

CiteSpace Report

Artificial Intelligence in Marketing: Topic Modeling, Scientometric Analysis, and Research Agenda

Abstract:

Today, artificial intelligence (AI) is becoming increasingly important in both industry and academics. To investigate AI in marketing, the authors have used bibliometric study, social network analysis (SNA), main path analysis, and content analysis to examine the top authors, top most cited articles, and top milestone papers from the 965 records. Bibliometric study identified leading authors, documents, universities, countries, and sources of these articles. By using SNA, they spotted an academic social network of crucial publications. Moreover, they recognized 965 articles that constitute the main knowledge flow in AI marketing through main path analysis. Finally, they discussed future directions based on the findings. The study is one among a few studies that have used bibliometric analysis methods to analyze and visualize the citation network of the AI-marketing interface.

1: Introduction

Marketing is a complex decision-making discipline that involves not only the commonly known 4Ps (product, price, promotion, and place) but also strategic issues such as new product development (NPD), customer relationship management (CRM), selling strategies, market segmentation, positioning and targeting, international marketing, marketing research, etc. (Rutz & Watson, 2019). With the ever-increasing amount and importance of “big data,” now scholars are interested in whether appropriate decision-making technologies can solve marketing problems. Artificial intelligence (AI), which refers to machines and software that exhibit human intelligence, can provide great opportunities to facilitate decision-making in marketing. The existence of AI could be traced back to 1955 when John McCarthy coined the term Artificial Intelligence. In his work, AI was defined as “making a machine behave in ways that would be called intelligent, if a human were so behaving” (McCarthy et al., 1955).

Recently, as an application of digital marketing tools, artificial intelligence (AI) has been actively catching people’s attention. Generally, AI is relevant to any intellectual task. There are many applications in the business world (Balducci & Marinova, 2018, Thomaz et al., 2020).

Banks use artificial intelligence systems to organize operations, maintain investments in stocks, detect fraud, and manage properties (Fethi & Pasiouras, 2010). AI tools make individualized pricing easy to achieve through estimating individualized demand and supply curves (Marwala & Hurwitz, 2017). Using AI tools, marketers can now track customers' digital footprints to predict their general online behaviors and target them with personalized promotions and products (Hennig-Thurau et al., 2015, Matz et al., 2017). Recently, the applications of personality computing AI tools have been used to reduce the cost of advertising campaigns because it adds psychological targeting to traditional behavioral targeting (Celli et al., 2017). AI is still a relatively new research stream, and there is a limited number of publications presenting artificial intelligence applications in marketing.

2: Data and Methods

2.1: Data Sources

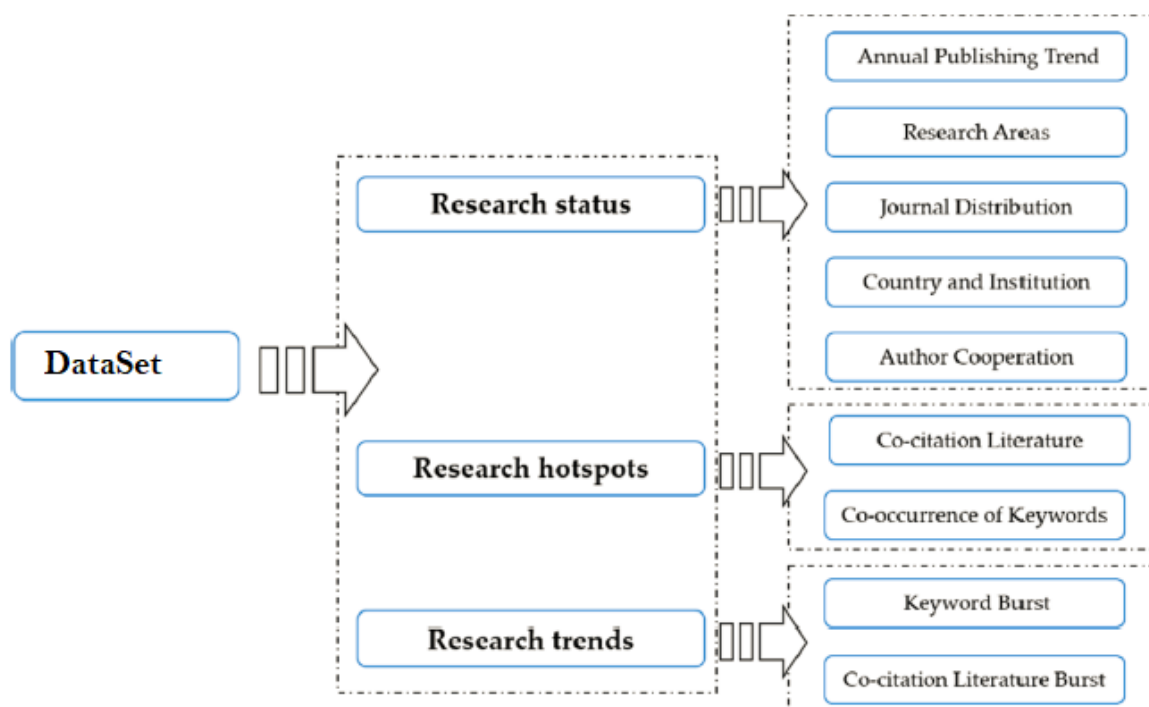
The Web of Science (WOS) is published by Thomson Reuters and is an interdisciplinary database with records from several bibliographic databases, among them Science Citation Index Expanded (SCI-EXPANDED) and Social Sciences Citation Index (SSCI). SCI-EXPANDED includes records from most of the medical disciplines. SSCI coverage includes public health, psychology, and psychiatry. The Web of Science contains records of publications from 1900 to the present. The web of sciences is an information retrieval platform. WoS keeps a details record of all aspects of the publications of the paper. Many scholars and researchers used the WoS database as the data source bibliometric and analysis of the literature. Therefore, to ensure the accuracy and reliability of the data, this report used publications in the Web of sciences core collection database as the sample data source to analyze the field of Artificial Intelligence (AI) in Marketing. The retrieval the information strategy was follows: “AI” OR “artificial intelligence” OR “machine learning” OR “robot” OR “automation” OR “big data” OR “neural network” OR “text mining” OR “natural language processing” OR “data mining” OR “soft computing” OR “fuzzy logic” OR “biometrics” OR “geotagging” OR “wearable*” OR “IoT” OR “internet of things” OR “algorithm” OR “deep learning” OR “intelligent automation” OR “ML” OR “intelligent agents” OR “LDA” OR “unsupervised learning” OR “topic model”AND”marketing” OR “service” OR “retailing” OR “consumer” OR “end user” OR “client” OR “customer”). A **total of 1200** effective publications were retrieved and the retrieval

results were saved and output in text format, each document contained author, institution, keywords, abstract, date and other information.

Artificial Intelligence in Marketing	WOS categories
“AI” OR “artificial intelligence” OR “machine learning” OR “robot” OR “automation” OR “big data” OR “neural network” OR “text mining” OR “natural language processing” OR “data mining” OR “soft computing” OR “fuzzy logic” OR “biometrics” OR “geotagging” OR “wearable*” OR “IoT” OR “internet of things” OR “algorithm” OR “deep learning” OR “intelligent automation” OR “ML” OR “intelligent agents” OR “LDA” OR “unsupervised learning” OR “topic model”AND”marketing” OR “service” OR “retailing” OR “consumer” OR “end user” OR “client” OR “customer”)	<ul style="list-style-type: none"> • Computer Science, Information Systems • Computer Science, Artificial Intelligence
Abstract, Title, Keywords	1200 Articles Found

2.2: Analysis Tools

To achieve our objectives, we combined the traditional statistical method and scientific knowledge mapping tool CiteSpace to describe the research status (Figure 1). CiteSpace is a data visualization software developed by the team of Chen Chaomei, which is widely used in many fields such as science, information and bibliometric. It could visualize the location and size of nodes in the knowledge network. In this report, the software was used to analyze the knowledge base, research hotspots and development context by using the modules of country, institution, author, keyword and reference. The software was used to analyze the AI in Marketing research field visually and draw the corresponding knowledge map. The parameters were as follows: Node Type: Selection based on analysis; Time Period: 2000-2022; Time Slice Length = 1; Threshold Selection Criteria: Top 25 per slice; others were default settings. In the cluster graph, the silhouette value was used to measure the homogeneity of the network. The closer to 1, the higher homogeneity of the network was, and the value above 0.5 indicates that the cluster result was reasonable. Meanwhile, the color and size of each node represented different years and the number of citations, which were used to represent the citation history of the literature since its publication.

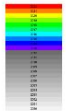
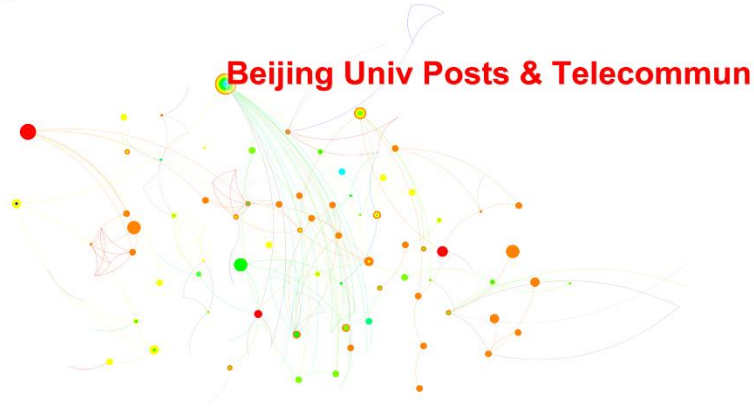


Research framework.

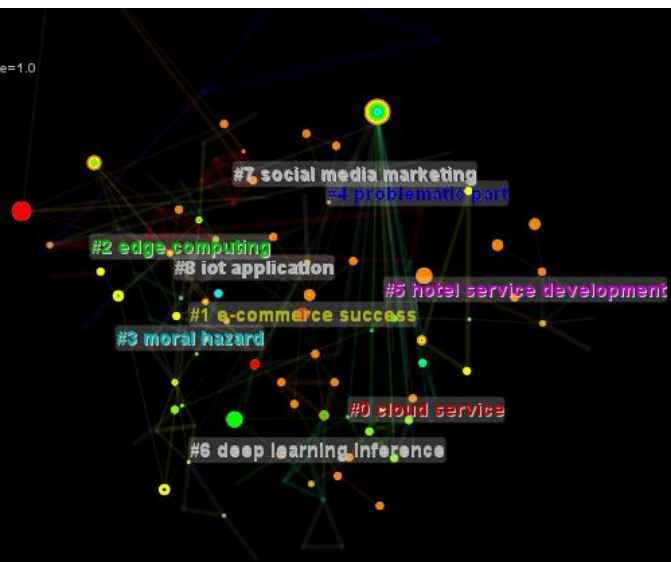
Institute

Knowledge of Map:

CiteSpace, v. 6.1.R6 (64-bit) Basic
 December 26, 2022 at 2:19:30 PM PKT
 WoS: C:\Users\ARHAM JUTTD\Desktop\5th dataset\data
 Timespan: 2000-2022 (Slice Length=1)
 Selection Criteria: g-index (k=25), LRF=3.0, L/N=10, LBY=5, e=1.0
 Network: N=454, E=321 (Density=0.0031)
 Largest CC: 121 (26%)
 Nodes Labeled: 1.0%
 Pruning: None
 Modularity Q=0.9206
 Weighted Mean Silhouette S=0.9638
 Harmonic Mean(Q, S)=0.9417



CiteSpace, v. 6.1.R6 (64-bit) Basic
 December 26, 2022 at 9:33:01 PM
 WoS: C:\Users\ARHAM JUTTD\Desktop\5th dataset\data
 Timespan: 2000-2022 (Slice Length=1)
 Selection Criteria: g-index (k=25), LRF=3.0, L/N=10, LBY=5, e=1.0
 Network: N=454, E=321 (Density=0.0031)
 Largest CC: 121 (26%)
 Nodes Labeled: 1.0%
 Pruning: None
 Modularity Q=0.9267
 Weighted Mean Silhouette S=0.9607
 Harmonic Mean(Q, S)=0.9434






Summary:

