Introduction of Non-Traditional Machining Institution of China

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1. INTRODUCTION

The Japan Society of Electrical-Machining Engineers (JSEME) as an independent academic origination has been established for more than 50 years. In China, a similar organization named “The Non-traditional Machining Institution (NMI)” was established in 1979 for national non-traditional machining researchers and engineers, about 13 years later after JSEME. Last year marks the 40th anniversary of the founding of the NMI. As one of the thirty-three branches, NMI belongs to and is led by the Chinese Mechanical Engineering Society (CMES), which was found in 1936.

In comparison to JSEME, NMI covers a wider variety of academic exchanges, mainly including Electrical Discharge Machining (EDM), Electrochemical Machining (ECM), Laser Machining (LM), Additive Machining (AM) and Ultrasonic Machining (USM). The leading body of NMI is the Council, which is composed of academic discipline leaders, experts, entrepreneurs and managers in the field of non-traditional manufacturing. The standing organization responsible for the daily work is the Secretariat, which is under the leadership of the Council. The Secretariat is located in Suzhou Electromachining Machine Tool Research Institute Co., Ltd. The council serves four-year terms and the current president is Professor Di Zhu from Nanjing University of Aeronautics and Astronautics, who is also a member of the Chinese Academy of Sciences. To date, NMI has more than 400 individual members and about 120 group memberships respectively.

Centering on academic exchanges, the mission of NMI is to vigorously promote the development and application of new technologies, new processes and new equipment in the special manufacturing field, accelerate the process of transforming scientific and technological achievements into productivity, improve academic standards, develop industrial markets, and contribute to the country's economic construction.

2. INSTITUTIONAL FRAMEWORK

Two departments are created under the Council of NMI, namely professional technical committee and executive committee, respectively. As for the professional technical committees, the association has six divisions including:
1) Sink EDM Technical Committee
2) Wire EDM Technical Committee
3) ECM Technical Committee
4) LM Technical Committee
5) AM Technical Committee
6) USM Technical Committee.

On the other hand, the executive committee deals with the daily activities of the institution. Currently, there are six of them:
1) Academic Committee
2) International Exchange Committee
3) Organizational Committee
4) Education & Popular Science Committee
5) Editing and Publishing Committee
6) Young Researcher Committee

3. NATIONAL CONFERENCE OF NON-TRADITIONAL MACHINING

National Conference of Non-traditional Machining is the largest and most important conference in the field of non-traditional machining, which has played an active role in the progress and technical development of non-traditional machining disciplines. The conference is regularly held every two years by NMI and is one of the most influential conferences in CMES. Usually the conference set 8 parallel sessions including EDM, ECM, USM, LM, AM, Hybrid...
machining, High-energy Beam Machining etc.

In 2019, the 18th National Conference of Non-traditional Machining, hosted by NMI, co-organized by Xinjiang University and Suzhou Electric Machine Tool Research Institute Co., Ltd., and co-organized by the Xinjiang Mechanical Engineering Society, opened on August 1 in Urumqi, Xinjiang. As shown in Fig. 1, nearly 500 experts, scholars, scientific and technical personnel and students from universities, research institutes and enterprises in the non-traditional manufacturing field nationwide attended the conference. Based on the increasing trend of multidisciplinary integration and multi-energy field research, the theme of the conference was set as "Cross-border integration and innovation". This conference demonstrated the latest academic research results and application progress in the field of non-traditional machining in China and promoted the future cross-disciplinary integration and innovation.

At the beginning of the conference, four keynote speeches, as listed in Table 1, were presented. After that, the conference set up eight parallel sessions as mentioned above for comprehensive communication. A total of 15 invited talks and more than 150 papers were presented in the parallel sessions, of which 10 papers were selected by the academic committee of the conference, and they were rated as excellent papers of the conference and were commended and rewarded. In addition, the conference published the full-text electronic version and abstract paper version of all accepted papers. Specifically, a total of 234 papers (253 abstracts) were included. The contents of the papers covered all branches of non-traditional processing, among which, as plotted in Fig. 2, 37 papers were on sink EDM, 16 papers on micro EDM, 23 papers on wire EDM, 10 papers on small hole EDM, 51 papers on ECM, 34 papers on LM, 40 papers on AM (3D printing), 26 papers on USM, and 16 papers on other non-traditional processes, respectively.

| Table 1 Keynote speeches presented at the conference |
|-----------------------------------------------------|
| 1 Aerospace Development and Special Processing Technology |
| 2 Research and Development of Aero Engine Manufacturing Technology |
| 3 World landscape of 3D printing and China's opportunities |
| 4 On research trends of non-traditional machining based on published papers of ISEM2018 |

![Fig. 1 Group photo at the conference site in Urumqi, Xinjiang, 2019](image)

![Fig. 2 Distribution of accepted papers at the 18th National Conference of Non-traditional Machining](image)
On the other hand, in order to commemorate the 40th anniversary of the founding of the NMI, and carry forward the spirit of pragmatic and innovative scientific research, the association specially organized a selection activity of "40 outstanding papers at the 40th anniversary of the establishment of the NMI", and the award was represented to the outstanding paper winners on the site by President Di Zhu, as the photo in Fig. 3.

