

Research on Insurance Issues of Traffic Accidents Involving Autonomous Vehicles

Gulisong Aishan, Lv Jiani, Li Yangyue, Li Wenling

Beijing Wuzi University, Beijing, China

ABSTRACT

The popularization of autonomous driving technology has reshaped the operation mode of road traffic. Nevertheless, emerging risks arising from algorithm failures, hardware malfunctions, cyber threats and other technical defects have exerted severe impacts on China's traditional motor vehicle insurance regime and relevant legal systems. At present, China lacks top-level national legislation governing autonomous driving and dedicated insurance rules for autonomous vehicles, while the traditional insurance system demonstrates poor adaptability to new scenarios, giving rise to numerous challenges including ambiguous liability boundaries, inconsistent judicial adjudication standards and backward claim settlement mechanisms. Based on differentiated risks corresponding to Level 2 to Level 4 autonomous driving, this paper adopts normative analysis, case analysis and comparative research methods, draws on advanced institutional experiences from foreign jurisdictions, and innovatively constructs a three-tiered insurance mechanism integrating basic protection, commercial supplementary coverage and subrogation and loss allocation. Breaking the research limitation of the traditional "human liability-oriented" paradigm, this study can provide theoretical and practical references for improving China's autonomous driving insurance system, innovating insurance products and realizing standardized industrial development.

KEYWORDS: *insurance system; traffic accidents of autonomous vehicles; liability insurance; applicable value.*

I. INTRODUCTION

1.1. Research Background and Significance

As an entirely new form of vehicle operation, autonomous driving fundamentally subverts conventional driving modes and substantially reduces the frequency of traffic accidents, thereby mitigating personal and property losses sustained by accident victims. Driven by rapid technological advancement and the widespread application of artificial intelligence, the integration of autonomous driving technologies into road transportation represents an inevitable trend of social development. Meanwhile, multiple traffic accidents recorded during road tests of autonomous vehicles in recent years have exposed a series of latent risks. Against this backdrop, technical upgrades and optimizations alone are insufficient; standardized legal regulations and supporting insurance systems are urgently required to fully safeguard personal and property safety of the general public. The motor vehicle insurance industry

boasts a long development history. Rooted in the stable framework of manual driving, the core mechanisms of motor vehicle insurance have remained largely unchanged over the past century. The emergence of autonomous driving, as a cutting-edge emerging technology, delivers a drastic shock to existing legal and insurance frameworks. Although China has issued a number of special administrative provisions governing road tests of autonomous vehicles, unified national top-level legislation is still absent, and dedicated insurance regulations for autonomous vehicles remain vacant. The current Compulsory Traffic Accident Liability Insurance (CTPL) regime is tailored for manual driving scenarios and cannot properly address liability identification and indemnification issues triggered by autonomous vehicle accidents, resulting in severe mismatches between institutional design and practical

How to cite this paper: Gulisong Aishan | Lv Jiani | Li Yangyue | Li Wenling "Research on Insurance Issues of Traffic Accidents Involving Autonomous Vehicles" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-10 | Issue-4, August 2026, pp.840-846, URL: www.ijtsrd.com/papers/ijtsrd142107.pdf



Copyright © 2026 by author (s) and International Journal of Trend in Scientific Research and Development Journal. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0) (<http://creativecommons.org/licenses/by/4.0>)



demands. The lag in legal and insurance systems has severely restricted the research, development, marketization and commercialization of autonomous driving technologies.^[3]

This study sorts out differentiated risks corresponding to Level 2 to Level 4 autonomous driving, clarifies insurance liability boundaries under human-machine hybrid driving scenarios, and constructs a localized tiered insurance framework incorporating advance indemnity and subrogation theories. It delivers theoretical references for insurance companies' product innovation and the refinement of regulatory policies. Theoretically, this paper abandons the conventional "human liability-centered" research mindset, integrates product liability and risk diversification theories of insurance, and enriches interdisciplinary legal research on intelligent transportation. Practically, the proposed framework establishes an expedited claim settlement mechanism to ensure timely compensation for victims, balances the interests of vehicle manufacturers, consumers and insurance companies, and facilitates standardized development of the autonomous driving industry. In addition, this research proposes standardized supervision for the autonomous vehicle sector to accelerate the large-scale application and popularization of autonomous driving technologies.

