Structural Analysis of Scientific Research Group in the Chinese Computer Field

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Abstract : *A coauthor network is formed by these papers published on the prestigious chinese journals in computer fields during the period 2011-2015, including Journal of Software, Chinese Journal of Computers, and Computer Research and Development. By analyzing the co-authorship network using social network analysis method, some statistic characteristics of scientific research groups in domestic computer field are analyzed. The results show that most of the research cooperation appears in a fraction of the stable and mature research groups, and the research groups consisting of researchers with higher administrative position can develop with a stable growth rate.*
Keywords: *social network analysis, coauthor network, scientific research group*

I. Introduction

During the procedure of scientific research, cooperation and communication between researchers is becoming more common. The research achievements of scientific research activities generally appear in many forms, such as papers, reports, patents and a variety of technology products, etc. In the field of computer science, most significant academic achievements can be reflected in scientific papers, which play the most important role in theoretical research [1, 2]. As the increase of the number of staffs in universities working at scientific research task, the scale of coauthor network formed by scientific papers is growing [3. 4]. By utilizing the coauthor network, both methods of bibliometrics and social network analysis are often used to obtain the potential structure characteristics of scientific research groups.

There are many research works in the field of coauthor network. Newman investigated the co-authorship networks of physics, biomedicine and computer science, and pointed out the differences of co-authorship networks in different types of disciplines [5, 6]. Zhou *et al* analysed the dynamics of international collaboration and the national characteristics of Chinese cooperation in science [7]. In [8], the authors proposed a novel weighted coauthor graph to analyze the formed coauthor networks. Feng Fu *et al* studied the connection relationship between the blogging network and the social network system [9]. Yoshikane *et al* used a modified HITS algorithm to analysis coauthor network in computer science [10].

Although these works presented the methods how to analyze the formed coauthor network, how there is few works refering to the coauthor network in the Chinese computer science filed, which makes rapid progress in recent years. Motivated by this, in this paper, we construct a coauthor network by using the papers published on the principal computer journals in China, including Journal of Software, Chinese Journal of Computers, and Chinese Journal of Computer Research and Development, and discuss the structural characteristics and development trend of the research groups in the computer field.

II. The Analysis Of The Coauthor Network

A coauthor network is formed by the papers published on the principal computer journals Journal of Software, Chinese Journal of Computers, and Computer Research and Development during the period 2011-July, 2015. In the coauthor network, nodes represent authors, the line represent the academic paper which two authors published together. Some statistic characteristics of scientific research groups in domestic computer field are analyzed. Social network analysis method is used to study the coauthor network.

The degree of collaboration is an important metric in coauthor networks. By exploiting the statistical analysis method for these papers published in the three principal computer journals above, while considering that only a part of papers in 2015 are incorporated, although the number of published papers keeps fixed basically, it is seen that the degree of collaboration slightly increases with the increase of time. The average number of authors to one paper of three principal computer journals is 3.67 in 2011, and 3.86 in 2014. An academic paper is usually finished by three or four authors.
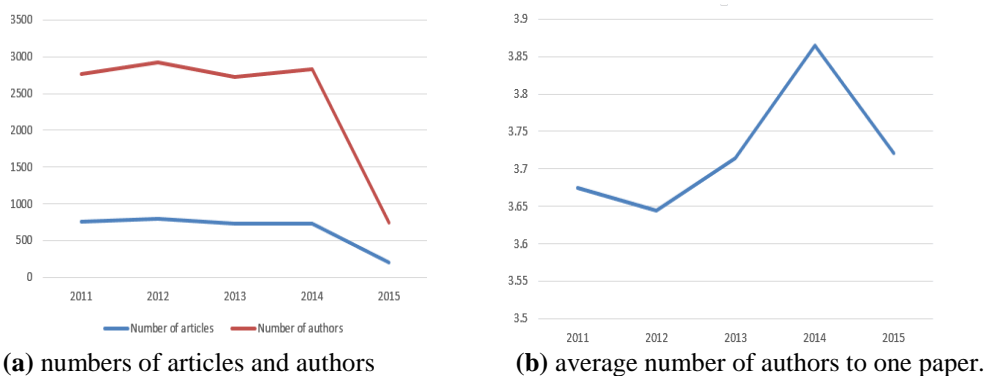
(a) numbers of articles and authors   **(b)** average number of authors to one paper.
Fig. 1 The annual co-authorship analysis of the Chinese three computer journals

