Doctoral Dissertations on Tourism in China: A Co-Word Analysis †

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Abstract: The aim of this paper is to map the foci of research in doctoral dissertations on tourism in China. In the paper, co-word analysis is applied, with keywords coming from six public dissertation databases, i.e. CDFD, Wanfang Data, NLC, CALIS, ISTIC, and NSTL, as well as some university libraries providing doctoral dissertations on tourism. Altogether we have examined 928 doctoral dissertations on tourism written between 1989 and 2013. Doctoral dissertations on tourism in China involve 36 first level disciplines and 102 secondary level disciplines. We collect the top 68 keywords of practical significance in tourism which are mentioned at least four times or more. These keywords are classified into 12 categories based on co-word analysis, including cluster analysis, strategic diagrams analysis, and social network analysis. According to the strategic diagram of the 12 categories, we find the mature and immature areas in tourism study. From social networks, we can see the social network maps of original co-occurrence matrix and k-cores analysis of binary matrix. The paper provides valuable insight into the study of tourism by analyzing doctoral dissertations on tourism in China.

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1.0 Introduction

Knowledge organization research (Tennis 2008) lays emphasis on exploring knowledge organization's epistemological foundations, building scientific methodologies for designing knowledge maps, and expanding its applicability to other areas of human activity. Knowledge mapping (Zins 2004) is fairly important in constructing, learning, and knowledge disseminating. Actually, knowledge organization is the domain that combines interdisciplinary approaches with the order of knowledge (Hjørland 2003, 2008), which has the order of concepts from both a theoretical angle and an applied angle (Friedman and Smiraglia 2013) and enfolds analytical methods for ontology extraction in the science of information (Smiraglia and López-Huertas 2015).

Domain analysis is a new and frequently-used front in information science (Hjørland and Albrechtsen 1995; Hjørland 2002), which provides a series of skills for extracting and analyzing coherent groups' semantic intellectual contents (Smiraglia 2013). Hjørland (2002) emphasized its relevance to information science and explained eleven methods to describe, analyze, organize, and finally retrieve domain-specific information, and those approaches supply tools for information scientists to research domains. It is a quantitative technique for dissecting the structure and content of subject domain literature (Beghtol 1995), and it is a theoretical model that can be applied to domain-related discourse communities which require disciplinary knowledge (López-Huertas 2015). Meanwhile, visualization technique (Börner et al. 2003) will be applied to drawing the ever-increasing disciplinary domain structure and to backing up information searching and categorization. The scientific literature (Börner et al. 2003; White and McCain 1998; Small 1999) supplies elements which may offer profound understanding into the nature of potential interrelationships. Bibliographic research has become necessary, offering domain information, identifying and viewing scientific knowledge within a certain theme (Castanha and Grácio 2014), and creating the metaphorical bibliographical universes in relationship to each other (Smiraglia and Heuvel 2013).

Domain analysis is a major study topic in knowledge organization (Castanha and Grácio 2014; Lee et al. 2010; Smiraglia 2013; Marteleto and Carvalho 2015), and is an important methodological approach to studying knowledge organization (Chaves and Tognoli 2015), which involves lots of skills in identifying a designated knowledge base (Smiraglia 2015). Skills for domain analysis in knowledge organization are introduced by Hjørland and Albrechtsen (1995; 1998), and they (1995) both claimed that issues in knowledge theory are more radical than knowledge about information system users. The specific methods are demonstrated by Hjørland (2002). As an effective approach (Raghavan et al. 2015) for visualizing the extensive array of themes and sub-themes, domain analysis helps to identify research directions and trends. Substantial development of domain analysis with broadly covered fields (Albrechtsen 2015) has been witnessed in information science. In the light of domain analysis, together with metatheory, bibliometric studies (Castanha and Grácio 2014) are approached within knowledge organization in information science. Domain analysis has been successfully used in diverse domains such as gourmet cooking (Hartel 2010), information science (Zins 2007; White and McCain 1998), fiction studies (Beghtol 1995), digital libraries (Lee et al. 2010), *FRBR* (Smiraglia 2013), information retrieval (Raghavan et al. 2015), health (Marteleto and Carvalho 2015), law (Martinez and Guimarães 2008) and social work (Zins and Guttmann 2003). This paper studies the tourism domain in China by using co-word analysis.

Prior to the 1970s, China's involvement with foreign countries was mainly for the purposes of politics, trade, and technology without much hospitality and tourism industry (Wen 1997). Since the adoption of economic reforms and the open-door policy in 1978, China's economy has grown rapidly, including tourism. The tourism industry boosts economic development (Xu 1999). It is beyond doubt (Zhang et al. 2005) that there exist a series of important relationships between economic development and public policy. Along with the rapid growth of GDP in the 1990s, China's domestic tourism has developed by leaps and bounds. In particular, China's current adoption of tourism as a strategic pillar industry in the national economy has also greatly promoted this growth. The tourism industry is important to China's regional development and national economy (Lew et al. 2002). Since 1978, rapid development of the tourism industry has been witnessed in China, and the country could become globally the largest tourism market by 2020 (Tsang and Hsu 2011).

In 2009, the State Council of China issued *Opinions on Accelerating the Development of Tourism Industry* in which tourism was proposed to be developed into a strategic pillar industry in the national economy. With the development of tourism research, the scholarly community needs to become more concerned about the direction and depth of their research. There has been a boom of tourism education due to the growing tourist industry and more and more tourism institutes and tourism departments in the universities have been set up. This rapid tourism development in China has led to many tourism academics undertaking research projects (Scott and Ding 2008).

Along with the growth of tourism in China, much importance has been attached to the study of tourism by scholars (Airey and Chong 2011). Tourism research has contributed not only to academic advancement but also to the practical application of research findings. Since the reform and opening up, the booming development of China's tourism industry has effectively promoted the comprehensive progress of China's higher education and tourism research. The tourism industry has also helped to improve China's strategic position. In recent years, the rapid development of China's tourism education (Huang 2011) and the increasing number of tourist classes in higher education institutions has provided a solid foundation for nurturing professional personnel in the tourism industry. China's tourism education officially started in 1980 and developed apace in the early 1990s. Departments of geography in universities, management systems and tourism professionals have witnessed this period of development. In the mid-1990s tourism-related majors appeared in departments of history, foreign languages, and so on in higher education institutions of China (Sofield and Li 1998). The number of institutions of higher education, which were established by the National Tourism Department, had reached 1,115, while in 2002 the number was only 407, an average annual increase rate of 10.6% during that decade (China National Tourism Administration 2012).

As a tourism discipline has quickly gained importance over the past few years, tourism studies have registered remarkable progress. There exists a great and increasing amount of literature (Wen and Tisdell 2001) on tourism development in China. Research interest (Ryan 2005; Park et al. 2011; Zhao and Zhang 2011; Benckendorff and Zehrer 2013; McKercher 2005; Barrios et al. 2008) in this regard within the academic community has grown and many scholars have begun to pay close attention to the theses of tourism journals using bibliometrics.

Relevant research has already been conducted from the following perspectives, i.e. 1) journals (McKercher et al. 2006; Murphy and Law 2008; Zhong et al. 2015; Barrios et al. 2008; Park et al. 2011; Benckendorff and Zehrer 2013); 2) institutions (Jogaratnam et al. 2005; Barrios et al. 2008; Park et al. 2011; Law et al. 2010; Severt et al. 2009); 3) authors (Racherla and Hu 2010; Zhao and Ritchie 2007; Sheldon 1991; McKercher 2008; Zhong et al. 2015; Barrios et al. 2008; Park et al. 2011; Benckendorff and Zehrer 2013); 4) subjects (Kim et al. 2009; Tsang and Hsu 2011; Jafari et al. 1988); 5) topics (Tsang and Hsu 2011; Zhong et al. 2015; Hu and Racherla 2008); 6) methodologies (Palmer et al. 2005; Tsang and Hsu 2011); and, 7) keywords (Hunt et al. 2014; Zhong et al. 2015).

