



Visualizing information science: Author direct citation analysis in China and around the world



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ABSTRACT

Author direct citation analysis (ADCA, also called inter-citation or cross citation) is a new feasible and applicable technique for exploring knowledge communication and discovering scientific structure. This study explored ADCA among prolific, highly cited, and core authors in information science in China and around the world. The results revealed the following. (1) The datasets in China and around the world cover overlapping, but also unique topics. Research subjects on information science around the world can be divided into three categories and 10 clusters; meanwhile, that in China can be divided into three categories and 9 clusters. Chinese scholars who are mostly involved in cross subjects and multi-fields are not as specialized and profound as foreign scholars. An obvious imbalance exists in the evolution of discipline structure around the world, indicating the necessity of a synchronous promotion of research specialty and cross comprehensiveness. Chinese scholars concentrate more on topics such as competitive intelligence, information resource management, and information retrieval, and they focus less on information security and user analysis. (2) Knowledge communication between active authors is stronger than the knowledge flow from highly influential authors to active authors around the world; meanwhile, Chinese researchers tend to adopt the knowledge of authoritative literature. The knowledge flow through bidirectional direct citation is related to mutual knowledge communication. Authoritative scholars are produced when prolific authors cite highly cited authors. The level of mutual recognition among Chinese scholars has not reached that among foreign scholars; in the former, less bidirectional flow of knowledge is involved, and unidirectional flow is limited to geographical proximity, cooperation, or teacher–student relationship. (3) In contrast to traditional author co-citation analysis (ACA), ADCA pays more attention to the mutual interaction among currently active scholars and to mainly showing the current research focus.

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1. Introduction

Although scientific journals first appeared during the 16th century, the systematic practice of citation was popularized much later (Nicolaisen, 2007). By the 20th century, the practice of citing other works has become second nature to anyone writing a scholarly or scientific paper (Kaplan, 1965). At present, citation analysis is widely used in scientific evaluation,

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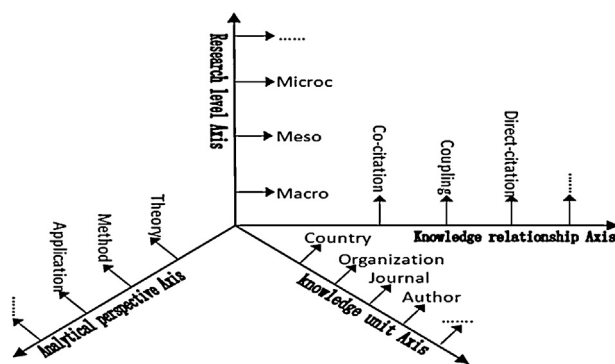


Fig. 1. Four-dimensional model of identifying discipline structure by citation analysis.

scholarly communications, academic behavior analysis, and information retrieval (Ding, Zhang, Chambers, Song, Wang, & Zhai, 2014; Garfield, 1983; Hammarfelt, 2011; Ketzler & Zimmermann, 2013).

An important component of citation analysis is discovering academic communities and scientific knowledge structures from the citing behaviors of authors. Citation analysis mainly includes three types: author co-citation, author coupling, and author direct citation. These types can be extended to other types depending on the different knowledge units, and each type has different characteristics and function; examples of other types include document co-citation, journal coupling, and country direct citation (White, 1990). Fig. 1 shows a four-dimensional model of identifying discipline structure through citation analysis. By combining the different dimensions, the disciplinary or field structure can be displayed in multiple functions and aspects, and the development hotspot and trend of these subjects can be analyzed from the perspective of multiple co-occurrences of knowledge units, such as year-keyword-institution, year-keyword-journal, and author-keyword-citation.

Author co-citation analysis (ACA) is the most widely used method for the empirical analysis of disciplinary paradigm, and have been frequently studied and improved upon. As the mainstream approach, ACA has formed a standard ACA or Drexel model (McCain, 1990); among its uses is the application of clustering figure and multidimensional scaling analysis, which is the most extensive visual performance of co-citation analysis. With the development of visualization technology, more advanced applications of co-citations analysis were developed later on. Many ACA studies have been conducted since Small (1973) introduced document co-citation analysis and White and Griffith (1981) introduced ACA. White, McCain, and Griffith et al. applied ACA to describe the structure of information science (White, 2003; White & Griffith, 1981; White & McCain, 1998). Klavans and Boyack (2011) used document co-citation analysis to compare the global and local knowledge map of information science. On the whole, ACA has been systematically and comprehensively studied by many scholars. These studies investigated first author and all authors co-citation, content-based ACA, setting up co-citation diagonal matrix, matrix transformation, and improving co-citation strength calculation etc.; ACA has also been applied in many scientific fields (Eom, 2008; Jeong, Song, & Ding, 2014; Rousseau & Zuccala, 2004).

Bibliographic coupling was proposed as early as 1963. Authors as the unit of citation analysis (vs. documents or journals) have the distinctive advantage (White, 1990). However, author coupling relationship received significant attention and application from informetrics scientists only after it was recently proposed and empirically studied by scholars. Basing on previous findings and theoretical considerations, Jarneving (2007) suggested that bibliographic coupling could be combined with a cluster method to develop a technique for scientific mapping that is complementary to the prevailing method for co-citation cluster analysis. Zhao and Strotmann (2008) expanded bibliographic coupling to author bibliographic coupling analysis (ABCA) and analyzed the recent knowledge structure in information science. Continuing the long history of ABCA of the intellectual structure of information science, Zhao and Strotmann (2014) recently tested and confirmed a previously made forecast by comparing knowledge-based and research-front findings. Meanwhile, Ma (2012) used ACA and ABCA to perform a visual analysis of the subject structure of library and information science in China.

Direct citation is sometimes also called inter-citation or cross citation (Zhang, Glänzel, & Liang, 2009). Compared with co-citation and bibliographic coupling, direct citation is a direct citing relationship without a third party paper. Fig. 2 shows the citation networks of scientific papers. A and G share a co-citation relationship, whereas A and F share a bibliographic coupling relationship. These relationships are indirect, i.e., they are established by third-party documents. However, A and B or A and D represent direct citation; to some extent, they share a mutual cited and citation relationship. Although researchers are aware of direct citation analysis and employed from time to time (Shibata, Kajikawa, Takeda, & Matsushima, 2008), it was ignored because of the unavailability of data, difficulty of implementation, and need to use very long time windows to obtain a sufficient linking signal for clustering; however, scholars are gradually paying attention to this topic recently (Boyack & Klavans, 2010). A number of studies have focused on journal direct citation; a series of research achievements has shown that journal direct citation can reveal the academic influence of journals as well as the theme evolution and field division of periodicals (Zhang et al., 2009; Zhang, Janssens, Liang, & Glänzel, 2010). Other studies have focused on comparative analysis of methods. Shibata, Kajikawa, Takeda, and Matsushima (2009) compared cluster solutions from direct

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