1.2. Research Status and Methodology

Foreign jurisdictions have developed mature autonomous driving insurance systems. The European Union has enacted legislation stipulating that vehicle manufacturers bear primary insurance liabilities for Level 3 and higher autonomous vehicles; the United States adopts dynamic premium pricing based on real-time driving data; the United Kingdom establishes the rule of advance insurance indemnity followed by subrogation against technology providers. Scholars abroad generally advocate a multi-layered risk security model with shared risk bearing between vehicle manufacturers and vehicle owners. Existing studies in China predominantly focus on the division of tort liabilities, lacking systematic analysis of insurance products and claim settlement procedures, while empirical research targeting high-level autonomous driving remains scarce. A broad academic consensus holds that the existing CTPL system should be restructured with a special technical liability insurance scheme for autonomous driving added.

Four research methodologies are adopted in this paper: first, normative analysis, which sorts out legal instruments including the *Civil Code of the People's Republic of China*, the *Insurance Law of the People's Republic of China* and the *Regulations of Shenzhen*

Special Economic Zone on Intelligent and Connected Vehicles, and identifies gaps in legal application; second, case analysis, which sorts adjudicative cases involving accidents under assisted driving via China Judgments Online and summarizes pain points in claim settlement practice; third, comparative research, which draws on insurance regimes of Europe, America and Japan and screens rules compatible with China's national conditions; fourth, interdisciplinary analysis, which conducts comprehensive research combining autonomous driving classification standards and insurance premium pricing logic.^[2]

II. Risk Characteristics of Autonomous Vehicles and Basic Theories of Autonomous Driving Insurance

2.1. Classification Standards and Unique Risk Features of Autonomous Vehicles

In accordance with the national standard GB/T 40429-2021, mass-produced mainstream autonomous vehicles are categorized into three levels. Under Level 2 combined driving assistance, human drivers bear full driving liabilities at all times. Level 3 conditional automated driving allows the system to dominate vehicle operation within restricted scenarios, and vehicle manufacturers shall assume product liabilities arising from system malfunctions. Level 4 high-level automated driving eliminates the need for human takeover, with liabilities attributable to vehicle manufacturers and operation platforms. As the automation level rises, the primary source of risks shifts from human operational errors to intelligent driving systems.^[1]

Compared with conventional motor vehicles, autonomous vehicles carry four categories of exclusive risks: first, system failures caused by defects in algorithms and codes; second, exorbitant maintenance costs for intelligent hardware such as LiDAR and autonomous driving chips; third, cyber security risks such as vehicle network intrusion and data tampering that may lead to vehicle loss of control; fourth, intertwined faults attributable to drivers, vehicle manufacturers and software developers, which drastically increase the difficulty of evidence collection for liability identification. Overall, autonomous driving risks feature low accident frequency coupled with extremely high single indemnity amounts, rendering traditional risk calculation logics of motor vehicle insurance inapplicable.

2.2. Comparative Analysis of Autonomous Driving Insurance and Conventional Motor Vehicle Insurance

Core disparities between the two insurance types lie in five dimensions. First, liability attribution logic:

conventional motor vehicle insurance determines indemnity proportions based on drivers' fault degrees, while autonomous driving insurance implements advance indemnity and subsequent subrogation to prioritize victims' compensation. Second, insured parties: conventional motor vehicle insurance is solely purchased by vehicle owners, whereas Level 3 and above vehicles mandate compulsory technical liability insurance for manufacturers, with commercial vehicles additionally covered by operational liability insurance. Third, coverage scope: conventional motor vehicle insurance only covers mechanical damage and third-party losses, while autonomous driving insurance extends coverage to intelligent hardware damage, losses from algorithm failures and cyber security incidents. Fourth, evidence collection for claim settlement: traditional cases rely on traffic police records and surveillance footage, while autonomous driving accident liability identification centers on vehicle-mounted black box driving data. Fifth, premium pricing mechanism: conventional insurance premiums are calculated based on drivers' driving experience and historical accident records, while autonomous driving insurance adopts Usage-Based Insurance (UBI) dynamic pricing, with floating rates tied to intelligent driving usage duration and human takeover frequency.

