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Barging along the Conflitual Line Between Protocals and Practicals: Autonomous Driving Solution Between Chinese Manufacturers and Tesla

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Abstract. This paper explores the technological underpinnings and regulatory challenges of autonomous driving systems in New Energy Vehicles (NEVs), with a focus on three core components: electric control systems, electric motors, and batteries. By comparing the differing design philosophies and regulatory responses between countries—particularly between the U.S. and China—the paper highlights how national protocols influence the feasibility and development trajectory of NEV technologies. Special attention is given to Tesla's vision-based autonomous driving model and its contrast with the sensor-integrated, high-computation approaches adopted by Chinese manufacturers. The analysis further examines how protocol constraints in China shape system integration, latency issues, and real-time performance. Ultimately, the study provides a technical and policy-oriented overview of NEV development, contributing to a deeper understanding of the interaction between engineering innovation and geopolitical frameworks in the era of intelligent mobility.

Keywords: Electric motor, Electric control, Battery management, Autonomous driving solution

1. Introduction

The automotive industry has witnessed a transformative shift toward sustainable transportation solutions, with new energy vehicles (NEVs) emerging as a critical component in addressing global environmental challenges and reducing fossil fuel dependence. Tesla Motors' entry into the Chinese market in 2014 marked a pivotal moment in this transformation, representing the first foreign-capital-financed vehicle manufacturer to establish operations in China. This strategic market entry has yielded remarkable results, with Tesla achieving over 657,000 vehicle sales in China by 2024, representing a year-on-year growth of approximately 8.8% and establishing new industry benchmarks [1]. The Tesla Gigafactory Shanghai has evolved beyond a local manufacturing facility to become Tesla's primary global export hub, demonstrating the company's continued commitment to expanding its presence in the Chinese market through sustained investment and technological advancement.

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The proliferation of NEVs in the Chinese automotive market exemplifies a broader paradigm shift from traditional energy vehicles (TEVs) to electric alternatives, driven by both technological innovation and supportive government policies. The Chinese government's strategic emphasis on environmental sustainability has created a favorable regulatory environment for NEV adoption, recognizing that the transition from fossil fuel-dependent transportation systems to electric alternatives represents a crucial step toward achieving national carbon neutrality goals. Traditional energy vehicles present significant environmental challenges through their reliance on fossil fuels, contributing to air pollution and greenhouse gas emissions. In contrast, NEVs utilize electrical energy as their primary power source, substantially reducing the environmental impact associated with transportation while addressing the challenges imposed by fossil fuel dependence.

The technical distinctions between NEVs and TEVs extend beyond their power sources to encompass fundamental differences in control systems, motor technologies, and autonomous driving capabilities. This paper focuses specifically on the control management systems of NEVs and their autonomous driving features, areas where significant technological divergence has emerged among manufacturers. NEVs incorporate complex subsystems and components, including sophisticated electrification transport systems, advanced battery management technologies, and most critically, autonomous driving systems that represent the cutting edge of automotive innovation.

A particularly noteworthy aspect of the current NEV landscape is the fundamental philosophical and technical divide between Tesla's approach to autonomous driving and the strategies employed by Chinese manufacturers. Tesla has adopted a vision-based autonomous driving solution that relies primarily on camera systems and artificial intelligence algorithms to interpret road conditions and make driving decisions. However, this approach has encountered regulatory challenges in China, where government policies regarding data collection and storage have created barriers to full implementation. Chinese car manufacturers, conversely, have developed mixed-method approaches to autonomous driving that combine multiple sensor technologies and real-time processing capabilities to achieve end-to-end autonomous functionality.

This technological divergence presents several critical challenges and considerations. The mixed-method approach employed by Chinese manufacturers involves complex multi-modal data acquisition, categorization, coding, and analysis processes [2]. These systems must integrate information from various sensors, including cameras, lidar, radar, and other detection technologies, creating sophisticated but computationally intensive solutions. The complexity of these systems is reflected in their hardware requirements, with Chinese autonomous NEVs typically requiring dual processing chips compared to Tesla's single-chip architecture, resulting in approximately double the electrical consumption for autonomous driving functions.

