

A Review of Full-Text Citation Analysis Research: Postprint

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Abstract

[Purpose/ Significance] To review the current development status of full-text citation analysis, clarify the different emphases in domestic and international full-text citation analysis, and analyze the challenges faced by full-text citation analysis as well as its potential future development directions. [Method/ Process] By reviewing domestic and international research papers on full-text citation analysis, the research content is summarized into three aspects: citation location analysis, citation intensity analysis, and citation context analysis. The applications of full-text citation analysis in interdisciplinary fields, scientific evaluation, and other domains are examined, and differences between domestic and international approaches are summarized. [Results/ Conclusion] Literature review reveals that current research on citation location in full-text citation analysis is significantly associated with chapter and section structure. Citation intensity analysis is closely integrated with citation location analysis, with an emphasis on developing novel computational methods. Regarding citation context, sentiment analysis represents the primary research hotspot. Applications are concentrated in interdisciplinary measurement and the construction of scientific evaluation systems. This study also forecasts future challenges and development directions for full-text citation analysis.

Full Text

A Review of Full-Text Citation Analysis Research

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Abstract

[Purpose/Significance] This study reviews the current development status of full-text citation analysis, clarifies the different research focuses between domes-

tic and international scholars, and analyzes the challenges and potential future directions of full-text citation analysis to better promote its development.

[Method/Process] By reviewing relevant research papers on full-text citation analysis from both domestic and international sources, this paper summarizes the research content into three main areas: citation location analysis, citation intensity analysis, and citation context analysis. It also examines the application of full-text citation analysis in interdisciplinary research and scientific evaluation, and summarizes the differences between domestic and international research approaches.

[Results/Conclusions] Through comprehensive literature review, we find that current full-text citation analysis research on citation locations has important connections with chapter structure. Citation intensity analysis is closely integrated with citation location analysis, with particular emphasis on developing new computational methods. In citation context analysis, sentiment analysis represents the main research hotspot. Applications primarily concentrate on interdisciplinary measurement and scientific evaluation system construction. This study also predicts future challenges and development directions for full-text citation analysis.

Keywords: full-text analysis; citation analysis; sentiment analysis; citation location analysis

1 Introduction

Full-text citation analysis has developed rapidly and become an important direction in bibliometrics research. As a method that automatically identifies citation relationships between documents by analyzing textual information in literature, citation analysis represents a crucial research area within bibliometrics. It studies the citation behavior and academic influence of literature, providing deeper insights than traditional methods.

Since the 1990s, researchers have begun to analyze documents using full-text citations. Traditional citation analysis primarily relies on reference lists and author citation markers, but this approach has limitations, such as its inability to identify full-text citations and ensure citation accuracy. Compared with traditional citation analysis, full-text citation analysis is more accurate and comprehensive, helping researchers better understand citation relationships and academic influence among literature.

Full-text citation analysis primarily involves machine learning and natural language processing techniques, including text feature extraction, keyword extraction, topic modeling, and sentiment analysis, focusing on the analysis of citation content. With the further development of text mining and machine learning technologies, and the establishment of open-access full-text databases for public

use, full-text citation analysis has been widely applied in bibliometrics, disciplinary development trend analysis, and other fields.

With increasing data volumes, full-text citation analysis also faces challenges in data quality, precision, and efficiency. A systematic review is needed to better promote its development. Before formal retrieval, preliminary searches were conducted on full-text research domain articles, with search terms initially set as full-text citation analysis and its synonyms, which were refined during the retrieval process based on specific research objects.

2 The Rise and Development of Full-Text Citation Analysis

For a considerable period, due to small-scale paper data, difficulties in obtaining full-text documents and data, and other reasons, full-text analysis and related citation research remained in early stages, with scarce research output, especially before the large-scale application of computer technology. Entering this century, with the rise of the open access movement and the rapid development of natural language processing and text mining technologies, it has become more convenient to obtain full-text academic paper data for analysis. Full-text analysis research, including citation analysis, has regained researchers' attention.

In Web of Science, we conducted a subject search using English keywords with OR relationships, setting the document type as Article and the time span as 2000-2023. After screening early highly-cited articles, we obtained 135 non-review articles. BIRNDL, BIR, and other related international symposiums have emerged in recent years, with researchers dedicated to interdisciplinary studies in information retrieval, bibliometrics, and natural language processing. After manual screening based on titles and abstracts, 72 relevant English-language documents were selected.