Doctoral dissertations are different from journal or conference publications. We can derive a knowledge-generating system through calculation of certain classical bibliometric studies about doctoral dissertations (Ryan 2005; Duman 2013; He 1999; Jermen 2004). Doctoral dissertations play an important role in the development of a discipline (Brun 1997; Duman 2013), especially in demonstrating its research achievement. Keywords aptly represent the major problems and questions that authors try to link together in their articles (Law et al. 1988; Hu et al. 2013). Research fields can be characterized by a list of important keywords (Börner et al. 2003; Berelson 1952; Kassarjian 1977). Via keywords we can derive the foci of certain fields (Romo-Fernández et al. 2013; Yang et al. 2012). Thus, mapping the foci of tourism-themed doctoral dissertations is important. Analysis of research on Chinese doctoral dissertations on tourism could provide more important insight into this field. With the development of tourism, tourism research becomes urgently needed and scholars' concern should be aroused in this field.

Based on the research on the doctoral dissertations on tourism in China we have the opportunity to be acquainted with the foci of this research topic between 1989 and 2013 from keywords by co-word analysis. This paper provides valuable insights into the tourism-related doctoral dissertations on tourism in China by bibliometrics which are different from the doctoral dissertations on tourism before (Jafari and Aaser 1988; Meyer-Arendt 2000; Meyer-Arendt and Justice 2002; Pizam and Chacko 1982; Ying and Xiao 2012; Hall 1991; Bao 2002; Huang 2011; Hu and Huang 2011; Botterill et al. 2002) or theses of journals (Ryan 2005; Park et al. 2011; Zhao and Zhang 2011; Benckendorff and Zehrer 2013; McKercher 2005; Barrios et al. 2008; Bao et al. 2014; Leung et al. 2014; Bao and Ma 2010; Zhong et al. 2015).

After a literature review and discussion of the methodology used to obtain former research achievements, we selected the co-word analysis method and gathered data from many databases. Before analyzing the keywords of doctoral dissertations on tourism in China, we should take into consideration the following questions: 1) what are the disciplines; 2) what are the high-frequency keywords; 3) how should we cluster those keywords; 4) what

is the strategic diagram of keywords; and, 5) what is the social network of keywords?

2.0 Literature review

Current research on the literature of doctoral dissertations on tourism is mainly focused on North America, Australia, Britain, China, and so on. The research on doctoral dissertations on tourism is conducted from many aspects, including growth, degree granting of disciplines, status of institutes, authors, methods of analysis, and so on.

As for research on North America, Pizam and Chacko (1982) searched internationally sixty-five abstracts of doctoral dissertations that had a high relevance to hospitality and tourism from the *Humanities and Social Sciences Index* in the period from 1976 to 1980. Jafari and Aaser (1988) analyzed one hundred fifty-seven doctoral dissertations on tourism of North America from 1951 to 1987 based on dissertation abstracts in the aspects of general growth, degree granting disciplines, degree granting institutes, and authors. Meyer-Arendt (2000) analyzed sixty-six North American doctoral dissertations of geography from 1951 to 1998, and a case analysis was carried out annually regarding tourism geography dissertations of North American universities. Meyer-Arendt and Justice (2002) concluded that three hundred seventy-seven doctoral dissertations in North America were identified as tourism research from 1987 to 2000. They studied the academic institutes involved in the composition of doctoral dissertations on tourism in North America. Ying and Xiao (2012) presented a social network analysis of doctoral dissertations on tourism based on ProQuest Dissertations and Theses-Full Text database (1994-2008). A total of 304 terms were selected as identifiers from 812 doctoral dissertations on tourism. Longitudinal examination revealed a structural change in doctoral dissertations on the development of tourism knowledge.

As for research on Britain, Botterill et al. (2002) gathered one hundred forty-nine doctoral dissertations on tourism accepted by universities in the UK and Ireland between 1990 and 1999. These doctoral dissertations on tourism were analyzed from different aspects, such as awarding university, year of acceptance, subject categories, location of fieldwork, and methods. As for research on Australia, Hall (1991) analyzed twenty-eight graduate and doctoral dissertations of tourism written by Australian scholars between 1968 and 1988 classified according to year of publishing, type of degree, and institution. Finally, as for the comparative analysis of several countries, Weiler et al. (2012) analyzed the objectives, methodology, findings, and recommendations of one thousand eight hundred eighty-eight tourism focused doctoral theses between 1951 and 2010 from the United States, Canada, Australia, and New Zealand. They were analyzed to determine disciplinary influences, differences between countries, and changes over time by abstracts of theses.

Doctoral education on tourism in China begins later than North America, Australia, and the UK. Doctoral dissertations on tourism research in China first appeared in Nankai University, which began tourism research in doctoral level education in 1989. Before 2000, the total number of doctoral dissertations on tourism was only twenty-two (Bao 2002). Tourism developed swiftly, and was embraced as an academic research domain in higher education institutes (Xiao 2000). After thirty years of improvement, tourism research in China has become an independent discipline (Huang 2011) which has not only earned its reasonable place, but also attracts widespread attention of other disciplines. Universities and research institutes are the main organs conducting tourism research in China.

In terms of bibliometric analysis of doctoral dissertations on tourism in China, Bao (2002) analyzed author, title, supervisor's degree or institution, and period of grant in doctoral dissertation in tourism geography in China from 1989 to 2000. Huang (2011) analyzed two hundred nineteen dissertations from The China Doctoral Dissertations Full-text Database (CDDFD) on tourism by disciplines (1999-2009), and also classification by disciplines or universities. Hu and Huang (2011) selected thirty-one doctoral dissertations from the China Doctoral Dissertations Full-text Database (CDDFD) after searching for doctoral dissertations related to tourism management in 2010 according to the topics of tourism management dissertations, research scope, and methodologies to analysis.

However, until now, research into doctoral dissertations on tourism is still scarce and has only been obtained from limited databases. Descriptive statistics and analyses previously conducted by scholars are mainly from the perspectives of subjects, tutors, numbers of dissertations, research methods, granting schools and research topics. Previous research (Jafari and Aaser 1988; Meyer-Arendt 2000; Meyer-Arendt and Justice 2002; Pizam and Chacko 1982; Ying and Xiao 2012; Hall 1991; Bao 2002; Huang 2011; Hu and Huang 2011; Botterill et al. 2002) was not aimed at conducting a comprehensive analysis or mapping the foci of the research on doctoral dissertations on tourism. Little attention has been drawn to the intra-disciplinary and inter-disciplinary relationships of research fields in doctoral dissertations on tourism. Compared with previous studies, this research focuses more on the entirety of relationships between each research field in doctoral dissertations on tourism. This research collects doctoral dissertations on tourism in China from many databases and the official websites of different universities and colleges. The research is carried out from both first and second level disciplines.

Besides, combined with cluster analysis, strategic diagram analysis and social network analysis, the method of co-word analysis is applied to the research on the topic of doctoral dissertations on tourism in China with the aim of looking deeply into this research topic.

3.0 Methodology

3.1 Co-word analysis

3.1.1 Method of co-word analysis and its development

The main method that we have chosen is co-word analysis (Callon et al. 1991, 1986; Courtial 1994; Courtial et al. 1989; Law and Whittaker 1992; Turner and Rojouan 1991; Whittaker 1989; Muñoz-Leiva et al. 2012; Wang et al. 2012; Romo-Fernández et al. 2013; Su and Lee 2010; Rokaya et al. 2008; Leydesdorff and Zhou 2008; An and Wu 2011; Yang et al. 2012; Ying and Xiao 2012). Co-word analysis is a method of content analysis (Small 1973; Small and Griffith 1974; Hu and Zhang 2015; Naghizadeh et al. 2014). Co-word analysis was proposed as a content analysis technique that is effective in mapping the strength of association between information items in textual data by Callon et al. (1983). In recent years, the co-word analysis has developed rapidly with its related visualization methods (Ding et al. 2001; Wang et al. 2014; Ravikumar et al. 2015; Assefa and Abebe 2013), which not only make the thematic analysis more thorough and intuitive but also reveal the micro-structure and development of discipline. Co-word analysis has become an important measurement method describing the development status and structure of a discipline (Callon et al. 1983, 1991; Coulter et al. 1998; Whittaker 1989), which is a content analysis technique that effectively illustrates the strongest association between various co-occurrence term strengths. The presence of many co-occurrences or pairs of keywords within articles demonstrates that they may belong to one research theme (Ding et al. 2001; Wang et al. 2015; Dehdarirad et al. 2014). In co-word analysis (Cambrosio et al. 1993; Cho 2014; Viedma-Del-Jesus et al. 2011), if two keywords co-occur within the same paper, it is the indication of a link between them.

