Liability Challenges in AI-Driven Autonomous Vehicles

Zihe Wang

Abstract:

Artificial intelligence systems have advanced rapidly in recent years, particularly in the development of autonomous vehicles. As these technologies become more integrated into public life, they have raised urgent legal and ethical questions—most notably, how liabilities should be assigned in the event of an accident. Unlike traditional traffic incidents, accidents involving autonomous vehicles are rarely the results of human misconduct. Instead, they stem from complex interactions among software, sensors, algorithms, and their environments. To address these questions, this article argues that a strict liability regime is the most appropriate legal framework for addressing accidents involving autonomous vehicles, mainly because it bypasses the need to assign faults to entities incapable of moral or legal responsibility. By removing the burden of proving negligence, the strict liability regime better accommodates the technological opacity and the causal complexity that characterize AI-operated systems. Contra the claim that such a regime might hinder innovation, this article contends that it would enhance public trust, ensure victim compensation, and promote responsible deployments of autonomous technologies. To ground the discussion in real-world applications, the article examines a recent controversial accident involving an autonomous vehicle in mainland China. In doing so, it evaluates competing legal approaches and addresses key counterarguments, ultimately demonstrating that the strict liability regime is not only fair and pragmatic, but necessary for the sustainable integration of AI into transportation systems.

Keywords: Artificial intelligence; Liability challenges; AI-Driven Autonomous Vehicles

1. Introduction

The fourth industrial revolution is increasingly driven by artificial intelligence (AI), with rapid innovation and integration of AI systems across sectors such as healthcare, finance, law, and transportation

(Hossin, 2025). Since 2017, over 700 AI policy initiatives have been launched by more than 60 national and sub-national governments (Hajkowicz, 2023). One of the most transformative applications of AI takes place in autonomous vehicles. Major manufacturers—including Tesla, BMW, Toyota, and local corporations—have spent the past decade developing systems capable of navigating traffic autonomously. Driven by this trend, the volume of academic literature on autonomous vehicles has tripled every ten years since 1991 (Woo, 2021). In Europe, a leading automobile market, companies like Volvo and Mercedes-Benz have pioneered the integration of AI navigation (Bikeev, 2019). To regulate this emerging industry, the European Parliament has introduced Directive 85/374 EEC, a strict liability regime, holding manufacturers and sellers accountable for defective AI-driven products (European Parliament, 2020). By contrast, China's regulatory response has been less proactive, with incidents such as the Xiaomi autonomous vehicle accident exposing gaps in legal accountability. The United States, meanwhile, has taken a more fragmented approach, relying on state-level experimentation and a preference for innovation over comprehensive federal regulation.

Along with the growth of technology, and also indicated by the European legal regulation, such innovation also raises critical questions about accountability and liability when these systems cause harm. While there are nuanced differences between accountability and liability in certain circumstances, in this article, these two will be used interchangeably, and both are defined as the state of being responsible for an act that causes harm. Further, such responsibilities are often governed by two sets of liability laws, strict liability, and negligence liability (Shavell, 2007). The differences and nuances between these two regimes will be explored in Section 2. When AI systems are incorporated into consideration in legal frameworks concerning liability, the opaqueness and interconnectedness of such systems bring multiple challenges to establish who is at fault. Scholars and regulators alike have begun to grapple with the dilemma of "who is liable" when the output of AI leads to unintended and unpredictable consequences–especially when there is no clear human in decision-making loop (Pagallo, 2013).

This article argues for the implementation of a strict liability regime as the most effective, and also fairest approach to assigning legal responsibilities in AI-operated transportation. Through an examination of literature on the theory of liability regimes, case studies, and a recent accident in mainland China, this article makes clear the limitations of a negligence-based regime and the ethical & policy advantages for a strict liability regime. The structure of this article is arranged as follows. Section 2 will explain the general theory behind liability regimes and the differences between negligence and strict liability, section 3 will briefly cover the technological advancements, section 4 will present the positives of a strict liability regime, section 5 will address counter arguments, section 6 will analyze a controversial accident that recently occurred in mainland China, and section 7 will conclude.

