A Comparative Analysis of Gesture Recognition Technology Between China and the United States

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Abstract: In this study, Web of Science Core Collection database is used as data source. Using Excel, VOSviewer and CiteSpace software for data mining and quantitative analysis of research papers on gesture recognition, we explore the trend of change, the distribution of research forces, key areas, research hot spots and international cooperation. These provide a reference for the research of relevant scholars.

1. Introduction

Gesture recognition plays an important role in the design of intelligent and efficient human-machine interface. At present, gesture recognition has been applied to sign language recognition, intelligent monitoring, virtual reality and other fields [1]. The study of gesture recognition has a long history. Historically, Grimes first used data gloves to realize gesture recognition, and obtained AT&T "data gloves" patent. In 1991, Fujitsu Laboratory also carried out research on the related aspects of gesture recognition system. The designed recognition system can recognize a gesture symbol. In 1995, Christopher Lee and others successfully developed the gesture command operating system [2]. In recent years, the research progress in the field of gesture recognition mainly includes: data set annotation method, gesture recognition method and data set, gesture recognition feature extraction, classification and segmentation method, three-dimensional information acquisition, recognition and application [3].

In this study, bibliometrics is used to analyze and excavate gesture recognition technology and explore its development status and trend in the United States and China in order to provide scientific reference and theoretical guidance for the future research of gesture recognition.

2. Method and source

In this study, the Web of Science Core Collection of Clarivate is selected as the data source, and the papers included in this database can reflect the development trend of the scientific frontier to a certain extent [4-6]. The language is English, and the time range is all year. The retrieval time was January 16, 2019. Using Excel, VOSviewer and CiteSpace software to analyze and excavate the information of the publication year, organization, research area, subject word (key word) and so on, we obtain the development trend of gesture recognition technology, cooperative network, research focus and hot spot.

3. Analysis of annual change trend

The change of the amount of literature in each year directly reflects the quantitative process of scientific research. It is one of the important measures to measure scientific research achievements. We have retrieved data from all year but there have papers related to gesture recognition technology between 1982 and 2019(Fig.1). There are 961 articles in China and 929 in the United States. As can be seen from Fig.1, the research on gesture recognition in the United States is about ten years earlier than that in China. Before 2011, both were at a slow stage of development. Gesture recognition technology is developing rapidly during 2012-2018. Beginning in 2013, China has sent more papers

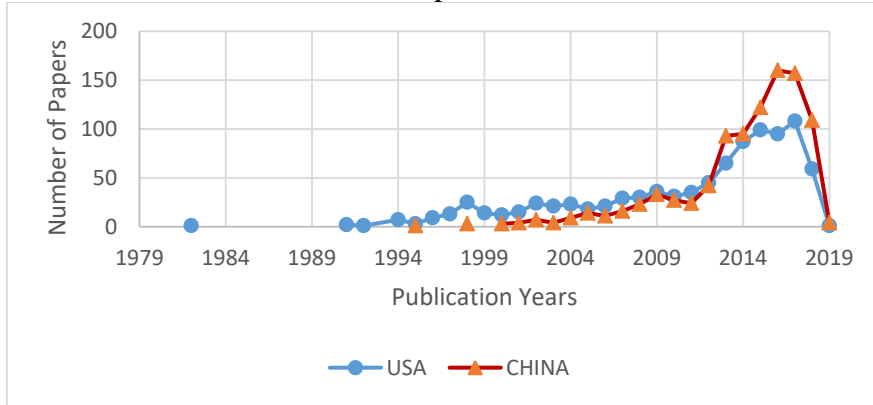than the United States. In 2017, 157 articles were published in China.

Fig.1. The annual published numbers of gesture recognition

4. Organization analysis

Through the analysis of the author's organization, we can understand the distribution of the main scientific research forces in a professional field. We have made statistics on the top 10 organizations in the two countries. These organizations are universities and institutes. The Chinese Academy of Sciences is far ahead of other institutions with 162 articles published. It is more than twice as many as the University of California System (Table.I).