The research questions that guide this investigation emerge from these fundamental technological and regulatory differences: First, what are the specific differences in electric control systems between Tesla and Chinese car manufacturers, and how do these differences impact overall vehicle performance and efficiency? Second, how do the electric motor technologies employed by Tesla compare to those utilized by Chinese manufacturers in terms of power delivery, efficiency, and integration with autonomous systems? Third, what are the comparative advantages and limitations of charging and battery technologies between Tesla and Chinese manufacturers, particularly in the context of supporting autonomous driving capabilities?

An intriguing market dynamic has emerged wherein Chinese car manufacturers continue to benchmark their new products against Tesla models that are several years old, primarily due to Tesla's superior battery longevity and performance characteristics. Tesla's battery systems demonstrate the ability to maintain optimal performance over extended periods, while Chinese

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manufacturers' batteries typically retain approximately 80% of Tesla's performance metrics over comparable timeframes. This performance gap has significant implications for consumer adoption, vehicle resale values, and long-term market competitiveness.

The autonomous driving solutions employed by these manufacturers represent fundamentally different approaches to achieving similar objectives. Tesla's visual autonomous driving system operates by storing comprehensive road data in cloud-based databases, which vehicles access in real-time to inform navigation and decision-making processes. This system utilizes a sophisticated multi-camera array that provides complete 360-degree field-of-view coverage around the vehicle, effectively eliminating blind spots and enhancing safety through comprehensive environmental awareness [3]. The system's reliance on pre-mapped data and visual recognition algorithms enables consistent performance across various driving conditions and geographic locations.

Chinese manufacturers have predominantly adopted real-time road lane detection systems that enable vehicles to make autonomous decisions based on immediate environmental conditions rather than pre-stored data. These systems maintain intelligent vehicle operation from origin to destination through continuous analysis of road conditions, traffic patterns, and environmental factors. However, this approach presents significant challenges, particularly when operating at high speeds, and requires advanced computer vision algorithms supported by powerful processing systems capable of high-speed data analysis [4].

The fundamental debate between these approaches centers on the types of data acquisition and processing methodologies employed. Vision-based systems utilize video-type data that is synchronized through segmented photographic analysis of road situations, creating a comprehensive but static representation of driving environments. Mixed-method approaches, conversely, acquire and process multi-modal data in real-time, enabling dynamic adaptation to changing conditions but requiring substantially greater computational resources and processing power.

The regulatory environment in China has shown greater support for real-time road lane detection systems, primarily due to data sovereignty and security considerations. These systems operate through machine learning algorithms that enable continuous improvement during operation, eliminating the need for centralized data storage and external access to sensitive geographic and infrastructure information. Tesla's vision-based approach, while technologically sophisticated and globally successful, conflicts with Chinese government policies regarding data collection and storage by foreign entities, particularly concerning detailed road and mapping information that could have strategic implications.

Both technological approaches present distinct advantages and limitations that impact their practical implementation and market acceptance. Real-time road lane detection systems require minimal human training data, as the systems learn to navigate traffic conditions on local roads regardless of lane marking presence or absence. These systems demonstrate particular effectiveness on highways and in challenging environments such as parking lots and unpaved roads where traditional navigation aids may be insufficient [5]. However, the absence of distinctive environmental features can cause lane detection algorithms to become confused by objects with similar visual characteristics, while inconsistent lane configurations and diverse marking patterns, including solid, broken, single, double, merging, and splitting lines, further complicate system performance [6].

Tesla's visual autonomous driving approach offers the advantage of comprehensive obstacle detection through camera systems that provide complete 360-degree environmental awareness without blind spots. The integration of cloud-based database information significantly reduces accident probability by providing vehicles with access to detailed environmental data and predictive

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analytics. Nevertheless, the system faces substantial challenges in detecting obstacles accurately at high speeds and long distances, representing one of the most significant technical hurdles for vision-based autonomous driving implementation.

To facilitate comprehensive evaluation and comparison of the predominant autonomous NEV driving solutions, this paper categorizes NEV technologies into two primary classifications: pure vision solutions and mixed-data approaches. The analysis encompasses general knowledge of autonomous vehicle technologies, including detailed examination of vision-based recognition systems and mixed-method solution architectures. The paper concludes with a thorough comparison of these methodologies, analyzing their respective advantages, limitations, and implications for the future development of autonomous NEV technologies.