The statistical analysis of the coauthor papers published by three principal computer journals during the period 2011-2015 is shown in Fig. 2. The number of papers finished by one author is 48, which only accounts for approximately one percent of the total number of papers. Most of the computer science researchers choose cooperative research rather than work alone. The number of papers with 3 authors is 930, which accounts for 29 percent of the total number of papers while the number of papers with four authors is 1059, which accounts for 33 percent. The academic papers are usually finished by 3 authors or 4 authors.
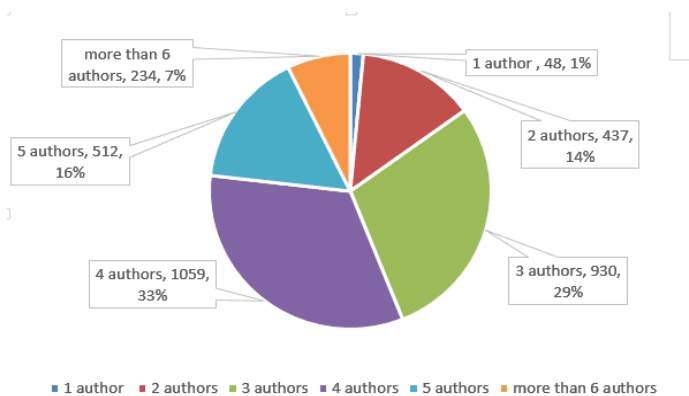

Fig. 2 The co-authorship statistical analysis of these papers

Now we utilize the coauthorship data to construct a complex coauthor network and then use the software of UCINET to intuitively depict the co-author network in Fig. 3. The node centralityof the coauthor network is measured in the following three different metrics: degree, closeness and betweeness, and is shown in Tab. 1. The top three authors are LuoJZ, FengDG, and JiaY in the degree factor, the top three authors are ZhangW, ZangP, and FangBX in the case of betweenness, while the top three authors are ZhangP, QianDP, and FangBX in the case of closeness. The Degree of author LuoJZ is 80, which means that he has 80 co-authors. However, the value of betweenness and that of closeness of author LuoJZ are not large, which means that his status in the co-authorship network is not high.

Tab. 1 Central analysis of three principal computer journals

Num	Degree		Betweenness		Closeness		
1	LuoJZ	80.000	ZhangW	290319.125	ZhangP	4402357.000	0.073
2	FengDG	72.000	ZangP	243412.109	QianDP	4402516.000	0.073
3	JiaY	69.000	FangBX	182198.016	FangBX	4402621.000	0.073
4	YuG	60.000	LinC	173556.641	LiC	4402689.000	0.073
5	FangBX	59.000	MaJF	156803.031	LinC	4402814.000	0.073
6	DaiGZ	47.000	LiQ	156442.938	GuoL	4402870.000	0.073
7	LiZC	44.000	JiaY	151280.813	JiaY	4402891.000	0.073
8	WangZA	44.000	LiuL	147697.969	ShunLH	4402919.000	0.073
9	WangHM	42.000	LiW	139796.922	LiQ	4402930.000	0.073
10	LiJZ	42.000	WangHM	136103.078	ShanZG	4402957.000	0.073
…	…	…	…	…	…	…	…

Analytical results of 2 cliques of the coauthor network of three principal computer journals is given in Tab. 2. In the 2 cliques methods, an *n*-clan is an *n*-clique which has diameter less than or equal to *n* as an induced subgraph. We choose *n*-cliques analysis to deal with the data. The results show that there are 729 cliques in the co-authorship network of three principal computer journals. FangBX, ZhangPeng, and JiaYan appear 15, 9, and 7 times in the list of top15 cliques separately，which means that they are leading members and have great influence.

Tab.2 Analytical results of 2 cliques of the coauthor network of three principal computer journals