Meanwhile, using corresponding Chinese terms to construct keyword search formulas in CNKI, we initially retrieved 128 documents. After similar manual screening of titles and abstracts, 53 Chinese-language documents were obtained. After synthesizing English and Chinese articles and removing similar works by the same authors, 125 documents were selected for analysis. Currently, full-text citation analysis research content mainly focuses on citation location analysis, citation intensity analysis, citation context analysis, and the application of full-text citation analysis[1].

3 Research Content of Full-Text Citation Analysis

3.1 Citation Location Analysis

With the gradual opening of full-text data, researchers are no longer limited to reference lists at the end of articles and can further locate the specific positions

where references are cited within the text. Research on citation location can be summarized into qualitative and quantitative aspects. One part of full-text citation analysis research content can be divided into citation location analysis, citation intensity analysis, and citation context analysis, primarily determined based on keywords and word frequency in each article. Citation context can be regarded as three different aspects of specific citation content: the location of the citation, the article structure where it appears, and the context of the citation.

As early as 2000, He Rongli et al.[2] conducted qualitative analysis of citation locations, studying 300 articles and their 7,857 citations in the introduction, methods, and results sections, concluding that citation functions are related to their locations. In 2010, Li Yan[3] argued that simply ranking scientific journals based on citation counts was inaccurate, as citations carry different emotions, word choices, and contexts that affect their impact. Liu Xi et al.[4] questioned this hypothesis and found that the distribution of citation locations in articles changes regularly over time.

In 2013, Halevi et al.[5] analyzed articles published in the Journal of Informetrics in 2007 regarding citation usage in different sections of papers, using matrices for quantitative calculations. In 2016, Hu Zhigang[6] used visualization to intuitively display the distribution of citations in texts, comparing citation positions across different years and citation frequencies to provide a more intuitive interpretation of citation behavior. In 2017, Zhang Chengzhi et al.[7] took academic monographs as research objects, manually annotating them and analyzing citation behavior from perspectives such as citation content and location distribution. This research expanded the study objects of full-text citation analysis from common research papers to academic monographs, promoting future research on other academic output formats such as patents. Zhang Lin et al.[8] analyzed interdisciplinary degree based on citation annotations in different chapters of papers.

3.2 Citation Intensity Analysis

Citation intensity analysis primarily refers to the number of times a reference is cited in a document and its distribution across different sections, where the number of citations is directly proportional to citation intensity. However, this also includes the distribution of citations across different locations when a reference is cited multiple times in a document. The intensity of citation varies depending on the location of the citation.

In 2013, Ding et al.[10] proposed two different methods for calculating citation intensity, named Count One and Count X, and found that different counting methods lead to different analysis results. In practice, researchers need to choose appropriate methods based on their research purposes. Hu Zhigang et al.[11] studied the relationship between the number of cited articles and citation frequency, proposing a new weighted method for calculating total citation counts

that has important value in scientific evaluation. Hu Zhigang has long focused on this area[6], and in his 2017 article[12], he systematically studied what kinds of citations and citing documents are more likely to be cited multiple times, involving both total citation counts and citation locations.

Wang Yuzhuo et al.[13] built upon the above methods to conduct algorithmic academic impact analysis considering full-text content. At the 2016 Full-Text Bibliometric Analysis Academic Salon, Hu Zhigang[14] proposed that full-text bibliometric analysis needs to combine citation location analysis with citation intensity analysis.

3.3 Citation Context Analysis

Citation context analysis involves word selection, focusing on two concepts: content words and cue words. Content words primarily contain the core textual information, while cue words only need to express the author's emotions and states during citation. Together, they form the foundation of citation context analysis. Citation context analysis can be divided into three aspects: word selection, sentiment analysis, and citation motivation and behavior analysis.

3.3.1 Word Selection During the citation process, authors from different disciplines have different word preferences, which provides impetus for further application of location analysis. This leads to exploration of the relationship between word preference and citation relationships. Hyland[15] demonstrated that verbs used in articles vary significantly according to discipline and citation context, with scholars in humanities and social sciences using more reporting verbs than other disciplines. Kim et al.[16] used citation content and word similarity to indicate possible implicit themes in author keywords.

Hu Zhigang et al.[17] analyzed connective words, reporting verbs, and behavioral verbs in citation contexts, collecting, counting, and analyzing cue words during citation to identify the functional classification of different word usages. Rosati[18] conducted linguistic analysis to reveal unique and statistically significant linguistic structures belonging to each citation type, promoting model construction for citation context analysis.

3.3.2 Sentiment Analysis Citation is closely related to sentiment. Sentiment analysis research can be divided into classification studies, methodological studies, and model construction.

