

# An Overview of Drive by Wire Technology for Automobiles

Arvind Goyal  
Mechanical Engineering Department  
Amity University  
Uttar Pradesh, India  
aaravgoyal7@hotmail.com

Ayushi Thakur  
Mechanical Engineering Department  
Amity University  
Uttar Pradesh, India  
athakur@gn.amity.edu

**Abstract**—Drive-by-wire is one of the recently developed technologies in automotive industry. Drive by wire technology is also known as “X by Wire” or simply “By Wire” technology. The vehicle equipped with this kind of technology basically runs on electronically controls various range of operations including braking, throttle, Steering and Acceleration. Conventional functioning cars run primarily on hydraulics and mechanical technology to operate the same operations. Conventional system might be powerful but, in the end, are far too complex and not very efficient to wear and tear over the years but Drive by wire technology gives the designer more space due to the replacement of mechanical linkage. Due to the industrialization and innovations in the field of Automotive industry manufacturers and inventors have been used the integrated approach of computers and electronics into modern cars functioning. The functioning of the vehicles is performed by the instructions from computers and sensors. It is also proven to be a boon for the environment by becoming fuel efficient, reduces and improves the engine emissions. This paper describes the concept and types of Drive-by-wire technologies and drawbacks and limitation of it.

**Keyword:** throttle, hydraulics, sensors, emission,

## I. INTRODUCTION

Drive by wire technologies used for automobiles give whole new experience to the driver Drive by wire is kinds of technology that can be used in the place of all the mechanical wires into the electrical wires, in any kind of drive by wire technology sensors records the signals (information) and pass this data to the series of computers or computer which transfers the electrical energy to mechanical motion [1].

Over the years, Research and Development of the automobile sector has been experimenting by introducing the computers into the cars and making it smarter. If the drivers get used to the idea, Drive by wire powered system has the proven to have a great impact on overall automobile industry. As with the use of this system, several factors from safety to comfort, functionality and vehicle operative system increases efficiently. Sensors / Actuators would analyze the command and instruct the vehicle to exactly what to do. It is also proven to be a boon for the environment by becoming fuel efficient, reduces and improves the engine emissions [2].

It is most common technology used in the aviation industry, as the airplanes are using this system with the name “flying over the wires” since the 90s. This technology works on the same principal of electronically wires to do the operations.

## II. BASIC DESCRIPTION

Automobile Sector is facing a new trend where mechanical wires and hydraulics are being replaced with the electric wires. Weight of an automobile vehicle can easily be reduced with the replacement of some major components like: Hydraulics, Brakes, hoses, fluids and coolers etc. With the introduction of Stability Control feature, safety of the vehicles can be increased up to appreciable extent. Electronic cables tend to increase the flexibility of the motor vehicle, making it easier to modify or upgrade vehicle. Several features like: Fuel Efficiency, improve handling and shorten response time in case of emergency are some pros of Electronic controls.

Even though it seems pretty cool features that are being introduced by Electronic cables but with the implementation of such wires, it invites the complexity of the system control functions which makes it even much harder to model also integrating and fail-closed performance poses a compelling the challenge for the automotive industry.



Fig. 1. Drive by wire [13]

## III. TYPES OF DRIVE BY WIRE SYSTEM

With the implementation of drive by wire, electric cables have potential to replace all the mechanical controls in the automobile vehicle. By-wire works on the principal of recording the data by the sensors and passes this data to the computer or a processor where this data is further accumulated, converting electrical energy into the mechanical motion. Due to the existence of various kinds of drive by wire systems, generally this is also called as x-by wire system. Some major drive by wire systems are as follows:

### A. Steer by wire

Today number of vehicles is already under the impression of electronic cables where throttle and brakes have already been replaced with the same.