This method of co-word analysis has been improved considerably (Ronda-Pupo and Guerras-Martin 2012; Danell et al. 2014), thus it has been widely used and achieved some significant results. It can be used to reveal the development and evolution trend of certain fields of study: e.g., biomedicine (Callon et al. 1991), information science (Jeong and Kim 2010), chemical engineering (Peters and Van Raan 1993a), environmental energy (Romo-Fernández 2013), education (Ritzhaupt et al. 2010), patent (Tseng et al. 2007; Courtial et al. 1984), and business administration (Muñoz-Leiva et al. 2012).

Keyword analysis is a kind of content analysis that uses description to analyze the content of scientific or other types of articles (Berelson 1952; Kassarjian 1977), and it has been applied to co-word analysis (Hu et al. 2013; Liu et al. 2011). The basic assumption in bibliometric mapping is that each research field can be characterized by a list of important keywords (Börner et al. 2003); keywords represent the major problems and questions that authors were trying to link together in their articles (Law et al. 1988; Hu et al. 2013). Today, many researchers have regarded the keywords of scientific works as a way to study the theme and link it with different fields. Keyword analysis could serve as a unique approach to understanding the subject matter "codified" by authors as they present topical summaries and help capture the theme or essence of a piece of research (Wu et al. 2012; Xie 2015). Co-word analysis has the potential of effectively revealing patterns and trends in a specific discipline (Ding et al. 2001).

Prior studies have employed co-word analysis to discover the development of knowledge in a scientific field (He 1999), to map it (Peters and Van Raan, 1993a, 1993b; Kopcsa and Schiebel,1998), and to trace its foci (Coulter et al. 1998). It is through co-word analysis that we can find the connection strength between the representative terms of relevant literature, as well as the trends of research and development in a particular subject area (Lee and Jeong 2008). A research theme can be identified by identifying common occurrences of keywords in articles. The deduction of distance between descriptors (or keywords) by co-word analysis enables multiple smaller spaces related to each other, which effectively illustrates the strongest associations, contributes to easier comprehension of the relationship, and indicates actual partitions of interrelated concepts in the literature (Coulter et al. 1998; Ding et al. 2001). The co-word, mainly through co-occurrence matrix, multivariate and statistical methods, and social network analysis, reveal the study status and trends of specific research fields (Yang et al. 2012; Liu et al. 2011; Hu and Racherla 2008), and these method have also been used to ascertain trends and to identify topics (Yale and Gilly 1988; Roznowski 2003; Cho and Khang 2006; Williams and Plouffe 2007). Co-word analysis is an automatic content analysis technique that is effective in mapping the strength of relationships among textual data, and it employs a graphical modeling technique that is similar to association analysis (Kaufman and Rousseeuw 1990; Liu et al. 2011). Stronger correlation in keyword pairs, if there is a higher frequency of co-occurring co-word, can further suggest that two keywords are related to the research of the discipline (Cambrosio et al. 1993). By using co-word analysis, complex networks of relationships hidden be-

hind real term networks can be found (Yang et al. 2012; Liu et al. 2011; Hu and Racherla 2008; Gan and Wang 2015; Hu et al. 2013).

3.1.2 Method of co-occurrence analysis

According to the research results of some scholars (An and Wu 2011; Lee and Jeong 2008; Bhattacharya et al. 1998; Cambrosio et al. 1993; Courtial et al. 1984; Leydesdorff 1997), the method of similar matrix analysis is adopted to process the data. The higher frequency with which two keywords co-occur, the closer relationship between the two (Ding et al. 2001). Using an equivalence index (Cahlik 2000; Callon et al. 1991; Coulter et al. 1998), the symmetrical co-occurrence matrix is transformed into a correlation matrix. In this paper, we apply the equivalence index Eij into describing the strength of the association between words i and j in each word pair ij (Neff and Corley 2009; Callon et al. 1991; Salton and McGill 1983; Leydesdorff and Zhou 2008; Callon et al. 1983; Rip and Courtial 1984). Eij means the value of the cell indicating the distance of two keywords; the higher value refers to the closer relationship between them. Otherwise, the further distance between them indicates that they are not closely related (Ding et al. 2001). In order to eliminate the influence of keyword frequency on co-word phenomenon, we adopt inclusive treatment on co-occurrence frequency of word pairs. The equivalence index eij describes the strength of the association between words i and j in each word pair ij: $e_{ij}=e_{ij}^2/c_{ii}c_{jj}$.

A co-occurrence matrix is converted to a binary matrix by the program developed in RUBY. If the keyword has a connection with the high-frequency keywords (in the co-occurrence matrix) then the value of the cell in a binary matrix would be one. Otherwise, the value would be zero. For the purpose of obtaining a strategic diagram, the density and centrality should be determined. Clustering is applied to the analysis of co-occurrence matrix. Then the relationship among the categories is revealed; from the social networks we get maps of the original co-occurrence matrix and the k-core analysis of binary matrix.

3.1.3 Method of hierarchical cluster analysis

According to the previous research results, on the one hand, clusters are suggested to be greatly internally homogenous (Hu and Zhang 2015; Viedma-Del-Jesus et al. 2011), i.e., members are similar to each other; on the other hand, they shall be greatly externally heterogeneous, i.e., members are not like members of other clusters (Börner et al. 2003; Hu et al. 2013). A hierarchical clustering algorithm coupled with co-word analysis has been used widely in many studies (Callon et al. 1986; Neff and Corley 2009; Callon et al. 1991; Salton and McGill 1983; Leydesdorff and Zhou 2008; Callon et al. 1983; Rip and Courtial 1984). With the clustering as the analysis object, clustering of keywords is based on co-occurrence matrix analysis (Romo-Fernández et al. 2013; Cho 2014). Analyzing the co-occurrence matrix with closely related themes (Liu et al. 2011) could form new groups, expressing a branch in some fields. Clusters of the keywords are obtained through a hierarchical clustering algorithm.

3.1.4 Method of strategic diagrams

Law et al. (1988) put forward a strategic diagram, which is mainly used to describe internal relations within a certain research area and interactions between research fields, which can identify the evolutionary trends and relational patterns of the topics represented by clusters. The strategic diagram developed from co-word analysis has great merit (Lee and Jeong 2008), which means that the strategic diagram is a visual method of co-word analysis that is widely used in many current co-word analysis studies (Turner and Rojouan 1991; Courtial et al. 1989; Coulter et al. 1998; Liu et al. 2011; Real et al. 2000) and in the analysis based on the similarities among these studies. In a strategic diagram, the x-axis stands for centrality showing the strength of mutual influence between fields, and the y-axis stands for density showing the strength of mutual influence of internal fields (Callon et al. 1986; Law et al. 1988; Muñoz-Leiva et al. 2012; Viedma-Del-Jesus et al. 2011). Centrality has been concluded as centrality henceforth, which measures the integration of a network with other networks (Callon et al. 1991; Cobo et al. 2011), and it has been defined as $c=10\times\Sigma e_{kh}$, i.e. k, a keyword belongs to the theme and h a keyword belongs to other themes. Centrality would measure the strength of external connections with other themes, and it is understood as the reflection of the important role played by a theme in the process of developing a research field. In this study, centrality is calculated by taking the square root of the sum of the squares of all external link values (Coulter et al. 1998). As for the density, it is concluded that it refers to density henceforth that measures the internal strength of the network (Callon et al. 1991), and it can be defined as $d=100\times(\Sigma e_{ij/w})$, i.e. i and j keywords belong to the theme and w refers to the number of keywords in the theme. Density would measure the strength of internal connections with all keywords that reflect the research theme, as well as the development of the theme. In this study, density of word groups is calculated by taking the average value of the number of times of internal keywords co-occurr (Callon et al. 1991; Coulter et al. 1998; Cobo et al. 2015).

The strategic diagram is the two-dimensional diagram drawn with centrality and density as its parameters. It gen-

erally shows the structure of the subordinate area (Cimino and Barnett 1993), which means the strategic diagram of a certain field is being divided into four quadrants to describe the research and development status of each subject by the two-dimensional space of centrality and density (Callon et al. 1991; Cho 2014; Hu and Zhang 2015). Based on co-word matrix and clustering, the strategic diagram comprehensively shows internal and external links between different word groups in a visual form (Cobo et al. 2011; Yan et al. 2015; Zhang et al. 2015). It explains how the concept of strategy has become the backbone of the development of tourism, and which fields tend to be mature or immature in the research focus in doctoral dissertations on tourism.