This comparative analysis aims to contribute to the broader understanding of autonomous driving technologies in the NEV sector, providing insights that may inform future technological development, regulatory frameworks, and market strategies. By examining the technical, regulatory, and market factors that influence the adoption and implementation of different autonomous driving approaches, this research seeks to illuminate the complex interplay between technological innovation, government policy, and market dynamics in shaping the future of sustainable transportation.

2. Research review

The method of archival research is adopted for search and selection of apt academic literatures for composing of this paper. The keywords the author adopted for preliminary literature search was: New energy vehicle, technical aspects, autonomous driving. The resulted two literatures have been found as focusing on the following fields: electrical motor, electrical control, electrical charging system. The terminology “electrical motor” is the one and only power source to provide power for the electrical vehicle, it has challenges such as torque accuracy yet it still provides a good reference for electrical vehicle motor drive system design. In terms of electrical control, it refers to the control on a variety of functionalities with speed control as one of the core aims. Electrical vehicles are driven by motor without any gears in the scopes of fixed torque and fixed power, electrical control are required to make sure they can work under certain circumstances. The battery and charging systems are mainly reliant on the Li-ion battery. They are very important and reliable as a power source, and are more environmentally friendly than the traditional power source as burning fuel. Aiming at these three keyword terminologies, the author has searched up on search engines such as Google Scholar and Bing Academics. The literature searches lead me on to the following databases: ELSEVIER ScienceDirect, Sage Journals, Wiley and Springer Nature. The papers screening process involves identifying whether the paper is relevant with the utilised keywords and related subfields. Some of these papers describe directly the functions of particular technology, some make references to the differences of technology.

The main topics the author is going to be shedding light on three aspects in this paper. Respectefully, they are the differences in terms of accuracy, safety level, and feasibility with Chinese context between visual autonomous driving and mixed method autonomous driving. In reference to accuracy, it means the data fetched by the vehicle using its method need to be accurate and same with the actual organisation of road managment such as the markings on the road surface. The terminology safety level, means the ability of the autonomous car keeping its passengers safe while using these autonomous driving solutions. Feasibility with Chinese context is compared between China and other countries since the former has a unique road condition and social organisation style. The literatures enlisted above have been selected and will be used at further lengths as sources of

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discussion for this paper. The resulted selection process has yielded 13 existing literatures for the extraction of concnerned data in coverage of electrical control, electrical motor and electrical charging system.

3. Traditional vehicles vs new energy vehicles: the driving control system and its autonomous future

The modes which the vehicles are currently using is these main 4 types: traditional driving mode, motor-drive axle combined driving mode, motor-drive axle integrated driving mode, and wheel motor driving mode. For the traditional driving mode, although it has replacable engines, yet it has a complex structure with a really low effeciency. For the motor-drive axle combined driving mode, it has high efficiency and is easy to install, similar to the motor-drive axle integrated driving mode, which has its gears penetrating each other. For the wheel motor driving system, it has various advantages such as little usage of space and little magnetic and mechanical noice.

The fundamental architecture of electric vehicle driving control systems represents one of the most critical technological differentiators between Tesla's approach and Chinese manufacturers' methodologies. Guirong, Henghai, and Houyu's comprehensive analysis of pure electric vehicle driving control systems provides essential insights into the four primary driving modes currently implemented across the industry: traditional driving mode, motor-drive axle combined driving mode, motor-drive axle integrated driving mode, and wheel motor driving mode. Each of these driving modes presents distinct advantages and limitations that significantly impact overall vehicle performance, efficiency, and integration with autonomous driving capabilities.

The traditional driving mode, while offering the advantage of replaceable engine components that facilitate maintenance and component upgrades, suffers from inherent structural complexity that results in substantially reduced operational efficiency. This complexity stems from the need to integrate multiple mechanical systems that were originally designed for internal combustion engines, creating inefficiencies when adapted for electric propulsion. The mechanical complexity not only reduces energy conversion efficiency but also increases maintenance requirements and potential failure points, making this approach less suitable for advanced autonomous driving applications that require consistent and reliable power delivery.