Muppidi et al.[19] emphasized the classification of positive and negative polarities of citation emotions in papers. Amjad et al.[20] used VerbNet ontology and four different machine learning algorithms for natural language processing to conduct semantic analysis of verbs in citation texts, proposing a verb-oriented citation sentiment classification. Vyas et al.[21] developed eight datasets containing citation sentences, manually annotated with three emotional polarities

(positive, negative, and neutral), and compared ten algorithms to determine which performed better.

Small[22] proposed that citation context analysis requires a generalized sentiment concept that respects different attitudes and emotions involved in citations. Ikram et al.[23] proposed a new method for identifying citation emotions based on corpus and linguistic research methods, comparing the occurrence of cue words in citation contexts. Aljuaid et al.[24] proposed a binary classification method for text citation sentiment analysis to reveal hidden patterns in academic big data. Umer et al.[25] used machine learning models combined with frequency-based and predictive feature representation techniques on a public citation sentiment dataset. Mercier et al.[26] proposed an end-to-end trainable multi-task model that covers emotion and intention analysis using out-of-domain datasets to overcome data scarcity.

3.3.3 Citation Motivation and Behavior Analysis Citation behavior can be studied using empirical surveys and data analysis to verify conclusions from previous citation analysis. Research generally combines citation motivation with citation behavior analysis. For this classification problem, many scholars have proposed different frameworks.

Teufel et al.[27] analyzed the relationship between scientific argumentation structures and citations, proposing a citation motivation classification. Shen et al.[28] divided citations into categories and advocated focusing on article content in bibliometric analysis. Stevens et al.[29] divided citation motivations into 15 categories, including providing knowledge background, expressing respect for predecessors, selecting and comparing research methods and tools, correcting previous research, and expressing personal opinions.

Citation motivation and behavior research methods generally include questionnaire surveys and content analysis or bibliometric methods. Warraich et al.[30] conducted an online questionnaire to study the citation motivation and behavior of LIS graduates in Pakistan. Qiu Junping et al.[31] used questionnaire surveys to study researchers' citation motivations and mutual influences. Liu et al.[32] applied text similarity algorithms to analyze scientists' triangular citation behavior. Liu Yunmei et al.[33] used content annotation to deeply explore hidden citation motivations.

Citation motivation and behavior research is not limited to journal papers but can be extended to other academic outputs. Li et al.[34] studied patent citation motivation and behavior, proposing four hypotheses for verification.

3.4 Main Applications of Full-Text Citation Analysis

Full-text citation analysis has wide applications in bibliometrics, scientific evaluation, and other fields.

3.4.1 Full-Text Citation Analysis in Interdisciplinary Research For interdisciplinary measurement, Zhang Chengzhi et al.[35] conducted citation content analysis to measure interdisciplinary situations across different disciplines in full-text databases. Teufel et al.[36] conducted frequency statistical analysis on nearly 1,000 theoretical citations in over 50 informatics journals, analyzing the source disciplines of each theory, which contributed to analyzing the theoretical sources of Chinese informatics. Zhang Huanling et al.[37] used citations to identify interdisciplinary journals and studied their identification methods. Kong Ling et al.[38] conducted co-occurrence analysis of disciplines between journals from the perspective of interdisciplinary field characteristics.

Shang Xianli et al.[39] used natural language processing technology to extract reference text information and citation contexts to explore the knowledge integration process in interdisciplinary fields. Chen et al.[40] measured the external influence of Chinese library and information science on other disciplines from a citation perspective. Lee et al.[41] explored the interdisciplinary nature of Korean human resource development and its influence on other disciplines.

Zhang Yiman et al.[42] studied knowledge flows based on citation content and full-text citation analysis. Liu Lifan et al.[43] used citation content analysis with open academic paper full-text data from the PLoS platform to automatically extract knowledge from citation sentences, combined with discipline and location information to reveal interdisciplinary knowledge flows. Kong Ling et al.[44] proposed a content annotation and connection analysis framework for interdisciplinary full-text citations, conducting empirical research using Lenovo Enterprise as a case study.

3.4.2 Full-Text Citation Analysis in Scientific Evaluation Currently, academic researchers are generally evaluated using the IF (Impact Factor) value of their published articles as the criterion, but various studies are attempting to find more reasonable and appropriate scientific evaluation methods. Giliarevskii et al.[45] discussed the imbalance of major countries' publications in indexes and the need to establish national evaluation indicators.

Huang et al.[46] proposed a new framework for measuring interdisciplinary interactions based on citation and semantic analysis. Chen et al.[47] used Tobit regression models to explore the relationship between interdisciplinary component citation intensity and scientific impact. Daud et al.[48] proposed a context-based article influence factor (CBAIF) that considers positive, neutral, or negative citation contexts and conflicts of interest between citing and cited authors.