III. Practical Dilemmas of China's Motor Vehicle Insurance System for Autonomous Driving

3.1. Deficiencies in Legislation and Institutional Adaptation of Autonomous Driving Insurance

Level 2 assisted driving has achieved large-scale popularization nationwide, while Level 3 conditional automated driving has entered road trials in multiple regions, representing accelerated industrial commercialization. Nevertheless, the current domestic legal framework governing insurance is entirely constructed around manual driving, creating an obvious institutional disconnect with novel technical risks of intelligent vehicles and massive gaps in top-level legislation.^[4] The Tort Liability Chapter of the *Civil Code*, the *Insurance Law* and the *Regulations on Compulsory Traffic Accident Liability Insurance for Motor Vehicles* only stipulate general insurance purchase obligations for vehicle owners and managers, without distinguishing shared insurance liabilities of drivers, vehicle manufacturers and algorithm R&D enterprises by Level 2 to Level 4 automation tiers. Currently, only the *Regulations of Shenzhen Special Economic Zone on Intelligent and Connected Vehicles* refine the compensation sequence for autonomous vehicle accidents; however, this document is a local statute effective merely within

Shenzhen, and unified national standards for insurance underwriting and claim settlement remain absent.^[5]

Exempt clauses of traditional motor vehicle insurance fail to cover accident triggers specific to autonomous technologies, including sensor malfunctions, algorithm recognition biases and system decision failures. In practice, insurance companies frequently claim exemption from compensation on the ground that drivers fail to monitor vehicles continuously. Following accidents, vehicle owners, manufacturers and insurers often shift liabilities to one another, obstructing victims' access to timely relief. Under the *Product Quality Law of the People's Republic of China*, producers shall bear strict product liabilities for personal and property damage arising from defective vehicles.^[6] Yet China does not enforce compulsory purchase of special autonomous driving product liability insurance by manufacturers, making it impossible to allocate corporate technical risks through insurance mechanisms. The existing legal framework cannot form a complete risk guarantee system compatible with human-machine co-driving scenarios.

3.2. Existing Problems in Insurance Product Design, Premium Pricing and Claim Settlement Practices

At present, the insurance market lacks differentiated auto insurance products specifically designed for autonomous driving levels. Existing insurance types are merely simple modifications of traditional auto insurance and cannot match the unique risk characteristics of intelligent vehicles. Premium calculation still relies on driver-related indicators such as driving experience and age, without incorporating technical evaluation factors such as the safety level of the autonomous driving system, on-board hardware failure rates, and driving data integrity, resulting in insufficient accuracy in risk-based pricing.

The claim settlement phase is plagued by prominent challenges of difficult evidence collection and cumbersome procedures. Core liability identification data for autonomous vehicle accidents is stored in manufacturers' background servers, with ordinary vehicle owners and victims deprived of access rights, forming an information barrier that drastically prolongs loss assessment cycles and reduces claim settlement efficiency. The traditional on-site manual loss assessment model is unsuitable for accidents involving mixed human and machine faults, and unified national loss assessment specifications for autonomous driving have not yet been formulated. Where accidents stem from both drivers' negligence

in monitoring and vehicle system defects, victims struggle to obtain full and one-off compensation. In general, insurance products and claim settlement workflows lag far behind the development pace of the autonomous driving industry.

IV. Judicial Dilemmas in Liability Determination for Insurance Claims Arising from Autonomous Vehicle Accidents

4.1. Ambiguous Liability Boundaries of Multiple Parties under Autonomous Driving Scenarios

Autonomous driving subverts the traditional liability attribution logic of "human driving bears human liability". Accident triggers are no longer limited to human operational errors; composite causes including algorithm loopholes, component failures and delayed human takeover emerge extensively, intertwining rights and obligations of drivers, vehicle owners, complete vehicle manufacturers and software developers. Current laws fail to clearly define liability scopes for each subject. Under Level 2 assisted driving, drivers retain full continuous monitoring obligations, yet explicit legal standards for dividing primary and secondary liabilities between vehicle owners and manufacturers remain absent when Level 3 and above systems take over vehicle operation.