3.2 Social network analysis

Visualization techniques are applied to mapping the continuously developing domain structure of scientific disciplines (Börner et al. 2003), and are also adopted as the foundation of information retrieval and classification. Social network analysis (SNA) is the mapping and measuring of relationships among components in a system (Knoke and Kuklinski 1982; Wasserman and Faust 1997; Scott 2012), which assesses the unique structure of inter relationships among individuals (Lurie et al. 2009; Baggio et al. 2010). In SNA, a knowledge domain is often known as a field of scrutiny, and characteristic of interrelated subject areas (Hu and Racherla 2008). SNA has been extensively used in social science, management science, scientometrics, etc., because it can map the network by using methods of information visualization (Burt 2001, 2007, 2008; Gulati 1998; Gulati et al. 2000; Ye et al. 2013). In recent years, we have witnessed a growing trend in the study of various types of co-word through subject network analysis (Yang et al. 2012; Liu et al. 2011; Lee and Jeong 2008; Leydesdorff and Hellsten 2006; Leydesdorff and Zhou 2008; Leydesdorff and Welbers 2011; Courtial et al. 1989).

Bibliometrics (Baloglu and Lisa 1999; Hall 2011; Tribe 2010; Ren et al. 2010) also provide another window for exploring the architecture of tourism research by SNA. To understand the structure of the keyword network in literature on tourism, we evaluated the location of keywords in the network by measuring the k-cores (Carrington et al. 2005). A k-core is a maximal group of words, all of which are connected to some number (k) of other members of the group (Wang et al. 2015; Gan and Wang 2015; Maimon and Rokach 2005). In bibliometrics, some studies (Yang et al. 2012; Zhao and Zhang 2011) have investigated hot research topics through co-word analysis coupled with k-core analysis. A k-core is a maximal group of nodes, all of which are connected to at least several other k nodes in the group (Wang et al. 2015; Gan and Wang 2015; Maimon and Rokach 2005). By varying the value of k (namely, the number of members of the group that need to be connected to), different maps of network topology can be merged (Carrington et al. 2005; Contractor et al. 2006; Tsvetovat and Kouznetsov 2011). From the visualization results of a co-word network analysis we could see the relationships in the co-occurrence data which depicted the strength of connections between two words. The thicker the line between the two nodes, the closer the relationship is (Ying and Xiao 2012).

Co-word networking of the linking analysis based on the co-word analysis technique is represented graphically by the use of the Pajek software package (Batagelj and Mrvar 1998; Larsen and Levine 2005; Benckendorff and Zehrer 2013; Muñoz-Leiva et al.2015). Social network maps of original co-occurrence matrix and k-core analysis of binary matrix suggest an openness and vibrancy of tourism from a social network perspective (Zhang et al. 2015; Wu and Leu 2014; Liu et al. 2011). K-core analysis is widely applied in SNA, and with this method (Muñoz-Leiva et al. 2012; Hu et al. 2013; Viedma-Del-Jesus et al. 2011), a visualization is thus obtained to describe the status of a particular subject area in detail.

IBM-SPSS22 is used while performing the hierarchical cluster analysis and strategic diagram analysis. Simultaneously, the co-words matrix is input into Ucinet (Scott et al. 2005), Pajek (Vitevitch 2008), and Netdraw (Creswick and Westbrook 2010). Ucinet software is utilized for social network analysis, and the network visualization software NetDraw is used to analyze original co-occurrence matrix and a binary matrix.

4.0 Data selection and processing steps

4.1 Data selection and pre-processing

Words are the most important research elements in co-word analysis (Cambrosio et al. 1993). Some researchers need to choose keywords added by indexers and title words from specific databases. Looze and Lemarie (1997) conducted co-word studies based on the keywords proposed by the experts. Some researchers (Courtial 1994; Law and Whittaker 1992; Courtial et al. 1994) downloaded keywords from online databases, which were added by database indexers and authors. Keywords of journal articles, conference papers, doctoral dissertations, or even books can be extracted from keyword lists, title, abstract, and sometimes classification codes (Ronda-Pupo and Guerras-Martin 2012; Danell et al. 2014; Muñoz-Leiva et al. 2012; Hu et al. 2013; Liu et al. 2011; Wu et al. 2012; Xie 2015). In this study, keywords concerning research on tourism are from dissertation titles.

In China, doctoral dissertations must be submitted directly to the library or archive of the institute that awarded the doctoral degree. The dissertation and its bibliography also may be submitted to dissertation databases. China Doctoral Dissertation Full-text Database (CDDFD) and China Dissertation Database (Wanfang Data) cover the largest quantity of doctoral dissertations. Others, such as National Library of China (NLC), China Academic Library & Information System (CALIS), Institute of Scientific and Technical Information of China (ISTIC), and National Science and Technology Library (NSTL) also incorporate a certain amount of dissertation literature. These six databases contain a large number of doctoral dissertations and cover almost all of the doctoral dissertations in China. CDFD and Wanfang Data provide column information according to disciplines or study field that each doctoral dissertation is concerned with, and the whole doctoral dissertations can be downloaded. However, NLC, CALIS, ISTIC, and NSTL do not provide download service, therefore we could only get the main part of doctoral dissertations. Table 1 shows the six dissertation databases in China.

No.	Database name	URL	Type
1	CDFD	http://acad.cnki.net	Full text, bibliography
2	Wanfang Data	http://s.wanfangdata.com.cn	Full text, bibliography
3	NLC	http://mylib.nlc.gov.cn	Full text of first 24 pages, Bibliography
4	CALIS	http://www.yidu.edu.cn	Bibliography
5	ISTIC	http://www.istic.ac.cn	Bibliography
6	NSTL	http://www.nstl.gov.cn	Bibliography

Table 1. Public database of doctoral dissertations in China.

The doctoral dissertations on tourism in China used in this study were collected from six databases. There were four steps to obtain doctoral dissertations. First, because keyword is an especially important element in the study of co-word analysis, we chose proper index words carefully in order to get all the articles we need. We reviewed doctoral dissertations, and we also searched for keywords including the fields of tourism, recreation, holiday, leisure, travel, hotel, scenic, tours, hiking, adventure and lodging, as well as information from various databases. Second, we downloaded the articles to check keywords for each record and to see if correct search terms were included in the six dissertation databases. Third, we found that some articles were not recorded in the six databases from libraries of universities which grant doctoral degrees in tourism. Finally, we needed to get the full text through dissertation databases of authors' schools or inter-library loans, or by visiting the authors, in order to check the corresponding keywords. We extracted useful information from the retrieved literature and put it in an Excel table before we merged and carefully reviewed the data.

In order to obtain doctoral dissertations on tourism with high quality, four steps were followed for the preprocessing of doctoral dissertations. First, we got 940 doctoral dissertations on tourism between 1989 and 2013 which were relevant to China's tourism industry from the six databases, and we searched these from September 2013 to June 2014. Second, five professors and five associate professors were invited to distinguish doctoral dissertations that came from the disciplines of tourism management and library and information management. Two professors were from the Higher School Teaching and Steering Committee of Major of Tourism Management of Ministry of Education in China, and one professor was from the State Council Commission of Academic Degrees and the Ministry of Education in China. Therefore, the participants were a representative sample of researchers on tourism from July 2014 to August 2014. Finally, we obtained 928 doctoral dissertations on tourism.

4.2 Data processing steps

Specifically, the data processing covers five essential steps. The first step was literature collection and data extraction to achieve and download relevant tourism information about doctoral dissertations on tourism from many databases. The second step was to extract a group of representative keywords as a study object from the full texts (Cambrosio et al. 1993). The third step was data processing: obtaining high-frequency keywords of doctoral dissertations on tourism through co-word analysis, transforming a matrix into a correlation matrix by using a specific correlation coefficient (Ding et al. 2001), and building a co-word matrix. The fourth step was data mapping: designing a strategic diagram of co-occurrence matrix by clustering high-frequency keywords that co-occur twice or more. A strategic diagram of co-occurrence matrix is useful here. The fifth step was data visualization: co-word analysis was adopted to make classifications of the tourism discipline and to examine the connections between tourism keywords to reveal the relationship among the categories or words graphically. From social networks, we can get maps of the original co-occurrence matrix and k-cores analysis of binary matrix.

