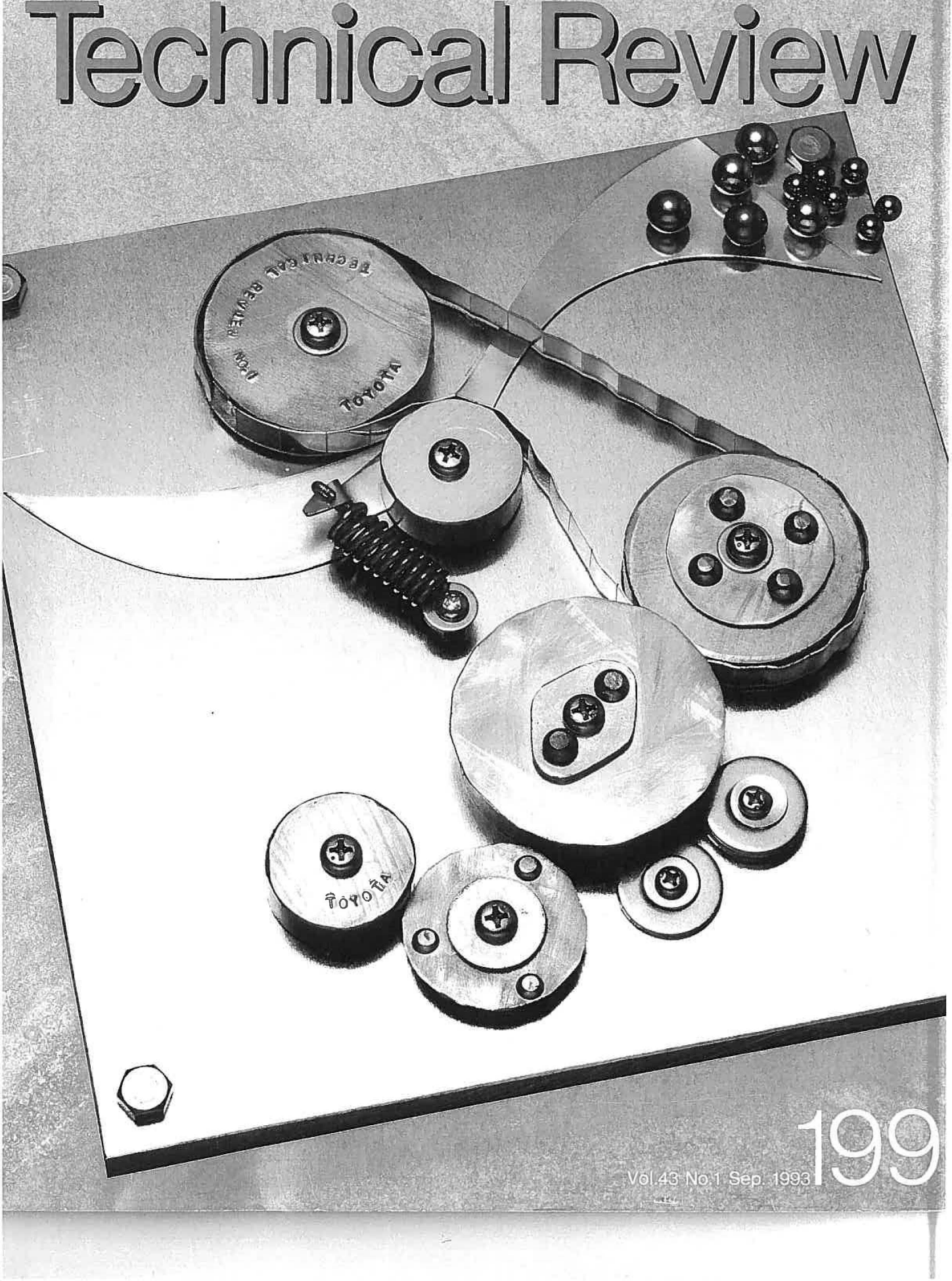
Technical Review



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We are hereby sending you "TOYOTA Technical Review" Vol. 43, No. 1.

With this edition, we are pleased to announce a new line-up of editorial staff. We will be doing our best to make this magazine as interesting as possible, and count on your support.