2. Negligence liability vs Strict liability

Liability laws play a crucial role as a device of indirect risk control in the development and use of artificial intelligence. Negligence liability is also known as faulty-based liability, it is a fundamental method to distribute responsibilities through establishing the levels of negligence that leads to accidents and causes thereby harm to any victims. Such a regime provides only the incentive to reach the minimal level of care, and no more than that. The level of negligence and care is often determined through a judiciary procedure, through assessing the social benefits and risks of the conduct. Under such a regime, the influences also extend to the victims and users. For any party involved that is not the producer or manufacture, there is an incentive effect for them to reduce damage themselves. Given these features of negligence liability, it is clear that such a regime has many limitations. First of all, since the level of negligence and care is set by the judiciary, this system can only function well under the assumption that the judiciary has sufficient knowledge in the field, which proves to be difficult in novel and advanced areas of technology. Additionally, this difficulty is aggregated by the fact that there could be risks of bias when ruling on specific cases. Without a deep understanding of how autonomous systems function, courts may unintentionally favor more familiar narratives—such as blaming the user—rather than accurately assessing the responsibility of developers or manufacturers.

Secondly, Similarly, the users do not have adequate knowledge on novel technologies to effectively minimize risk. If the user affected have the incentive but no ability to reduce damage, then no responsibility can fall on him/her.

In contrast, strict liability is a legal framework that holds manufacturers and operators accountable, liable, and responsible for any harm caused by products or technologies, regardless of whether they act negligently or not. In the context of AI and autonomous systems, strict liability is increasingly relevant because it directly internalizes the economic risks involved. By assigning responsibilities without requesting proofs of fault, it pushes developers and companies to consider the risks of their technologies before selling them.

It is often claimed that strict liability has several advantages over negligence-based regimes, particularly in the context of emerging technologies like AI. Firstly, it may initiate private risk knowledge: since developers are typically more familiar with the technical risks of their systems than regulators, strict liability can encourage them to proactively assess whether the expected benefits of an AI system justify its potential harms. Secondly, it is argued that this approach encourages safer design, as companies anticipating liability may be more motivated to improve reliability before public deployment. Thirdly, strict liability may enhance public trust; when the burden of risk is clearly assigned and victims are more likely to be compensated, the public might be more open to adopting new technologies. Combined with tools like liability insurance, this regime is seen by some as a mechanism for fair risk distribution.

However, critics point out that strict liability can also stifle innovation, especially for smaller firms unable to absorb high legal exposure. It may also lead to over-deterrence, where developers avoid valuable but uncertain technologies. Therefore, the debate between strict and negligence liability remains active, with each framework offering distinct benefits and limitations depending on context.

3. Technological advancements

Self-autonomous vehicles (SAVs) are rapidly becoming more capable of preventing possible accidents and dangers. In a study conducted by Hossin et al. (2025), they created a table which identifies the significant advancements AI has led to in SAVs. Such advancements include those in sensor technologies, machine learning algorithms, Decision Making systems, Integration of AI systems with 2X communications, and computational power & Data analytics. These advancements, although with certain uncertainties, contribute greatly to the five crucial phases that reduces risk in a SAV. In their research, they laid out how the advancements might reduce risk:

In the detection phase, the AI system collects data from Light Detection & Ranging (LiDAR) and Radio Detection & Ranging (RADAR) about the surrounding environment, such as vehicle distance, speed, state, and lane, then it proceeds to analyze the data (You et. al, 2022).

In the process phase, the AI system interprets and evaluates the data collected and informs the vehicle in a transparent manner (Gallab et.al, 2024). suchinformation displays levels of risk from surrounding vehicles and helps the vehicle to understand the actions taken by vehicle and the intentions of the system. The AI system continuously collects new data about its surroundings (Pan et.al, 2022).

In the prediction phase, the AI system forecast imminent vehicle movements to navigate traffic. Additional to forecasting physical behaviors from previous data, it is also crucial for the system to consider potential interaction between actors (Sefidgar, and Landry, 2022).

