

Safety Report



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Mars Auto at a glance

- 700,000mi of commercial self-driving.
- Vertically integrated autonomous trucking.
- Korea's top 3 logistics & retail companies are customers.

Mission

Since its founding in 2017, Mars Auto has focused on long-haul trucking of heavy-duty trucks, aiming to transform trucking as more stable and scalable.





Neural-net centered design

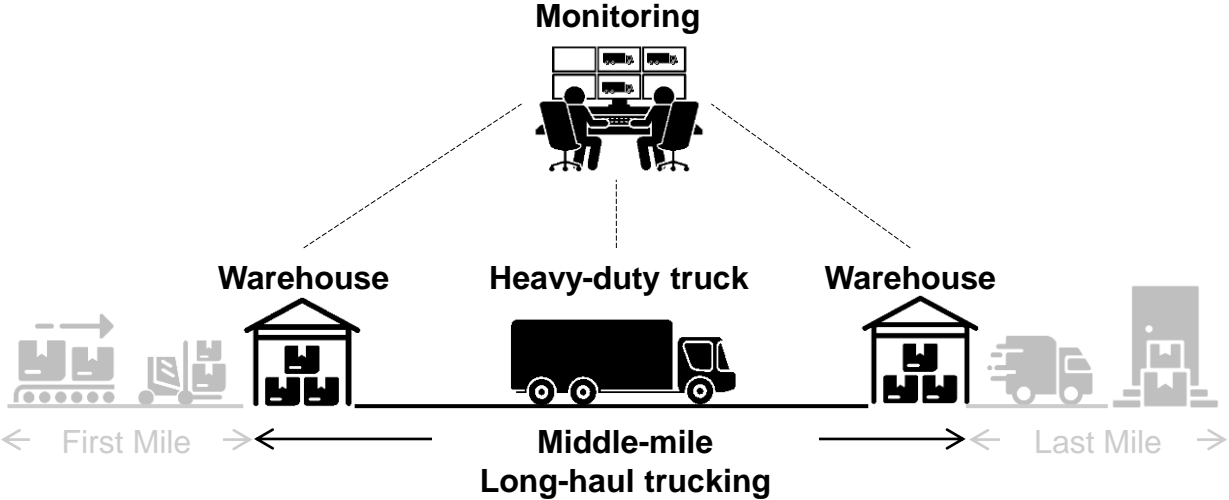
- Mars Auto's self-driving system, featuring cameras, a computer, and actuators, is retrofitted into trucks.
- Due to their significantly larger size and weight compared to passenger cars, trucks require faster and more sophisticated autonomous driving technologies.
- This includes the need for longer-range perception, precise state estimation, and sophisticated chassis control, all to be executed in a very short timeframe.
- Additionally, the driving approach needs to be tailored to the specific nature of the cargo being hauled, further complicating the technological requirements.
- To satisfy both stability and scalability, a data-driven approach that maximizes the potential of neural nets has been adopted.



Dual safety assurance system

- Mars Auto's autonomous trucking operation ensures safety through dual verification by both an operator and a control team.
- In the control room, skilled analysts don't just watch video streams; they also comprehensively analyze the autonomous vehicle's metadata to make informed decisions. They track the vehicle's mechanical status and the operator's focus level, ready to intervene immediately if necessary.
- This layered approach to monitoring underscores Mars Auto's commitment to maintaining high safety standards in their autonomous trucking operations.

