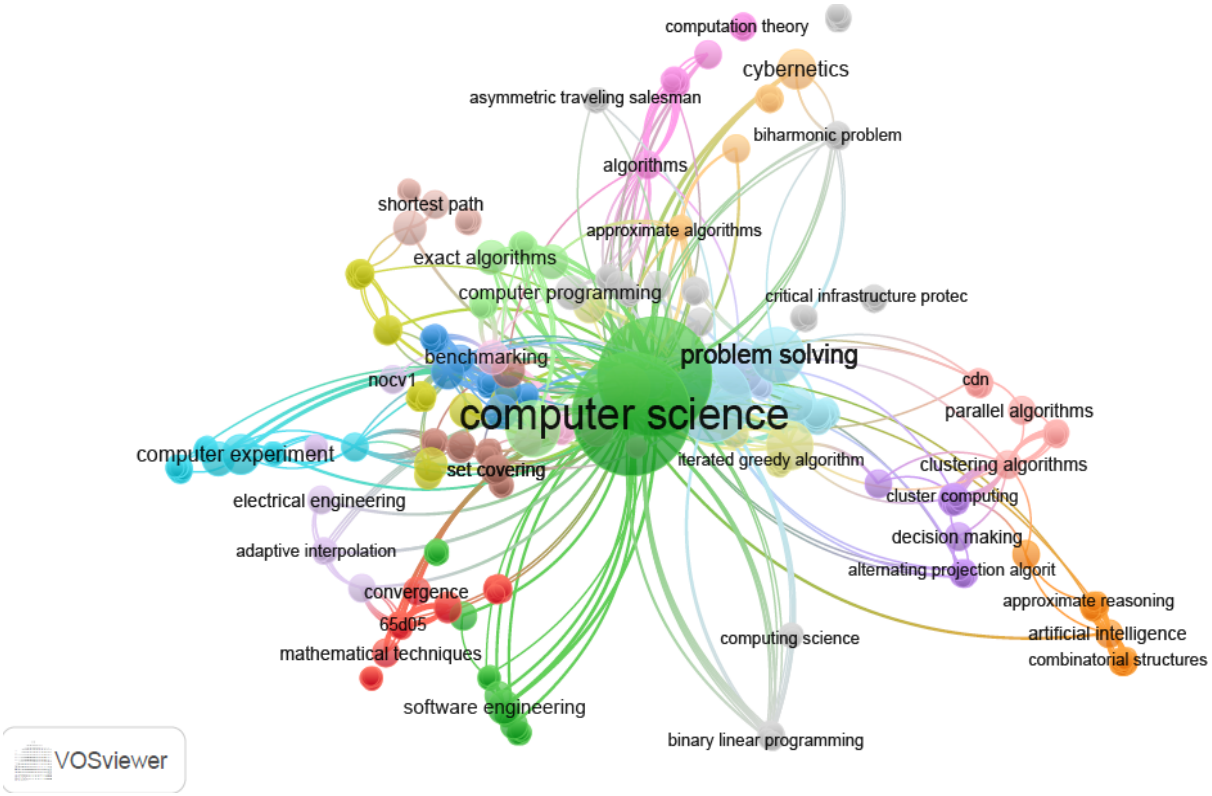

Figure 4. Cooccurrence analysis in Scopus

THREATS TO VALIDITY

Search results vary between Scopus and WoS. This may introduce a bias according to what is established by.[42] One of the main threats to the validity of this bibliometric study is the selection bias of the databases. Although Scopus and Web of Science are recognized sources, they do not cover all the relevant literature in computer science. Some important conferences and open-access repositories might be excluded, which could lead to an incomplete representation of the field.[43] Additionally, the restriction to articles in English could exclude valuable contributions in other languages, especially considering the global nature of research in computer science.