5.0 Results and discussion

5.1 Doctoral dissertations on tourism by discipline

5.1.1 Doctoral dissertations on tourism by first level disciplines

The standards published by academic degree committees of the state council of China in *Discipline of Degree Granting and Talent Cultivation (2011)* and *Award Doctor's and Master's Degree Discipline (1997)* have been applied in doctorates awarded, recruitment, and training in China. The classification standard of *Discipline of Degree Granting and Talent Cultivation (2011)* clearly states that the disciplines must be qualified by the discipline information signed by the candidate. Besides, these standards are also used for discipline construction and education of statistical classification. We classified doctoral dissertations on tourism in China by the first and secondary discipline according to the standards mentioned above. If the disciplinary information is insufficient or inept, the semantics of the full text will be analyzed to classify the discipline. 928 doctoral dissertations were divided on the basis of the first level disciplines and categorized on the basis of the secondary level disciplines.

As shown in Appendix Table 2, the 928 doctoral tourism dissertations involved 36 first level disciplines. Currently the first level disciplines mainly focus on business administration (250) and geography (228). The number of doctoral dissertations relating to business administration and geography is over 50% of the total doctoral dissertations on tourism. The other first disciplines are as follows: management science and engineering (59), applied economics (53), biology (47), economic management of forestry (39), theoretical economics (36) and ethnology (33).These disciplines have more doctoral dissertations on tourism and these first level disciplines issued 708 dissertations, accounting for 80% of the total. The statistical results of the first level disciplines classification standard indicated that the researchers in the field of the above subjects are undertaking the principal part of tourism research. Tourism research was undertaken by many disciplines, such as business administration, geography, management science and engineering, and so on. Moreover, they benefited from a large quantity of research results in these first fields. The characteristics of doctoral dissertations on tourism are involve in many interdisciplinary aspects. Therefore, a doctoral dissertation on tourism research will cover a wide range of disciplines. Research of tourism management was originally just one part of the geography discipline in China, but it has been studied within other first-level or second-level disciplines now. During the whole process from infancy, through development to continuous improvement in recent years, tourism research has the characteristics of integrity and interaction among multiple disciplines. For instance, ethnology interacts with tourism research in minority areas; architecture interacts with tourism landscape planning and design, as well as forestry interaction with forest tourism resources research. Specifically, many disciplines conducted research about tourism actively, which greatly promoted the progress of tourism research.

5.1.2 Doctoral dissertations on tourism by secondary level disciplines

As seen in Appendix Table 2, the 928 doctoral tourism dissertations involved 102 secondary level disciplines. Currently the secondary level disciplines mainly focus on human geography (155), tourism management (143), management science and engineering (59), physical geography (57), ecology (43), business management (33), and technology economy and management (31). The number of doctoral dissertations relating to secondary level disciplines which are listed above account for 56.1% of the whole. The other secondary disciplines are as follows: cultural heritage and tourism development (19), tourism geography and tourism planning (10), industry economics (26), forestry economy and management (22), agricultural economics and management (17), political economy (18), Chinese minority economy (19), ethnology (13), urban planning and design (19), and quaternary geology (13). Other disciplines relate to tourism research in a lesser extent, such as natural disaster science (1), circular economics (1), environmental engineering (1), science of religion (1), and forest engineering (1). Similar to first level disciplines, the secondary level disciplines about doctoral tourism research demonstrate that tourism research is interdisciplinary.

In the UK and Ireland, prior statistical analysis (Meyer-Arendt and Justice 2002) showed that recreation, anthropology, and geography play an important role in tourism research. In North America, economics, anthropology, geography and recreation make the largest contribution to the field of tourism research (Jafari and Aaser 1988). In Australia, recreation, anthropology and geography play a major role in the field of tourism research (Hall 1991). Different from the UK and Ireland, North America and Australia, China's anthropology discipline has much less research on tourism. It is considered that the tourism discipline belongs to the cross discipline domain, and therefore tourism should establish itself as an independent discipline.

5.2 High-frequency keywords analysis

In total, we obtained 4,329 keywords from 928 doctoral dissertations on tourism in China. According to Donohue's scientific principle of bibliometrics, high-frequency word

occurence has great significance in literature, and on the basis of the calculation formula of high-frequency words put forward by Donohue (1973), keywords that occur four times or more are selected for high-frequency keyword analysis. In addition, the formula is designed to measure the boundary between high or low word frequency, i.e. T refers to the lowest frequency in the high-frequency words while I_1 refers to the number of words that occur once. According to the calculation formula, high- frequency words appear more than four times in the paper. We select keywords for which word frequency is equal to four times or more, and get 857 keywords as the data sample for co-word analysis. Due to a lack of unified indexing on keywords, we standardize these keywords by merging the synonyms (e.g., "scenic area" is replaced by "scenic spot"). We also notice that the keywords "tourism," evaluate," "China," "protest" and "developing" have very broad meanings. In other words, these types of keywords are meaningless for this study, and we therefore exclude them from further analysis. Finally, 68 keywords with a frequency of more than four times are selected as shown in Table 3. The frequency of these 68 keywords is around 857 times (about 19.8% of the total), and they cover main research topics of doctoral dissertations on tourism.

Table 2 shows the high-frequency keywords with a frequency of four times or more in the 928 dissertations. The words with high frequency of occurrence can reflect research focuses to some extent. The top ten keywords with a high frequency of occurrence are tourism industry (91), sustainable development (61), eco-tourism (58), tourism resources (42), scenic spots (36), tourism destinations (34), tourism resources development (32), tourism developing model (26), tourism environmental carrying capacity (21), and rural tourism (20). This indicates that these research topics are major focuses in the doctoral dissertations on tourism.

5.3 Cluster analysis

By means of graphic representation, hierarchical cluster analysis is used (Yang et al. 2012; Liu et al. 2011; Lee and Jeong 2008; Dehdarirad et al. 2014). The clustering measure is "with groups linkage" and the distance measure is "Euclidean Distance." Through the dendrogram of the cluster analysis (Yang et al. 2012; Liu et al. 2011; Gan and Wang 2015), the 68 keywords of doctoral dissertations on tourism are divided into 12 named clusters as shown in Table 3. As can be seen, cluster 1, cluster 5 and cluster 6 have the largest number of keywords, indicating that cluster 1 (Tourism supply chain), cluster 5 (Eco-tourism) and cluster 6 (Tourism experience) are the most focused research fields. The keywords, that is, the research topics in cluster 1 (Tourism supply chain), cluster 5 (Eco-tourism) and cluster 6 (Tourism experience) are paid close attention to in doctoral dissertations on tourism. In contrast, clusters 2 (Tourism cooperation) and 10 (Tourism economy) have the least number of keywords. Our investigations indicate that the research fields of doctoral dissertations on tourism are very diverse.

5.4 Strategic diagram analysis

Callon et al. (1983; 1986; 1991) divided the strategic diagram of a certain field into four quadrants to describe the research on and developments of each subject by the centrality and density parameters which could reflect the strength of relationships between clusters. With the x-axis representing the centrality and the y-axis representing the density (Gan and Wang 2015; Dehdarirad et al. 2014; Hu et al. 2013), we calculate the values of centrality and density of 12 clusters, and obtain the values of x and y, as shown in Table 4. Then we draw the strategic diagram, as shown in Figure 1.

Cluster name	Centrality	Density	X axis	Y axis
1	5.29	2	-0.95	-2.66
2	6.24	1	-1.95	-1.7
3	13.49	3	0.05	5.54
4	18.44	8	5.05	10.49
5	13.96	7.43	4.48	6.02
6	6.86	2.25	-0.7	-1.09
7	8.19	3.2	0.25	0.24
8	7.28	2	-0.95	-0.67
9	3	1.6	-1.35	-4.95
10	3	1.33	-1.62	-4.95
11	6.16	2.8	-0.15	-1.78
12	3.46	0.8	-2.15	-4.48

Table 4. Centrality and density of 12 clusters.