TABLE I. Top 10 Author Institutions in China and USA

NO.	China		USA	
---	Organizations	Number of papers	Organizations	Number of papers
1	CHINESE ACADEMY OF SCIENCES	162	UNIVERSITY OF CALIFORNIA SYSTEM	74
2	TSINGHUA UNIVERSITY	57	UNIVERSITY OF TEXAS SYSTEM	48
3	ZHEJIANG UNIVERSITY	42	STATE UNIVERSITY SYSTEM OF FLORIDA	46
4	HARBIN INSTITUTE OF TECHNOLOGY	41	MASSACHUSETTS INSTITUTE OF TECHNOLOGY MIT	45
5	CHINESE UNIVERSITY OF HONG KONG	38	UNIVERSITY SYSTEM OF GEORGIA	36
6	UNIVERSITY OF SCIENCE TECHNOLOGY OF CHINA	34	CARNEGIE MELLON UNIVERSITY	31
7	SHENZHEN INSTITUTE OF ADVANCED TECHNOLOGY CAS	32	GEORGIA INSTITUTE OF TECHNOLOGY	31
8	SOUTH CHINA UNIVERSITY OF TECHNOLOGY	29	UNIVERSITY SYSTEM OF MARYLAND	31
9	BEIJING UNIVERSITY OF POSTS TELECOMMUNICATIONS	28	PURDUE UNIVERSITY	29
10	UNIVERSITY OF CHINESE ACADEMY OF SCIENCES CAS	26	PURDUE UNIVERSITY SYSTEM	29

5. Cooperation analysis

Through the analysis of cooperative relationship, we have counted the top 10 countries or regions

that have strong cooperation with USA. Figure 2 shows the cooperation network (China, India, South Korea, Spain, Canada, Japan, Australia, England, Germany). The top 11 countries or regions with strong cooperation with China are: USA, Singapore, France, Italy, Japan, South Korea, Canada, Taiwai(China), England, Australia(Fig.3). The thickness of the lines represents the strength of the cooperative relationship. We can see that the cooperative relationship between China and the United States is the strongest. China and the United States all cooperate with Japan, Canada, Australia, South Korea and England.

Fig.2. The United States cooperation network for gesture recognition
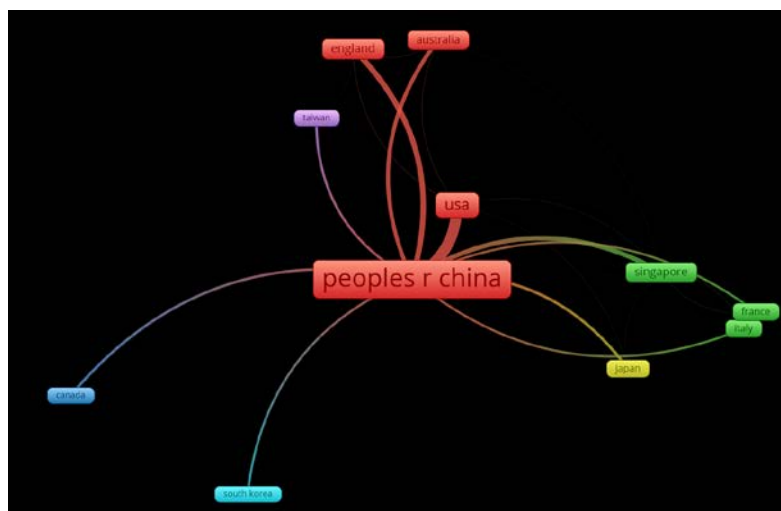