Pursuant to the subrogation rules of the *Insurance Law*, insurers may pursue compensation against ultimately liable parties after indemnifying victims. However, autonomous vehicle accident tracing chains are highly complex, with complete vehicle manufacturers, component suppliers and algorithm developers all potentially at fault. Laws have not specified the subrogation sequence and liability allocation ratios under multi-party mixed fault scenarios. Insurers face high burden of proof and low enforceability when exercising subrogation rights, elevating overall underwriting risks and dampening the industry's enthusiasm to develop exclusive autonomous driving insurance products.

4.2. Confusion of Liabilities and Controversies in Judicial Adjudication

Chinese courts have not formed unified adjudication standards for similar autonomous vehicle accidents, giving rise to widespread liability confusion and divergent judgments. For traffic accidents occurring while Level 3 autonomous systems are in operation, some courts order vehicle owners and insurers to make advance compensation per motor vehicle accident liability rules, after which insurers exercise subrogation against manufacturers. Other cases directly apply product liability rules and rule that manufacturers bear primary compensation liabilities,

leading to drastically disparate outcomes for analogous cases and depriving insurers of stable claim settlement expectations.

Most standard insurance contract clauses stipulate that drivers assume full liabilities for accidents occurring under autonomous driving modes, yet courts across regions adopt inconsistent standards to judge whether such clauses improperly exempt manufacturers from statutory product liabilities and constitute invalid standard terms. For accidents caused by mixed faults of drivers and vehicle systems, current laws lack quantitative criteria for fault division, granting judges broad discretionary power and easily triggering multi-party litigation over indemnification disputes. China has not issued unified judicial adjudication guidelines for tiered autonomous driving levels, leaving insurance liability identification without clear legal grounds. This situation undermines victims' right to remedies and hinders the establishment of normalized risk-sharing mechanisms between vehicle manufacturers and the insurance sector.

V. Institutional Practices of Autonomous Driving Insurance in Foreign Jurisdictions and Enlightenment

5.1. Representative Institutional Practices of Autonomous Driving Insurance in Foreign Countries

The United Kingdom centers its regime on victim relief. The *Automated and Electric Vehicles Act 2018* stipulates that insurers shall compensate victims for losses arising from accidents occurring while vehicles operate under autonomous modes; vehicle owners shall bear corresponding liabilities where vehicles lack valid insurance coverage. After making indemnity payments, insurers may exercise subrogation against parties bearing ultimate liabilities in accordance with general legal rules.^[9] The core of this model lies in identifying a readily identifiable indemnity party with stable solvency as the primary compensation channel.

Germany retains compulsory motor vehicle liability insurance as the institutional foundation, while amending the *Road Traffic Act* to introduce provisions such as technical supervisors for high-level and fully automated vehicles, and mandating preservation of vehicle operation data. Japan maintains continuity of its motor vehicle damage compensation liability system, conducts policy research centered on accident data, liable parties and insurance subrogation, and prioritizes stable victim relief before allocating ultimate losses stemming from technical defects.^[10] Despite divergent institutional paths, all three jurisdictions place immediate victim

compensation ahead of complex technical liability identification.

5.2. Optimization Paths and Innovative Application of the Tiered Autonomous Driving Insurance Mechanism

China may absorb the shared institutional logics of "advance indemnity followed by subrogation, data-backed liability identification and risk-based loss allocation" from foreign jurisdictions, yet mechanical transplantation of foreign regulations is inappropriate. First, the Compulsory Traffic Accident Liability Insurance shall serve as the bottom-line basic protection layer, supplemented by a progressive linkage system consisting of commercial third-party liability insurance, product liability insurance and technical liability insurance, to avoid unconditionally shifting product risks attributable to manufacturers to ordinary vehicle owners. Second, tiered insurance configuration shall be implemented based on automation levels and usage scenarios: Level 2 vehicles remain centered on drivers' duty of care; Level 3 scenarios strengthen obligations of human takeover, preconditions for system operation and manufacturers' burden of proof via operational data; Level 4 scenarios incorporate complete vehicle manufacturers, operators and remote technical support providers as key underwriting and subrogation targets. Third, data governance rules must be formulated in tandem with insurance regimes. Insurers shall only access vehicle operational data necessary for accident identification and claim settlement, while complying with laws governing personal information protection, data security and trade secret protection.