The strategic diagram gives an indication of the structure of tourism research fields. The 12 cluster fields are divided into two quadrants, and the other two are free of clusters. As shown in Figure 1, clusters in quadrant I (upper right hand quadrant) include cluster 3 (Tourism market), cluster 4 (Tourism planning), cluster 5 (Eco-tourism) and cluster 7 (Ethnic tourism). These clusters have high centrality and density values, which indicates that they are widely connected with other clusters. Furthermore, studies in these fields tend to be mature, and therefore represent the core of tourism research. Clusters in quadrant IV (lower left hand quadrant) contain cluster 1 (Tourism supply chain), cluster 2 (Tourism cooperation), cluster 6 (Tourism experience), cluster 8 (Tourism destination), cluster 9 (Tourist), cluster 10 (Tourism economy), cluster 11 (Tourism spatial organization) and cluster 12 (Tourism system). These clusters have low centrality and density

NO.	Keyword	Abbreviation	Frequency
1	Tourism industry	Tou-In	91
2	Sustainable development	Su-De	61
3	Eco-tourism	Ecot	58
4	Tourism resource	Tou-R	42
5	Scenic spot	S-Sp	36
6	Tourism destination	Tou-D	34
7	Tourism resources development	TRD	32
8	Tourism developing model	TDM	26
9	Tourism environmental carrying capacity	TEBC	21
10	Rural tourism	Ru-T	20
11	Tourism planning	Tou-Pl	17
12	Urban tourism	Ur-T	17
13	Tourism economy	Tou-Eco	17
14	Tourism spatial structure	TSS	15
15	Tourist flow	Tou-F	14
16	Regional tourism	Re-T	14
17	Stakeholder	Sta	14
18	Evaluation of tourism resource	ET	13
19	Tourism competitiveness	Tou-Com	12
20	Nature reserve	Na-Re	10
21	Cultural tourism	Cu-T	10
22	Leisure	Lei	10
23	Tourism landscape	Tou-L	10
24	Places of cultural heritage	PCH	10
25	Tourism enterprise	Tou-En	10
26	Community participation in tourism	CPT	9
27	Ethnic area	Eth-A	9
28	Tourist	Tou	9
29	Tourist city	Tou-C	9
30	Tourist experience	Tou-Ex	8
31	Tourism development	Tou-De	8
32	Travel agency	Tra-Age	8
33	Eco-tourism resource	ETR	7
34	Regional tourism cooperation	RTC	7
35	Tourism market	Tou-M	7
36	Management system	Mana-S	7
37	Geographic information System	GIS	7
38	Sustainable tourism	Sus-T	7
39	Tourism industrial cluster	TIC	7
40	Ecological environment	Eco-En	6
41	Forest tourism	Fo-T	6
42	Tourism product	Tou-P	6
43	Protection of tourism resource	PTR	6
44	Sports tourism	Spo-T	6
45	Tourism service	TS	5
46	Heritage tourism	He-T	5
47	Tourism consumption	Tou-Con	5
48	Perceived value	Per-Va	5
49	Pro-poor tourism	PPT	5
50	Social change	So-Ch	5
51	Man-land relationship	MLR	5
52	Spatial distribution	Spa-Dis	5
53	National culture	Na-Cul	4
54	Tourism system	Tou-Sys	4
55	Boundary effect	Bo-Ef	4
56	Spatial organization	Spa-Org	4
57	Forest park	Fo-Pa	4
58	Economic effect	Eco-Ef	4
59	Tourism supply chain	TSC	4
60	Tourist market	Tou-Mar	4
61	Tourist behavior	Tou-Be	4
62	Tourism motivation	Tou-Mo	4
63	Satisfaction	Sat	4
64	Experience value	Ex-Va	4
65	Tourism spatial effect	TSE	4
66	Tourism satellite account	TSA	4
67	Tourist resort	Tou-Re	4
68	Natural heritage	Na-H	4

Table 2. The top keywords.

values. Thus, they are loosely connected with the research field, and they are still immature and located on the edge of the research network. Clusters in quadrant IV need to be strengthened considerably, and much more attention needs to be paid to research on these fields in the future.

5.5 Social network analysis

In respect to social network maps of original co-word matrix, we conduct social network mapping and k-core analysis of the binary matrix types of co-word networks through Netdraw. In each network, nodes represent keywords, and a line between two nodes indicates that the two keywords have appeared in the same dissertation (Liebowitz 2005; Hu and Zhang 2015; Wang et al. 2015). Social network maps focus on the relationships between research topics, while k-core analysis of binary matrix aims at finding core-peripheral research topics.

Social network maps are generated by using original co-occurrence matrix, which could intuitively demonstrate the

Cluster NO.	Cluster name	Number of keywords	Member of cluster
1	Tourism supply chain	8	Travel agency, Tourism supply chain, Tourism service, Tourism enterprise, Tourism development, Cultural tourism, Tourism industrial cluster, Forest park
2	Tourism co-operation	4	Regional tourism cooperation, Boundary effect, Stakeholder, Community participation in tourism
3	Tourism market	6	Tourist city, Ecological environment, Tourism market, Tourism spatial effect, Tourism consumption, Tourism industry
4	Tourism planning	6	Sustainable development, Rural tourism, Sustainable tourism, Tourism planning, Tourism resource, Tourist resort
5	Eco-tourism	7	Eco-tourism, Nature reserve, Evaluation of tourism resource, Tourism environmental carrying capacity, Tourism developing model, Forest tourism, Economic effect
6	Tourism experience	8	Tourism competitiveness, Sports tourism, Tourist experience, Heritage tourism, Tourism landscape, Experience value, Scenic spot, Social change
7	Ethnic tourism	5	Tourism resources development, Ethnic area, National culture, Places of cultural heritage, Natural heritage
8	Tourism destination	6	Eco-tourism resource, Geographic Information System, Protection of tourism resource, Main-land relationship, Management system, Tourism destination
9	Tourist	5	Leisure, Perceived value, Tourist, Satisfaction, Tourist behavior
10	Tourism economy	3	Tourism economy, Tourism satellite account, Spatial distribution
11	Tourism spatial organization	5	Urban tourism, Tourism spatial structure, Regional tourism, Tourist market, Pro-poor tourism
12	Tourism system	5	Tourism product, Spatial organization, Tourist flow, Tourism system, Tourism motivation

Table 3. Twelve clusters of research topics of doctoral dissertations on tourism in China.

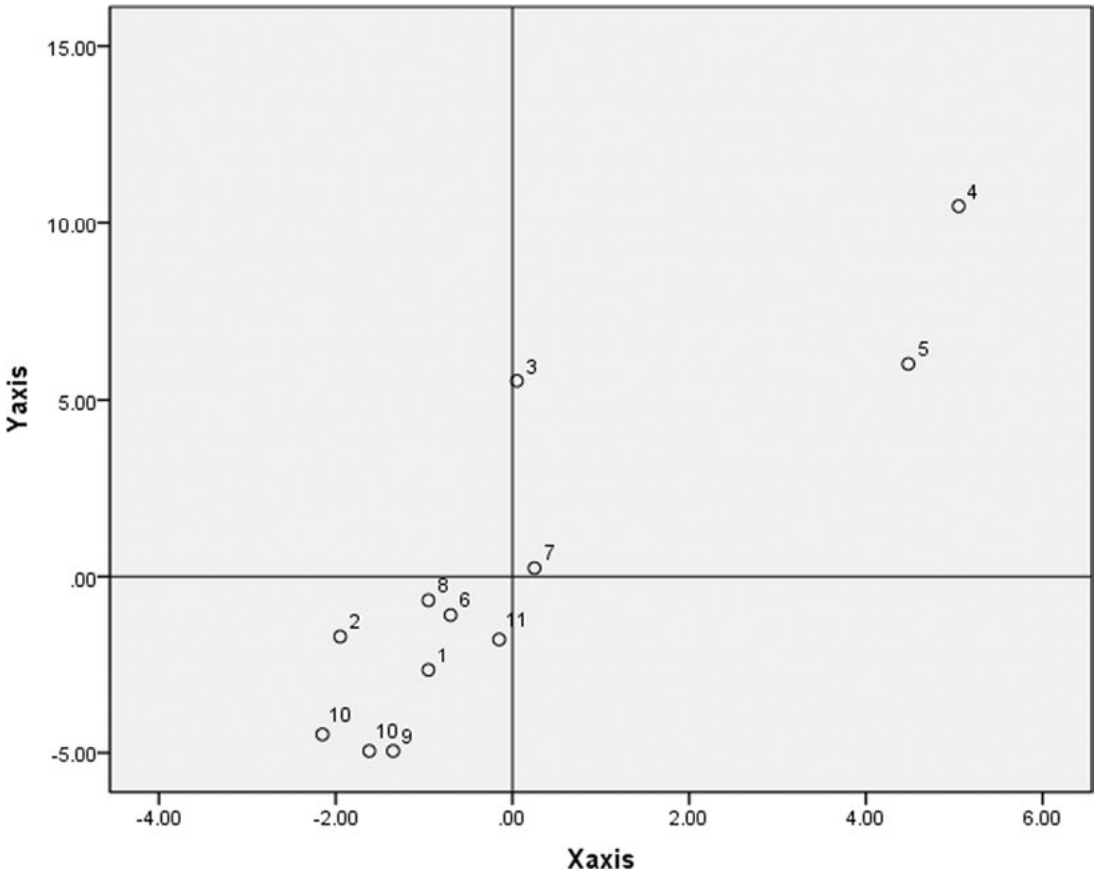

Figure 1. Strategic diagram of clusters.