1. A rear steer by wire with front steering are some conventional supplement to improve and increase the maneuverability and high-speed stability. Even though it seems daunting concept for the most the Conventional drivers to completely replace the steering system with the electronic wire than the throttle wire or break by wire, has some advantages.
2. The design of the automobile can be made simple and accessible with the eradication of the steering column, resulting in simplification of interiors of the car.
3. The steering wheel can be compatibly set up into the dashboard according the need of the driver, whether it is left hand drive or the right hand one.
4. Other advantage of using steer by wire is that without mechanical connection between the steering wheel and the road wheel, it is less likely that the impact of the frontal crash will force the steering wheel to intrude into the driver's survival space.
5. Also Steering system characteristics can be easily adjusted to optimize the steering response [3].

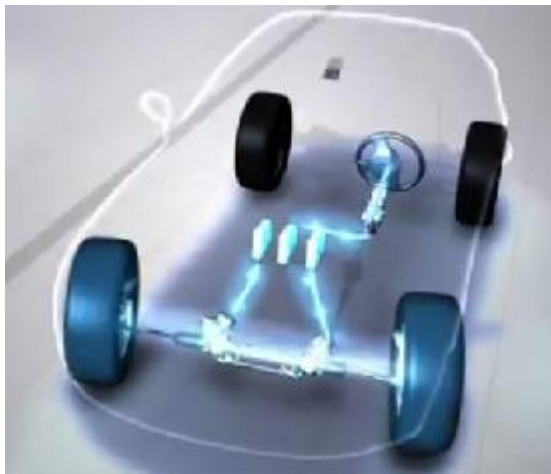


Fig. 2. Steer by wire Technology [14]

### B. Throttle by Wire

Throttle by wire is extensively known as the acceleration by wire, which is a one of its kind in the automobile sector. Pedal unit and Engine management system is used in the type of concept. The pedal acts as a sensor that tracks the pressure put on the driver on the same and then this information is transferred to the engine management system, which is nonetheless a computer with a processor that processes the information and performs the task, determines how much fuel is required, this kind of the information is further transferred to the actuator. The pad here can be the same conventional pad that is being used in the past for the decades by the automotive drivers. Video controllers or joysticks can incorporate the same operations that are being performed by the pad. Of course, vehicle

operations like acceleration, braking and steering has to be controlled with the use of Hands.

Throttle by wire is being widely used as automotive technology in the vehicles nowadays, where it replaces the clutches throttle linkage with the pedal position sensor and throttle operated electronically [4].

#### *Advantages of Throttle by Wire:*

1. It eradicates binding problems in mechanical linkages for forbidding the accelerator from sticking.
2. Emission can be reduced; efficiency and fuel economy can be improved by provides automatic throttle control arrangement.
3. Advanced modulated system can be formed using modeling and installation of throttle by wire [5].
4. It also allows the ECM to integrate the features such as torque management with cruise control, traction control and stability control. The accelerator pad detects the position of accelerator pedal, retrieve the information and convey it to the ECM as a variation in the electric resistance. The ECM operates a servo-motor, which controls the movement of butterfly valve, the feedback circuit with the help of the ECM, collects the feedback and continuously monitors the position of the throttle.

The traditional type of throttle system connected gas pedal and throttle using a wire [6]. When the gas pedal experiences force or pressure, the gas valve gets open with the linkage of cable. In vehicles this is done with the use of electric throttle control (ETC), there is no mechanical linkage between the gas pedal and the accelerator. It works on the same principle of the brake-by-wire system. Where the gas pedal sends a signal, which causes an electromechanical actuate to open the throttle [7].

### C. Brake by Wire

Brake by Wire is an automotive technology which is used to implement so that it will completely eradicate the clutches mechanical and hydraulic components and replacing them with the electronic sensors and actuates to control the brakes of vehicles.