Cluster ID	Size	Silhouette	mean(Year)	Top Terms (LSI)	Top Terms (log-likelihood ratio, p-le...	Terms (mutual information)
0	26	0.979	2015	qos service composition; coevolutio...	qos service composition (28.97, 1.0...	cross-application cooperation (2.4
1	15	0.981	2015	big data; predicting online consume...	using metaheuristic pso algorithm (...	qos-aware service composition n
2	15	0.921	2016	edge computing; artificial intelligenc...	edge computing (63.03, 1.0E-4); tru...	differential privacy (0.2); precise a
3	15	0.977	2011	soliciting customer requirement; pic...	government service provision (36.4...	based mobile group handoff arch
4	12	0.921	2012	using clustering; machine learning; ...	using clustering (34.74, 1.0E-4); ser...	navigation behavior selection (0.1
5	12	0.933	2015	qos-based web service compositio...	relaxable service selection algorith...	segmentation analysis (0.21); onl
6	9	0.978	2015	gpu coprocessor; deep learning inf...	high energy physics (18.61, 1.0E-4);...	deep learning service (0.02); ibm
7	9	1	2021	cryptonight mining algorithm; yac co...	using blockchain (29.7, 1.0E-4); yac...	customer view (0.06); qos-aware
8	8	0.988	2016	big data recommendation; quantile ...	big data recommendation (31.21, 1...	m2m communication (0.14); clou

Count	Centrality	Year	Institutions
34	0.07	2008	Beijing Univ Posts & Telecommun
13	0.06	2006	Chinese Acad Sci
4	0.05	2019	Minist Educ
4	0.04	2020	Macquarie Univ
9	0.03	2019	Shanghai Univ
9	0.03	2000	Nanyang Technol Univ
6	0.03	2017	Nanjing Univ Informat Sci & Tec...
5	0.03	2016	Beijing Jiaotong Univ
5	0.03	2020	Peng Cheng Lab
12	0.02	2019	King Saud Univ
9	0.02	2022	Natl Chiao Tung Univ
7	0.02	2015	Beijing Inst Technol
6	0.02	2017	MIT
5	0.02	2014	Tianjin Univ
4	0.02	2018	Natl Taiwan Univ
3	0.02	2015	Ajou Univ
3	0.02	2018	Acad Sinica
2	0.02	2019	Natl Taipei Univ Technol
18	0.01	2011	Islamic Azad Univ
10	0.01	2006	Sejong Univ
8	0.01	2004	Nanjing Univ
6	0.01	2007	Korea Univ
6	0.01	2018	Univ Elect Sci & Technol China
5	0.01	2010	Shandong Univ
4	0.01	2006	Natl Cheng Kung Univ
4	0.01	2018	Dalian Univ Technol
4	0.01	2021	Prince Sattam Bin Abdulaziz Univ
4	0.01	2011	Tunghai Univ
4	0.01	2018	Zhejiang Univ
3	0.01	2009	Seoul Natl Univ
3	0.01	2010	Natl Yunlin Univ Sci & Technol
2	0.01	2021	Univ Calif San Diego

Brustness:

Top 3 Institutions with the Strongest Citation Bursts

Institutions	Year	Strength	Begin	End	2000 - 2022
Chinese Acad Sci	2006	3.38	2017	2019	
Islamic Azad Univ	2011	3.38	2018	2022	
King Saud Univ	2019	3.54	2019	2022	

The summary highlights major clusters first, including citing articles and cited references. The importance of nodes will be summarized in terms of citation-based metrics such as citation

counts and citation bursts, network-based metrics such as degree centrality and Betweenness centrality. Sigma is a combination of both types, i.e., burst and Betweenness centrality.

There are other features that are not included in the current summary, for example, structural variation analysis, analysis of uncertainties, concept trees, and dual-map overlays.

Major Clusters

The network consists of **9** clusters. The largest **9** clusters are summarized as follows.

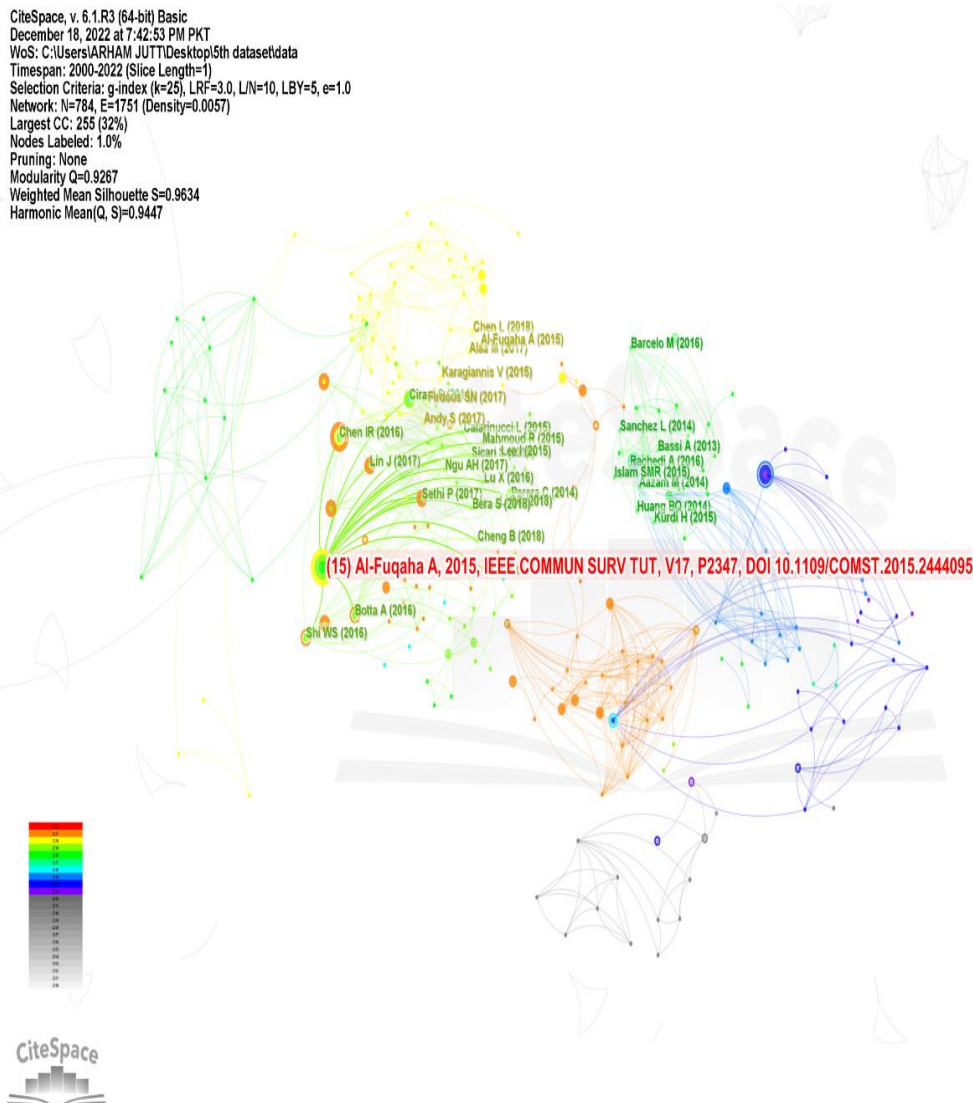


Figure. An overview of the network.

Table 1. Summary of the largest 9 clusters.

ClusterID	Size	Silhouette	Label (LSI)	Label (LLR)	Label (MI)	Average Year
0	26	0.979	qos service composition	qos service composition (28.97, 1.0E-4)	cross-application cooperation (2.54)	2015
1	15	0.981	big data	using metaheuristic pso algorithm (38.15, 1.0E-4)	qos-aware service composition mechanism (0.77)	2015
2	15	0.921	edge computing	edge computing (63.03, 1.0E-4)	differential privacy (0.2)	2016
3	15	0.977	soliciting customer requirement	government service provision (36.46, 1.0E-4)	based mobile group handoff architecture (0.26)	2011
4	12	0.921	using clustering	using clustering (34.74, 1.0E-4)	navigation behavior selection (0.18)	2012
5	12	0.933	qos-based web service composition	relaxable service selection algorithm (33.43, 1.0E-4)	segmentation analysis (0.21)	2015
6	9	0.978	gpu coprocessor	high energy physics (18.61, 1.0E-4)	deep learning service (0.02)	2015
7	9	1	cryptonight mining algorithm	using blockchain (29.7, 1.0E-4)	customer view (0.06)	2021
8	8	0.988	big data recommendation	big data recommendation (31.21, 1.0E-4)	m2m communication (0.14)	2016

Cluster #0 Qos Service Composition

The largest cluster (#0) has 26 members and a silhouette value of 0.979. It is labeled as **qos service composition** by both LLR and LSI, and as *cross-application cooperation (2.54)* by MI.

The major citing article of the cluster is: *Li, Y (2018.0) Research on qos service composition based on coevolutionary genetic algorithm. SOFT COMPUTING, V22, P10 DOI 10.1007/s00500-018-3510-5.*

The most cited members in this cluster are:

- 34 Beijing Univ Posts & Telecommun
- 13 Chinese Acad Sci
- 7 Beijing Inst Technol

Cluster #1 Using Metaheuristic Pso Algorithm

The second largest cluster (#1) has 15 members and a silhouette value of 0.981. It is labeled as *using metaheuristic pso algorithm* by LLR, *big data* by LSI, and *qos-aware service composition mechanism* (0.77) by MI.

The major citing article of the cluster is: Yu, J (2021.0) **Service management mechanisms in the internet of things: an organized and thorough study.** *JOURNAL OF AMBIENT INTELLIGENCE AND HUMANIZED COMPUTING* DOI 10.1007/s12652-020-02885-0.

The most cited members in this cluster are:

- 18 Islamic Azad Univ
- 9 Shanghai Univ
- 4 Shanghai Univ Finance & Econ

Cluster #2 Edge Computing

The third largest cluster (#2) has 15 members and a silhouette value of 0.921. It is labeled as *edge computing* by both LLR and LSI, and as *differential privacy* (0.2) by MI.

The major citing article of the cluster is: Xu, X (2022.0) *Artificial intelligence for edge service optimization in internet of vehicles: a survey.* *TSINGHUA SCIENCE AND TECHNOLOGY*, V27, P18 DOI 10.26599/TST.2020.9010025.

The most cited members in this cluster are:

- 8 Nanjing Univ
- 6 Nanjing Univ Informat Sci & Technol
- 5 Peng Cheng Lab

Cluster #3 Government Service Provision

The 4th largest cluster (#3) has 15 members and a silhouette value of 0.977. It is labeled as *government service provision* by LLR, *soliciting customer requirement* by LSI, and *based mobile group handoff architecture* (0.26) by MI.

The major citing article of the cluster is: Zheng, Y (2020.0) *Addressing the challenges of government service provision with artificial intelligence.* *AI MAGAZINE*, V41, P11.

The most cited members in this cluster are:

- 9 Nanyang Technol Univ
- 5 Shandong Univ
- 5 Beijing Jiaotong Univ

Cluster #4 Using Clustering

The 5th largest cluster (#4) has 12 members and a silhouette value of 0.921. It is labeled as *using clustering* by both LLR and LSI, and as *navigation behavior selection (0.18)* by MI.

The major citing article of the cluster is: *Benzaid, C (2020.0) Ai-driven zero touch network and service management in 5g and beyond: challenges and research directions. IEEE NETWORK DOI 10.1109/MNET.001.1900252.*

The most cited members in this cluster are:

- 10 Sejong Univ
- 6 Korea Univ
- 3 Carnegie Mellon Univ

Cluster #5 Relaxable Service Selection Algorithm

The 6th largest cluster (#5) has 12 members and a silhouette value of 0.933. It is labeled as *relaxable service selection algorithm* by LLR, *qos-based web service composition* by LSI, and *segmentation analysis (0.21)* by MI.

The major citing article of the cluster is: *Lin, C (2011.0) A relaxable service selection algorithm for qos-based web service composition. INFORMATION AND SOFTWARE TECHNOLOGY, V53, P12 DOI 10.1016/j.infsof.2011.06.010.*

The most cited members in this cluster are:

- 9 Natl Chiao Tung Univ
- 4 Tunghai Univ
- 4 Dongguan Polytech

Cluster #6 High Energy Physics

The 7th largest cluster (#6) has 9 members and a silhouette value of 0.978. It is labeled as *high energy physics* by LLR, *gpu coprocessor* by LSI, and *deep learning service (0.02)* by MI.

The major citing article of the cluster is: *Bhattacharjee, B (2017.0) Ibm deep learning service. IBM JOURNAL OF RESEARCH AND DEVELOPMENT DOI 10.1147/JRD.2017.2716578.*

The most cited members in this cluster are:

- 6 MIT
- 2 Fermilab Natl Accelerator Lab
- 2 IBM Res

Cluster #7 Using Blockchain

The 8th largest cluster (#7) has 9 members and a silhouette value of 1. It is labeled as *using blockchain* by LLR, *cryptonight mining algorithm* by LSI, and *customer view (0.06)* by MI.

