Foreword

Motor Technology is Still Interesting

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I am very proud to have this opportunity to write the Foreword for the KYB Technical Review No.63 published by KYB Corporation, which has broad operations mainly related to hydraulic equipment.

Readers of this Foreword are probably involved in manufacturing in some individual way, depending on their position in concrete efforts. Many may have felt or been strongly moved by the fact that manufacturing offers convenience, functionality and/or effectiveness. In relation to the motor technology that supports the Japanese manufacturing industry, I would like to describe in this Forward how I have been fascinated by the technology, what I am studying about it now, and what future motors will be like.

1. Encounter with motors

In my childhood, my daily life was spent among "vivid" learning materials for production. As my family were part-time farmers, I saw how rice grains were threshed in autumn. I also had the opportunity to see stone craftsmen striking rocks with push hammers in Ishiya-machi, Okazaki City, where I used to live and which is famous for its marble stone. I was surrounded by many things that would motivate my curiosity about manufacturing. Today, we live in a society flooded with meticulously made products. I am rather worried about today's children, who are given virtually no occasion to repair things themselves and could grow up without feeling anything about production.

When I was a third-year university student, I was enrolled in a lecture on electric equipment, including direct-current motors. I studied this subject with enthusiasm, probably because I had kept my passion for manufacturing ever since my childhood. Unlike the other subjects I was enrolled in during the year, the electric-equipment curriculum greatly fascinated me because, in addition to the fact that the curriculum covered "motors," which are one of the historical industrial products, I thought it was a discipline of "genuine engineering" that integrates different theories, including electromagnetics as well as material science, mechanical engineering and control technology. Motors, which have a history as long as nearly 200 years, even now account for about 50 percent of power consumption. I think that the motor is an electromechanical energy conversion device that can hardly be substituted by any other device, in that they have a quite good balance among cost, reliability and power density. At that time, the world's first mass-production hybrid car "Prius" happened to be released to the market. I had had an impression that a motor was a low-technology product made of iron and copper, but I changed that impression when I encountered the car designed based on a brand-new concept equipped with a newly-structured motor. Eventually, I came to recognize motors as being extremely interesting high technology. That experience also made me want to be involved in research on the front line of the field. I then made a decision to join one of the few laboratories engaged in motor research and development.

2. My research activity in university

Neary 20 years have passed since I became acquainted with the world of motors under the theme of computer-aided design of application-oriented electric motors in the master's course I was doing. The concept of application-oriented electric motors was proposed in 1995 by Nobuyuki Matsui, who is an ex-President of Nagoya Institute of Technology and also my mentor. One example of application-oriented electric motors is the hybrid car drive motor. To deliver the highly demanding performance in the limited space of the engine room, even the motor structure and mechanism are specifically designed from the beginning according to required specifications. The concept of application-oriented electric motors was based on an idea that, unlike traditional general-purpose motors, motors developed in this way would virtually be future-proof motors, and that a shorter design lead time was critical to open up such a world. In other words, computer-aided design enabling general design, detailed design, prototyping and evaluation processes to be completed in a short period was indispensable. As the computing power had dramatically advanced, it certainly became easier to clarify electromagnetic phenomena, including three-dimensional magnetic saturation, thereby enabling specially-designed advanced motors to be used for various applications, as forecasted by my mentor. Now, with a

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focus on material technology that may determine the advancement of motors, I am trying to create a motor technology that satisfies the demands of the next era, under the belief that new material will be a key to enhancing the motor characteristics.

3. Future motors

Recently, motors have found wider applications and more users in additional fields to activate product development, allowing motors to be more easily used by anybody. Behind this trend is the penetration of Internet of Things (IoT). We have just entered the age of "Networked Appliances" and "Connected Cars," where home appliances, automobiles and various other applications are networked. How will motors used in such scenarios evolve? For example, air-conditioners may no longer need to have the capability of quickly heating/cooling a room if their controls can be remotely operated by users before they return home. For automobiles, your car may never hit an object even if you, in an extreme case, fall asleep while driving, or you can drive anywhere while seeing real-time video of the scenery. That is, your car is robotized. Perhaps such an age may come. If so, the motor requirements, including required performance, will substantially change, and we will need to create new technologies in response to the changes. Motor technology is still interesting, as it can create new values to adapt to the modern social structure and ever-changing lifestyle. You are unable to take your eyes off the advancement of the technology.