Motor-drive axle combined driving mode represents a significant advancement in electric vehicle architecture, offering substantially improved efficiency compared to traditional systems while maintaining relative ease of installation and integration. This approach combines the electric motor directly with the drive axle, reducing mechanical complexity and improving power transmission efficiency [7]. The system's design facilitates better integration with vehicle control systems, making it particularly suitable for applications requiring precise speed and torque control, which are essential for autonomous driving functionality. The reduced mechanical complexity also translates to lower maintenance requirements and improved reliability, factors that are crucial for autonomous vehicles that must operate with minimal human intervention.

The motor-drive axle integrated driving mode builds upon the combined approach by further integrating mechanical components, with gear systems that interpenetrate to create even more efficient power transmission [7]. This integration reduces energy losses associated with mechanical interfaces and provides more precise control over power delivery to the wheels. The enhanced integration facilitates better coordination between propulsion systems and autonomous driving algorithms, enabling more responsive and accurate vehicle control. However, the increased integration also presents challenges in terms of component replacement and maintenance, requiring more sophisticated diagnostic and repair capabilities.

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Wheel motor driving systems represent the most advanced approach to electric vehicle propulsion, offering numerous advantages that make them particularly suitable for autonomous driving applications [7]. These systems provide exceptional space efficiency by integrating motors directly into wheel assemblies, eliminating the need for traditional drive shafts and differential systems. This configuration significantly reduces mechanical noise and magnetic interference, creating a quieter operational environment that enhances passenger comfort and reduces electromagnetic interference with sensitive autonomous driving sensors and communication systems.

3.1. Driving control system and driving modes

The wheel motor approach offers unprecedented precision in individual wheel control, enabling advanced stability management, traction control, and dynamic handling adjustments that are essential for autonomous driving safety. Each wheel can be controlled independently, allowing for precise torque vectoring that enhances vehicle stability and maneuverability in challenging driving conditions. This level of control precision is particularly valuable for autonomous systems that must respond rapidly to changing road conditions, obstacles, or emergency situations.

Tesla's implementation of electric vehicle driving control systems emphasizes integration and efficiency, utilizing a centralized approach that coordinates all vehicle systems through a single, powerful computing platform [7].This architecture enables seamless integration between propulsion control and autonomous driving algorithms, allowing for real-time optimization of power delivery based on driving conditions and autonomous system requirements. The centralized control approach reduces system complexity and potential communication delays between subsystems, enhancing overall system responsiveness and reliability.

Chinese manufacturers have generally adopted more distributed control architectures that separate propulsion control from autonomous driving systems, requiring coordination between multiple processing units. While this approach offers advantages in terms of system modularity and component replacement, it also introduces potential communication delays and coordination challenges that can impact autonomous driving performance [8]. The distributed architecture requires more sophisticated communication protocols and redundancy systems to ensure reliable operation, particularly in safety-critical autonomous driving scenarios.

The energy efficiency implications of different driving control approaches have significant impacts on autonomous driving capabilities, as autonomous systems require substantial electrical power for sensor operation, data processing, and communication systems. Tesla's integrated approach typically achieves higher overall system efficiency, allowing more electrical energy to be allocated to autonomous driving functions without compromising vehicle range. Chinese manufacturers' distributed systems, while offering greater flexibility, often require additional energy for inter-system communication and coordination, potentially reducing the energy available for autonomous driving operations.

The integration of driving control systems with autonomous driving algorithms presents different challenges and opportunities for each approach. Tesla's centralized architecture facilitates direct integration between propulsion control and autonomous decision-making, enabling rapid response to autonomous system commands and seamless coordination between navigation, obstacle avoidance, and vehicle control functions. This integration allows for advanced features such as predictive power management, where the autonomous system can anticipate power requirements based on planned routes and driving conditions.

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3.2. Combination of chinese protocol and autonomous driving system

Chinese manufacturers' distributed architectures require more complex integration protocols but offer advantages in terms of system redundancy and fault tolerance. If one control system experiences problems, other systems can potentially maintain vehicle operation, enhancing overall safety. However, this redundancy comes at the cost of increased system complexity and potential coordination challenges that must be carefully managed to ensure reliable autonomous operation.

The maintenance and diagnostic implications of different driving control approaches also impact long-term autonomous vehicle viability. Tesla's integrated systems require specialized diagnostic equipment and training but offer comprehensive system monitoring and predictive maintenance capabilities. Chinese manufacturers' modular approaches facilitate component-level maintenance and replacement but require more complex diagnostic procedures to identify inter-system communication issues and coordination problems [6].