In the decision phase, information pertaining to surrounding vehicles can change, AI systems can use this opportunity to assess potential disrupting factors and when they might take effect (Hu et al. 2022). This allows vehicles to react better to events of emergency.

In the final performance phase, the AI system considers all the phases above to aid in adjusting the performance of vehicles, rout planning, speed control, attitude control, and maintenance after the continuous action of the previous phases (Gallab et al. 2024). These advancements show that self-autonomous vehicles are increasingly capable of minimizing risk through integrated AI systems. Now since SAVs can actively mitigate danger, it is reasonable to hold developers and operators accountable for failures, regardless of fault. Strict liability, in this context, aligns with the technological maturity and risk management capacity of modern autonomous systems, as will be argued below.

4. A case for strict liability

In this section, first I will make a case for strict liability by exploring its key advantages, such as public confidence, deterrence, and securing compensation for the victim. Second, I will argue against the myth that strict liability necessarily hinders innovation through an analysis of the pharmaceutical industry in the U.S.

4.1 The advantages of strict liability

Given that the integration of AI systems in SAVs does indeed provide significant assistance in risk management, which is a premise for a strict liability regime, the vehicle holder/driver no longer has any influence over risks. Since it is common sense not to hold someone responsible for something they cannot control (King, 2014), and after considering technological developments, this article suggests that the producers/manufacturers, and traffic engineers be the key targets/subjects of a strict liability regime.

Producers/manufacturers include many different occupations when it comes to SAVs, defined by the European Parliament (2020). A front-end engineer is defined as a natural or legal person who exercises a degree of control over a risk connected with the operation and functioning of the AI systems and benefit from its operation. A back-end operator is defined as a natural or legal person who, on a continuous basis, decides on (?) the features of the technology, provides data and essential background supporting service, and therefore also exercises a degree of

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control over the risk of the system (Zech, 2021). In addition to manufacturers, traffic engineers, road builders and managers, also have similar roles in risk control (Hansson et al. 2021).

Speaking of the advantages of strict liability, it is useful to start by considering one of the major problems of introducing novel technology, that is, the public resistance that it faces. There have been cases of public protest due to fear or novelties and thus throwing rocks, impeding the SAV, and other actions (Cuthberston, 2018). In a study conducted in China (Liu et al. 2019), there needs be a decrease in risk and casualties by 75-80% for the public to tolerate SAVs. The public tends to have a much lower tolerance towards failure rates in SAVs. Another factor that might develop negative reactions toward SAVs is the difference from conventional road traffic experience. In a human driven vehicle, actors expect an informal kind of communication to show that they are switching lanes or pedestrians waiting for drivers to signal that when they should cross the street (Hansson et al. 2021). There also might be disapproval towards patterns of movements that is not customized to the passenger's personal tendencies, such as the acceleration and deceleration, and strictly following speed limits (Prakken, 2017). Given these concerns, a strict liability regime might help generate public confidence. To be sure, a strict liability regime itself does not directly provide the public with immense confidence; but it can provide producers/manufactures with the incentives to minimize risk, as they are the sole bearers of liability. With a complete internalization of risks, the users and customers feel safer and the acceptance of the technology by the public might be increased (Zech, 2021).

Moreover, the advantages of strict liability move beyond concerns over public confidence. Additionally, liability laws serve the two main purposes of compensation and deterrence, that is, protecting the injured party by ensuring compensation and providing incentives for the "responsible" person to take adequate measures to prevent the occurrence of damage (Best et. al 2014). From the point of view of the victim, his/her interest does not change because of the fact that an AI system defection is responsible for his/her suffering or if the driver was drunk driving (Lohmann, 2016). A strict liability regime is advantageous in securing a compensation for the victims because, under negligence law, they will face many difficulties in establishing negligence of the manufacturers under an increasing level of interconnectedness (K. Maziner, 2015), which might lead to situations where it is no longer possible to prove that a particular system is responsible. Which can be problematic because victims will face the injustice from not receiving compensation and the economic burden to cover medical and personal expenses.