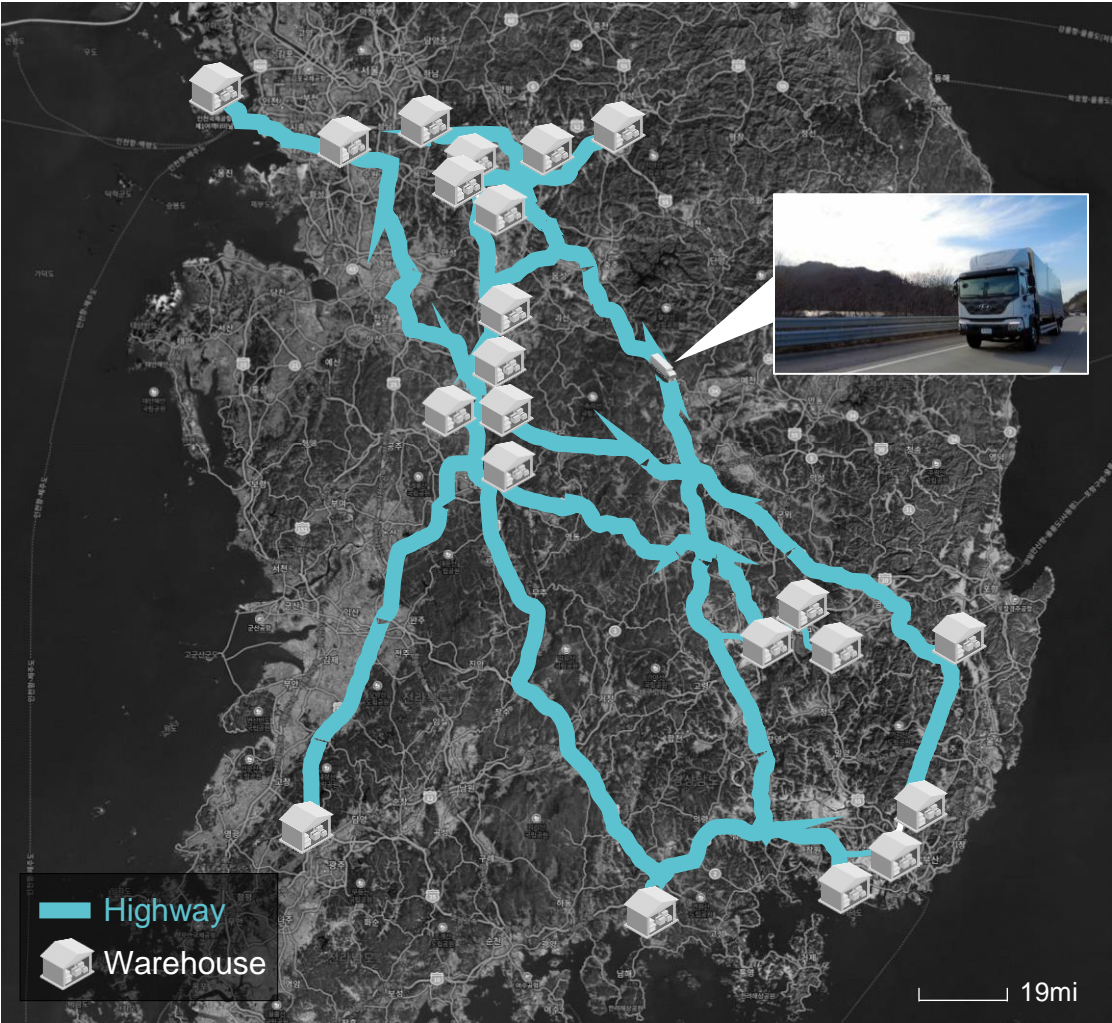
Operational Design Domain



Long-haul trucking of heavy-duty trucks

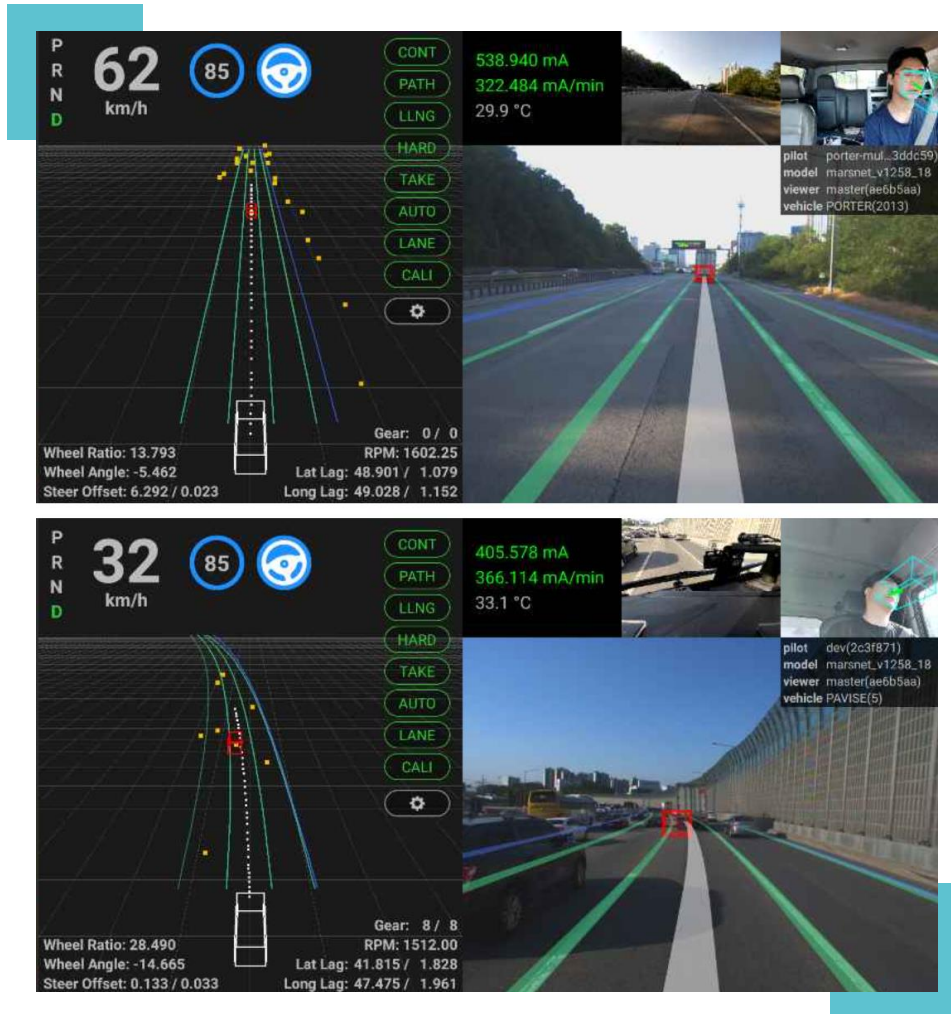
- Mars Auto is developing a self-driving system for heavy-duty trucks, tailored to long-haul trucking between warehouses.
- We have designed our technology to evolve from partial to fully unmanned autonomous driving in the long term.
- Mars Auto is in the validation phase of Level 3 self-driving and is developing Level 4 capabilities.

