Identification of Tort Liability Subjects in Artificial Intelligence: The Case of Autonomous Vehicles

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Abstract: As a significant achievement in artificial intelligence (AI) development, autonomous vehicles promise substantial convenience and societal transformation. However, their integration into transportation systems introduces legal risks and challenges, particularly regarding the determination and allocation of tort liability for accidents caused by such vehicles. Accelerating commercialization has intensified complex legal issues, with the identification of liable parties emerging as a central concern in legal academia and practice. This paper takes autonomous vehicles as a focal point, analyzing the challenges in attributing tort liability within existing legal frameworks while accounting for the unique technological features of autonomous systems. It proposes a risk-control-centered multi-party liability allocation mechanism. This framework clarifies the responsibilities of manufacturers, users, and regulators, supplemented by insurance systems and technical safeguards, to fully protect the legitimate interests of victims.

***Keywords*:** artificial Intelligence, autonomous vehicles, tort liability

1. Introduction

Advancements in AI technology have propelled autonomous vehicles toward commercialization. Per the Society of Automotive Engineers (SAE) classification, Level 3 (L3) and higher autonomous systems can independently execute partial or complete driving tasks, requiring human intervention only upon system request. Yet, this technological autonomy challenges traditional tort liability theories: When an accident stems from algorithmic flaws or environmental misjudgment, should liability fall on the user, producer, or system developer? This issue necessitates not only legal reinterpretation but also addresses ethical boundaries in technology application and the construction of social trust.

Several disputes involving autonomous vehicles have arisen globally. For instance, in a 2016 Tesla "Autopilot" rear-end collision, courts attributed primary liability to the driver for failing to timely resume control. Conversely, in the 2018 Uber autonomous test vehicle pedestrian fatality, Arizona prosecutors charged the safety operator, not the manufacturer. These cases highlight the ambiguity in liability attribution and legal lag. This paper aims to provide theoretical support for constructing a tort liability system suited to the AI era through systematic analysis.

2. Legal Challenges in Attributing Tort Liability for Autonomous Vehicles

2.1 Limitations of Existing Legal Frameworks

First, defining liable parties is problematic. Traditional motor vehicle accident liability centers on "driver fault," yet the "driver" in an autonomous vehicle is essentially a passenger incapable of real-time system monitoring. Direct application of Article 76 of China's Road Traffic Safety Lawmay unjustly shift liability to users, violating equity principles. While the Product Quality Law imposes liability for defective products, the complexity of autonomous systems renders "defect" exceedingly difficult to prove—particularly due to the "black-box nature" of algorithmic decisions obscuring causation.

Second, the applicability of liability principles is contentious. Traditional tort law employs a dual system of fault-based and no-fault liability. For autonomous accidents, fault liability falters due to the absence of subjective fault elements, while no-fault liability (e.g., product liability) is constrained by technological novelty and ambiguous defect identification. Granting autonomous vehicles legal personhood remains unrealistic; liability must instead focus on risk allocation under an "instrumental agency" framework.

2.2 Judicial Difficulties Arising from Technical Characteristics

Establishing causation is complex. Autonomous systems rely on vast data training and deep learning; accidents may result from algorithmic errors, sensor failures, or external interference. For example, in a 2022 test vehicle crash, the system failed to recognize environmental boundaries, yet distinguishing technical defects from operational errors proved challenging.

Burden of proof imbalance disadvantages victims. Ordinary claimants struggle to access system data proving product defects, while manufacturers may invoke "technological neutrality" defenses.[1]International practice increasingly advocates for reversing the burden of proof, requiring manufacturers to demonstrate system integrity.

3. Theoretical Reconstruction of Liability Attribution

The unique nature of autonomous vehicles necessitates moving beyond traditional liability models toward a "chain allocation" framework encompassing producers, users, and regulators. This clarifies responsibilities across different stages, ensuring scientific and equitable distribution.

3.1 Core Responsibility of Producers and Developers

As creators and commercial beneficiaries, producers/developers bear core liability under the "risk-benefit" theory. Their control over core technology, assumption of R&D risks, and resulting profits justify primary responsibility for product/technology defects.

Germany's amended Road Traffic Act offers valuable insights: It mandates strict (no-fault) liability for manufacturers during autonomous operation, unless defect absence is proven. This model protects victims and incentivizes rigorous safety controls. China could adopt similar principles, legally requiring producers to ensure algorithmic robustness, compliant data training, and hardware reliability (e.g., sensors, chips). Clear legislative boundaries promote technological advancement and provide predictable liability standards.