In certain cases, it is argued that the vehicle holder shall be responsible for the compensation, as they are choosing to introduce the risk to the public when purchasing and also benefiting from the reduced risk a SAV brings them. However, the holder must be able to take recourse against the manufacturer or else liability's law of incentive function will no longer work (Robolaw Consortium, 2014). To overcome this difficulty, a strict liability regime should impose the burden of the compensation upon manufacturers/producers, even though the vehicle holders can take certain measures to reduce risk, as established earlier, it is irrational to hold them accountable. It is more desirable to incentivize the manufacturers to make incremental improvements to their products (Marchant and Lindor, 2012). Manufacturers profit from the selling of SAVS and can transfer some of the costs back to the costumers through higher prices (Lohmann, 2016). Not only does such regime ensure compensation for victims, but also provide incentives for the manufacturers. The following discussion will address the why there is no clear disadvantage in the power imbalance between the manufacturers and victims.

4.2 The myth of hindering innovation

The main argument against a strict liability regime some critics argue that imposing a strict liability framework on AI development in self-autonomous cars might hinder innovation. Such concerns exist because in certain cases, such regulatory regime might persuade corporations and users to abandon self-autonomous vehicles as they are the sole bearers of responsibility when accidents occur. However, strict liability regime only requires user (operators, manufacturers, users, depending on who the regime is applied to) to assess whether they want to use the technology or not, not prohibiting them from doing so (Zech, 2021).

In reality, innovation and market behaviors have more complexities that cannot be oversimplified to the effect of strict regulations. The pharmaceutical industry in USA offers a compelling analogy affirming why such concerns are not justified.

Since the establishment of FDA in 1906, a small scientific bureau has become an agency that is charged with the responsibility to protect the nation's supply of food and drugs, and ever since this establishment, the FDA has been known for its rigorous strict liability regime. A prominent policy that is often critiqued upon is the prohibition of marketing negligent of evidence of reduced risk known as the premarket review. Medical companies have filed lawsuits against the FDA claiming that this is a violation of the First Amendment, the protection of freedom from gov-

ernment interventions. The companies have argued that he FDA can interfere only after they can provide sufficient evidence to the court that the former's premarket claims are false. However, the FDA believes such a regulation is necessary as developing such evidence is resource and time consuming, and the evidence that proves ineffectiveness or harm would only be effective after patients have already suffered various effects (Hamburg, 2010). Additionally, such a regulation has been justified throughout the course of history. In 1902, a pharmaceutical company advertised their drug which they claim, "a remedy in the treatments of coughs, bronchitis…asthma, laryngitis, pneumonia, and whooping cough." This remedy was heroin. There are countless more cases of corporations selling drugs that has no sufficient proof of effectiveness and caused countless deaths. The rigorous regulations placed by the FDA has brought modern medicine to the place it is now.

After the above consideration why such regulations have been employed; the question arises, did such regulations really deter innovation and caused a decline in the pharmaceutical industries? Most critiques like Sam Peltzman (1973) have argued that the 1962 Kefauver-Harris amendments significantly deterred pharmaceutical innovation in USA. However, this wasn't exactly the case, as the results of these amendments are heterogenous. Firstly, it is crucial to recognize that the 1962 amendments were deployed gradually, most of the necessary guidelines were not completed until 1970. Thus, there were no discontinuity in production for most drug firms. In a study conducted by Thomas (1990), the data of total New Chemical Entities (NCEs), Domestic discovered NCE introductions, and Research & Development(R&D) expenditures were mapped on a graph; The trends on said graph showed that there was there was indeed as significant decrease in totals NCEs and Domestic discovered NCEs, however, but there was a rise in R&D expenditure. Thomas (1990) later concluded that the 1962 amendments gave big medical firms in the US a comparative advantage because of the amendments required a large and increase in interaction with physicians and pharmacologists on the staffs of research hospitals. Additionally, the medical firms that produced "me-too" drugs (identical and similar drugs before 1962 were exempt from premarket testing from a certification by the FDA) were required to generate their own premarketing tests for both safety and efficacy, which had a detrimental effect on these firms.