Operational Design Domain



700,000 miles of safe trucking operation

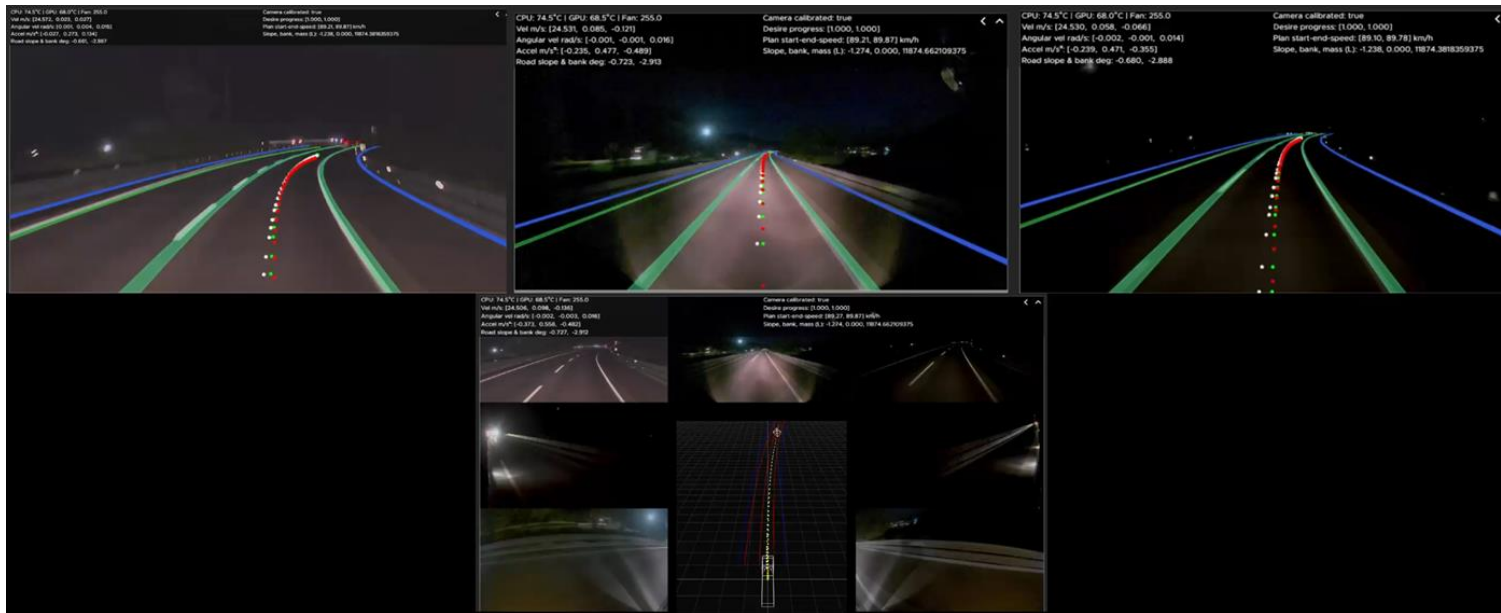
- Mars Auto has conducted paid autonomous trucking operations with Korea's top 3 logistics and retail companies.
- We have accumulated 700,000 miles on major Korean highways, as the unrivaled leader in the market.
- Starting in the second half of 2024, Mars Auto plans to begin its transportation operations in the Texas triangle in the United States.



Interface for safe operation

- The autonomous software's outputs are shown on displays. For instance, a red box signifies a leading vehicle's detection, and a stable drive is indicated by the center of lanes outlined in green.
- The operator can disengage the autonomous driving mode by using any of the following methods: maneuvering the steering wheel or pedals, interacting with the touch display, pushing the emergency button, or turning off the system.