The major citing article of the cluster is: *Hil, AM (2022.0) Cryptonight mining algorithm with yac consensus for social media marketing using blockchain. CMC-COMPUTERS MATERIALS & CONTINUA, V71, P16 DOI 10.32604/cmc.2022.022301.*

The most cited members in this cluster are:

- 12 King Saud Univ
- 4 Taiz Univ
- 4 Prince Sattam Bin Abdulaziz Univ

Cluster #8 Big Data Recommendation

The 9th largest cluster (#8) has 8 members and a silhouette value of 0.988. It is labeled as ***big data recommendation*** by both LLR and LSI, and as *m2m communication (0.14)* by MI.

The major citing article of the cluster is: *Yang, Y (2020.0) Quantile context-aware social iot service big data recommendation with d2d communication. IEEE INTERNET OF THINGS JOURNAL DOI 10.1109/JIOT.2020.2980046.*

The most cited members in this cluster are:

- 6 Huazhong Univ Sci & Technol
- 5 Tianjin Univ
- 4 Dalian Univ Technol

Citation Counts

The top ranked item by citation counts is Beijing Univ Posts & Telecommun (2008) in Cluster #0, with citation counts of **34**. The second one is Islamic Azad Univ (2011) in Cluster #1, with citation counts of **18**. The third is Chinese Acad Sci (2006) in Cluster #0, with citation counts of **13**. The 4th is King Saud Univ (2019) in Cluster #7, with citation counts of **12**. The 5th is Sejong Univ (2006) in Cluster #4, with citation counts of **10**. The 6th is Shanghai Univ (2019) in Cluster #1, with citation counts of **9**. The 7th is Natl Chiao Tung Univ (2005) in Cluster #5, with citation counts of **9**. The 8th is Nanyang Technol Univ (2000) in Cluster #3, with citation counts of **9**. The 9th is Nanjing Univ (2004) in Cluster #2, with citation counts of **8**. The 10th is Beijing Inst Technol (2015) in Cluster #0, with citation counts of **7**.

Citation Counts	References	DOI	Cluster ID
34	Beijing Univ Posts & Telecommun, 2008, null, null, null		0
18	Islamic Azad Univ, 2011, null, null, null		1
13	Chinese Acad Sci, 2006, null, null, null		0
12	King Saud Univ, 2019, null, null, null		7
10	Sejong Univ, 2006, null, null, null		4
9	Shanghai Univ, 2019, null, null, null		1
9	Natl Chiao Tung Univ, 2005, null, null, null		5
9	Nanyang Technol Univ, 2000, null, null, null		3
8	Nanjing Univ, 2004, null, null, null		2
7	Beijing Inst Technol, 2015, null, null, null		0

Bursts

The top ranked item by bursts is King Saud Univ (2019) in Cluster #7, with bursts of **3.54**. The second one is Islamic Azad Univ (2011) in Cluster #1, with bursts of **3.38**. The third is Chinese Acad Sci (2006) in Cluster #0, with bursts of **3.38**. The 4th is Beijing Univ Posts & Telecommun (2008) in Cluster #0, with bursts of **0.00**. The 5th is Sejong Univ (2006) in Cluster #4, with bursts of **0.00**. The 6th is Shanghai Univ (2019) in Cluster #1, with bursts of **0.00**. The 7th is Natl Chiao Tung Univ (2005) in Cluster #5, with bursts of **0.00**. The 8th is Nanyang Technol Univ (2000) in Cluster #3, with bursts of **0.00**. The 9th is Nanjing Univ (2004) in Cluster #2, with bursts of **0.00**. The 10th is Beijing Inst Technol (2015) in Cluster #0, with bursts of **0.00**.

Bursts	References	DOI	Cluster ID
3.54	King Saud Univ, 2019, null, null, null		7
3.38	Islamic Azad Univ, 2011, null, null, null		1
3.38	Chinese Acad Sci, 2006, null, null, null		0
0.00	Beijing Univ Posts & Telecommun, 2008, null, null, null		0
0.00	Sejong Univ, 2006, null, null, null		4
0.00	Shanghai Univ, 2019, null, null, null		1
0.00	Natl Chiao Tung Univ, 2005, null, null, null		5
0.00	Nanyang Technol Univ, 2000, null, null, null		3
0.00	Nanjing Univ, 2004, null, null, null		2
0.00	Beijing Inst Technol, 2015, null, null, null		0

Degree

The top ranked item by degree is Beijing Univ Posts & Telecommun (2008) in Cluster #0, with degree of **18**. The second one is Nanjing Univ (2004) in Cluster #2, with degree of **9**. The third is Nanjing Univ Informat Sci & Technol (2017) in Cluster #2, with degree of **9**. The 4th is Chinese Acad Sci (2006) in Cluster #0, with degree of **8**. The 5th is MIT (2017) in Cluster #6, with degree of **8**. The 6th is King Saud Univ (2019) in Cluster #7, with degree of **7**. The 7th is Shanghai Univ (2019) in Cluster #1, with degree of **6**. The 8th is Natl Chiao Tung Univ (2005) in Cluster #5, with degree of **6**. The 9th is Nanyang Technol Univ (2000) in Cluster #3, with degree of **6**. The 10th is Beijing Inst Technol (2015) in Cluster #0, with degree of **6**.

Degree	References	DOI	Cluster ID
18	Beijing Univ Posts & Telecommun, 2008, null, null, null		0
9	Nanjing Univ, 2004, null, null, null		2
9	Nanjing Univ Informat Sci & Technol, 2017, null, null, null		2
8	Chinese Acad Sci, 2006, null, null, null		0
8	MIT, 2017, null, null, null		6
7	King Saud Univ, 2019, null, null, null		7
6	Shanghai Univ, 2019, null, null, null		1
6	Natl Chiao Tung Univ, 2005, null, null, null		5
6	Nanyang Technol Univ, 2000, null, null, null		3
6	Beijing Inst Technol, 2015, null, null, null		0

Centrality

The top ranked item by centrality is Beijing Univ Posts & Telecommun (2008) in Cluster #0, with centrality of **0.07**. The second one is Chinese Acad Sci (2006) in Cluster #0, with centrality of **0.06**. The third is Minist Educ (2019) in Cluster #2, with centrality of **0.05**. The 4th is Macquarie Univ (2020) in Cluster #2, with centrality of **0.04**. The 5th is Nanjing Univ Informat Sci & Technol (2017) in Cluster #2, with centrality of **0.03**. The 6th is Shanghai Univ (2019) in Cluster #1, with centrality of **0.03**. The 7th is Nanyang Technol Univ (2000) in Cluster #3, with centrality of **0.03**. The 8th is Peng Cheng Lab (2020) in Cluster #2, with centrality of **0.03**. The 9th is Beijing Jiaotong Univ (2016) in Cluster #3, with centrality of **0.03**. The 10th is MIT (2017) in Cluster #6, with centrality of **0.02**.

Centrality	References	DOI	Cluster ID
0.07	Beijing Univ Posts & Telecommun, 2008, null, null, null		0
0.06	Chinese Acad Sci, 2006, null, null, null		0
0.05	Minist Educ, 2019, null, null, null		2
0.04	Macquarie Univ, 2020, null, null, null		2
0.03	Nanjing Univ Informat Sci & Technol, 2017, null, null, null		2
0.03	Shanghai Univ, 2019, null, null, null		1
0.03	Nanyang Technol Univ, 2000, null, null, null		3
0.03	Peng Cheng Lab, 2020, null, null, null		2
0.03	Beijing Jiaotong Univ, 2016, null, null, null		3
0.02	MIT, 2017, null, null, null		6

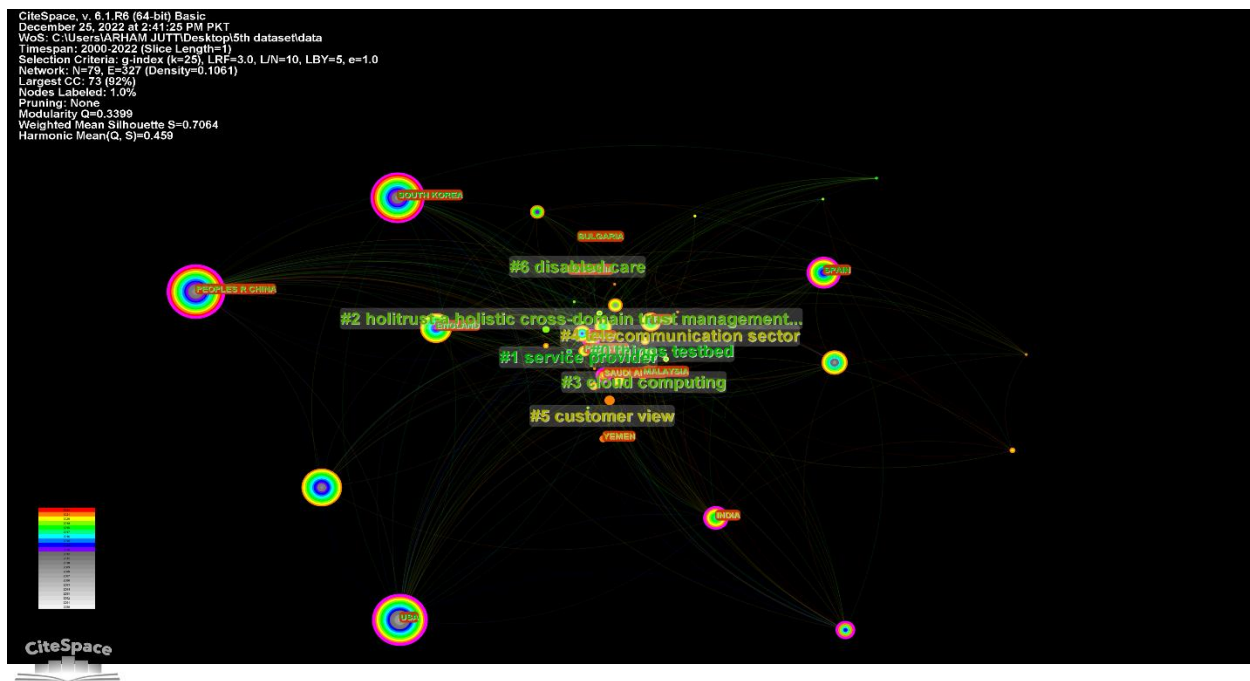
Sigma

The top ranked item by sigma is Chinese Acad Sci (2006) in Cluster #0, with sigma of **1.22**. The second one is King Saud Univ (2019) in Cluster #7, with sigma of **1.06**. The third is Islamic Azad Univ (2011) in Cluster #1, with sigma of **1.04**. The 4th is Beijing Univ Posts & Telecommun (2008) in Cluster #0, with sigma of **1.00**. The 5th is Minist Educ (2019) in Cluster #2, with sigma of **1.00**. The 6th is Macquarie Univ (2020) in Cluster #2, with sigma of **1.00**. The 7th is Nanjing Univ Informat Sci & Technol (2017) in Cluster #2, with sigma of **1.00**. The 8th is Shanghai Univ (2019) in Cluster #1, with sigma of **1.00**. The 9th is Nanyang Technol Univ (2000) in Cluster #3, with sigma of **1.00**. The 10th is Peng Cheng Lab (2020) in Cluster #2, with sigma of **1.00**.

Sigma	References	DOI	Cluster ID
1.22	Chinese Acad Sci, 2006, null, null, null		0
1.06	King Saud Univ, 2019, null, null, null		7
1.04	Islamic Azad Univ, 2011, null, null, null		1
1.00	Beijing Univ Posts & Telecommun, 2008, null, null, null		0
1.00	Minist Educ, 2019, null, null, null		2
1.00	Macquarie Univ, 2020, null, null, null		2
1.00	Nanjing Univ Informat Sci & Technol, 2017, null, null, null		2
1.00	Shanghai Univ, 2019, null, null, null		1
1.00	Nanyang Technol Univ, 2000, null, null, null		3
1.00	Peng Cheng Lab, 2020, null, null, null		2

Country:

Knowledge of Map:







Summary:

Select	ClusterID	Size	Silhouette	mean(Year)	Top Terms (LSI)	Top Terms (log-likelihood ratio, p-le...	Terms (mutual information)
<input type="checkbox"/>	0	16	0.78	2013	interoperable internet; things testbe...	things tested (200.15, 1.0E-4); ser...	applying data mining technique (0.3...
<input type="checkbox"/>	1	15	0.71	2008	machine learning; big data; artificial...	service provider (214.44, 1.0E-4); h...	disabled care (3.75); customer sati...
<input type="checkbox"/>	2	13	0.778	2013	service-centric internet; holtrust-a h...	holtrust-a holistic cross-domain tru...	general service robot (0.19); disabl...
<input type="checkbox"/>	3	11	0.374	2013	data mining; big data; service robot...	cloud computing (177.35, 1.0E-4); s...	web service (3.56); disabled care (3...
<input type="checkbox"/>	4	10	0.777	2012	big data; machine learning; telecom...	telecommunication sector (155.91, ...	radial basis function (0.36); univers...
<input type="checkbox"/>	5	5	0.708	2017	customer view; using blockchain; cr...	customer view (108.22, 1.0E-4); usi...	customer satisfaction (0.02); smart ...
<input type="checkbox"/>	6	3	0.97	2016	case study on human-robot interacti...	disabled care (17.91, 1.0E-4); remo...	machine learning (0.02); big data (0...