Another significant threat is the temporal limitation of the study. By considering only articles published between 2013 and 2014, there is a risk of missing long-term trends and recent developments in the field of computational experiments. This narrow timeframe might not adequately capture the evolution of methodologies and technologies in computer science, which advance rapidly.[44] Furthermore, publication delays could lead to the exclusion of relevant works that were conducted during the period of interest but published outside the specified date range.

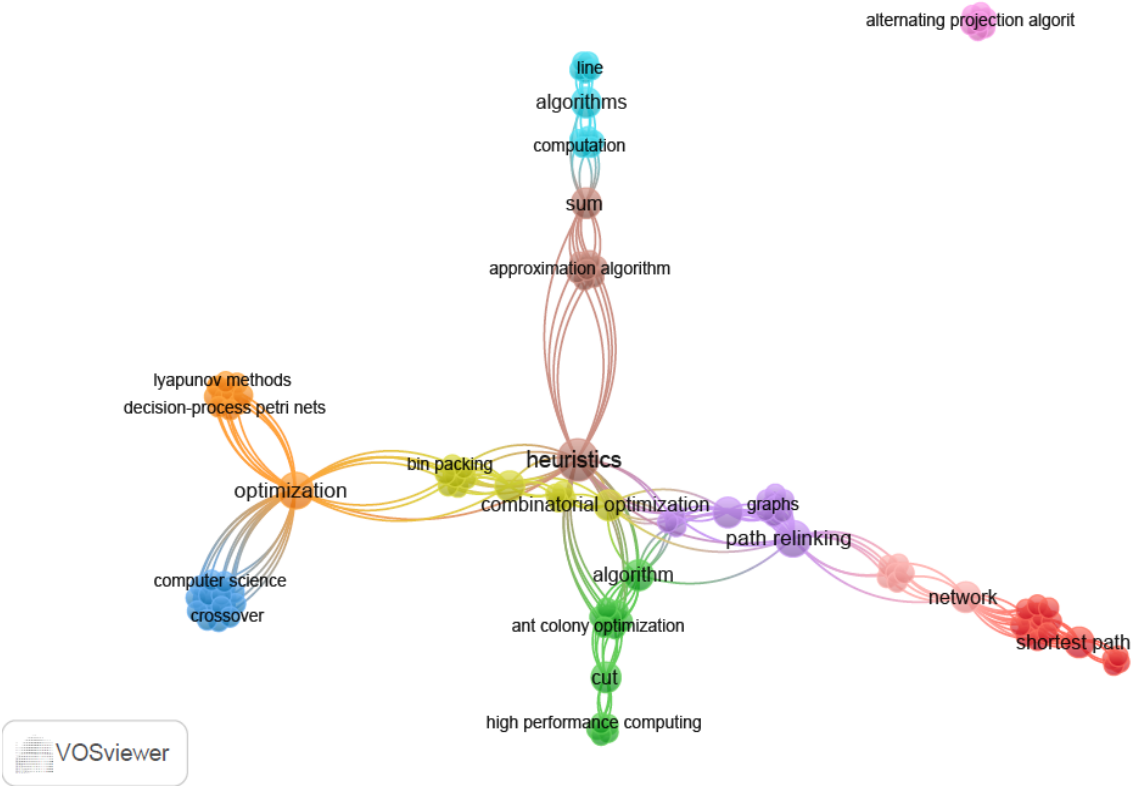

Figure 5. Cooccurrence analysis in WoS

The restriction to peer-reviewed articles published in journals presents another potential threat. While this approach ensures a certain level of quality, it may also introduce a bias towards more established and conventional research. Innovative or controversial computational experiments might be underrepresented, as they are often first presented at conferences or published as preprints.[45] Additionally, the exclusion of grey literature, such as technical reports or doctoral theses, could lead to the loss of valuable information on computational experiments that have not yet reached the journal publication stage.

DISCUSSION

In Computer Science there have been multiple bibliometric analyses and systematic literature reviews; in order to know the most relevant literature reviews, we have performed a search in Scopus for the most cited papers in these aspects and some of the most relevant ones are mentioned below. The search string used for this was “computer science” AND “bibliometric analysis”.