Future developments in electric vehicle driving control systems are likely to focus on further integration of propulsion and autonomous systems, with emphasis on energy efficiency, response time, and safety redundancy. The evolution of these systems will significantly impact the practical implementation and market acceptance of autonomous driving technologies, making the comparative analysis of current approaches essential for understanding future technological trajectories and market dynamics [8].

The thermal management implications of different driving control architectures represent another critical dimension in the comparative analysis between Tesla and Chinese manufacturers. Tesla's integrated approach to driving control systems incorporates sophisticated thermal management strategies that coordinate cooling requirements across all vehicle systems, including the propulsion motors, power electronics, battery systems, and autonomous driving computing hardware. This holistic thermal management approach enables optimal performance across all systems while minimizing energy consumption dedicated to cooling, thereby maximizing the energy available for vehicle propulsion and autonomous driving operations. The integrated thermal management system utilizes predictive algorithms that anticipate thermal loads based on driving patterns, environmental conditions, and autonomous system requirements, enabling proactive cooling adjustments that maintain optimal operating temperatures without excessive energy consumption [8].

Chinese manufacturers' distributed control architectures often require separate thermal management systems for different vehicle subsystems, potentially leading to less efficient overall thermal management and higher energy consumption for cooling purposes. Each subsystem may operate its own thermal management protocols, which can result in suboptimal coordination and potential conflicts between cooling requirements of different systems. For instance, the autonomous driving computing systems may require intensive cooling during complex processing operations, while the propulsion systems may generate significant heat during high-performance driving scenarios. Without integrated thermal management, these competing cooling demands can strain the vehicle's electrical systems and reduce overall efficiency [9].

The software architecture underlying driving control systems presents fundamental differences between Tesla's approach and Chinese manufacturers' methodologies. Tesla's software-centric approach treats the vehicle as a computing platform with wheels, where driving control functions are implemented through software algorithms that can be updated and optimized remotely. This approach enables continuous improvement of driving control performance through over-the-air updates, allowing Tesla to refine control algorithms, optimize energy efficiency, and enhance integration with autonomous driving systems without requiring physical modifications to the vehicle. The software-centric architecture also facilitates rapid deployment of new features and

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capabilities, enabling Tesla to respond quickly to changing market demands and regulatory requirements.

Chinese manufacturers have traditionally employed more hardware-centric approaches to driving control, where control functions are implemented through dedicated hardware systems with limited software flexibility. While this approach can offer advantages in terms of system reliability and predictable performance, it limits the ability to implement improvements and optimizations after vehicle production. However, recent developments among Chinese manufacturers have shown increasing adoption of software-defined vehicle architectures that enable greater flexibility and update capabilities, though these implementations often maintain greater separation between propulsion control and autonomous driving systems compared to Tesla’s integrated approach [8].

The real-time performance characteristics of driving control systems significantly impact autonomous driving capabilities, particularly in emergency situations where rapid response times are critical for safety. Tesla’s integrated architecture enables extremely low latency communication between autonomous driving algorithms and propulsion control systems, allowing for rapid implementation of emergency maneuvers such as collision avoidance, emergency braking, and stability corrections. The direct integration eliminates communication delays that might occur in distributed systems, enabling response times measured in milliseconds rather than the tens of milliseconds that might be required for inter-system communication in distributed architectures.

3.3. Latency on real-time operating system

Chinese manufacturers’ distributed systems must carefully manage communication protocols and system coordination to achieve acceptable real-time performance for autonomous driving applications. Advanced communication buses and real-time operating systems are employed to minimize latency and ensure deterministic response times, but the fundamental requirement for inter-system communication introduces inherent delays that must be carefully managed. Some Chinese manufacturers have implemented dedicated high-speed communication channels between autonomous driving systems and propulsion control to minimize these delays, but the distributed architecture still presents challenges in achieving the ultra-low latency performance that may be required for advanced autonomous driving scenarios [10].

4. Modular manufacturing of autonomous vehicles

The scalability and modularity implications of different driving control approaches have significant impacts on manufacturing efficiency, cost management, and product differentiation strategies. Tesla’s integrated approach enables economies of scale through standardized control architectures that can be deployed across multiple vehicle models with minimal modification. This standardization reduces development costs, simplifies manufacturing processes, and enables consistent performance characteristics across Tesla’s vehicle lineup. However, the integrated approach can limit flexibility in adapting to different vehicle configurations or market-specific requirements, potentially constraining product differentiation opportunities.