Brustness:

Top 4 Countries with the Strongest Citation Bursts

Countries	Year	Strength	Begin	End	2000 - 2022
USA	2000	3.75	2000	2005	
TAIWAN	2005	6.14	2006	2013	
SPAIN	2009	4.11	2009	2014	
SOUTH KOREA	2002	5.36	2014	2015	

The summary highlights major clusters first, including citing articles and cited references. The importance of nodes will be summarized in terms of citation-based metrics such as citation counts and citation bursts, network-based metrics such as degree centrality and betweenness centrality. Sigma is a combination of both types, i.e., burst and betweenness centrality.

There are other features that are not included in the current summary, for example, structural variation analysis, analysis of uncertainties, concept trees, and dual-map overlays.

Major Clusters

The network consists of 7 clusters. The largest 7 clusters are summarized as follows.

CiteSpace, v. 6.1.R3 (64-bit) Basic
December 18, 2022 at 7:42:53 PM PKT
WoS: C:\Users\ARHAM JUTTI\Desktop\5th dataset\data
Timespan: 2000-2022 (Slice Length=1)
Selection Criteria: g-index (k=25), LRF=3.0, L/N=10, LBY=5, e=1.0
Network: N=784, E=1751 (Density=0.0057)
Largest CC: 255 (32%)
Nodes Labeled: 1.0%
Pruning: None
Modularity Q=0.9267
Weighted Mean Silhouette S=0.9634
Harmonic Mean(Q, S)=0.9447

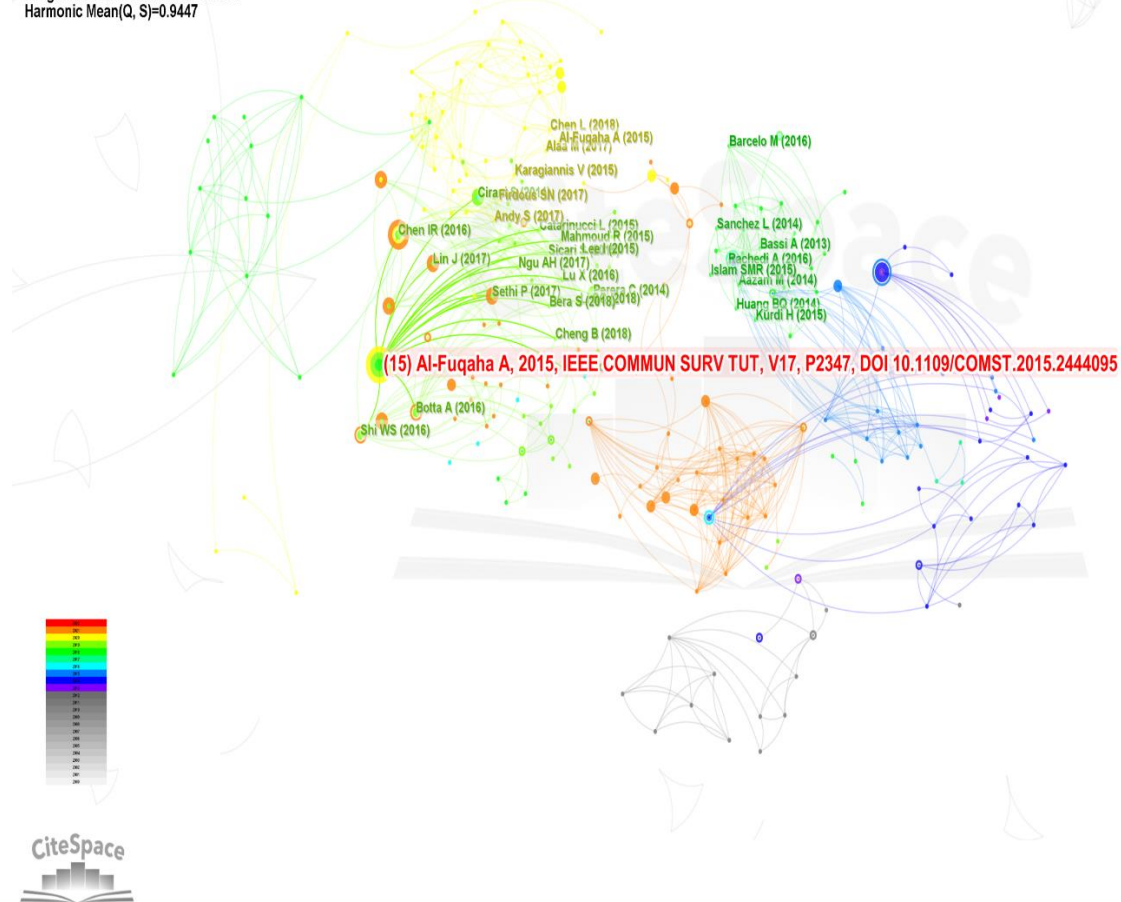


Figure. An overview of the network.

Table 1. Summary of the largest 7 clusters.

ClusterID	Size	Silhouette	Label (LSI)	Label (LLR)	Label (MI)	Average Year
0	16	0.78	interoperable internet	things testbed (200.15, 1.0E-4)	applying data mining technique (0.37)	2013
1	15	0.71	machine learning	service provider (214.44, 1.0E-4)	disabled care (3.75)	2008
2	13	0.778	service-centric internet	holitrust-a holistic cross-domain trust management mechanism (124.27, 1.0E-4)	general service robot (0.19)	2013
3	11	0.374	data mining	cloud computing (177.35, 1.0E-4)	web service (3.56)	2013
4	10	0.777	big data	telecommunication sector (155.91, 1.0E-4)	radial basis function (0.36)	2012
5	5	0.708	customer view	customer view (108.22, 1.0E-4)	customer satisfaction (0.02)	2017
6	3	0.97	case study on human-robot interaction of the remote-controlled service robot for elderly and disabled care	disabled care (17.91, 1.0E-4)	machine learning (0.02)	2016

Cluster #0 *Things Testbed*

The largest cluster (#0) has 16 members and a silhouette value of 0.78. It is labeled as *things testbed* by LLR, *interoperable internet* by LSI, and *applying data mining technique (0.37)* by MI.

The major citing article of the cluster is: *Zincir-heywood, N (2020.0) Guest editorial: special section on data analytics and machine learning for network and service management-part i. IEEE TRANSACTIONS ON NETWORK AND SERVICE MANAGEMENT DOI 10.1109/TNSM.2020.3038736.*

The most cited members in this cluster are:

- 45 ENGLAND
- 41 SPAIN
- 30 GERMANY

Cluster #1 *Service Provider*

The second largest cluster (#1) has 15 members and a silhouette value of 0.71. It is labeled as *service provider* by LLR, *machine learning* by LSI, and *disabled care (3.75)* by MI.

The major citing article of the cluster is: *Javadpour, A (2021.0) Enhancement in quality of routing service using metaheuristic pso algorithm in vanet networks. SOFT COMPUTING DOI 10.1007/s00500-021-06188-0.*

The most cited members in this cluster are:

- 128 USA
- 103 SOUTH KOREA
- 77 TAIWAN

Cluster #2 Holitrust-A Holistic Cross-Domain Trust Management Mechanism

The third largest cluster (#2) has 13 members and a silhouette value of 0.778. It is labeled as *holitrust-a holistic cross-domain trust management mechanism* by LLR, *service-centric internet* by LSI, and *general service robot (0.19)* by MI.

The major citing article of the cluster is: *Sodhro, AH (2019.0) Quality of service optimization in an iot-driven intelligent transportation system. IEEE WIRELESS COMMUNICATIONS DOI 10.1109/MWC.001.1900085.*

The most cited members in this cluster are:

- 31 ITALY
- 20 PAKISTAN
- 11 BELGIUM

Cluster #3 Cloud Computing

The 4th largest cluster (#3) has 11 members and a silhouette value of 0.374. It is labeled as *cloud computing* by LLR, *data mining* by LSI, and *web service (3.56)* by MI.

The major citing article of the cluster is: *Adekiigbe, A (2017.0) An efficient cluster head election algorithm for client mesh network using fuzzy logic control. JOURNAL OF INTERNET TECHNOLOGY, V18, P11 DOI 10.6138/JIT.2017.18.5.20130627.*

The most cited members in this cluster are:

- 353 PEOPLES R CHINA
- 15 MALAYSIA
- 5 SWITZERLAND

Cluster #4 Telecommunication Sector

The 5th largest cluster (#4) has 10 members and a silhouette value of 0.777. It is labeled as *telecommunication sector* by LLR, *big data* by LSI, and *radial basis function (0.36)* by MI.

The major citing article of the cluster is: *Pustokhina, IV (2021.0) Multi-objective rain optimization algorithm with welm model for customer churn prediction in telecommunication sector. COMPLEX & INTELLIGENT SYSTEMS DOI 10.1007/s40747-021-00353-6.*

The most cited members in this cluster are:

- 60 INDIA
- 37 IRAN
- 12 U ARAB EMIRATES

Cluster #5 Customer View

The 6th largest cluster (#5) has 5 members and a silhouette value of 0.708. It is labeled as *customer view* by both LLR and LSI, and as *customer satisfaction (0.02)* by MI.

The major citing article of the cluster is: *Hossain, MS (2016.0) Big data-driven service composition using parallel clustered particle swarm optimization in mobile environment. IEEE TRANSACTIONS ON SERVICES COMPUTING DOI 10.1109/TSC.2016.2598335.*

The most cited members in this cluster are:

- 37 SAUDI ARABIA
- 5 YEMEN
- 4 BANGLADESH

Cluster #6 Disabled Care

The 7th largest cluster (#6) has 3 members and a silhouette value of 0.97. It is labeled as *disabled care* by LLR, *case study on human-robot interaction of the remote-controlled service robot for elderly and disabled care* by LSI, and *machine learning (0.02)* by MI.

The major citing article of the cluster is: *Chivarov, N (2019.0) Case study on human-robot interaction of the remote-controlled service robot for elderly and disabled care. COMPUTING AND INFORMATICS, V38, P27 DOI 10.31577/cai_2019_5_1210.*

The most cited members in this cluster are:

- 2 SLOVAKIA
- 2 BULGARIA
- 2 AUSTRIA

Citation Counts

The top ranked item by citation counts is PEOPLES R CHINA (2002) in Cluster #3, with citation counts of **353**. The second one is USA (2000) in Cluster #1, with citation counts of **128**. The third is SOUTH KOREA (2002) in Cluster #1, with citation counts of **103**. The 4th is TAIWAN (2005) in Cluster #1, with citation counts of **77**. The 5th is INDIA (2006) in Cluster #4, with citation counts of **60**. The 6th is ENGLAND (2005) in Cluster #0, with citation counts of **45**. The 7th is SPAIN (2009) in Cluster #0, with citation counts of **41**. The 8th is SAUDI ARABIA (2016) in Cluster #5, with citation counts of **37**. The 9th is IRAN (2007) in Cluster #4, with citation counts of **37**. The 10th is AUSTRALIA (2006) in Cluster #1, with citation counts of **35**.