In conclusion, the strict liability regime that the FDA placed on medical firms with the 1962 amendments–it is a strict liability regime since the medical firms were responsible with the premarket testing and prohibition from marketing–only decreased financial attractiveness for im-

itative products and deterred the development of smaller firms. However, the regime actually resulted in more production of innovative products and most investment not the industry to produce higher quality products.

5. Case analysis of Xiaomi Su 7 accident on autopilot mode

Three college students were killed on March 9th, 2025, in one of the newest Xiaomi's SUVS, SU 7 EV (Global Times, 2025); The vehicle was operating in NOA (Navigation on Autopilot) mode, maintaining a speed of 116 kilometers per hour before the accident which occurred on a section of road under construction where traffic barriers had closed off the original lane which diverted vehicles to the opposite lane, Xiaomi reports. This accident caused many public interrogations upon the technology stability in SAVs, the manufacturing of the car itself (some question that the doors of the vehicle was unable to be opened, thus causing the death of the victims), and also how Xiaomi will respond to this unfortunate event (BBC, 2025). The controversy of SAVs is perfectly demonstrated in this accident, firstly, Xiaomi reports that the AI system reports that there is a barrier ahead at 22:44:24, and a second later, NOA was overruled, and the driver now took control of the car. Additionally, the cause of death was not the crash, but the vehicle caught aflame and although the reports of the vehicle are not finalized, the door of the car seems to be locked. The question arises, who is responsible for this tragedy? The road planner who placed the barrier which can be argued to be in an inappropriate position, or the Backend operators which did not program the AI system well enough, or the frontend operators who are responsible for manufacturing the vehicle doors.

Unlike the EU, under the Civil Code of the People's Republic of China, liability for motor vehicle accidents is primarily determined based on fault. This means the party at fault is responsible for damages (Ulrike Gluck and WU, 2020), which is why the parents of the victims have yet to be compensated for their loss, as the parties at fault have yet to be identified. As insinuated earlier, the advantages of a strict liability regime now should become clear, because under such a regime, Xiaomi would be responsible for compensating the victims. Indeed, a result of this accident, the public has lost confidence in Xiaomi's products. Shares of Xiaomi Inc fell as much as 5 percent in intraday intruding on the Hong Kong Stock Exchange on Tuesday, after the company released the details of the report (Global times, 2025).

This accident wouldn't have been so controversial in China if a strict liability regime was implied. Contrary to

what happened, Xiaomi would be held accountable for the harm caused by its vehicle, regardless of it was a systemic error that was out of their control. Not only would this ensure that the victims are compensated promptly, but this would also provide Xiaomi with a strong incentive to ensure that such accidents are minimized in the future, through technological innovation and more through scrutiny on their products before it sold to the public. Lastly, in the aftermath of this accident, the public would gain confidence from how quickly compensation was given and the fine imposed upon Xiaomi.

6. Conclusion

This article has surveyed the literature of AI systems for SAVs and examined the evolution of the technological landscape that enables them. The article explores the key advantages through the different theories provided in the literatures. The article also addresses the major counter argument–the potential hindrance of innovation–against a strict liability regime by drawing a parallel to the rigorous regulations set by the FDA. Contrary to common critiques, the regulations not only preserve but encourage innovation by promoting safer, more tested products. Through this lens, the article has argued that the implementation of a strict liability regime for SAVS is both a necessary and feasible step forward. Such a regime realigns responsibilities with abilities to control, ensuring that the parties most capable of managing risk–manufacturers, frontend/backend operators, and developers–bear solely the burdens of failure. This shift in liability guarantees compensation for victims, regardless of the complexity of causation, and fosters public confidence in novel technologies by reinforcing a culture of accountability. Lastly, the article explores the current controversy and imperfection in the liability systems through a recent Xiaomi SU 7 EV accident in mainland China. As long as a negligence/faulty liability regime is unestablished, victims may remain uncompensated and therefore lost public trust.

In the age of the Fourth Industrial Revolution, the legal frameworks must evolve in a tandem with the technologies they aim to regulate. With the aid of the appropriate framework, SAVs and novel technologies will diacritically improve the safety of the people, sustainability of the planet, and overall comfort. Together, AI systems will achieve rapid growth and ultimately promote the coming of a new era.

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