3.2 Reasonable Duty of Care for Users

Despite system control, users retain reasonable duties of care. They must monitor operations, respond promptly to takeover requests, and avoid activating automation in unsuitable conditions (e.g., adverse weather, complex roads). Failure to uphold these duties, causally linked to an accident, incurs fault-based liability. Judicial precedents consistently assign partial liability to users neglecting takeover prompts.

3.3 Institutional Safeguard Responsibility of Regulators

Widespread deployment requires robust regulatory frameworks. Governments must establish technical access standards, dynamic oversight mechanisms (e.g., mandating "black boxes" for L3+ vehicles per Beijing's Autonomous Vehicle Regulations), and ensure real-time data uploads for post-accident analysis. Implementing lifecycle supervision—covering R&D, testing, production, sales, and operation—via regular inspections and safety assessments is essential.

4. Adaptive Adjustment of Liability Principles

4.1 Tiered Application of No-Fault Liability and Presumption of Fault

4.1.1 Balancing interests and easing victims' burden necessitates tiered principles

No-Fault Liability for ProducersProducers' advantageous position—controlling core technology/data and possessing risk mitigation capabilities—justifies no-fault liability.[2]Victims need only prove product defect and causation, not producer fault. Chinese courts have upheld this, e.g., awarding damages for accidents caused by software design flaws.

4.1.2 Presumption of Fault for Users

Users' responsibilities involve reasonable system usage, software updates, and situational awareness. Applying presumption of fault is appropriate: Users are presumed negligent unless they prove fulfillment of their duties. Data from "black boxes" can objectively assess user compliance. For example, failing to act on takeover requests triggers fault presumption. This protects victims while promoting responsible usage.

4.2 Introduction of "Risk Funds" and Compulsory Insurance

4.2.1 Lessons from the UK's Automated and Electric Vehicles Act

The UK Act mandates insurers' primary compensation to victims, with subsequent recourse against liable parties. China could adopt a "dual-insurance" system.

Compulsory Traffic Accident Liability Insurance (CTALI): Provides baseline victim compensation.

Specialized Product Liability Insurance: Covers unique autonomous vehicle risks, enhancing coverage. Insurers can later seek reimbursement from responsible entities (e.g., manufacturers).

4.2.2 Establishment and Operation of "Risk Funds

A supplementary "Risk Fund," pooled by manufacturers, software developers, and hardware suppliers, compensates victims where liability is unclear or parties are insolvent. Managed by a dedicated agency (akin to social accident assistance

funds), it ensures timely compensation and proper oversight.

5. Optimizing Legislation and Judicial Practice

5.1 Recommendations for Legal System Improvement

5.1.1 Specialized Legislation Clarifying Liability Framework

Enacting an Autonomous Vehicle Management Regulation is crucial. It should delineate liability rules per automation level:

L3 Systems: Users bear supplementary liability for failures to takeover when prompted.

L4/L5 Systems: Producers assume full liability during autonomous operation. Clear stratification provides judicial clarity and incentivizes safety.

5.1.2 Linking Technical Standards and Legal Interpretation

Establishing a national autonomous vehicle data platform ensures unified algorithm testing and accident forensics standards. Judicial interpretation should expand "product defect" to include software flaws and data security issues (referencing Supreme Peoples Court Interpretations on Road Traffic Accident Compensation, Art. 9), aligning law with technological realities.

5.2 Innovative Explorations in Judicial Adjudication

5.2.1 Application of Case Guidance System

Guiding cases can clarify liability boundaries. Drawing from the Hangzhou Internet Court's ruling on AI-generated content infringement, which emphasized platform auditing duties, courts can stress proactive safety verification obligations* for autonomous technology providers. This enhances judicial consistency.

5.2.2 Strengthening the Expert Assessor System

Addressing "algorithmic black boxes" requires integrating technical experts and forensic institutions into litigation. Similar to forensic analysis in EV fire cases (e.g., identifying battery defects via data reconstruction), expert testimony provides judges with specialized insights, ensuring scientifically sound and credible rulings.

6. Conclusion and Outlook

Autonomous vehicles revolutionize transportation but challenge conventional "human-centered" tort liability paradigms. Constructing a dynamic liability system centered on technological characteristics and risk distribution is imperative. Legislatively defining the responsibilities of producers, users, and regulators, applying tiered liability principles (no-fault for producers, fault presumption for users), and implementing insurance/technical safeguards balances stakeholder interests while protecting victims. This approach fosters technological innovation and societal equity.

Acknowledgments

Funding Project: Stage Achievement of Yili Normal University Discipline Enhancement Project "Research on Legislative Safeguards for Basic Elderly Care Services from a People-Centered Perspective" (22XKSY54).

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