4. OTHER ACADEMIC CONFERENCES AND PUBLICATIONS

Except for the conference introduced above, there are a series of other conferences in NMI. In recent years, with the aim to strengthen exchanges and cooperation among young scientific researchers, and to promote the growth of young scholars and the innovative development of non-traditional machining technologies, national conferences specially for young researchers have been started. Currently, there are two of them:

1) National Conference of Non-traditional Machining for Young Researchers, started in 2018 and will be held every two years in the future.

2) National Conference of Additive Manufacturing for Young Researchers, every year.

Except for the above national conferences organized by NMI, each technical committee organizes their own national symposium which is more focused on a certain topic. Below is a list of the technical-committee-based national symposiums:

3) National Symposium on Sink EDM Technology, every two year.

4) National Symposium on Wire EDM Technology, every two year.

5) National Symposium on LM Technology, every two year.

6) National Symposium on USM Technology, every two year.

7) National Symposium on ECM Technology, every two year.

8) Conference on Hybrid Intelligent Manufacturing, every two year.

All the presented paper at the conferences or symposiums will be included in the conference proceedings and provided to the participants. Except for the proceeding, there is a periodical called “Electromachining & Mold”, which was found in 1966 to facilitate scientific communication in non-traditional manufacturing field. Currently, it has become the official journal of NMI. The journal is bimonthly, and it publishes at every 20th of each even month.

5. CURRENT STATUS OF THE EDM MACHINE TOOL INDUSTRY IN CHINA

At present, there are about 170 EDM machine tool makers in China, with about 12,000 employees. The number of manufacturers is far greater than in other countries in the world, but globally strong company has not yet emerged. Except for domestic companies, the world's leading manufacturers of EDM machine tool, such as Agie-charmilles of Switzerland, Sodick, Mitsubishi Electric and Makino Milling of Japan, have factories in China. Below is a brief introduction of the EDM machine tool industry in China based on a statistical analysis report of the EDM machine tool market in China in 2018 recently published [1].

5.1 Sales of EDM Machine Tools

According to the statistics of the operating data of 22 key enterprises of non-traditional machine tool industry by the China Machine Tool & Tool Builders' Association (CMTBA), the total sales of EDM machine tools in China were 17,286 units in 2018, an increase of 1203 units (7.48%) from 16 083 in 2017. The total sales value amounted to 271.24 million yuan, an increase of 111.78 million yuan (4.33%) from the 2.6346 million yuan in 2017 (Fig. 4).

On the other hand, the sales volume of foreign-funded and joint venture enterprises only accounted for 21.9% of the total market, but the sales value contribution rate reached 57.6%, showing that the average price of single machine tool was nearly 5 times that of domestic enterprises. It fully reflects the economic benefits created by technology and quality, and also shows that the maker for high-end electrical processing machine tool is basically occupied by foreign brands.
5.2 Export Situation

In 2018, the export volume of the 22 key companies for EDM machine tools was 2,859 units, and the export value was 129.53 million US dollars, with a growth rate of 20.48% and 14.52% compared with 2017, respectively. Although trade frictions have occurred between China and the United States this year, since the machine tools are mainly exported to Europe, Southeast Asia, the Middle East and other regions, the trade war had little impact on EDM machine tool exports (Fig. 5).

Among them, the export volume of unidirectional wire EDM machine tools was 1,282 units, accounting for 44.84% of the total, and it was the “export champion”. At the same time, the reciprocating wire EDM machine ranked the second, with an export volume of 724 units, an increase of 77.02% from 409 units in 2017. It accounted for 25.32% of total exports. The main reasons behind this are considered as follows:

1) In recent years, there has been a welcome change in the company's business philosophy, focusing on corporate image, strengthening brand building, actively participating in various exhibitions, especially foreign exhibitions, displaying in multiple directions, and strengthening publicity.

2) Strengthen cooperation with professional foreign trade companies, establish a good mutual trust and win-win relationship, actively expand overseas markets, strengthen product pre-sale consultation, sales test and after-sales service, and be enthusiastic, honest and timely.