To be perfectly honest, until I was invited to join the editorial team in February, I had no idea that the old TOYOTA ENGINEERING had changed to the TTR. In the former days of the TOYOTA ENGINEERING, I had dearly wanted to publish a report on certain development work, but was disappointed when I didn't get the opportunity to do so. That was my main experience with the journal. The TTR is Toyota's only journal publishing technical reports, and is in that sense one of the faces of Toyota. Consequently, I will use this opportunity as a member of the editorial staff to let more people know about the journal and its contents. (M. Yamashita)

The history of the automobile goes back over a century, and industrially it appears to have reached the saturation region of the growth curve. Automobile technology is already adequate if we think of motor vehicles as instruments to get us from A to B. Recent technical development has focused on making the trip there more comfortable and safe. However, our attention is now turning to the harm the automobile brings to the environment, seen in such problems as carbon dioxide gas control and disposal of scrapped cars. We are now facing the task of developing technologies that will remove the contradictions between motoring convenience and conservation of the environment. When these problems are solved, I believe the automobile will move along a new growth curve that may be very dramatic indeed. (T. Mori)

From this year I have been given the responsibility of supervising the editorial team. Considering the outstanding record of this magazine, I hope I'm up to the task. At any rate, I'll give it my best shot. The theme for this issue is "Intelligent Vehicles". This is the magazine's first attempt at active editing, in contrast to the passive stance it has assumed until now. We are anticipating that this issue will appeal to a wider audience, and that TTR will become even more popular. Happy reading! (Y. Masuda)

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技術資料室［保存用

Driving Environment Recognition for Active Safety

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Peripheral Recognition for Active Safety Peripheral enhancement/advisory systems which provide perceptual enhancements and warnings of hazards for drivers are expected to contribute to active safety. This paper describes three types of peripheral recognition techniques which have been researched and developed by TOYOTA Motor Corp. since 1980's, that is, millimeter-wave radar and laser radar based on active-sensing and CCD image processing based on passive-sensing. Both millimeter-wave radar and laser radar feature excellent weather resistance and provide range detection for relatively far objects. The CCD image processing system adopts template matching method to perform lane-line recognition and approaching vehicle detection by stereo vision and optical-flow detection.

1. Introduction

It has been well known that driving operation by a driver is performed in three steps: perception/recognition, decision making and control/response. Along with complication of driving environment due to increasing traffic in recent years, the driver's load for perception/recognition and decision making has been increasing. One of Japanese highway accident statistics shows that collisions with roadside structures and rear-end collisions account for over 50% of total accidents. Most of fatal accidents may be avoided by preventing departure from the traveling lane and rear-end collisions.

One conceivable method for preventing these is to install electronic perceptual enhancement/advisory systems for active safety. In other words, it is to make vehicles have intelligence for recognizing the driving environment and informing drivers of the surrounding conditions and any possible danger.

Such a perceptual enhancement/advisory system, however, is to provide the driver with only the information required for safe driving, and the driver must assume the final responsibility for driving operation.

Sufficient discussion may be required for obtaining social consensus on the system reliability and resultant change in the driver's safety consciousness while clarifying the scope of responsibility.

To make perceptual enhancement/advisory systems more reliable, infrastructure such as roadside monitoring and vehicle/roadway communication systems should be implemented.

Intelligent vehicle systems can be used more efficiently when they are well coordinated with the roadside infrastructure.

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Fig. 1 shows four definite types of perceptual enhancement/advisory systems that may be put into practical use.

The peripheral recognition technologies for such systems must involve minimum lowering of the detecting performance due to changes in weather and other environmental conditions and less cost burden on the user side. Manufacturers have been studying various methods, but they have not been established as technologies for recognition of vehicle peripheral conditions.

Toyota Motor Corp. has been studying and developing millimeter-wave radar, laser radar and image processing technologies shown in **Table 1** as peripheral recognition technologies for perceptual enhancement/recognition systems.

While active-sensing systems detect the electromagnetic wave (beam) emitted from the built-in device and reflected from targets, passive-sensing systems detect reflected electromagnetic waves existing in the ordinary state or and the electromagnetic wave radiated from targets. Because an active-sensing system irradiates the wave itself, the S/N of the received signal is high. As compared with a passive-sensing system, an active-sensing system is less affected by changes in weather conditions such as rain and fog. The existing active-sensing systems have problems such as insufficient resolution for accurate locating of targets and difficulty in mounting on vehicles.

This paper describes the results of our studies on various peripheral recognition methods and themes to be studied in the future.

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