Accordingly, the most valuable experience extracted from foreign systems is not a fixed configuration of liable parties, but the institutional mindset of relying on insurance to absorb external victim losses upfront before tracing technical risks via operational data. Within China's existing CTPL and road traffic governance framework, a tiered insurance system linking basic protection, commercial supplementary coverage and loss allocation via subrogation shall be gradually established, with premium rates, data management and subrogation rules refined through pilot projects.

VI. Applicable Value of the Innovative Tiered Insurance Mechanism for Autonomous Driving

6.1. Core Connotation and Adaptation Advantages of the Tiered Insurance Mechanism

The tiered insurance mechanism for autonomous driving distributes loss coverage and ultimate loss

bearing separately in light of risk sources, autonomous driving tiers and liable parties. The first tier constitutes the basic protection layer centered on CTPL, which provides priority indemnity for third-party losses and prevents delayed compensation for victims arising from liability disputes between drivers, vehicle owners and system providers. The second tier is the commercial supplementary coverage layer, composed of commercial third-party liability insurance, product liability insurance and technical liability insurance, which mainly covers exclusive autonomous driving risks including algorithm defects, sensor failures and system misjudgments. The third tier serves as the subrogation and loss allocation layer, under which insurers exercise subrogation or right of recourse against actual liable parties based on vehicle operational data, system logs and accident appraisal conclusions, shifting ultimate losses to parties with optimal risk control capacity.^{[7][8]}

Compared with the single motor vehicle insurance structure centered on drivers' fault, the tiered mechanism adapts better to the multi-stakeholder liability chain involving "human, vehicle, road and cloud" in autonomous vehicle accidents. It moderately separates victim relief from liability identification and sustains the social security function of CTPL, while enabling differentiated underwriting aligned with automation levels. Level 2 vehicles remain dominated by driver liability insurance, whereas Level 3 and Level 4 vehicles require higher coverage ratios of technical liability insurance and product liability insurance. Consequently, insurers may reverse-incentivize manufacturers to upgrade system safety and improve data retention quality through adjustable premium rates, deductibles and subrogation cost allocation.

6.2. Feasibility of the Tiered Insurance Mechanism in Resolving Difficulties of Autonomous Driving Insurance

The tiered insurance mechanism possesses solid foundations under current domestic laws. The *Regulations on Compulsory Traffic Accident Liability Insurance for Motor Vehicles* aims to guarantee victims' lawful access to compensation, with established institutional tools including liability limits, advance payments and subrogation.^[7] Following autonomous vehicle accidents, the basic protection layer may make advance indemnity payments, after which insurers judge liability based on vehicle operational records, system logs and accident appraisal materials, and exercise recourse against manufacturers, algorithm developers or other liable parties. This approach eliminates the need to complete full complex technical liability

identification prior to compensation, directly addressing prominent challenges including lengthy liability determination cycles, asymmetric information on evidence access and excessive victim litigation costs.

Local legislation also provides practical support. The *Regulations of Shenzhen Special Economic Zone on Intelligent and Connected Vehicles* distinguishes intelligent connected vehicles with and without human drivers, and formulates linkage rules for accident handling and liability allocation.^[8] Insurers may accordingly incorporate data interfaces, software versions and human takeover records as preconditions for underwriting and claim settlement, forming a closed-loop workflow of "advance compensation, evidence verification and subsequent subrogation". The UK's advance-indemnity-then-subrogation model, Germany's regulatory provisions on technical supervision liabilities and relevant policy research in Japan all prove the operability of separating expedited victim compensation from ultimate liability attribution, premised on credible systems for data storage, retrieval and joint investigation.

VII. Conclusions and Prospects

7.1. Research Conclusions

Adopting normative analysis, case research and comparative legal analysis, this paper systematically investigates core pain points of insurance governance for autonomous vehicle traffic accidents and draws four core conclusions:

First, fundamental conflicts exist between the logical framework of traditional motor vehicle insurance systems and novel risks inherent to autonomous driving. Current laws and insurance products lack targeted rules addressing system malfunctions, triggering practical challenges including ambiguous liability identification, prolonged claim settlement cycles and obstacles to victims' rights relief. Institutional development lags far behind the pace of industrial commercialization.