Fig.3. China cooperation network for gesture recognition

6. Key research field and hot spot analysis

6.1 Distribution of research areas

The top 10 subject areas involved in the research of gesture recognition mainly concentrated in the first two fields, of which the maximum number of documents in Computer Science is 660 and 583 respectively, indicating that the researchers have the highest degree of concern. Ranked second was Engineering, 450 and 498 respectively. In these two areas, China and the United States are comparable. In Automation Control Systems, the volume of Chinese publications is significantly higher than that of the United States (Fig.4).
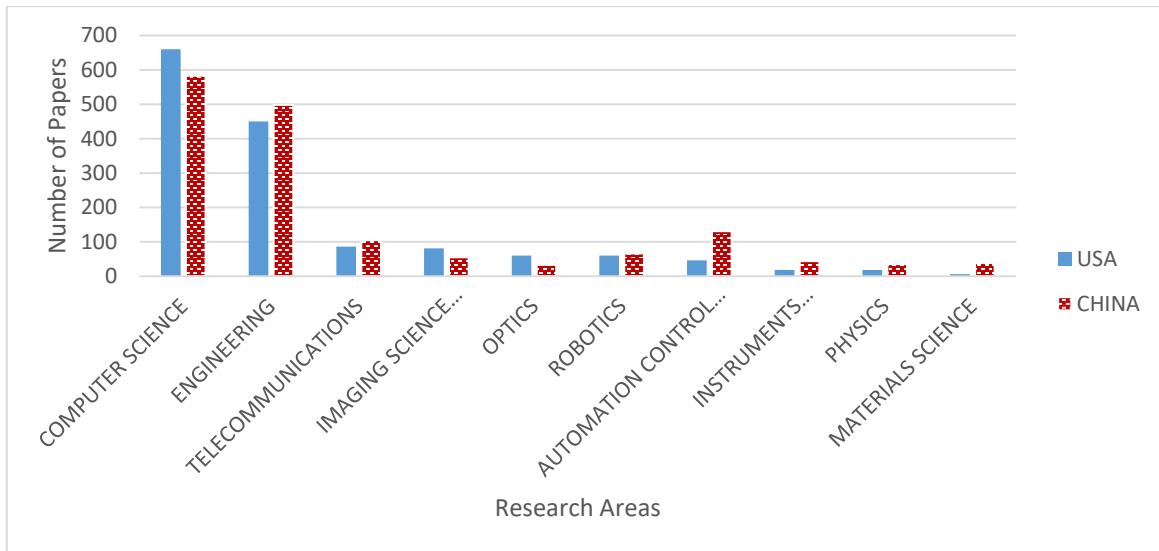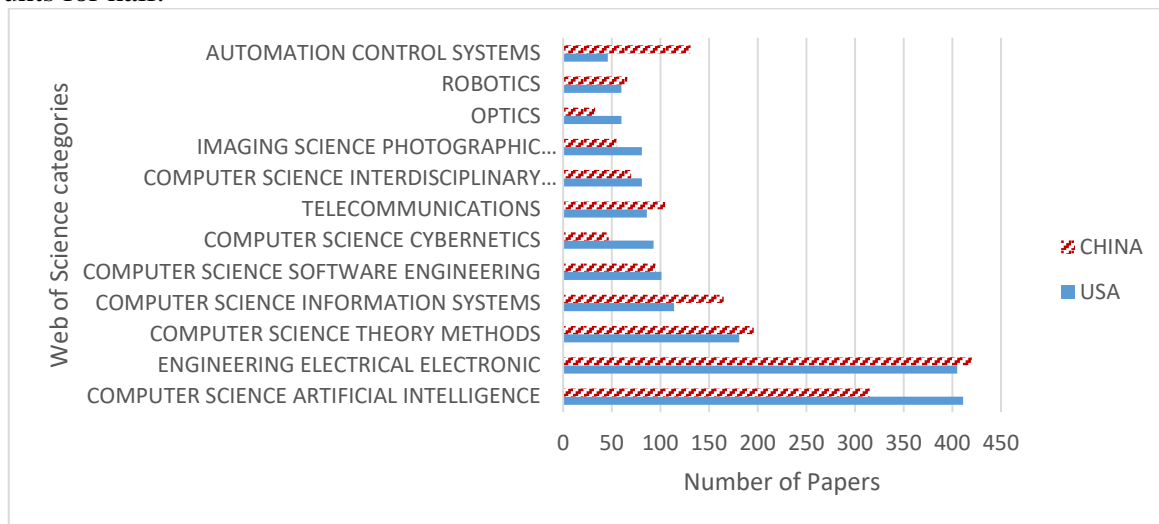
Fig.4. The major research areas of gesture recognition

6.2 Web of science category analysis

In the top 12 web of science categories, there are the most papers in Engineering Electrical Electronic and Computer Science Artificial Intelligence (Fig.5). Research area of Computer Science accounts for half.