Citation Counts	References	DOI	Cluster ID
353	PEOPLES R CHINA, 2002, null, null, null		3
128	USA, 2000, null, null, null		1
103	SOUTH KOREA, 2002, null, null, null		1
77	TAIWAN, 2005, null, null, null		1
60	INDIA, 2006, null, null, null		4
45	ENGLAND, 2005, null, null, null		0
41	SPAIN, 2009, null, null, null		0
37	SAUDI ARABIA, 2016, null, null, null		5
37	IRAN, 2007, null, null, null		4
35	AUSTRALIA, 2006, null, null, null		1

Bursts

The top ranked item by bursts is TAIWAN (2005) in Cluster #1, with bursts of **6.14**. The second one is SOUTH KOREA (2002) in Cluster #1, with bursts of **5.36**. The third is SPAIN (2009) in Cluster #0, with bursts of **4.11**. The 4th is USA (2000) in Cluster #1, with bursts of **3.75**. The 5th is PEOPLES R CHINA (2002) in Cluster #3, with bursts of **0.00**. The 6th is INDIA (2006) in Cluster #4, with bursts of **0.00**. The 7th is ENGLAND (2005) in Cluster #0, with bursts of **0.00**. The 8th is SAUDI ARABIA (2016) in Cluster #5, with bursts of **0.00**. The 9th is IRAN (2007) in Cluster #4, with bursts of **0.00**. The 10th is AUSTRALIA (2006) in Cluster #1, with bursts of **0.00**.

Bursts	References	DOI	Cluster ID
6.14	TAIWAN, 2005, null, null, null		1
5.36	SOUTH KOREA, 2002, null, null, null		1
4.11	SPAIN, 2009, null, null, null		0
3.75	USA, 2000, null, null, null		1
0.00	PEOPLES R CHINA, 2002, null, null, null		3
0.00	INDIA, 2006, null, null, null		4
0.00	ENGLAND, 2005, null, null, null		0
0.00	SAUDI ARABIA, 2016, null, null, null		5
0.00	IRAN, 2007, null, null, null		4
0.00	AUSTRALIA, 2006, null, null, null		1

Degree

The top ranked item by degree is PEOPLES R CHINA (2002) in Cluster #3, with degree of **37**. The second one is USA (2000) in Cluster #1, with degree of **32**. The third is ITALY (2006) in Cluster #2, with degree of **26**. The 4th is ENGLAND (2005) in Cluster #0, with degree of **23**. The 5th is FRANCE (2002) in Cluster #0, with degree of **23**. The 6th is INDIA (2006) in Cluster #4, with degree of **21**. The 7th is PAKISTAN (2016) in Cluster #2, with degree of **20**. The 8th is SOUTH KOREA (2002) in Cluster #1, with degree of **19**. The 9th is AUSTRALIA (2006) in Cluster #1, with degree of **18**. The 10th is SAUDI ARABIA (2016) in Cluster #5, with degree of **17**.

Degree	References	DOI	Cluster ID
37	PEOPLES R CHINA, 2002, null, null, null		3
32	USA, 2000, null, null, null		1
26	ITALY, 2006, null, null, null		2
23	ENGLAND, 2005, null, null, null		0
23	FRANCE, 2002, null, null, null		0
21	INDIA, 2006, null, null, null		4
20	PAKISTAN, 2016, null, null, null		2
19	SOUTH KOREA, 2002, null, null, null		1
18	AUSTRALIA, 2006, null, null, null		1
17	SAUDI ARABIA, 2016, null, null, null		5

Centrality

The top ranked item by centrality is PEOPLES R CHINA (2002) in Cluster #3, with centrality of **0.38**. The second one is USA (2000) in Cluster #1, with centrality of **0.28**. The third is ITALY (2006) in Cluster #2, with centrality of **0.15**. The 4th is SOUTH KOREA (2002) in Cluster #1, with centrality of **0.15**. The 5th is SAUDI ARABIA (2016) in Cluster #5, with centrality of **0.15**. The 6th is FRANCE (2002) in Cluster #0, with centrality of **0.14**. The 7th is SPAIN (2009) in Cluster #0, with centrality of **0.13**. The 8th is INDIA (2006) in Cluster #4, with centrality of **0.12**. The 9th is NIGERIA (2017) in Cluster #3, with centrality of **0.09**. The 10th is PAKISTAN (2016) in Cluster #2, with centrality of **0.08**.

Centrality	References	DOI	Cluster ID
0.38	PEOPLES R CHINA, 2002, null, null, null		3
0.28	USA, 2000, null, null, null		1
0.15	ITALY, 2006, null, null, null		2
0.15	SOUTH KOREA, 2002, null, null, null		1
0.15	SAUDI ARABIA, 2016, null, null, null		5
0.14	FRANCE, 2002, null, null, null		0
0.13	SPAIN, 2009, null, null, null		0
0.12	INDIA, 2006, null, null, null		4
0.09	NIGERIA, 2017, null, null, null		3
0.08	PAKISTAN, 2016, null, null, null		2

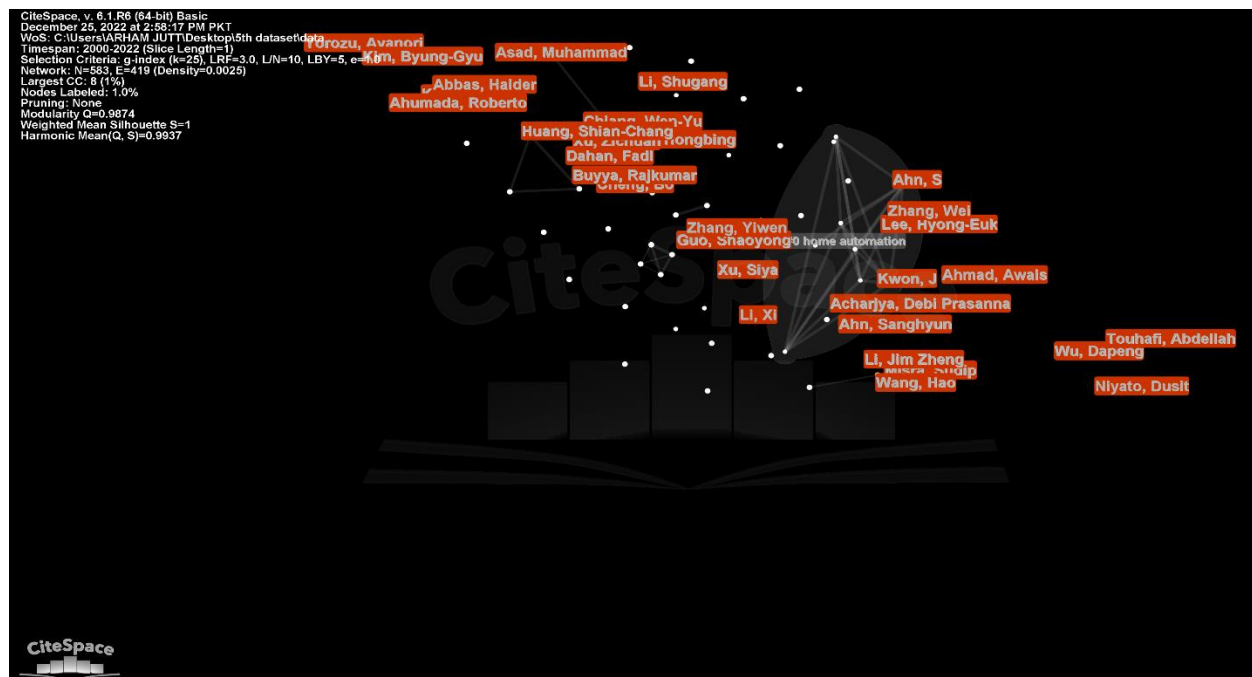
Sigma

The top ranked item by sigma is USA (2000) in Cluster #1, with sigma of **2.53**. The second one is SOUTH KOREA (2002) in Cluster #1, with sigma of **2.15**. The third is SPAIN (2009) in Cluster #0, with sigma of **1.63**. The 4th is TAIWAN (2005) in Cluster #1, with sigma of **1.08**. The 5th is PEOPLES R CHINA (2002) in Cluster #3, with sigma of **1.00**. The 6th is ITALY (2006) in Cluster #2, with sigma of **1.00**. The 7th is SAUDI ARABIA (2016) in Cluster #5, with sigma of **1.00**. The 8th is FRANCE (2002) in Cluster #0, with sigma of **1.00**. The 9th is INDIA (2006) in Cluster #4, with sigma of **1.00**. The 10th is NIGERIA (2017) in Cluster #3, with sigma of **1.00**.

Sigma	References	DOI	Cluster ID
2.53	USA, 2000, null, null, null		1
2.15	SOUTH KOREA, 2002, null, null, null		1
1.63	SPAIN, 2009, null, null, null		0
1.08	TAIWAN, 2005, null, null, null		1
1.00	PEOPLES R CHINA, 2002, null, null, null		3
1.00	ITALY, 2006, null, null, null		2
1.00	SAUDI ARABIA, 2016, null, null, null		5
1.00	FRANCE, 2002, null, null, null		0
1.00	INDIA, 2006, null, null, null		4
1.00	NIGERIA, 2017, null, null, null		3

Author

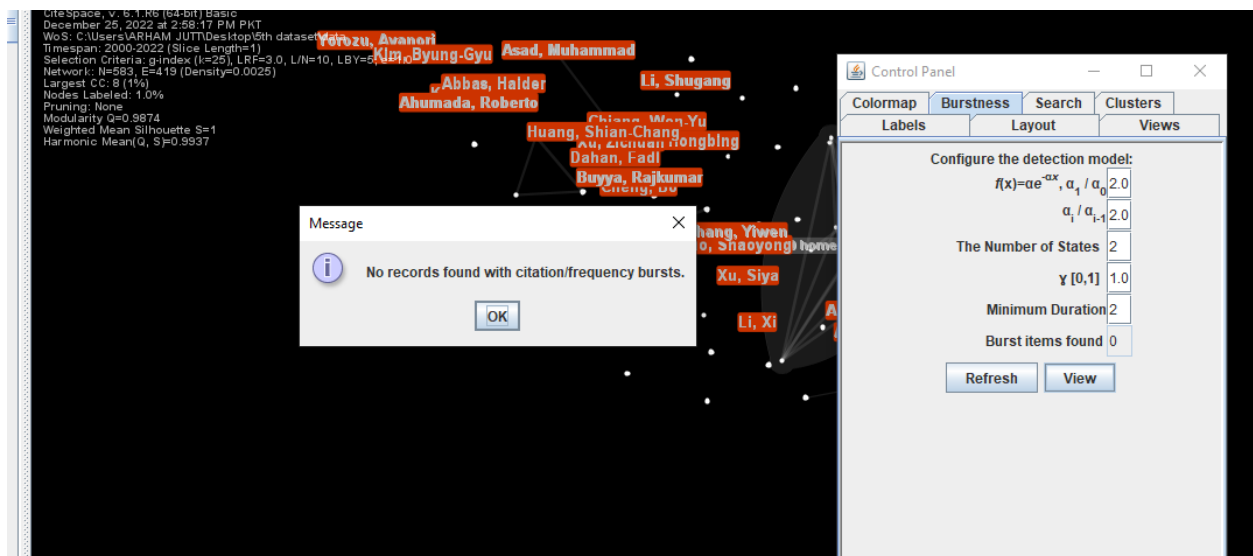
Knowledge of Map:



Summary:

Select	Cluster ID	Size	Silhouette	mean(Year)	Top Terms (LSI)	Top Terms (log-likelihood ratio, p-le...	Terms (mutual information)
<input type="checkbox"/>	0	8	1	2002	development of a residential gatew...	home automation (1.0); servic...	home automation (1.39); service se...

Brustness:



The summary highlights major clusters first, including citing articles and cited references. The importance of nodes will be summarized in terms of citation-based metrics such as citation counts and citation bursts, network-based metrics such as degree centrality and betweenness centrality. Sigma is a combination of both types, i.e., burst and betweenness centrality.

There are other features that are not included in the current summary, for example, structural variation analysis, analysis of uncertainties, concept trees, and dual-map overlays.

Major Clusters

The network consists of 1 clusters. The largest 1 clusters are summarized as follows.