Num	Teams
1	ShiJD ZhangHL FangBX WangX ZhangP JiaY ChenJ TanJL JinSC LiJ LiuWM YinLH ZhouB XuJ FanXH ZhaoJ LiYX CuiY TianZH GuoYC ZhouY CuiJ LiQ HeH WangYS ChenXJ TanQF ZhangHL GuoJ ZHouC CaoYN GuoL HanY ShiJQ LiuTW YuXS JianWY LinJ LiuCY WangW JinSY YangZ
2	FangBX ZhangP JiaY ChenJ TanJL JinSC LiJ YinLH ZHouB XuJ ChenXJ GuoJ ZhouC CaoYN GuoL HanY ShiJQ LiuTW LiuYB ZhangY LiuP JinSY YanZ
3	FangBX ZhangP JiaY TanJL LiJ YinLH ZhouB XuJ XiongG ChenXJ GuoJ ZhouC CaoYN GuoL HanY ShiJQ LiuTW LiuYB ZhangY LiuP JinSY YanZ
4	FangBX ZhangP JiaY TanJL LiJ YinLH XiongG ChenXJ GuoJ ZhouC CaoYN GuoL HanY ShiJQ LiuTW LiuYB ShaoY WangY LiuQY ZhangY LiuP WuJY JinSY YanZ
5	ZhangHL FangBX ZhangP JiaY TanJL LiJ LiuWM YinLH GuoYC ZhouY ChenXJ GuoJ ZhouC CaoYN GuoL HanY ShiJQ LiuTW WuJY JinSY YanZ
6	ZhangHL FangBX ZhangP LiC LiJ LiuWM YinLH GuoYC ZhouY GuoJ ZhouC CaoYN GuoL WuJY JinSY YanZ
7	FangBX ZhangP LiC LiJ YinLH ShunB GuoYC GuoJ ZhouC CaoYN GuoL
8	LinC WangJX ChenXQ YangY YangJH WangYZ XuL XiangXD MengK YuJY QiuW ShenHW
9	LinC WangJX ChenXQ GuoJF YangY ChenF YangJH WangYZ JiaMY XiangXD MengK ZhangTY JinXL YuJY QiuW ShenJH LiGJ
10	LinC LiY WangJX TianY YaoM ChenXQ ChenXQ XuL ZhuM PangSC SongW HuJ KongXZ XiangXD JiaZX MengK ShanZG ShuWB LiuQ LiuWD FangQL YiH DongJQ YuJY QiuW ShenJH
…	…
728	ZhangCY ShunJL DingYQ
729	ChenKJ ShunWL ZhuL LiuWL

III. Conclusion

From the statistical analysis of co-authorship of three principal computer journals during the period 2011-2015, an academic paper is usually finished by three or four authors, which means that the academic research team is usually formed by three or four leading members. Considering the value of node centrality, the authors ZhangP, QianDP, and FangBX have high influence.

Most of the research cooperation appears in a fraction of the stable and mature research groups. In the co-authorship network, ZhangP and FangBX build a research team and cooperate smoothly with team members. The uneven development of the research team limits the development of most research teams and affects the academic atmosphere. The stable and influence research teams have members who hold leading posts in university or other organization, like FangBX, QianDP, and FengDG. Although they can't dedicate themselves to academic research work, they play important roles of organizers and coordinators.

REFERENCE
[1]. Backstrom L, Huttenlocher D, Kleinberg J. Group formation in large social networks: Membership, Growth, and Evolution[C]. Proceedings of the 12th ACM SIGKDD international conference on Knowledge discovery and data mining, 2006, 44-54.
[2]. Dar I R, Ahmed M S. Role of research and development in product innovation: a correlation study [J]. International review of business research papers, 2009, 5(4):147-156）.
[3]. Shibata, N, Kajikawa, Y, Takeda, Y. Detecting emerging research fronts based on topological measures in citation networks of scientific publications [J]. Technovation, 2010, 28(11):758-775.
[4]. Acedo F J. Co-authorship in management and organizational studies: an empirical and network analysis [J]. Journal of Management Studies, 2006, 43(5):958-983.I
[5]. Newman M E J, Park J. Why social networks are different from other types of networks[J]. Physical Review E, 2003, 68(2):036122.
[6]. Newman M E J. Assortative mixing in networks [J]. Physical Review Letters, 2002, 89(20):111-118.
[7]. Zhou P, Glanzel W. In-depth analysis on China's international cooperation in science[J]. Scientometrics, 2010，82(3):597-612.)
[8]. Borner K, Dallasta L, Ke W, Vespignani A. Studying the emerging global brain: Analyzing and Visualizing the Impact of Co-Authorship Teams[J]. Complexity, 2005, 10(4): 57-67.)
[9]. Mechanics and its Applications, 2008, 387:675-684.
[10]. F. Yoshikane, T. Nozawa, K. Tsuji.Comparative analysis of co-authorshipNetworks considering authors'roles in collabora tion: Differences between the Theoretical and Application Areas[J]. Scientometrics. 2006, 68(3):643-655.