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6.3 Web of science categories of gesture recognitionResearch focus and hot spot analysis

The timeline view of Citespace can show the time span and research process of each cluster (i.e. sub domain) evolution. The United States began to study gesture recognition technology around 1990, initially focusing on the #6(nonrigid motion analysis) and #1(face recognition). In recent years, research has focused on #0(acceleration) and #7(multimodal data analysis) (Fig.6, Fig.7). China began to study gesture recognition technology around 2000, initially focusing on #8(fourier descriptor). Recent research hotspots are #2(convolutional neural networks), #1(elm) and #13(high-resolution range profile)(Fig.6, Fig.7).
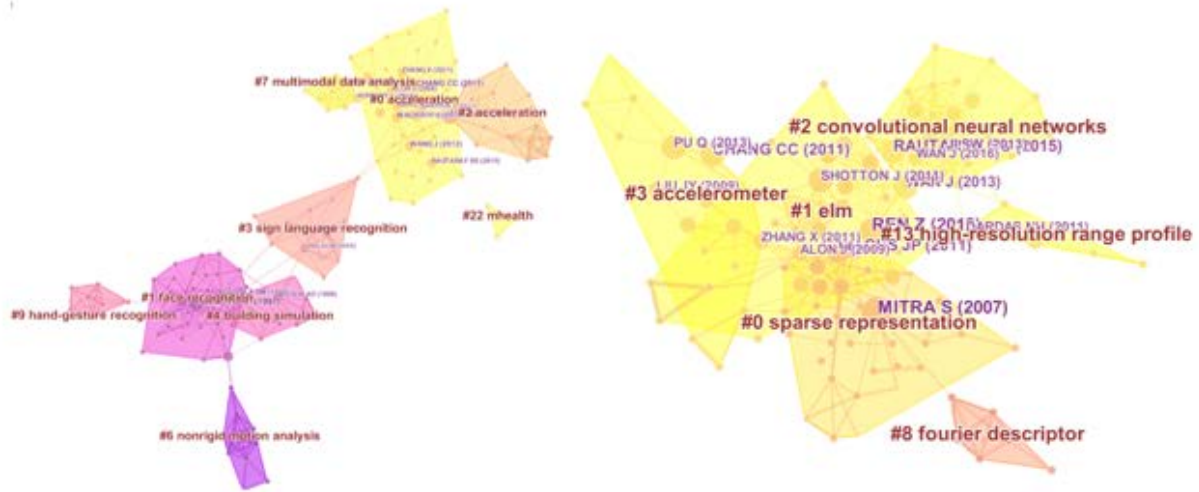
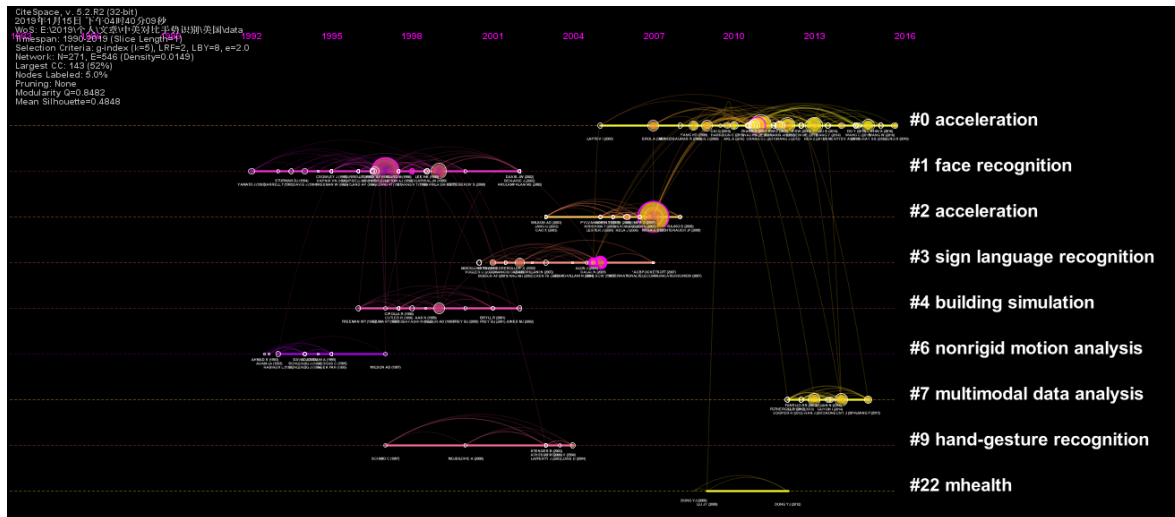Fig.5. Key words clusters network of gesture recognition(left - USA, right - China)

