A Review Paper on Analysis of Braking System by X-by-Wire System using FlexRay

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ABSTRACT:-

In the recent years, advanced technologies of electronic devices for the communication and computer engineering have been considered to be widely implemented in the vehicle systems. Among those possible applications, the automotive network which is so-called "X-by-Wire" scheme has been developed for steering control and braking control of the vehicles. It is known that the weight reduction of vehicle systems can decrease the power consumption in the design of electric driven vehicle by replacing the mechanical components with electronic devices. Therefore, X-by-wire system combined with fault-tolerant applications will be a trend in the automotive industry. Under the automotive circumstance, the time-trigged protocol improves the network capacity and guarantees the transmission of all safety related message. In order to ensure the safety of electronic devices, an advanced networking protocol FlexRay has been recently proposed to the design of X-by-wire system.

KEYWORDS:- X-By-Wire,Drive-By-Wire , Steer-By-Wire , AUTOSTAR

1. INTRODUCTION

Flex Ray is known to be an advanced networking protocol for by-wire system. It provides several benefits over CAN (Controller Area Network). Drive-by-wire automotive system uses electronic systems, human machine interface and sensors in automobiles instead of mechanical and hydraulic parts with electro- pneumatic actuators and communication network. There is no mechanical linkage between steering and wheels. X-by-wire system brings the advantages by decreasing their weight and cost and provides more safety and comfort. In BBW system, the amount of brake applied via brake pedal is propagated by wire to the brake pad, which is controlled by a electro mechanical system like electric motor or pneumatic actuator and a real time communication network.

2. LITERATURE REVIEW

Thomas Nolte Et al (2006) [1] a survey of existing and upcoming automotive networking technologies, identifying traditional and novel automotive application requirements and addressing to what extent existent and upcoming networking technologies are able to meet such requirements. The paper has discussed the next steps in automotive communications, with a specific focus on x-by-wire systems and wireless applications. One of the bigger challenges today is interconnecting a modern automotive architecture of possibly heterogeneous networks. This can be achieved by developing standardised middleware technologies.

Rainer Makowitz (2006) [2] FlexRay is the next generation communication architecture for automotive applications. Today, qualified Controller and Physical Network Interface products exist and automotive mass-production will begin in 2006. Safety critical applications like by-wire systems will use mechanisms built into FlexRay to support fault tolerance. No technical limits are known today that would limit its use for state-of-the-art systems. Full flexibility exists for emerging systems architectures for 'affordable' safety in vehicles. However, the FlexRay market is expected to develop in non-safety-critical application first.

Jianmin Duan (2009) [3] The bus technology, one of the key technologies of Steer-By-Wire technology was researched, using the latest Technology of FlexRay bus, proposing a two-node distributed control Steer-By-Wire system. The two ECU operates and controls independent, with FlexRay bus to transmit data. For this particular application environment, when establishing the FlexRay network, it can minimize each communication cycle; increase the length of time for each slot as much as possible. The data of each node is transmitted in the static segment to make sure the data is transmitted correctly, improve the real-time performance of the system as well. In addition, the use of time-triggered FlexRay characteristics, with the physical layer using the same dual-channel data transmission and the same data in different slots transmitted, further enhance the system security and reliability, which also have been proved by the experimental results, while explaining the rationality of configuration of FlexRay parameters in the SBW system.

Inseok Park (2011) [4] In this paper, we have presented a methodology for designing FlexRay network parameters. Our NPO method is predicated on the principles for optimizing the bandwidth utilization and WCRT of the frames. The method consists of two steps which determine the optimal ST slot length and communication-cycle length. This methodology makes it easy to design FlexRay network. In the first step of the

NPO method, the optimal ST slot length can be determined with optimal criteria such as protocol overhead and unused network resource. Using the results from the first step, the second step finds the optimal communication cycle length with WCRT analysis of ST and DYN frames. The process of the NPO method is clearly defined in a straightforward manner. Therefore, it can easily be applied to network design applications for automotive, avionic, and industrial fieldbus systems as well. Ultimately, designing a FlexRay configuration is an emerging field. There exists a wide array of possibilities for future work. Some important issues include supporting signal-based frame construction and multirate communication with cycle filtering and in-cycle repetition functionalities.