The work of,[46] performs a bibliometric analysis of the role of Artificial Intelligence in the construction of sustainable business models (SBMs). For this, they build a dataset of 73 English-language publications with publication dates from 1990 to 2019. The results show that the challenge of innovation involves ethical, social, economic and legal aspects.

In the investigation,[47] a bibliometric approach was used to identify and analyze the scientific literature on VR and AR research in medicine. The Web of Science database was used to identify relevant papers on VR research in medicine. They found 8399 papers and the data were exported to VOSviewer and Bibliometrix bibliometric software for further analyses. The conducted bibliometric analysis unequivocally reveals the versatile emerging applications of VR and AR in medicine.

Another bibliometric analysis was performed by,[48] where bitcoins have been studied as the main topic excluding other blockchain applications. For this purpose, the Web of Science Core Collection database was searched, finding 1162 papers from 2012 to 2019. That bibliometric study draws the landscape of the current state and trends of bitcoin-related research in different scientific disciplines.

Another paper reports a bibliometric analysis of the development of fuzzy theory (FT) in China.[49] Their dataset was composed of 12936 over a time range of 30 years. The results demonstrated FT research collaborations between researchers in the USA and China. They found that the research focuses on the areas of Computer Science and Engineering in sub areas such as decision making, optimization, modeling and design.

In the bibliometric analysis of Engineering Applications with Artificial Intelligence,[50] publications from 1988 to 2018 were analyzed in Web of Science and Scopus databases. In this review, publication distribution over the years, citations per year, co-citation over the years, co-authorship networks, geographical analysis and temporal analysis by country of publications were obtained as results.

In the research,[51] a review to the IEEE Transactions on Fuzzy Systems (TFS) journal indexed in Web of Science has been performed. Publications between the year 1994 to 2015 were analyzed. As a result, analyses of the general citation structure of the journal, the most cited articles, authorship and co-authorship, co-citation of authors, co-authorship, and the most influential countries were obtained.

Another bibliometric study on artificial intelligence was published in 2016.[52] The dataset was composed of publications between 1990 and 2014 from the databases Science Citation Index Expanded (SCI-Expanded) and Conference Proceedings Citation Index-Science (CPCI-S). This work analyzed the number of articles, collaborations, citations, subject categories, authors' countries of origin, keywords and their co-occurrence.

A bibliometric study was published in the year 2021 on blockchain.[53] This analysis was based on performance analysis and network analysis techniques. As a result, the analysis of countries, authors, subject areas, and journals for blockchain research was obtained. They also mention the identified clusters and their density measures.

Despite the existence of some bibliometric analyses in Computer Science, this study is important because it provides a comprehensive and up-to-date overview of the field's research trends and impacts. It offers unique insights into the evolving landscape of Computer Science publications, collaborations, and emerging sub-fields. Furthermore, in the period from 2013 to 2024 covered by this study, there are no similar works of this scope and depth, making it a valuable contribution to understanding the recent developments in the discipline.

CONCLUSIONS

Bibliometric analyses are important because they allow us to identify research trends as well as to find the areas of study where researchers are working. This allows future research to project their work in a better way by directing their studies towards the most relevant areas.

This bibliometric analysis has allowed us to know the impact and visibility of research using specific metrics to evaluate the quality of research related to Computational Experiments in Computer Science.

It is hoped that this work will help researchers make the best decisions regarding future studies on this subject.

A future work would be to analyze the collaborations that exist in relation to computational experiments, for which in addition to the analysis with VOSviewer, information from academic networks such as ResearchGate or LinkedIn could be used, where relevant information could be found by establishing the appropriate filters.

As a complement to this study, data mining techniques could be used to establish patterns in the publications and see their evolution over time.

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CONFLICTS OF INTEREST

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