Yang Siluo et al.[49] integrated full-text analysis methods into traditional two-dimensional evaluation models, fusing academic and social impact into a new indicator. Wu Jinghua et al.[50] improved academic journal evaluation methods from a single-paper citation perspective. Song Yanhui[51] applied knowmetrics to talent evaluation based on citation analysis and human capital measurement.

3.4.3 Full-Text Citation Analysis in Other Fields Beyond interdisciplinary research and scientific evaluation, full-text citation analysis has also developed in other areas. Peng Aidong[52] and Yan Xue et al.[53] explored the specific application of patent citation analysis in enterprise competitive intelligence. Wang Wenping et al.[54] studied patent citation situations of U.S. military giants in the US Patent and Trademark Office, exploring relationships between patent citations and the military field. Zhao Liming et al.[55] investigated the application of patent citation analysis in knowledge transfer mechanism research.

Anderson[56] conducted citation analysis on an organizational learning article, analyzing both positive and negative citations to identify future research directions. Gipp et al.[57] proposed citation proximity analysis for identifying related work. Jeong et al.[58] considered author citation content in co-citation analysis to measure relationships between co-cited authors from emotional perspectives. Peng Qiuru et al.[59] studied citation indicators based on full-text analysis.

Zhang Ruhao et al.[60] fused citation semantic and contextual features to optimize bibliographic coupling strength based on citation motivation similarity. Wang Lina et al.[61] studied content production and dissemination characteristics of Shanghai government new media from a full-text perspective. Yu Weihua[62] discussed news concepts in Weibo writing based on full-text analysis.

4 Differences Between Domestic and International Full-Text Analysis

Domestic research initially focused on full-text citation location, mainly to determine whether citation location in different academic publication forms correlates with citation function. International research emphasizes quantitative analysis of citation location, using mathematical methods and formulas to quantify specific functions. Recently, domestic research has gradually shifted to quantitative approaches, producing systematic and reliable quantitative measurement methods.

Citation intensity analysis is divided into simple citation intensity analysis and analysis combined with citation location. Both domestic and international research has produced relevant literature, with Professor Ding' s team and domestic Professor Zhang Chengzhi' s team having cooperative relationships and deep research in this direction.

In word selection, international scholars have conducted more research on the relationship between word preference and citation, focusing on cue word analysis. Domestic research in this direction is led by Professor Hu Zhigang' s team. Content words have been less studied due to their characteristics.

In sentiment analysis, international research is more comprehensive, currently focusing on sentiment analysis model setup and training. Domestic research is

relatively limited. In motivation and behavior analysis, domestic and international research directions are generally consistent, with unified classification and methods.

Currently, full-text open databases are concentrated in medical and biological fields, with insufficient investment in social sciences. Major publishing groups have successively opened OA and online-first models for their journals. Data volume continues to grow, but data quality varies across different open data websites.

5 Future Prospects of Full-Text Citation Analysis Research

5.2 Future Trends

Full-text citation analysis currently faces many challenges. Based on the above analysis, future development trends and possible directions include the following considerations:

Citation Semantic Analysis: Current full-text citation analysis mainly focuses on citation location and intensity analysis, while citation semantic analysis remains relatively scarce. Citation semantic analysis refers to understanding the correlation between citing and cited literature by analyzing semantic information in citation texts. With continuous development of natural language processing technology and related computer programming methods, citation semantic analysis may become an important direction.

Application Field Expansion: Current full-text citation analysis is mainly applied in academic research and evaluation, such as disciplinary development trends and academic cooperation. In future research, it can be extended to broader fields, including science and technology.

Big Data Challenges: With the explosive growth of data volume from internet and information technology, full-text citation analysis needs to process massive amounts of data. Whether future researchers can quickly follow up technological developments, introduce computer-related talents, or improve undergraduate and graduate curricula requires further research and discussion.

Data Privacy Protection: Full-text citation analysis involves large amounts of personal information. How to protect personal data privacy is an important issue that needs to be addressed.

Real-Time Analysis: Current full-text citation analysis is primarily based on static data. Future research needs to better adapt to real-time data analysis requirements.

6 Conclusion

Currently, full-text citation analysis mainly concentrates on citation location analysis, citation intensity analysis, and citation context analysis, with sentiment analysis being particularly popular. In terms of application, it is commonly used for analysis and scientific evaluation. Despite many challenges, full-text citation analysis still has great development potential. Future progress may be made in citation semantic analysis, application field expansion, big data analysis, data privacy protection, and real-time analysis. This paper reviews the current situation, application, and challenges of citation analysis, hoping to provide reference and insights for future research.

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