Purnendu Sinha (2011)[5] With recent advancements in automotive electronics, X-by-wire technology will play a key role in development of electric vehicles for enhancing safety, reliability and functionality. In this paper, we have studied the fault-tolerance requirements of brake-by-wire systems and proposed a system-level-architecture for a fail operational brake-by-wire system. Compliance to the evolving ISO 26262 functional safety standard will be an important requirement/consideration in automotive E/E system development in future. ISO 26262 calls for systematic safety analysis leading to functional safety concept definition and deriving safety requirements from architectural assumptions and system safety goals. With that perspective, following the recommendations/guidelines as outlined in the standard, we have performed reliability and safety analysis of fail-operational brake-by-wire system. The focus of this study has been to explore a safety analysis method suitable for concept level architecture evaluation towards meeting the draft ISO 26262 requirements. Our analysis shows that to achieve high dependability requirements, system architecture must support detection of the first failure and provide sufficient functionality following the first failure to ensure that the system continues to deliver desired services till the time it is repaired (or faults are fixed). We acknowledge that the results obtained are sensitive to the numerical values assumed in the paper. These reliability figures are based on approximate estimate of failure rates, coverage factors and repair rates, and the data must be carefully derived and examined. The concepts and methods discussed in the paper can be used as initial guidance in the preliminary phase of architecture design. Many subtle nuances of system design have not been explored and warrant supporting evidence through experiments.

Der-Cherng Liaw (2012) [6] In this paper, we proposed a FlexRay protocol-based network control system for drive-by-wire and brake-by-wire of electric vehicle. Based on our own developed FlexRay communication node, we have implemented such a system. The performance testing on both of the conveyer in the laboratory and the real road demonstrate the success of the design. It is found from this study that the size of FlexRay communication node and the control scheme for the synchronization of four-wheel motor speed play very important roles in practical implementation of X-by-wire system.

Jinfang Gou (2014) [7] This paper researches the FlexRay communication protocol based on AUTOSAR and make a three-node test verification.

From the research and the verification, it can be seen that the FlexRay bus has high speed, high flexibility, high reliability and high communications safety. Meanwhile, its control algorithm is simple and hardware architecture is simple. With the popularization of the AUTOSAR and the generalization of FlexRay, this researchment of FlexRay communication protocol based on AUTOSAR will be of great use.

Shreyas J (2015) [8] X-BY-WIRE system is a clear trend of automotive development due to the advantages in electronic components for enhancing safety, functionality and reducing cost. Modern cars are equipped with drive-by-wire systems and a combined mechanical backup. In the future mechanical backup systems will be replaced by pure electronic solutions. The real rime constrains in the X-BY WIRE system can be overcome by further research and analysis. The X-BY-WIRE system provides a better feature for automobile engineering with great precision and efficiency.

Lei Zhang (2016) [9] The application of the Brake-by-Wire (BBW) system in vehicles makes brake force allocation possible between axles or among wheels based on the fact that brake force of each wheel can be accurately regulated. Braking force allocation should make full use of tire-road friction and improve vehicles' braking performance. The classic straight-line braking force allocation only takes the adhesion coefficient into account, which is not suitable for braking-in-turn maneuvers due to the influence of the lateral braking force demand. Thus, a novel braking force allocation method during a braking-in-turn maneuver for vehicle with the BBW system is proposed in this paper. The proposed strategy takes into consideration not only the front-rear load transfer but also the lateral adhesion utilization in the braking force distribution. Since front-rear braking force allocation contributes more to preventing the rear wheels from locking up, it is determined first, followed by the allocations of inner-outer braking forces. The front-rear allocation is not sensitive to lateral acceleration and the yaw rate, which usually involve measurement noises. Thus, sequential allocation increases the robustness of the braking. I-curves with respect to three different parameters are

proposed that are capable to guide front-rear braking force allocation. The simulation and experimental results indicate that the proposed front-rear allocation makes good use of adhesion and achieves good performance in maintaining vehicle stability. Inner-outer wheel braking forces are allocated in proportion to vertical force. The simulation and experimental results show that the proposed allocation decreases the possibility of wheel lock up compared to equal allocation under the same braking rate condition. The proposed inner-outer allocation generates an active yaw moment to prevent the turn-inward tendency caused by braking-in-turn maneuvers, thus improving vehicles' steering stability. The proposed method provides theoretical guidelines on independent braking force allocation to control the BBW system in normal braking, which will enhance vehicle stability and braking performance. The main advantage of the proposed method over existing studies is that each of the wheels is able to make full use of the longitudinal friction and meets the lateral force demand as well. Sequential allocation decreases the sensitivity of allocation to lateral dynamics variables without compromising the braking-in-turn maneuver performance.

3. CONCLUSIONS

- FlexRay is the next generation communication architecture for automotive applications.
- The focus of this study has been to explore a safety analysis method suitable for concept level architecture evaluation.
- This paper is proposed for the design of FlexRay vehicle communication network for an ABS based on X-by-Wire under which the time triggered protocol improves the network capacity and guarantees the transmission of all safety related message.
- Our analysis shows that to achieve high dependability requirements, system architecture must support detection of the first failure and provide sufficient functionality following the first failure to ensure that the system continues to deliver desired services till the time it is repaired.
- With these recent advancements in automotive electronics X-by-Wire technology will play a key role in development of electric vehicles for enhancing safety.
- Therefore, X-by-Wire system combined with fault tolerant application will be in trend in the automotive industry.

4. REFERENCES

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