3) Adhering to originality and advocating unique development, it has significantly improved functions, performance and reliability, and the machine tools have gradually been recognized and accepted by foreign users.

4) Compared with the unidirectional wire EDM machine, the reciprocating wire EDM machine is cheaper and has higher cost performance on the premise of meeting the processing requirements and is favored by foreign low-end customers.
5.3 Market Demand Analysis of Various Types of EDM Machine Tools

According to statistics, the sales volume and proportion of various types of EDM machine tools in 2018 in China are shown in Fig. 6. Among them, the largest sales were reciprocating wire EDM machines, reaching 10330 units, and the smallest sales were ordinary EDM machines, with only 282 units. In addition, it can be found that:

1) sink EDM machine tools account for only 17.39% of the total sales, and it is inferred that a considerable part of the market share is squeezed by high-speed metal cutting machine tools. Furthermore, among them, the market share of ordinary EDM machines is only 1.63%, and sales have shrunk sharply. The market share of CNC EDM machines has reached 15.76%, accounting for more than 90% of the sales of sink EDM machines, indicating that CNC machine tools are the mainstream demand in the market today, especially for multi-axis CNC EDM machines that have been well applied in aerospace field and have promising prospects.

2) Wire EDM machine tools are the main force in the EDM application market, accounting for more than 70% of the market. Among them, the market sales of reciprocating wire EDM machines accounted for more than half of the entire market, which was nearly 4 times the sales of unidirectional wire EDM machines. As an original EDM machine tool in China, reciprocating wire EDM machine has played an irreplaceable role in the domestic market. Especially in recent years, the function and quality have been significantly improved and fully recognized by the market.

3) The market share of small hole EDM machines is 8.43%, which shows an increase of nearly 1.5% from 6.9% in 2017, reflecting that small hole EDM is gradually being identified as one of the main machining methods by the aerospace and mold manufacturing industries.

In the proportion of sales value, as shown in Fig. 7, CNC sink EDM and unidirectional wire

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Fig. 6 Proportion and volume of sales of various types of EDM machine tools in 2018 in China
(Created by the author based on the data in Reference 1)

Fig. 7 Proportion and value of sales of various types of EDM machine tools in 2018 in China
(Created by the author based on the data in Reference 1)
EDM machine tools reached 31.31% and 36.78%, respectively, indicating that the position of high-end precision CNC EDM machines in the application market is unshakable and the high-precision, high-end equipment concept is being accepted by users.

The sales volume and value of other special EDM machine tools have reached nearly 400 units and 62.01 million yuan, respectively, which have a relatively large increase compared with 2017. It indicates that good results have been achieved in terms of developing new EDM machine tool models and expanding the application of EDM technology.

On the other hand, except for the machine tool makers, state-owned enterprises, universities and research institutions are developing project-oriented high-end machine tools by industry-university research cooperation to meet the needs of national science and technology development. This has been contributing to the continuous and innovative development of the non-traditional manufacturing technology.

6. ABOUT CIMT 2019

CIMT is short for China International Machine Tool Show, which was founded in 1989 by China Machine Tool & Tool Builders’ Association. CIMT is the most prestigious international machine tool exhibition in China every odd-numbered year. It is one of the big-four international machine tools exhibition in the world. The other three are EMO, IMTS and JIMTOF. The 16th CIMT was held at Beijing New International Expo Center from April 15 to 20, 2019. The total exhibition area of this exhibition reached 142,000 square meters, which attracted 1,700 manufacturers from 28 countries and regions in the world to participate in the exhibition. According to statistics, there are more than 70 non-traditional machine tool builders participating in this exhibition, including more than 50 domestic exhibitors and more than 20 overseas exhibitors. More than 140 non-traditional machine tools (sets) are displayed, including more than 60 EDM machines, more than 60 laser processing machines, more than 10 additive manufacturing machines and a few other special processing machines.

In EDM field, a total of four main types of EDM machine tools were exhibited at this exhibition four, including CNC sink EDM machine, CNC wire EDM machine, Micro hole EDM machine, Special EDM machines, such as EDM machines for PCD tools and diamond wheel manufacturing and electrochemical deburring machines. On the whole, there were no major breakthroughs in the performance index and various manufacturers have focused on consolidating and improving existing products in recent years, for example, development of pulse power control technology with low or zero electrode wear, improvement of process reliability, stability and consistency. Especially, many efforts are made to promote the implementation of information technology to realize intelligentization, automation and networking. Also, EDM machine tool builders are seeking to further expand EDM application fields, deepen market segmentation and pay more attention to providing users with solutions.

REFERENCES

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