#### *Advantages of Brakes by wire technology:*

1. Reacts faster, reducing distance and storage time.
2. Elimination of vibrations and reduction in the power loss of mechanical system can be achieved in this arrangement.
3. Occupancy of Less space makes this system engine compatible and this space utilization contributes to a better use of space.
4. Allows the ECM to integrate torque management with cruise control, traction control and stability control.
5. Reduction in the total weight of the entire system, improves the energy efficiency.
6. Comparatively less amount of mechanical power can to introduce hybrid and fuel cell vehicles [8].

Lack of mechanical power can facilitate the need Brake by Wire concept is still under the R&D phase, so it cannot be implemented in the regular cars yet. This system consist rheostat that detects the position of the brake pedal and a signal is generated by it which is interoperated by the processor that further generate signals which operate the servo pump. The pump pressurizes the secondary circuit, which enables the braking fluid to be pushed against the piston, hence activating the brakes. The computer continuously monitors the pressure and receives signal which applies mechanical force to the pedal as feedback to the driver [9].

#### IV. BENEFITS & DRAWBACKS OF DRIVE BY WIRE SYSTEM

It seems very exciting to introduce the Drive by Wire technology into the vehicles. By implementing this Fascinating technology, various clutched moving parts can be significantly removed or replaced with the lighter and more efficient electronic wires. Various advantages like Weight reduction, operational accuracy and more importantly will turn out to be more convenient as it will stretch out the time between service visits for things like mechanical maintained and other improvisation. Some of the drive by wire system does not even need any maintained for decades, which results in lesser weight and better accuracy that in the end increase the fuel efficiency and fewer emissions [10].

This type of technology is not new to the world, as it's been used all around the globe in Airline Industry; while it will take much more time being introduced in cars. The major problem the big car industrialists are facing is to convince the vehicle owner or driver regarding the benefits of this System despite being much complex and the danger of electronic or electrical malfunction in the wire or sensors and computer might lead to the vehicle damage or even car accident or passenger injury. These are some of the major drawbacks and fear that Car manufacturers have to overcome before launching this technology to the world. Out of the various theories among the drivers and critics, one famous theory states the failure of the software system; no matter how many times it has been tested. For instance, the sensor of the brake by wire system could make an error in the calculations, causing the brake caliper and pad to apply incorrect amount of pressure - either too lightly or heavy despite the continuous efforts made by the driver to push the pedal, causing him trouble or even in the worst-case scenario, might lead to an accident [11].

In any case, most the people have common belief that any software or program is as good as the programmer and developer who builds it. With the successful running of the drive by wire system in the airline industry, it is quite evident that after few more tastings and product design could bring this system safely to the everyday cars. While, various luxurious and big brands like BMW, MERCEDES, TOYOTA, GM, NISSAN AND RANZE ROVER, have already been inclined towards the drive by wire system where they have used or been using this technology.

#### V. THE FUTURE OF DRIVE BY WIRE

Safety concerns has proven to be the main hurdle and major drawback of implementing this technology in the everyday cars, while mechanical systems do fail too yet they seem to be more reliable than the electrical wires, additionally the electrical wires are more expensive than the cliché wires due to the fact that they are more complex. However, the future of wire technology can lead to a large number of interesting events. Removing mechanical [12].

Controls could allow manufacturers to design vehicles that are more futuristic and far from the reality. Concept cars, such as on-wire, are allowed to sit, as they do not have mechanical controls that devote the driver's position. Drive by wire can also be integrated with the driverless car technology, can work together and in hand, which would allow driver to have the controls in hand or can operate the same with the help of the computer. Electromechanical actuators for controlling steering, braking and acceleration, which can be simplified by direct connection to wire technology.

#### VI. CONCLUSION

Intricacy of Drive by wire and the failure of the software is a concern to the automotive manufacturers as these setbacks might result in some major accident or injury of any passenger. On the contrary, the drive by wire system is being used in the airline industry for the years with a magnificent safety record. In the end, with the enhanced Safety features and the specific benefits of the electrical wires will certainly out weight the complexity and fear of the people. The authenticity and Accuracy of these wires, hence, drive by wire will used widely in aircraft and automotive industry [14].

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