CiteSpace, v. 5.1.R3 (64-bit) Basic
 December 16, 2022 at 7:42:53 PM PKT
 WoS: C:\Users\ARHAM\JUT\TDesktop\5th dataset\data
 Timespan: 2000-2022 (Slice Length=1)
 Selection Criteria: g-index (k=25), LRF=3.0, L/N=10, LBY=5, e=1.0
 Network: N=784, E=1751 (Density=0.0057)
 Largest CC: 255 (32%)
 Nodes Labeled: 1.0%
 Pruning: None
 Modularity Q=0.9267
 Weighted Mean Silhouette S=0.9634
 Harmonic Mean(Q, S)=0.9447

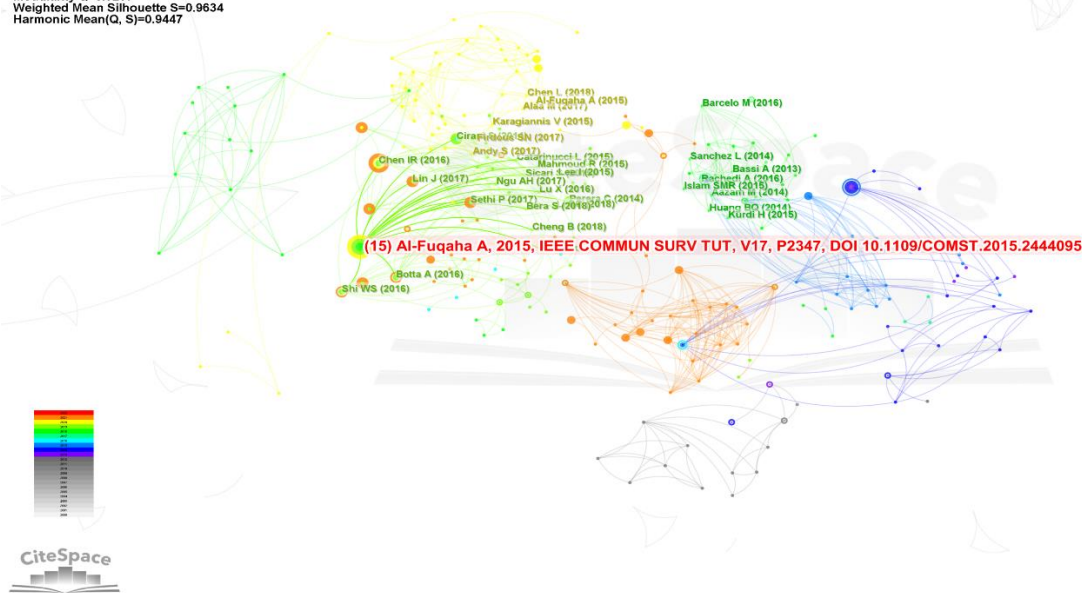


Figure. An overview of the network.

Table 1. Summary of the largest 1 clusters.

ClusterID	Size	Silhouette	Label (LSI)	Label (LLR)	Label (MI)	Average Year
0	8	1	development of a residential gateway and a service server for home automation	home automation (NaN, 1.0)	home automation (1.39)	2002

Cluster #0 Home Automation

The largest cluster (#0) has 8 members and a silhouette value of 1. It is labeled as *home automation* by LLR, *development of a residential gateway and a service server for home automation* by LSI, and *home automation (1.39)* by MI.

The major citing article of the cluster is: *Park, J (2002.0) Development of a residential gateway and a service server for home automation. ADVANCED INTERNET SERVICES AND APPLICATIONS, PROCEEDINGS LECTURE NOTES IN COMPUTER SCIENCE, V2402, P13.*

The most cited members in this cluster are:

- 2 Ahn, S
- 1 Kwon, J
- 1 Park, J

Citation Counts

The top ranked item by citation counts is Guo, Shaoyong (2019) in Cluster #23, with citation counts of **4**. The second one is Cheng, Bo (2016) in Cluster #10, with citation counts of **3**. The third is Zhao, Shuai (2016) in Cluster #10, with citation counts of **3**. The 4th is Li, Xi (2021) in Cluster #19, with citation counts of **3**. The 5th is Asad, Muhammad (2020) in Cluster #14, with citation counts of **3**. The 6th is Qiu, Xuesong (2020) in Cluster #23, with citation counts of **3**. The 7th is Xu, Siya (2020) in Cluster #23, with citation counts of **3**. The 8th is Kim, Byung-Gyu (2015) in Cluster #43, with citation counts of **3**. The 9th is Dahan, Fadl (2021) in Cluster #64, with citation counts of **3**. The 10th is Misra, Sudip (2021) in Cluster #96, with citation counts of **3**.

Citation Counts	References	DOI	Cluster ID
4	Guo, Shaoyong, 2019, null, null, null		23
3	Cheng, Bo, 2016, null, null, null		10
3	Zhao, Shuai, 2016, null, null, null		10
3	Li, Xi, 2021, null, null, null		19
3	Asad, Muhammad, 2020, null, null, null		14
3	Qiu, Xuesong, 2020, null, null, null		23
3	Xu, Siya, 2020, null, null, null		23
3	Kim, Byung-Gyu, 2015, null, null, null		43
3	Dahan, Fadl, 2021, null, null, null		64
3	Misra, Sudip, 2021, null, null, null		96

Bursts

The top ranked item by bursts is Guo, Shaoyong (2019) in Cluster #23, with bursts of **0.00**. The second one is Cheng, Bo (2016) in Cluster #10, with bursts of **0.00**. The third is Zhao, Shuai (2016) in Cluster #10, with bursts of **0.00**. The 4th is Li, Xi (2021) in Cluster #19, with bursts of **0.00**. The 5th is Asad, Muhammad (2020) in Cluster #14, with bursts of **0.00**. The 6th is Qiu, Xuesong (2020) in Cluster #23, with bursts of **0.00**. The 7th is Xu, Siya (2020) in Cluster #23, with bursts of **0.00**. The 8th is Kim, Byung-Gyu (2015) in Cluster #43, with bursts of **0.00**. The 9th is Dahan, Fadl (2021) in Cluster #64, with bursts of **0.00**. The 10th is Misra, Sudip (2021) in Cluster #96, with bursts of **0.00**.

Bursts	References	DOI	Cluster ID
0.00	Guo, Shaoyong, 2019, null, null, null		23
0.00	Cheng, Bo, 2016, null, null, null		10
0.00	Zhao, Shuai, 2016, null, null, null		10
0.00	Li, Xi, 2021, null, null, null		19
0.00	Asad, Muhammad, 2020, null, null, null		14
0.00	Qiu, Xuesong, 2020, null, null, null		23
0.00	Xu, Siya, 2020, null, null, null		23
0.00	Kim, Byung-Gyu, 2015, null, null, null		43
0.00	Dahan, Fadl, 2021, null, null, null		64
0.00	Misra, Sudip, 2021, null, null, null		96

Degree

The top ranked item by degree is Ahn, S (2002) in Cluster #0, with degree of **7**. The second one is Han, I (2002) in Cluster #0, with degree of **6**. The third is Hwang, J (2002) in Cluster #0, with degree of **6**. The 4th is Chang, W (2002) in Cluster #0, with degree of **6**. The 5th is Kim, H (2002) in Cluster #0, with degree of **6**. The 6th is Park, J (2002) in Cluster #0, with degree of **6**. The 7th is Kwon, J (2002) in Cluster #0, with degree of **6**. The 8th is Krupa, Jeffrey (2021) in Cluster #1, with degree of **5**. The 9th is Harris, Philip (2021) in Cluster #1, with degree of **5**. The 10th is Holzman, Burt (2021) in Cluster #1, with degree of **5**.

Degree	References	DOI	Cluster ID
7	Ahn, S, 2002, null, null, null		0
6	Han, I, 2002, null, null, null		0
6	Hwang, J, 2002, null, null, null		0
6	Chang, W, 2002, null, null, null		0
6	Kim, H, 2002, null, null, null		0
6	Park, J, 2002, null, null, null		0
6	Kwon, J, 2002, null, null, null		0
5	Krupa, Jeffrey, 2021, null, null, null		1
5	Harris, Philip, 2021, null, null, null		1
5	Holzman, Burt, 2021, null, null, null		1

Centrality

The top ranked item by centrality is Ahn, S (2002) in Cluster #0, with centrality of **0.00**. The second one is Han, I (2002) in Cluster #0, with centrality of **0.00**. The third is Hwang, J (2002) in Cluster #0, with centrality of **0.00**. The 4th is Chang, W (2002) in Cluster #0, with centrality of **0.00**. The 5th is Kim, H (2002) in Cluster #0, with centrality of **0.00**. The 6th is Park, J (2002) in Cluster #0, with centrality of **0.00**. The 7th is Kwon, J (2002) in Cluster #0, with centrality of **0.00**. The 8th is Krupa, Jeffrey (2021) in Cluster #1, with centrality of **0.00**. The 9th is Harris, Philip (2021) in Cluster #1, with centrality of **0.00**. The 10th is Holzman, Burt (2021) in Cluster #1, with centrality of **0.00**.

Centrality	References	DOI	Cluster ID
0.00	Ahn, S, 2002, null, null, null		0
0.00	Han, I, 2002, null, null, null		0
0.00	Hwang, J, 2002, null, null, null		0
0.00	Chang, W, 2002, null, null, null		0
0.00	Kim, H, 2002, null, null, null		0
0.00	Park, J, 2002, null, null, null		0
0.00	Kwon, J, 2002, null, null, null		0
0.00	Krupa, Jeffrey, 2021, null, null, null		1
0.00	Harris, Philip, 2021, null, null, null		1
0.00	Holzman, Burt, 2021, null, null, null		1

Sigma

The top ranked item by sigma is Ahn, S (2002) in Cluster #0, with sigma of **1.00**. The second one is Han, I (2002) in Cluster #0, with sigma of **1.00**. The third is Hwang, J (2002) in Cluster #0, with sigma of **1.00**. The 4th is Chang, W (2002) in Cluster #0, with sigma of **1.00**. The 5th is Kim, H (2002) in Cluster #0, with sigma of **1.00**. The 6th is Park, J (2002) in Cluster #0, with sigma of **1.00**. The 7th is Kwon, J (2002) in Cluster #0, with sigma of **1.00**. The 8th is Krupa, Jeffrey (2021) in Cluster #1, with sigma of **1.00**. The 9th is Harris, Philip (2021) in Cluster #1, with sigma of **1.00**. The 10th is Holzman, Burt (2021) in Cluster #1, with sigma of **1.00**.

Summary

Cluster ID	Size	Silhouette	mean(Year)	Top Terms (LSI)	Top Terms (log-likelihood ratio, p-le...	Terms (mutual information)
0	70	0.95	2016	edge computing; service discovery; ...	iot network (66.84, 1.0E-4); edge co...	cuckoo-inspired algorithm (4.98); sl...
1	43	0.98	2017	iot network; resilient service embed...	iot network (125.11, 1.0E-4); resilie...	slow denial (0.27); cuckoo-inspired ...
2	28	0.907	2015	qos service composition; coevolutio...	qos service composition (41.46, 1.0...	cuckoo-inspired algorithm (0.1); mu...
3	23	0.996	2010	qos-oriented web service compositi...	multi-population genetic algorithm (...)	monitoring elderly people (0.07); se...
4	22	0.947	2013	large-scale dynamic service compo...	large-scale dynamic service compo...	historical record (0.05); things servi...
5	19	0.995	2018	qos-aware cloud service compositi...	qos-aware cloud service compositi...	edge computing (0.03); qos-aware ...
7	17	0.958	2018	edge-cloud environment; energy-aw...	energy-aware service function chain...	stackelberg game (0.21); service d...
8	14	0.936	2007	qos-based web service selection pr...	applying gravitational search algorit...	edge computing (0.05); service disc...
9	13	1	2014	holistic approach; big data-enabled ...	holistic approach (30.76, 1.0E-4); bi...	edge computing (0.04); holistic app...
29	6	0.981	2017	mec-enabled 5g network; scaling; ...	learning-driven service function chai...	edge computing (0.04); trust-orient...

Brustness:

Top 3 References with the Strongest Citation Bursts

References	Year	Strength	Begin	End	2000 - 2022
Atzori L., 2010, COMPUT NETW, V54, P2787, DOI 10.1016/j.comnet.2010.05.010, DOI	2010	4.96	2011	2015	
Miorandi D., 2012, AD HOC NETW, V10, P1497, DOI 10.1016/j.adhoc.2012.02.016, DOI	2012	3.85	2014	2016	
Al-Fuqaha A., 2015, IEEE COMMUN SURV TUT, V17, P2347, DOI 10.1109/COMST.2015.2444095, DOI	2015	5.64	2018	2020	

The summary highlights major clusters first, including citing articles and cited references. The importance of nodes will be summarized in terms of citation-based metrics such as citation counts and citation bursts, network-based metrics such as degree centrality and betweenness centrality. Sigma is a combination of both types, i.e., burst and betweenness centrality.

There are other features that are not included in the current summary, for example, structural variation analysis, analysis of uncertainties, concept trees, and dual-map overlays.

Major Clusters

The network consists of **10** clusters. The largest **10** clusters are summarized as follows.