relationships among the high-frequency co-words and that between the numerous research topics of doctoral dissertations on tourism through NetDraw. The relative size of nodes is proportional to the occurrence frequency of keywords. Line thickness reflects the closeness of the connections between two keywords. According to SNA (Gan and Wang 2015; Lurie et al. 2009; Ronda-Pupo and Guerras-Martin 2012), the thicker the line, the closer the connection is, and the thinner the line, the looser the connection is. As shown in Figure 2, the "Tou-In (Tourism industry)" node has the biggest size, which confirms it has the highest frequency of keyword. "Su-De (Sustainable development)," "Ecot (Eco-tourism)," "Tou-R (Tourism resource)," "S-Sp (Scenic spot)," "Tou-D (Tourism destination)," and "TRD (Tourism resources development) " node has the bigger size, which confirms it has the higher frequency of keyword. The thicker lines between nodes show closer associations between two keywords, such as "Su-De (Sustainable development)," "Tou-In (Tourism industry)," "Ecot (Eco-tourism)," "RU-T (Rural tourism)," "Tou-In (Tourism industry)," "Tou-R (Tourism resources)" and "TEBC (Tourism environmental carrying capacity)."

The model of core-periphery analysis is aimed at looking into the core and periphery in the social network. By using the k-core binary matrix that is converted from the original co-word matrix in Ucinet, we establish core-verge topics. As shown in Figure 3, seven cores are identified by k-cores analysis. Different shapes are configured to display the cores clearly, and different colors mark the degree of core or edge. 13 diamond nodes (k=7), 8 circle-in-box nodes (k=6) represent core themes of the network. 13 down triangle nodes (k=5), 6 box nodes (k=4) are the themes, which are located between core and periphery. 11 up triangle nodes (k=3), 9 square nodes (k=2), and 7 circle nodes (k=1) are the periphery themes.

6.0 Conclusions

Along with the rapid development of the tourism industry over the past three decades, tourism research in China has gained tremendous progress. Dating back to the development of doctoral dissertations on tourism in China, study in this area is focused on the co-word analysis of doctoral dissertations on tourism in China. In this paper, we have conducted a bibliometric and co-word analysis of tourism research in China combined with various methods, including descriptive statistical analysis, hierarchical cluster analysis, strategic diagram, and social network analysis. These visualization methods are of guidance in that hierarchical cluster analysis suggests the subject structure, strategic diagrams indicate the vital role and feature of research themes within the research field, and social network analysis can intuitively show the interrelationship of these keywords. On this basis, we have identified some clear and reasonable research results about doctoral dissertation on tourism in China so that this study succeeds in identifying the major

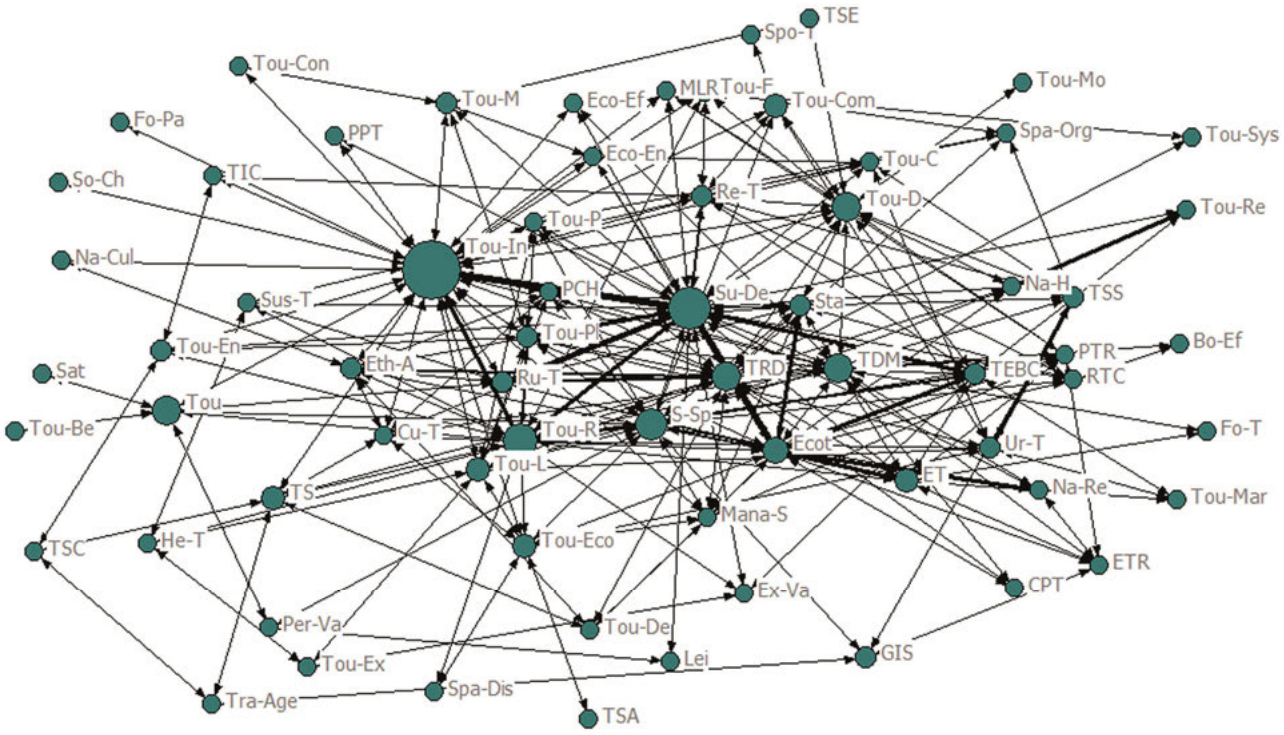

Figure 2. Social network maps of original co-occurrence matrix.

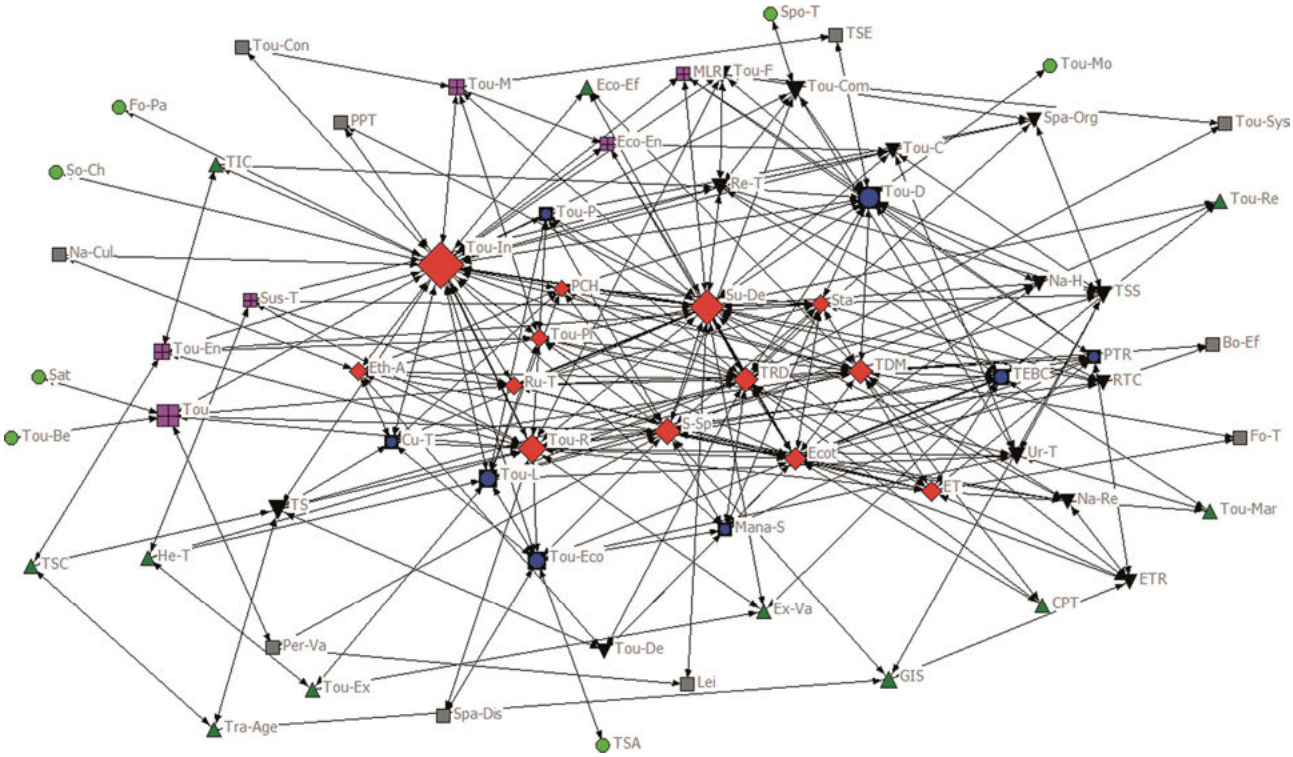

Figure 3. K-cores analysis of binary matrix.