Second, scenarios ranging from Level 2 to Level 4 autonomous driving involve drastically different sets of liable parties, rendering single-type insurance products incapable of covering tiered differentiated risks. The three-tiered insurance system represents the optimal solution compatible with China's market context. The combination of three insurance tiers, advance indemnity rules, insurers' subrogation rights and supplementary commercial insurance provisions can balance dual objectives of timely victim relief and industrial risk diversification.

Third, tiered insurance systems and compulsory manufacturer insurance requirements adopted in the

United States, the European Union and Japan deliver valuable reference experience, yet direct transplantation is infeasible. Localized adjustments must be made in accordance with China's existing CTPL and product liability legal systems.

Fourth, the improvement of autonomous driving insurance requires synchronized optimization of legislation, insurance product design, premium pricing mechanisms and claim settlement workflows. Establishment of a multi-layered risk security system can fill gaps in current institutional design and provide legal and insurance support for the commercialization of autonomous driving technologies.

7.2. Research Limitations and Future Prospects

7.2.1. Research Limitations

First, empirical case materials in China are insufficient. Major judicial litigation cases involving Level 3 and higher autonomous driving remain scarce in China, with most disputes resolved via private settlement. This research mainly relies on Level 2 accident cases and deductions from foreign institutional experience, lacking support from large-scale domestic judicial data. Second, the research team consists primarily of legal scholars; analysis of insurance actuarial science and underlying vehicle technologies remains theoretical, without constructing quantitative premium pricing models, leaving specific operational rules to be further refined. Third, this study only addresses insurance liabilities arising from road traffic accidents, excluding losses triggered by cyberattacks and data breaches, resulting in limited research coverage of application scenarios.

7.2.2. Future Prospects

In the short term, continuous rollout of Level 3 autonomous driving pilot projects across regions will generate growing judicial precedents. Subsequent research may collect domestic judicial documents and insurance pilot data to refine indemnity limits and tiered premium rate detailed rules for the tiered insurance mechanism. In the medium and long term, after large-scale commercial deployment of autonomous driving, integrated models combining operational liability insurance and cyber security insurance may be explored to construct full-chain risk protection frameworks.

From a legislative perspective, special statutes governing intelligent connected vehicles are expected to be promulgated in the future, establishing statutory requirements for the tiered insurance system. The insurance industry will launch standardized exclusive insurance products for autonomous driving and formulate unified industrial norms for secure data sharing. At the academic level, follow-up research

may integrate multidisciplinary knowledge of law, vehicle engineering and insurance actuarial science to construct complete risk assessment and premium pricing models, continuously refining China's localized legal system for autonomous driving insurance, and safeguarding steady industrial development via institutional improvement.

References

- [1] State Administration for Market Regulation of the People's Republic of China. GB/T 40429-2021 Classification of Automated Driving Systems for Motor Vehicles [S]. 2021.
- [2] Shen Jianfeng. Institutional dilemmas and reform paths of conventional motor vehicle insurance in the era of intelligent driving [J]. Journal of China University of Political Science and Law, 2026(02).
- [3] Qi Zhaoying. Research on the compulsory traffic accident liability insurance system for autonomous vehicles [D]. China University of Petroleum (East China), 2022.
- [4] Standing Committee of the National People's Congress. Insurance Law of the People's Republic of China (Revised 2015) [Z].
- [5] Standing Committee of the Shenzhen Municipal People's Congress. Regulations of Shenzhen Special Economic Zone on Intelligent and Connected Vehicles (Promulgated 2022) [Z].
- [6] Standing Committee of the National People's Congress. Product Quality Law of the People's Republic of China (Revised 2018) [Z].
- [7] State Council of the People's Republic of China. Regulations on Compulsory Traffic Accident Liability Insurance for Motor Vehicles (Issued March 21, 2006; Revised July 31, 2026) [Z].
- [8] Standing Committee of the Shenzhen Municipal People's Congress. Regulations of Shenzhen Special Economic Zone on Intelligent and Connected Vehicles [Z/OL]. (June 23, 2022) [July 31, 2026].
- [9] United Kingdom. Automated and Electric Vehicles Act 2018[Z/OL].(2018-07-19)[2026-07-31].