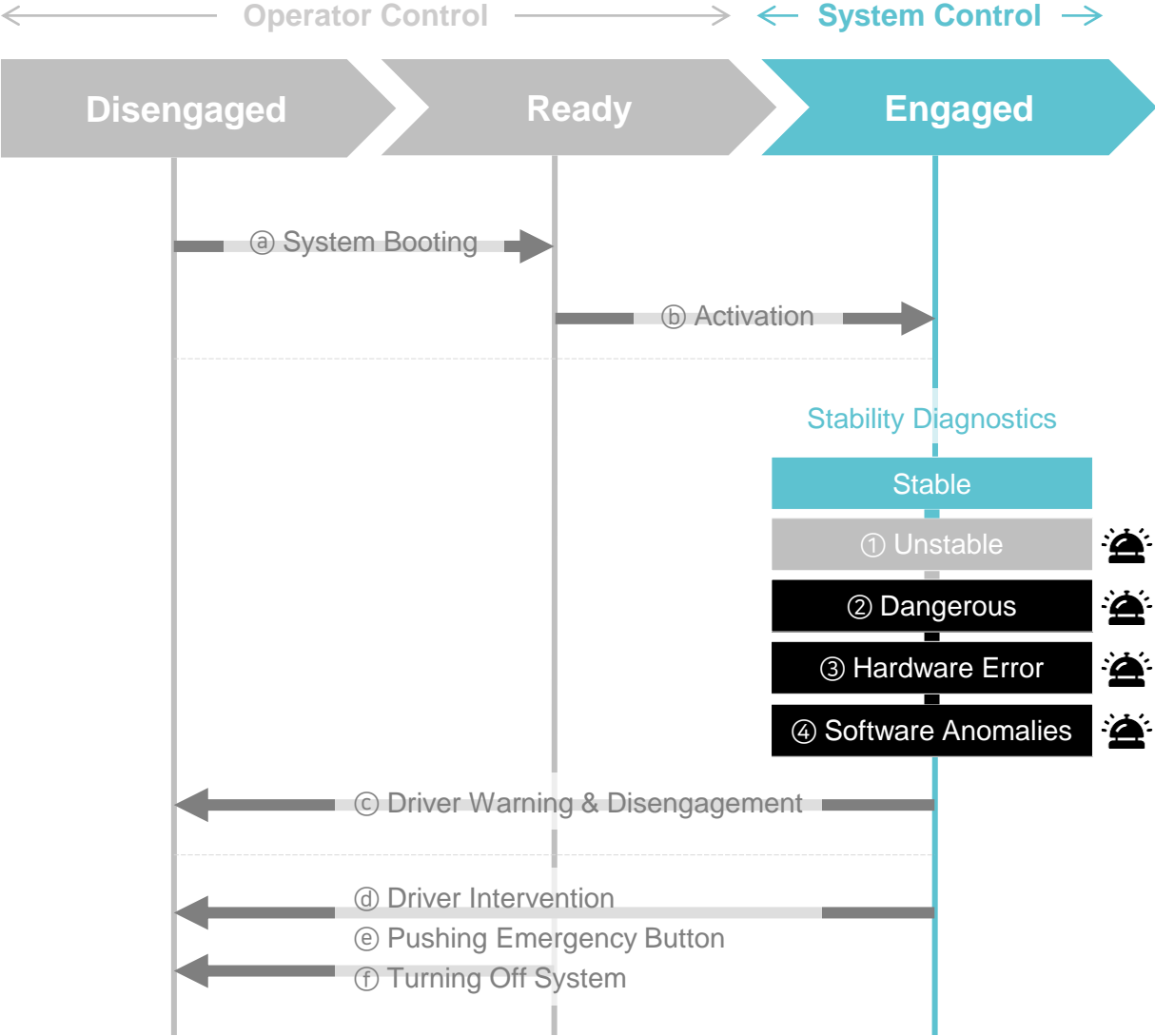
Object and Event Detection and Response




Vision-centered autonomous driving

- Mars Auto's self-driving software analyzes information inputted from sensors to detect objects and events essential for driving, such as vehicles and lane markings.
- Virtually all information necessary for driving is linked to machine learning models, leading to safer driving performance.
- The capability to perform all processes on lightweight computers is one of our core distinguishing features.