CiteSpace, v. 6.1.R3 (64-bit) Basic
December 18, 2022 at 7:42:53 PM PKT
WoS: C:\Users\ARHAM JUT\Desktop\5th dataset\data
Timespan: 2000-2022 (Slice Length=1)
Selection Criteria: g-index (k=25), LRF=3.0, L/N=10, LBY=5, $\alpha=1.0$
Network: N=784, E=1751 (Density=0.0057)
Largest CC: 255 (32%)
Nodes Labeled: 1.0%
Pruning: None
Modularity Q=0.9267
Weighted Mean Silhouette S=0.9634
Harmonic Mean(Q, S)=0.9447

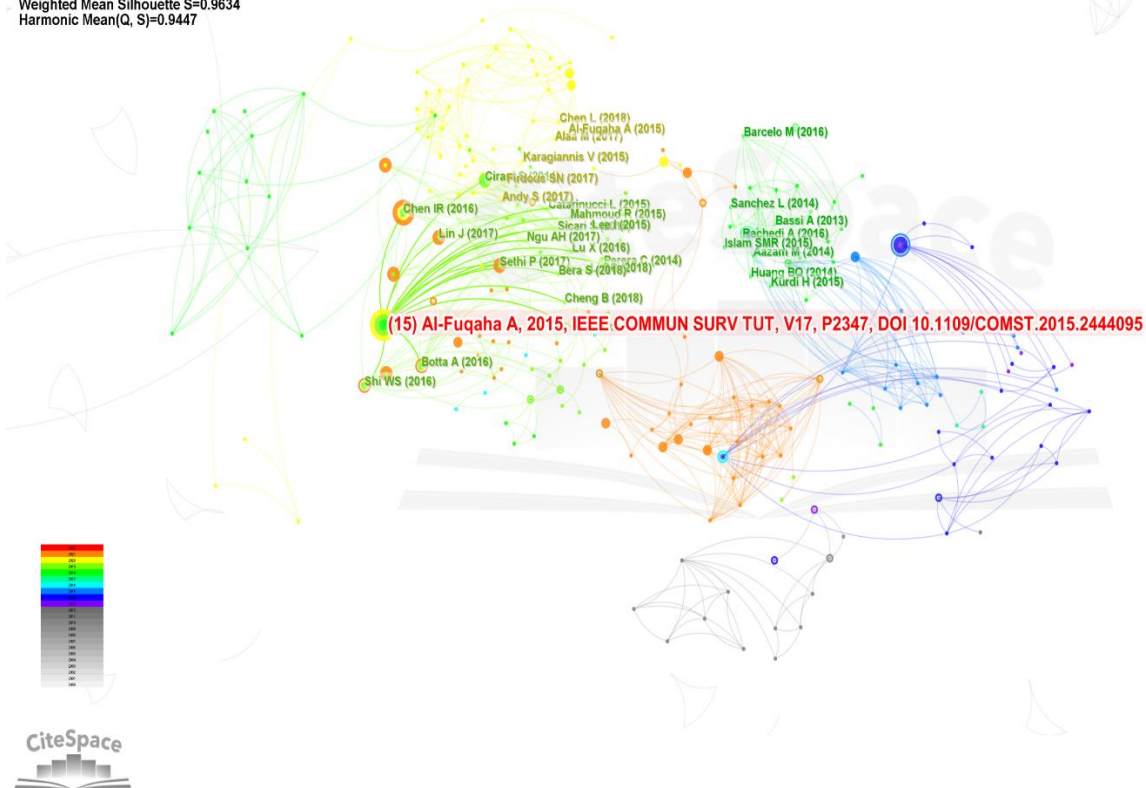


Figure. An overview of the network.

Table 1. Summary of the largest 10 clusters.

ClusterID	Size	Silhouette	Label (LSI)	Label (LLR)	Label (MI)	Average Year
0	70	0.95	edge computing	iot network (66.84, 1.0E-4)	cuckoo-inspired algorithm (4.98)	2016
1	43	0.98	iot network	iot network (125.11, 1.0E-4)	slow denial (0.27)	2017
2	28	0.907	qos service composition	qos service composition (41.46, 1.0E-4)	cuckoo-inspired algorithm (0.1)	2015
3	23	0.996	qos-oriented web service composition approach	multi-population genetic algorithm (37.81, 1.0E-4)	monitoring elderly people (0.07)	2010
4	22	0.947	large-scale dynamic service composition	large-scale dynamic service composition (40.24, 1.0E-4)	historical record (0.05)	2013
5	19	0.995	qos-aware cloud service composition	qos-aware cloud service composition (38.25, 1.0E-4)	edge computing (0.03)	2018
7	17	0.958	edge-cloud environment	energy-aware service function chain embedding (40.22, 1.0E-4)	stackelberg game (0.21)	2018
8	14	0.936	qos-based web service selection problem	applying gravitational search algorithm (22.64, 1.0E-4)	edge computing (0.05)	2007
9	13	1	holistic approach	holistic approach (30.76, 1.0E-4)	edge computing (0.04)	2014
29	6	0.981	mec-enabled 5g network	learning-driven service function chain placement (19.84, 1.0E-4)	edge computing (0.04)	2017

Cluster #0 *Iot Network*

The largest cluster (#0) has 70 members and a silhouette value of 0.95. It is labeled as *iot network* by LLR, *edge computing* by LSI, and *cuckoo-inspired algorithm* (4.98) by MI.

The major citing article of the cluster is: Awan, KA (2019.0) *Holitrust-a holistic cross-domain trust management mechanism for service-centric internet of things*. IEEE ACCESS DOI 10.1109/ACCESS.2019.2912469.

The most cited members in this cluster are:

- 15 Al-Fuqaha A, 2015, IEEE COMMUN SURV TUT, V17, P2347, DOI 10.1109/COMST.2015.2444095
- 11 Chen IR, 2016, IEEE T SERV COMPUT, V9, P482, DOI 10.1109/TSC.2014.2365797
- 9 Lin J, 2017, IEEE INTERNET THINGS, V4, P1125, DOI 10.1109/JIOT.2017.2683200

Cluster #1 *IOT NETWORK*

The second largest cluster (#1) has 43 members and a silhouette value of 0.98. It is labeled as *iot network* by both LLR and LSI, and as *slow denial* (0.27) by MI.

The major citing article of the cluster is: Al-shammari, HQ (2020.0) *Resilient service embedding in iot networks*. IEEE ACCESS DOI 10.1109/ACCESS.2020.3005936.

The most cited members in this cluster are:

- 5 Mijumbi R, 2016, IEEE COMMUN SURV TUT, V18, P236, DOI 10.1109/COMST.2015.2477041
- 4 Novo O, 2018, IEEE INTERNET THINGS, V5, P1184, DOI 10.1109/JIOT.2018.2812239
- 3 Tajiki MM, 2019, IEEE T NETW SERV MAN, V16, P374, DOI 10.1109/TNSM.2018.2873225

Cluster #2 *Qos Service Compositions*

The third largest cluster (#2) has 28 members and a silhouette value of 0.907. It is labeled as *qos service composition* by both LLR and LSI, and as *cuckoo-inspired algorithm* (0.1) by MI.

The major citing article of the cluster is: Li, Y (2018.0) *Research on qos service composition based on coevolutionary genetic algorithm*. SOFT COMPUTING, V22, P10 DOI 10.1007/s00500-018-3510-5.

The most cited members in this cluster are:

- 5 Gubbi J, 2013, FUTURE GENER COMP SY, V29, P1645, DOI 10.1016/j.future.2013.01.010
- 3 Huo Y, 2015, APPL INTELL, V42, P661, DOI 10.1007/s10489-014-0617-y
- 3 Tao F, 2014, IEEE T IND INFORM, V10, P1547, DOI 10.1109/TII.2014.2306397

Cluster #3 Multi- Populations Genetic Algorithm

The 4th largest cluster (#3) has 23 members and a silhouette value of 0.996. It is labeled as *multi-population genetic algorithm* by LLR, *qos-oriented web service composition approach* by LSI, and *monitoring elderly people (0.07)* by MI.

The major citing article of the cluster is: Zhao, X (2014.0) *Qos-aware web service selection with negative selection algorithm. KNOWLEDGE AND INFORMATION SYSTEMS, V40, P25 DOI 10.1007/s10115-013-0642-x.*

The most cited members in this cluster are:

- 9 Atzori L, 2010, COMPUT NETW, V54, P2787, DOI 10.1016/j.comnet.2010.05.010
- 7 Miorandi D, 2012, AD HOC NETW, V10, P1497, DOI 10.1016/j.adhoc.2012.02.016
- 2 Ai LF, 2011, FUTURE GENER COMP SY, V27, P157, DOI 10.1016/j.future.2010.08.003

Cluster #4 Large-Scale Dynamic Service Compositions

The 5th largest cluster (#4) has 22 members and a silhouette value of 0.947. It is labeled as *large-scale dynamic service composition* by both LLR and LSI, and as *historical record (0.05)* by MI.

The major citing article of the cluster is: Zhang, Y (2015.0) *Mr-idpso: a novel algorithm for large-scale dynamic service composition. TSINGHUA SCIENCE AND TECHNOLOGY, V20, P11 DOI 10.1109/TST.2015.7349932.*

The most cited members in this cluster are:

- 5 Julia A, 2014, EXPERT SYST APPL, V41, P3809, DOI 10.1016/j.eswa.2013.12.017
- 5 Alrifai M, 2012, ACM T WEB, V6, P0, DOI 10.1145/2180861.2180864
- 4 Wang SG, 2013, MOBILE NETW APPL, V18, P116, DOI 10.1007/s11036-012-0373-3

Cluster #5 Qos-Aware Cloud Service Compositions

The 6th largest cluster (#5) has 19 members and a silhouette value of 0.995. It is labeled as *qos-aware cloud service composition* by both LLR and LSI, and as *edge computing (0.03)* by MI.

The major citing article of the cluster is: *Dahan, F (2021.0) An efficient hybrid metaheuristic algorithm for qos-aware cloud service composition problem. IEEE ACCESS DOI 10.1109/ACCESS.2021.3092288.*

The most cited members in this cluster are:

- 6 Zhou JJ, 2017, INT J ADV MANUF TECH, V88, P3371, DOI 10.1007/s00170-016-9034-1
- 5 Dahan F, 2017, COMPUTING, V99, P507, DOI 10.1007/s00607-017-0547-8
- 4 Naseri A, 2019, J AMB INTEL HUM COMP, V10, P1851, DOI 10.1007/s12652-018-0773-8

Cluster #7 *Energy-Aware Service Function Chain Embedding*

The 7th largest cluster (#7) has 17 members and a silhouette value of 0.958. It is labeled as *energy-aware service function chain embedding* by LLR, *edge-cloud environment* by LSI, and *stackelberg game (0.21)* by MI.

The major citing article of the cluster is: *Thanh, NH (2021.0) Energy-aware service function chain embedding in edge-cloud environments for iot applications. IEEE INTERNET OF THINGS JOURNAL DOI 10.1109/JIOT.2021.3064986.*

The most cited members in this cluster are:

- 5 Baker T, 2017, J NETW COMPUT APPL, V89, P96, DOI 10.1016/j.jnca.2017.03.008
- 5 Asghari P, 2018, J NETW COMPUT APPL, V120, P61, DOI 10.1016/j.jnca.2018.07.013
- 4 Vinayakumar R, 2020, IEEE T IND APPL, V56, P4436, DOI 10.1109/TIA.2020.2971952

Cluster #8 *Applying Gravitational Search Algorithm*

The 8th largest cluster (#8) has 14 members and a silhouette value of 0.936. It is labeled as *applying gravitational search algorithm* by LLR, *qos-based web service selection problem* by LSI, and *edge computing (0.05)* by MI.

The major citing article of the cluster is: *Zibanezhad, B (2011.0) Applying gravitational search algorithm in the qos-based web service selection problem. JOURNAL OF ZHEJIANG UNIVERSITY-SCIENCE C-COMPUTERS & ELECTRONICS, V12, P13 DOI 10.1631/jzus.C1000305.*

The most cited members in this cluster are:

- 3 Alrifai M., 2009, P 18 INT C WORLD WID, V0, P881
- 3 Canfora G, 2008, J SYST SOFTWARE, V81, P1754, DOI 10.1016/j.jss.2007.12.792

- 2 Ardagna D, 2007, IEEE T SOFTWARE ENG, V33, P369, DOI 10.1109/TSE.2007.1011

Cluster #9 Holistic Approach

The 9th largest cluster (#9) has 13 members and a silhouette value of 1. It is labeled as *holistic approach* by both LLR and LSI, and as *edge computing (0.04)* by MI.