Chinese manufacturers’ modular approaches offer greater flexibility in adapting driving control systems to different vehicle configurations, market requirements, and price points. Different combinations of control modules can be selected to create vehicles with varying performance characteristics and cost structures, enabling more targeted market positioning and competitive pricing strategies. The modular approach also facilitates partnerships with different component suppliers and enables manufacturers to leverage specialized expertise from multiple vendors.

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However, this flexibility comes at the cost of increased system complexity, potential integration challenges, and higher overall development and validation costs.

The main disadvantage the autonomous vehicles are now having is that their control systems are not connected to each other. Different car manufaccturers have different control system within their cars. This carried out a major problem that if the car manufactuer have to close due to bankruptancy, this can lead to the dilemma of 'no back-up plan'.

The cybersecurity implications of driving control system architectures represent an increasingly critical consideration as vehicles become more connected and autonomous. Tesla’s integrated approach creates a unified attack surface that must be carefully protected, but also enables comprehensive security monitoring and coordinated response to potential threats [10]. The centralized architecture facilitates implementation of advanced security measures such as encrypted communication, secure boot processes, and real-time threat detection across all vehicle systems. Tesla’s software-centric approach also enables rapid deployment of security updates and patches through over-the-air updates, allowing for quick response to newly discovered vulnerabilities.

Chinese manufacturers’ distributed architectures present different cybersecurity challenges and opportunities. The separation between different control systems can provide security benefits by limiting the potential impact of successful attacks on individual subsystems. If one system is compromised, the distributed architecture may prevent attackers from gaining access to other critical vehicle systems [7]. However, the multiple communication interfaces required for distributed systems create additional potential attack vectors that must be secured and monitored. Each inter-system communication channel represents a potential entry point for malicious actors, requiring comprehensive security measures across all communication protocols.

The diagnostic and maintenance capabilities enabled by different driving control architectures have significant implications for vehicle lifecycle costs and autonomous driving reliability [9]. Tesla’s integrated approach provides comprehensive system monitoring and diagnostic capabilities that enable predictive maintenance and proactive identification of potential issues before they impact vehicle performance. The integrated architecture facilitates correlation of data across all vehicle systems, enabling sophisticated analysis of system interactions and identification of subtle performance degradations that might not be apparent when examining individual subsystems in isolation.

Chinese manufacturers’ modular approaches enable component-level diagnostics and maintenance, potentially simplifying repair procedures and reducing maintenance costs for specific subsystem failures. Individual modules can be diagnosed, tested, and replaced independently, potentially reducing vehicle downtime and repair complexity. However, the distributed architecture can complicate diagnosis of issues that involve interactions between multiple subsystems, requiring more sophisticated diagnostic procedures and potentially longer troubleshooting times for complex problems.

The energy management strategies enabled by different driving control architectures have direct impacts on autonomous driving capabilities and overall vehicle efficiency. Tesla’s integrated approach enables sophisticated energy management algorithms that optimize power distribution across all vehicle systems based on real-time driving conditions, autonomous system requirements, and predictive analysis of upcoming driving scenarios. The integrated energy management can dynamically allocate power between propulsion, autonomous driving computing, climate control, and other vehicle systems to maximize overall efficiency and performance [9].

Chinese manufacturers’ distributed systems require coordination between multiple energy management subsystems, potentially leading to suboptimal power allocation and reduced overall

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efficiency. Each subsystem may optimize its own energy consumption without full awareness of the energy requirements and priorities of other systems, potentially leading to conflicts and inefficiencies. However, some Chinese manufacturers have implemented centralized energy management systems that coordinate power allocation across distributed control architectures, attempting to achieve the benefits of integrated energy management while maintaining the modularity advantages of distributed systems [10].

The future evolution of driving control systems will likely be influenced by emerging technologies such as artificial intelligence, machine learning, and advanced semiconductor technologies. Tesla's integrated approach positions the company to leverage these technologies through software updates and algorithm improvements, potentially enabling continuous enhancement of driving control performance without hardware modifications [10]. The software-centric architecture facilitates implementation of machine learning algorithms that can optimize control parameters based on individual driving patterns and environmental conditions.

