



Visualizing the intellectual structure of information science (2006–2015): Introducing author keyword coupling analysis



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ABSTRACT

We introduce the author keyword coupling analysis (AKCA) method to visualize the field of information science (2006–2015). We then compare the AKCA method with the author bibliographic coupling analysis (ABCA) method in terms of first- and all-author citation counts. We obtain the following findings: (1) The AKCA method is a new and feasible method for visualizing a discipline's structure, and the ABCA and AKCA methods have their respective strengths and emphases. The relation within the ABCA method is based on the same references (knowledge base), whereas that within the AKCA method is based on the same keywords (lexical linguistic). The AKCA method appears to provide a less detailed picture, and more uneven sub-areas of a discipline structure. The relationships between authors are narrow and direct and feature multiple levels in AKCA. (2) All-author coupling provides a comprehensive picture; thus, a complete view of a discipline structure may require both first- and all-author coupling analyses. (3) Information science evolved continuously during the second decade of the World Wide Web. The KDA (knowledge domain analysis) camp became remarkably prominent, while the IR camp (information retrieval) experienced a further decline in hard IR research, and became significantly smaller; Patent analysis and Open Access emerged during this period. Mapping of Science and Bibliometric evaluation also experienced substantial growth.

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1. Introduction

Documents are carriers and recorders of knowledge. In today's knowledge era, the analysis and visualization of knowledge networks and intellectual structures based on documents have become increasingly important at all levels (countries, institutions, individuals, and other entities) and fields (economics, culture, technology, and other areas), along with the continuous development of science and technology. On the one hand, knowledge records are now widely available in digital form, and sufficient computing power is readily available for users to deal with large-scale knowledge networks (Zhao & Strotmann, 2008b). On the other hand, vast amounts of knowledge and information become a challenge for users in big data environments; the detailed analysis of complex and heterogeneous knowledge requires advanced tools and the continuous improvement of technology (Shiffrin & Börner, 2004).

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The study of knowledge networks in general can be presented in a three-dimensional framework that includes approaches, networks types, and aggregation levels (Yan & Ding, 2012). Compared with analyses at the paper, journal, and institution levels, author-level analysis maintains a good balance in granularity and benefits the research of scholars in addition to their papers (Zhao & Strotmann, 2008b). Author co-citation analysis (ACA) is the most widely used method for the empirical analysis of disciplinary paradigms, and it has been frequently studied and improved. Bibliographic coupling was proposed as early as 1963 by Kessler (1963). The author coupling relationship has received significant attention and application in recent years; it can provide important and distinctive insights into the intellectual structure and evolution of a certain field (Zhao & Strotmann, 2014). However, coupling analysis in informetrics is often focused only on bibliographic coupling.

Bibliographic coupling is defined as two documents sharing one or more of the same items in their reference lists; this case implies that the two documents share a common research topic. A document comprises different knowledge units, which can thus be shared (overlap) by two documents. Author bibliographic coupling analysis (ABCA) extends bibliographic coupling from the document level to an author-aggregated approach (Zhao & Strotmann, 2008b). Accordingly, this sharing of knowledge units results in several types of author coupling, such as author keyword coupling, author title-word coupling, author bibliographic coupling, and author journal coupling. Because papers containing common terms may imply a common, specific research topic (Morris & Yen, 2004), similarly, we can introduce author keyword coupling analysis (AKCA), which expands the keyword co-occurrence relationship to the author level, establishes author relationships through the keyword coupling strength of authors' oeuvres, analyzes the authors of the same research themes, and then describes the knowledge structure of a field or discipline. Although all- and first-author methods can produce different results, and although some scholars have studied all-author-based and first-author-based ACA (Zhao & Strotmann, 2008c), studies that compare all- and first-author counting methods in coupling analysis are still rare. In first-author counting, only the first author of a publication is considered; in all author counting, all authors are considered equally.

In the present study conducted at the first-author and all-author levels, we introduce the AKCA method and compare it with the ABCA method using information science (IS) as the discipline of focus. Specifically, this research aims to answer the following:

- (1) What are the differences between the analysis of author knowledge networks based on ABCA and AKCA and the study of the intellectual structures of research fields? Are they different in terms of the first- and all-author counting?
- (2) What was the intellectual structure of the IS field during the period of 2006–2015? How did it evolve between 1996–2005 and 2006–2015?

2. Related studies

2.1. Visualization of the intellectual structure of IS

The mapping of knowledge domains is an important topic in IS. Some IS researchers often visualize their own field when mapping knowledge domains because this type of study requires expert domain knowledge (Zhao & Strotmann, 2008a). White and Griffith (1981) introduced ACA and visualized IS for the period 1972–1979. Persson (1994) analyzed the Journal of the American Society for Information Science and Technology (JASIST) based on ACA and found that the ACA map closely resembles the map of IS produced with other methods. Later, White and McCain (1998) mapped the IS field by using 12 core journals for the period of 1972–1995 and analyzed the evolution of IS over an eight-year period by showing its two sub-fields, the distribution of authors, and other aspects. Following the same method and the journals of White and McCain (1998), Zhao and Strotmann (2008a) enriched the classic ACA such that it employs both orthogonal and oblique rotations in the factor analysis; they then mapped the field of IS for the period 1996–2005. Zhao and Strotmann (2008c) also found a number of differences between all- and first-author-based ACA in IS. Klavans and Boyack (2011) mapped IS at the document level using both local and global methods to provide a case illustration of the differences between the methods. Jeong, Song, and Ding (2014) proposed a new method for measuring the similarity between co-cited authors by considering authors' citation content in IS, and they found that their proposed approach provides more details about the sub-disciplines in the domain than traditional ACA.

Another approach used to visualize a discipline structure is co-word analysis, which has several advantages (direct, objective, and others) and disadvantages (polysemy, synonyms, and others). Specifically, only some keywords (often about 100) have been used in the co-word matrix, which doesn't completely represent a field. Yang, Wu, and Cui (2012) compared three visualization methods, namely, cluster tree, strategy diagram, and social network maps. They integrated different results together into one result through the co-word analysis of medical informatics and found that the three visualization methods have unique characteristics. Milojević, Sugimoto, Yan, and Ding (2011) composed a suite of analyses of words in article titles to reveal the cognitive structure of Library and Information Science (LIS) and found that LIS consists of three main branches: libraries, information, and science. Wang, Qiu, and Yu (2012a), Wang, Li, Li, and Li (2012b) proposed a semantic-based co-word analysis, which can integrate experts' knowledge into co-word analysis effectively and can improve the veracity of co-word analysis. Ravikumar, Agrahari, and Singh (2015) explored the intellectual structure of scientometrics for the period of 2005–2010 using text mining and co-word analysis; those words were extracted from the keywords, titles, and abstracts of the articles manually.

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