research focuses, the interactions among different research topics, and the current situation in this research area. In a word, the co-word analysis adopted in this paper is to obtain a clear understanding of the development of doctoral dissertations on tourism in China, and the methods used have been proved to be effective.

Doctoral dissertations have a broader disciplinary base and a hierarchically balanced knowledge. Through the analysis of disciplines, we have analyzed doctoral dissertations on tourism in China involving a large number of disciplines among which 36 belong to first level discipline and 102 belong to secondary level discipline. By the adoption of high-frequency processing and selection, the paper has revealed what topics are mainly focused on within the research of doctoral dissertations on tourism in China, and 68 high-frequency keywords have been identified concerned with the doctoral dissertations on tourism in China. By applying the method of cluster analysis, we have divided these keywords into Tourism supply chain, Tourism cooperation, Tourism market, Tourism plannin, Eco-tourism, Tourism experience, Ethnic tourism, Tourism destination, Tourist, Tourism economy, Tourism spatial organization, Tourism system different research clusters, and these 12 cluster fields have also been divided into two quadrants, in which there exist many clusters while there exist no other clusters in the remaining two quadrants. To be specific, there are 24 keywords such as Tourist city, Sustainable development, and Eco-tourism located in cluster 3 (Tourism market), cluster 4 (Tourism planning), cluster 5 (Eco-tourism) and cluster 7 (Ethnic tourism) which have been proved to be more mature. The other 44 keywords like Travel agency, Tourism competitiveness, and Perceived value located in other clusters are believed to be situated at the edge of the research. Combined with the social network maps of original co-occurrence matrix, the highest frequency of occurrence of keywords and closer associations between two keywords have been obtained. The k-core binary matrix has indicated that research fields like Tourism industry, Sustainable development, and tourism resources have the higher frequency of keywords, i.e. these fields have received more focus. Applying core-periphery analysis to the research results, on the one hand, there are 21 keywords such as Tourism industry, Eco-tourism, and Tourism resources development representing core themes of the network, on the other hand, there are 47 keywords like Tourism satellite account, Tourism consumption, and Tourist resort that are located on the edge of the research network.

However, the study also has several limitations. It is not an exhaustive review due to resource limitations. Furthermore, the submission of some dissertations to databases may be delayed for years. These doctoral dissertations are not necessarily opened to the public or not yet included in the database because some of them are still

confidential. It is possible that a small amount of dissertations has been lost from institution dissertation databases and public dissertation databases. Notwithstanding its limitation, this study has mapped the foci of research in 928 doctoral dissertations on tourism.

We suggest that the cluster analysis on keywords in tourism research should be made annually. Future studies are expected to re-evaluate the subcategories in each tourism research discipline every year. As time goes on, the evolution of disciplines is gradually manifested. In addition, it is suggested that further studies shall be carried out to look into the relationship between China and overseas countries for global communications.

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Appendix: The first and Secondary level disciplines of doctoral dissertations on tourism in China

First level discipline	Secondary level discipline	First level discipline	Secondary level discipline
Business Administration (252)	Tourism Management (143) Business Management (33)	Forestry (14)	Forest Cultivation (7) Wildlife Conservation and Utilization (3)
	Technology Economy and Management (31)		Forest Management (2) Science of Nature Reserve (1)
	Cultural Heritage and Tourism Development (19)		Soil, Water Conservation and Desertification Control (1)
	Tourism Geography and Tourism Planning (10)	Pedagogy (14)	Sports Humanistic Sociology (7) Physical Education Training (4)
	Marketing Management (5) Enterprise Management (7)		Basic Psychology (2) Education Economy and Management (1)
	Leisure Studies (2) Accounting (1)	Geological Resources and Geological Engineering (11)	Mineral Resource Prospecting and Exploration (8)
	Tourism Planning and Management (1)		Earth Detecting and Information Technology (1)
Geography (228)	Human Geography (155) Physical Geography (57)		Land and Resources Information Engineering (1)
	Cartography and Geographic Information System (7)		Tourism Geology and Geological Relics (1)
	Economic Geography (5) Historical Geography (3)	Sociology (11)	Anthropology (6) Sociology (5)
	Natural Disaster Science (1)	Landscape Architecture (7)	Garden Plants and Ornamental Gardening (7)
Management Science and Engineering (59)	Management Science and Engineering (59)	Agricultural Resources and Environment (7)	Land Resources Management (3) Soil Science (2)
Applied Economics (53)	Industry Economics (26) Regional Economics (9)		Agricultural Resource Utilization (2)
	Resources Industrial Economy (7) Statistical (5)	Political Science (4)	Political Theory (2) Ideological and Political Education (1)
	National Economics (2) Finance (1) Labor Economics (1)		History of the Communist Party of China (1)
	Applied Economics (1) Circular Economics (1)	Signal and Information Processing (3)	Signal and Information Processing (3)
Biology (47)	Ecology (43) Botany (3)	Aquatic (3)	Fishery Economy and Management (3)
	Plant Ecology (1)	Foreign Language and Literature (3)	Foreign Linguistics and Applied Linguistics (2)
Economic Management of Forestry (39)	Forestry Economy and Management (22)		English Language and Literature (1)
	Agricultural Economics and Management (17)	Control Science and Engineering (3)	Systems Engineering (2) Control Theory and Engineering (1)

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First level discipline	Secondary level discipline	First level discipline	Secondary level discipline
Theoretical Economics (36)	Political Economy (18) World Economy (9)	Chinese Language and Literature (3)	Ancient Times Literature (1) Art (1)
	Population, Resources and Environment Economy (7)		Linguistics and Applied Linguistics (1)
	Western Economics (2)	Computer Science and Technology (3)	Computer Science and Technology (2)
Ethnology (33)	Chinese Minority Economy (19) Ethnology (13)		Computer Software and Theory (1)
	Chinese Minority Arts (1)	Public Management (3)	Public Management (1) Administrative Management (1)
Architecture (25)	Urban Planning and Design (19) Architectural Design and Theory (3)		Public Administrative Management of Ethnic Minority (1)
	Architectural Technology Science (1)	Transportation Engineering (3)	Transportation Planning and Management (3)
	Landscape Architecture Planning and Design (1)	Crop Science (1)	Crop Science (1)
	Landscape Planning and Design (1)	Pratacultural Science (1)	Pratacultural Science (1)
History (24)	Chinese Modern History (9) Special History (8)	Philosophy (1)	Science of Religion (1)
	World History (5) Ancient Chinese History (2)	Sport Science (1)	Science of Ethnic Traditional Sport (1)
Geology (16)	Quaternary Geology (13) Paleontology and Stratigraphy (2)	Psychology (1)	Social Psychology (1)
	Structural Geology (1)	Mathematics (1)	Math (1)
Environmental Science and Engineering (15)	Environmental Science (9) Environmental Engineering (1)	Traditional Chinese Medicine (1)	Basic Theory of Traditional Chinese Medicine (1)
	Environmental Planning and Management (2)	Forestry Engineering (1)	Forest Engineering (1)
	Environmental Economic and Environmental Management (2)	Law (1)	Civil Law and Commercial Law (1)
	Gardening and Environmental Engineering (1)		