Future Brake Systems in the Automotive Industry

Mustafa Ata*
Continental Automotive Technologies GmbH, Guerickestr. 7, 60488 Frankfurt am Main, Germany
*Corresponding address: mustafa.ata@continental-corporation.com

Abstract: Regardless of the architecture of the vehicle and the architecture of future braking systems, the brake remains the most important element of active safety. Reliability is a must, and "brake manufacturers" do not make compromises. This mentality of the experts and the know-how that has grown over decades will become even more important in the future in order to equip the brake for future requirements and maintain absolute confidence in it: The status and appreciation of the "brake" function will remain untouched.

However, almost everything else is beginning to change.

Vehicles are being rethought. Global megatrends are behind this. With the electrification of the drive and the growing capability for automated driving (AD), vehicle architecture is changing. Braking systems are becoming increasingly intelligent in order to meet future requirements through automated driving and electrification. And this is newly designed vehicles with a modified architecture. This functional expansion requires a deep understanding of the system in order to combine uncompromising safety and sustainability in future braking systems, which will be also modular and distributed in the long term.

Digitalization and networking are bringing about a fundamental reorganization of the electrical and electronic architecture (E/E architecture), which is increasingly geared towards the software. Because it is the software that will determine the character of the car and the driving experience in the future!

Bits are taking the place of horsepower.

Apps and services are expanding the car into an immersive experience that is becoming ever safer and more comfortable. This presentation looks at what this means for future braking systems and for the foundry industry.

Keywords: brake system; automotive industry; autonomous driving; future technology; electric vehicles

1 Introduction

The roadmap ranges from FBS 0 to FBS 3 and shows the development from brake control to systems for controlling the entire vehicle movement. It charts the path to completely “dry” brakes on the rear and front axles.

At the beginning of this roadmap (FBS 0) is the award-winning, second generation of the MK C2 brake-by-wire brake system as an introduction to all Future Brake Systems. The subsequent generations are so called “one-box brake-by-wire” systems.

In the next development stage (FBS 1), it is no longer necessary to mount the system directly on the bulkhead at a specific point in front of the driver in order to enable a mechanical fallback level. Instead, an electronic pedal supports new vehicle concepts with different interior spaces and dimensions, such as the skateboard chassis of electrified vehicles, on which different superstructures can be mounted. Decentralization increases the degree of freedom of vehicle architectures

With FBS 2, the braking system begins to “go dry on one axle”. The first step is to stop applying the brakes hydraulically on the rear axle. For vehicle manufacturers, this decentralization means “breaking up” the conventional architecture and further increasing the degree of freedom of vehicle architectures.

With FBS 3, the braking system can ultimately be broken down into modules. In the long term, the hydraulic system could be completely eliminated, including all fluids, which would contribute to sustainability.

To achieve this, all four-wheel-corners could be actuated electromechanically and would be completely dry. Individual functions of a braking system are packaged as stand-alone products in modular, validated and proven software blocks

One of the further strategies is focusing on the future of drum brake system. This brake system technology is reducing CO_2 and particulate emissions and closed system offers additional protection.

The drum brake is almost as old as the automobile itself. For many, it is considered as an old-fashioned product that is used today at most in a low-powered small car. However, many overlook the great potential of the drum brake. Durability, robustness and brake dust reduction are just some of the reasons why car manufacturers should rely on this modified and further developed technology in the future. Old technology in modern cars-closed system- offers additional protection

Drum brakes are a real alternative to disc brakes, especially for electric cars. Due to the high recuperation performance of new electric cars, the brake is rarely used in many everyday situations. What at first sounds like a longer service life for brake linings and brake discs actually leads to the exact opposite with disc brakes. Due to their infrequent use, disc brakes are more susceptible to corrosion, they lose braking power after a long period of inactivity, which must be available 100% and spontaneously in an emergency.

The drum brake is a system that is completely encapsulated in a housing. This means that the mechanics and the braking surfaces inside are well protected against the effects of corrosion such as rain and salt. In addition, the brake shoes are reliably released from the drum surface by the force of a spring, so that residual braking torque is not an issue with the drum brake.

Particle emission reduction is given due to closed design.

While combustion engines have had to meet increasingly stringent exhaust emission limits in recent years, the focus is now also shifting to wheel brakes. This is because, depending on the size of the particles emitted, brake dust can have far-reaching harmful effects on human health. Experts are expecting stricter legal requirements from the EU Commission by 2025 at the latest. Closed design, accumulates brake dust inside the drum brake and can be therefore collected.

However, the use of the drum brake on the front axle is also very practical. The duo-servo principle used achieves a high braking torque with low actuation forces; the self-reinforcing effect of this functional principle can be positively utilized. This makes the drum brake on the front axle an ideal component for the next generation of dry-actuated wheel brakes. Continental is preparing for a wide range of customer requests and is continuing to develop a wide variety of wheel brakes.

In view of this mix of system characteristics, the drum brake is an attractive option not only for the rear axle of electric vehicles, but also for the front axle of vehicles, depending on the vehicle segment and requirements

"Green Caliper" is a further option with advanced features to improve residual resistance and the option of using slide rails with a special surface treatment for low friction. The pad surface is reduced, taking recuperation into account, and the weight of the brake caliper is optimized. Further weight optimization is possible by reducing the pad thickness for BEVs.

Another technology is the "Wheel hub drive with integrated brake

2 Conclusion

The brake **sys**tem architecture is changing.

A lot of researches and investigations are ongoing for the future brake systems, as the electrification of vehicles is progressing rapidly.

Automated driving (AD) and electrification pose new challenges for brakes as does the need for greater sustainability and lower friction losses due to residual resistance.

The mechanical part of brake actuates on the hydraulics can be replaced by electrical control.

Hydraulics may become optional in the long term, depending on the strategy of the individual vehicle manufacturers. In addition, electromechanical brake actuation offers more freedom in defining the vehicle architecture. Both basic types of wheel brake, the disc brake and the drum brake, offer potential for future requirements, regardless of whether with hydraulic or electromechanical actuation.