Chinese manufacturers' modular approaches may enable more rapid adoption of new hardware technologies as they become available, allowing for selective upgrades of specific subsystems without requiring complete system redesigns. This flexibility could enable Chinese manufacturers to incorporate cutting-edge technologies more quickly than integrated approaches that require comprehensive system validation and integration testing. However, the distributed architecture may limit the ability to implement system-wide optimizations that leverage advanced artificial intelligence and machine learning technologies.

The regulatory compliance implications of different driving control architectures vary significantly across different markets and jurisdictions. Tesla's integrated approach must ensure that the entire system complies with all applicable regulations, which can be challenging when regulations vary between different markets or change over time [8]. However, the software-centric architecture enables relatively rapid adaptation to new regulatory requirements through software updates, potentially reducing compliance costs and time-to-market for new regulations.

Chinese manufacturers' modular approaches may offer advantages in regulatory compliance by enabling selective modification of specific subsystems to meet different regulatory requirements without impacting other vehicle systems [10]. This flexibility can be particularly valuable when operating in multiple markets with different regulatory frameworks or when regulations change frequently. However, the distributed architecture requires careful coordination to ensure that modifications to individual subsystems do not inadvertently impact compliance of other systems or overall vehicle performance.

The competitive implications of different driving control approaches extend beyond technical performance to encompass market positioning, brand differentiation, and strategic partnerships. Tesla's integrated approach enables the company to maintain tight control over the entire driving experience and autonomous driving capabilities, supporting premium brand positioning and differentiation based on advanced technology integration [8]. The integrated approach also enables Tesla to capture more value from technological innovations and maintain competitive advantages through proprietary system integration.

Chinese manufacturers' modular approaches enable different competitive strategies, including partnerships with specialized technology providers, flexible product positioning across different market segments, and rapid adaptation to changing market conditions. The modular architecture facilitates collaboration with leading technology companies in specific domains, potentially enabling access to cutting-edge technologies that might be difficult to develop internally. However, the

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modular approach may limit the ability to create unique, integrated experiences that differentiate products in increasingly competitive markets.

5. Conclusion

In the modern society, NEVs have become a major part of the vehicle market. They consume a new type of energy (electricity) which are sustainable and environmentally friendly. A key focus of the paper has been the fundamental differences in control systems, motor technologies, and autonomous driving capabilities between NEVs and TEVs, with a specific emphasis on the divergence between Tesla's vision-based autonomous driving approach and the mixed-method strategies employed by Chinese manufacturers. Tesla's reliance on camera systems and AI algorithms for interpreting road conditions has faced regulatory challenges in China due to data collection and storage policies. Conversely, Chinese manufacturers have adopted mixed-method approaches integrating various sensor technologies like cameras, lidar, and radar, leading to more computationally intensive solutions requiring dual processing chips and higher electrical consumption for autonomous driving functions. The author has written mainly about the NEV's three major components: electric control, electric motor and battary. In the detailed discription of the writing above, the writer has written about driving modes and systems, combination of driving modes and protocols, latencies, manufacturing and future development. In the traditional driving systems there are mainly four types of systems each have their advantages and disadvantages. However, since the chinese protocals have many limitations, only some can be combined with the autonomous driving system. Chinese manufactuers are using realtime autonomous driving currently, there are some latencies and the manufacturing of the specific system has difficulties. Yet in the future, there are still developments on the autonomous drving systems.

In a further angle, the performance of NEVs and autonomous vehicles under the divers real-world conditions are really complicated. For example, a Chinese NEV company has made an experiment about autonomous vehicles coping with complicated road conditions, the performance of vehicles containing laser radar systems are not as good as Tesla's visual autonomous driving vehicles. NEVs are also facing many other threats such as cybersecurity vulnerabilities in its driving control systems ; long term battary degradation and autonomous system impacts. These factors can cause the NEVs major problems in their future developments. In light with the existing literatures, the uniformity in electrical motor and battaries cannot be easily achieved by the Chinese manufacturers. Under this condition, it is unrealistic to discuss the key components in autonomous vehicles. In further angles, this condition will be discussed considering about various issues which are limiting Chinese manufacturers.

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