The major citing article of the cluster is: *Zerbino, P (2018.0) Big data-enabled customer relationship management: a holistic approach. INFORMATION PROCESSING & MANAGEMENT, V54, P29 DOI 10.1016/j.ipm.2017.10.005.*

The most cited members in this cluster are:

- 3 Hashem IAT, 2015, INFORM SYST, V47, P98, DOI 10.1016/j.is.2014.07.006
- 3 Wu XD, 2014, IEEE T KNOWL DATA EN, V26, P97, DOI 10.1109/TKDE.2013.109
- 2 Chen DQ, 2015, J MANAGE INFORM SYST, V32, P4, DOI 10.1080/07421222.2015.1138364

Cluster #29 Learning-Driven Service Function Chain Placements

The 10th largest cluster (#29) has 6 members and a silhouette value of 0.981. It is labeled as *learning-driven service function chain placement* by LLR, *mec-enabled 5g network* by LSI, and *edge computing (0.04)* by MI.

The major citing article of the cluster is: *Subramanya, T (2020.0) Machine learning-driven service function chain placement and scaling in mec-enabled 5g networks. COMPUTER NETWORKS DOI 10.1016/j.comnet.2019.106980.*

The most cited members in this cluster are:

- 2 Boutaba R, 2018, J INTERNET SERV APPL, V9, P0, DOI 10.1186/s13174-018-0087-2
- 2 Farris I, 2018, T EMERG TELECOMMUN T, V29, P0, DOI 10.1002/ett.3169
- 2 Bhamare D, 2016, J NETW COMPUT APPL, V75, P138, DOI 10.1016/j.jnca.2016.09.001

Citation Counts

The top ranked item by citation counts is Al-Fuqaha A (2015) in Cluster #0, with citation counts of **15**. The second one is Chen IR (2016) in Cluster #0, with citation counts of **11**. The third is Lin J (2017) in Cluster #0, with citation counts of **9**. The 4th is Atzori L (2010) in Cluster #3, with citation counts of **9**. The 5th is Shi WS (2016) in Cluster #0, with citation counts of **8**. The 6th is Botta A (2016) in Cluster #0, with citation counts of **8**. The 7th is Miorandi D (2012) in

Cluster #3, with citation counts of **7**. The 8th is Guo J (2017) in Cluster #0, with citation counts of **7**. The 9th is Cirani S (2014) in Cluster #0, with citation counts of **7**. The 10th is Chen IR (2016) in Cluster #0, with citation counts of **7**.

Citation Counts	References	DOI	Cluster ID
15	Al-Fuqaha A, 2015, IEEE COMMUN SURV TUT, V17, P2347	10.1109/COMST.2015.2444095	0
11	Chen IR, 2016, IEEE T SERV COMPUT, V9, P482	10.1109/TSC.2014.2365797	0
9	Lin J, 2017, IEEE INTERNET THINGS, V4, P1125	10.1109/JIOT.2017.2683200	0
9	Atzori L, 2010, COMPUT NETW, V54, P2787	10.1016/j.comnet.2010.05.010	3
8	Shi WS, 2016, IEEE INTERNET THINGS, V3, P637	10.1109/JIOT.2016.2579198	0
8	Botta A, 2016, FUTURE GENER COMP SY, V56, P684	10.1016/j.future.2015.09.021	0
7	Miorandi D, 2012, AD HOC NETW, V10, P1497	10.1016/j.adhoc.2012.02.016	3
7	Guo J, 2017, COMPUT COMMUN, V97, P1	10.1016/j.comcom.2016.10.012	0
7	Cirani S, 2014, IEEE INTERNET THINGS, V1, P508	10.1109/JIOT.2014.2358296	0
7	Chen IR, 2016, IEEE T DEPEND SECURE, V13, P684	10.1109/TDSC.2015.2420552	0

Bursts

The top ranked item by bursts is Al-Fuqaha A (2015) in Cluster #0, with bursts of **5.64**. The second one is Atzori L (2010) in Cluster #3, with bursts of **4.96**. The third is Miorandi D (2012) in Cluster #3, with bursts of **3.85**. The 4th is Chen IR (2016) in Cluster #0, with bursts of **0.00**. The 5th is Lin J (2017) in Cluster #0, with bursts of **0.00**. The 6th is Shi WS (2016) in Cluster #0, with bursts of **0.00**. The 7th is Botta A (2016) in Cluster #0, with bursts of **0.00**. The 8th is Guo J (2017) in Cluster #0, with bursts of **0.00**. The 9th is Cirani S (2014) in Cluster #0, with bursts of **0.00**. The 10th is Chen IR (2016) in Cluster #0, with bursts of **0.00**.

Bursts	References	DOI	Cluster ID
5.64	Al-Fuqaha A, 2015, IEEE COMMUN SURV TUT, V17, P2347	10.1109/COMST.2015.2444095	0
4.96	Atzori L, 2010, COMPUT NETW, V54, P2787	10.1016/j.comnet.2010.05.010	3
3.85	Miorandi D, 2012, AD HOC NETW, V10, P1497	10.1016/j.adhoc.2012.02.016	3
0.00	Chen IR, 2016, IEEE T SERV COMPUT, V9, P482	10.1109/TSC.2014.2365797	0
0.00	Lin J, 2017, IEEE INTERNET THINGS, V4, P1125	10.1109/JIOT.2017.2683200	0
0.00	Shi WS, 2016, IEEE INTERNET THINGS, V3, P637	10.1109/JIOT.2016.2579198	0
0.00	Botta A, 2016, FUTURE GENER COMP SY, V56, P684	10.1016/j.future.2015.09.021	0
0.00	Guo J, 2017, COMPUT COMMUN, V97, P1	10.1016/j.comcom.2016.10.012	0
0.00	Cirani S, 2014, IEEE INTERNET THINGS, V1, P508	10.1109/JIOT.2014.2358296	0
0.00	Chen IR, 2016, IEEE T DEPEND SECURE, V13, P684	10.1109/TDSC.2015.2420552	0

Degree

The top ranked item by degree is Al-Fuqaha A (2015) in Cluster #0, with degree of **31**. The second one is Zhou JJ (2017) in Cluster #5, with degree of **29**. The third is Jula A (2014) in Cluster #4, with degree of **22**. The 4th is Chen IR (2016) in Cluster #0, with degree of **21**. The 5th is Dahan F (2017) in Cluster #5, with degree of **18**. The 6th is Alanazi S (2015) in Cluster #1, with degree of **17**. The 7th is Yang YF (2020) in Cluster #5, with degree of **16**. The 8th is Jatoth C (2019) in Cluster #5, with degree of **16**. The 9th is Naseri A (2019) in Cluster #5, with degree of **16**. The 10th is Dahan F (2019) in Cluster #5, with degree of **16**.

Degree	References	DOI	Cluster ID
31	Al-Fuqaha A, 2015, IEEE COMMUN SURV TUT, V17, P2347	10.1109/COMST.2015.2444095	0
29	Zhou JJ, 2017, INT J ADV MANUF TECH, V88, P3371	10.1007/s00170-016-9034-1	5
22	Jula A, 2014, EXPERT SYST APPL, V41, P3809	10.1016/j.eswa.2013.12.017	4
21	Chen IR, 2016, IEEE T SERV COMPUT, V9, P482	10.1109/TSC.2014.2365797	0
18	Dahan F, 2017, COMPUTING, V99, P507	10.1007/s00607-017-0547-8	5
17	Alanazi S, 2015, 2015 17TH INTERNATIONAL CONFERENCE ON E-HEALTH NETWORKING, V0, P205	10.1109/HealthCom.2015.7454499	1
16	Yang YF, 2020, APPL SOFT COMPUT, V87, P0	10.1016/j.asoc.2019.106003	5
16	Jatoth C, 2019, FUTURE GENER COMP SY, V94, P185	10.1016/j.future.2018.11.022	5
16	Naseri A, 2019, J AMB INTEL HUM COMP, V10, P1851	10.1007/s12652-018-0773-8	5
16	Dahan F, 2019, IEEE ACCESS, V7, P21787	10.1109/ACCESS.2019.2894683	5

Centrality

The top ranked item by centrality is Al-Fuqaha A (2015) in Cluster #0, with centrality of **0.11**. The second one is Jula A (2014) in Cluster #4, with centrality of **0.05**. The third is Zhou JJ (2017) in Cluster #5, with centrality of **0.04**. The 4th is Alrifai M (2012) in Cluster #4, with centrality of **0.03**. The 5th is Miorandi D (2012) in Cluster #3, with centrality of **0.03**. The 6th is Huang BQ (2014) in Cluster #2, with centrality of **0.03**. The 7th is Gubbi J (2013) in Cluster #2, with centrality of **0.03**. The 8th is Shi WS (2016) in Cluster #0, with centrality of **0.02**. The 9th is Qiu C (2019) in Cluster #1, with centrality of **0.02**. The 10th is Barcelo M (2016) in Cluster #2, with centrality of **0.02**.

Centrality	References	DOI	Cluster ID
0.11	Al-Fuqaha A, 2015, IEEE COMMUN SURV TUT, V17, P2347	10.1109/COMST.2015.2444095	0
0.05	Jula A, 2014, EXPERT SYST APPL, V41, P3809	10.1016/j.eswa.2013.12.017	4
0.04	Zhou JJ, 2017, INT J ADV MANUF TECH, V88, P3371	10.1007/s00170-016-9034-1	5
0.03	Alrifai M, 2012, ACM T WEB, V6, P0	10.1145/2180861.2180864	4
0.03	Miorandi D, 2012, AD HOC NETW, V10, P1497	10.1016/j.adhoc.2012.02.016	3
0.03	Huang BQ, 2014, ENTERP INF SYST-UK, V8, P445	10.1080/17517575.2013.792396	2
0.03	Gubbi J, 2013, FUTURE GENER COMP SY, V29, P1645	10.1016/j.future.2013.01.010	2
0.02	Shi WS, 2016, IEEE INTERNET THINGS, V3, P637	10.1109/JIOT.2016.2579198	0
0.02	Qiu C, 2019, IEEE INTERNET THINGS, V6, P4627	10.1109/JIOT.2018.2871394	1
0.02	Barcelo M, 2016, IEEE J SEL AREA COMM, V34, P4077	10.1109/JSAC.2016.2621398	2

Sigma

The top ranked item by sigma is Al-Fuqaha A (2015) in Cluster #0, with sigma of **1.83**. The second one is Miorandi D (2012) in Cluster #3, with sigma of **1.14**. The third is Atzori L (2010) in Cluster #3, with sigma of **1.05**. The 4th is Jula A (2014) in Cluster #4, with sigma of **1.00**. The 5th is Zhou JJ (2017) in Cluster #5, with sigma of **1.00**. The 6th is Alrifai M (2012) in Cluster #4, with sigma of **1.00**. The 7th is Huang BQ (2014) in Cluster #2, with sigma of **1.00**. The 8th is Gubbi J (2013) in Cluster #2, with sigma of **1.00**. The 9th is Shi WS (2016) in Cluster #0, with sigma of **1.00**. The 10th is Qiu C (2019) in Cluster #1, with sigma of **1.00**.

Sigma	References	DOI	Cluster ID
1.83	Al-Fuqaha A, 2015, IEEE COMMUN SURV TUT, V17, P2347	10.1109/COMST.2015.2444095	0
1.14	Miorandi D, 2012, AD HOC NETW, V10, P1497	10.1016/j.adhoc.2012.02.016	3
1.05	Atzori L, 2010, COMPUT NETW, V54, P2787	10.1016/j.comnet.2010.05.010	3
1.00	Jula A, 2014, EXPERT SYST APPL, V41, P3809	10.1016/j.eswa.2013.12.017	4
1.00	Zhou JJ, 2017, INT J ADV MANUF TECH, V88, P3371	10.1007/s00170-016-9034-1	5
1.00	Alrifai M, 2012, ACM T WEB, V6, P0	10.1145/2180861.2180864	4
1.00	Huang BQ, 2014, ENTERP INF SYST-UK, V8, P445	10.1080/17517575.2013.792396	2
1.00	Gubbi J, 2013, FUTURE GENER COMP SY, V29, P1645	10.1016/j.future.2013.01.010	2
1.00	Shi WS, 2016, IEEE INTERNET THINGS, V3, P637	10.1109/IIOT.2016.2579198	0
1.00	Qiu C, 2019, IEEE INTERNET THINGS, V6, P4627	10.1109/IIOT.2018.2871394	1

3: Conclusion

The summary highlights major clusters first, including citing articles and cited references. The importance of nodes will be summarized in terms of citation-based metrics such as citation counts and citation bursts, network-based metrics such as degree centrality and betweenness centrality. Sigma is a combination of both types, i.e., burst and betweenness centrality.

There are other features that are not included in the current summary, for example, structural variation analysis, analysis of uncertainties, concept trees, and dual-map overlays.