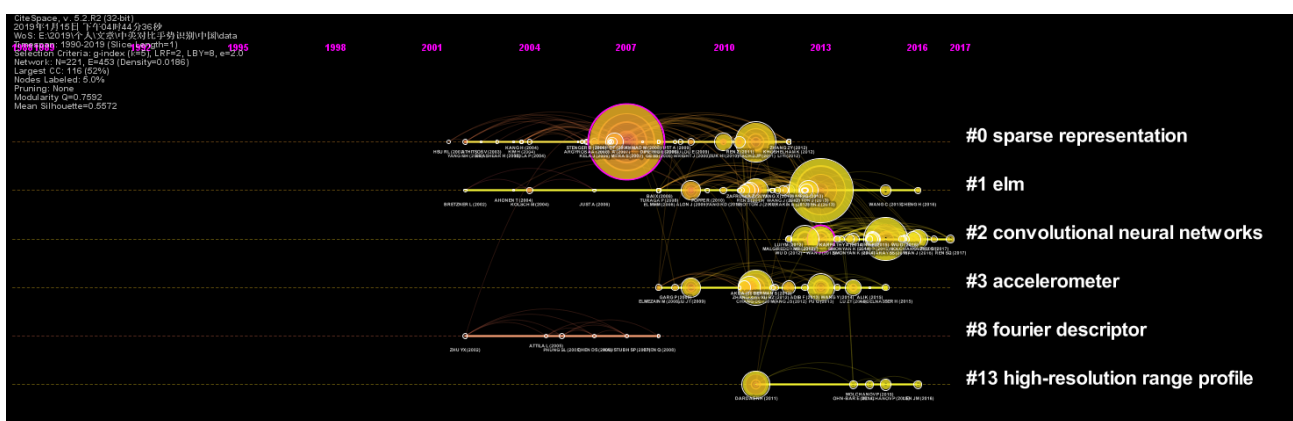Fig.6. Timeline view of gesture recognition(USA)

Fig.7. Timeline view of gesture recognition(China)

7. Summary

Through the data mining and analysis of gesture recognition research papers, the following conclusions are obtained:

(1) In 1991-2018, the number of research papers on gesture recognition is on the rise.

(2) The largest number of research papers in China. Chinese Academy of Sciences published the most papers, which is a very active research organization in the field.

(3) In cooperation network, China and the United States have the strongest cooperation. Both cooperate with Japan, Canada, Australia, South Korea and England.

(4) There are many subjects involved in the research of gesture recognition technology, mainly Computer Science, Engineering and Telecommunications. There are have a large number of papers in Engineering Electrical Electronic and Computer Science Artificial Intelligence.

(5) The hotspots of gesture recognition in China are convolutional neural networks, elm and high-resolution range profile. The hotspots of gesture recognition in the United States are acceleration and multimodal data analysis.

Acknowledgment

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