Fallback – Minimal Risk Condition



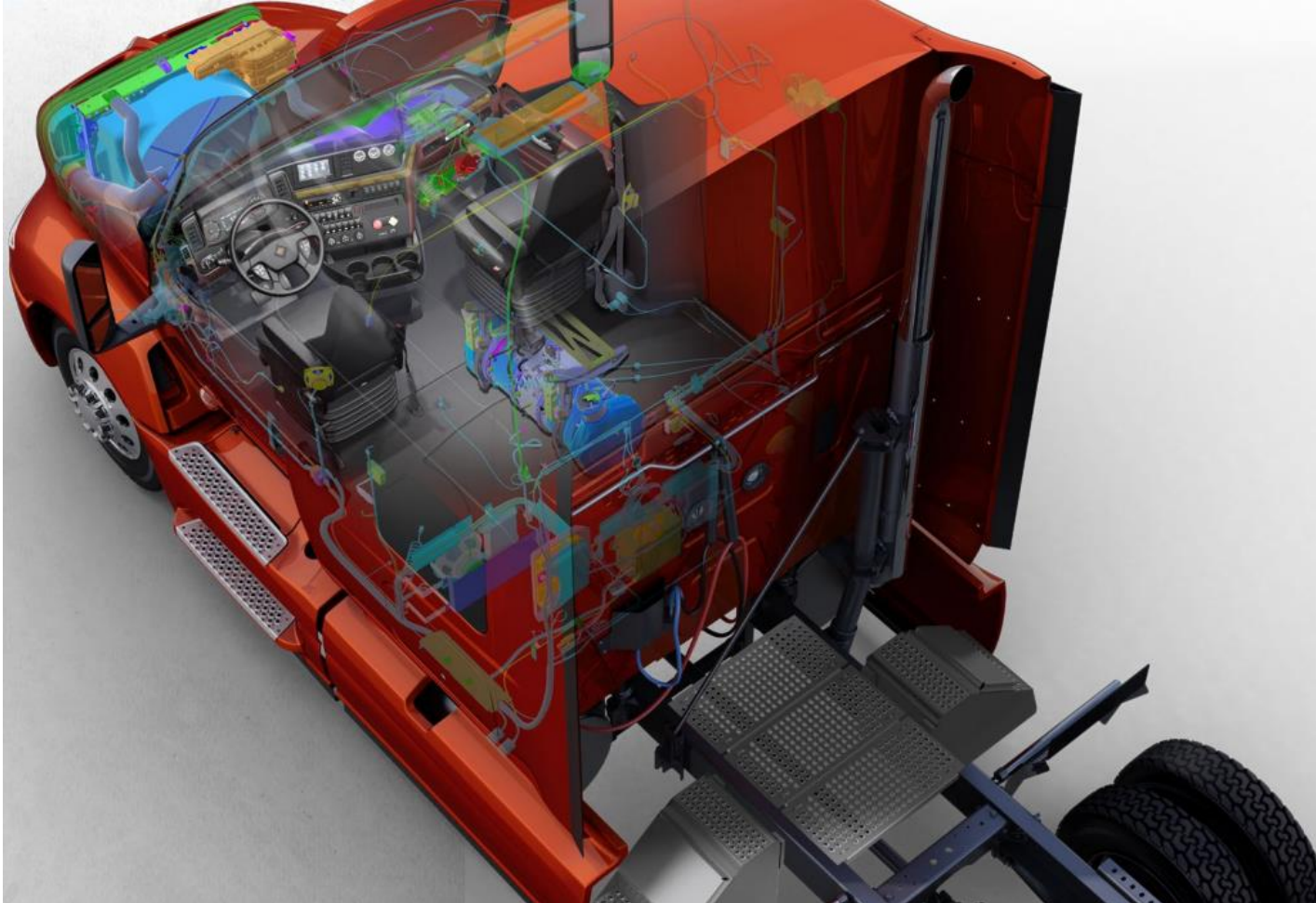
Multi-layer fallback-ready system

- According to the Society of Automotive Engineers (SAE) J3016 standard, in the event of a hazardous situation, a fallback plan involves the intervention of a driver to disengage autonomous driving following a specific scenario.
- An approach that automatically engages the brakes to decelerate can often lead to unsafe conditions. Therefore, the system is designed to allow a trained operator (fallback-ready user) to quickly take control.
- The self-driving system sends visual and auditory warnings  to the driver in four scenarios. These include when the autonomous driving safety diagnostics detect ① unstable and ② dangerous conditions, as well as ③ hardware errors and ④ software anomalies.
- There are three cases in which autonomous driving is automatically disengaged: ② if the system determines that it can no longer continue driving, ③ hardware errors, and ④ software anomalies. The operator can discontinue self-driving using any method among ④, ⑤, or ⑥.



Compliance in Autonomous Trucking

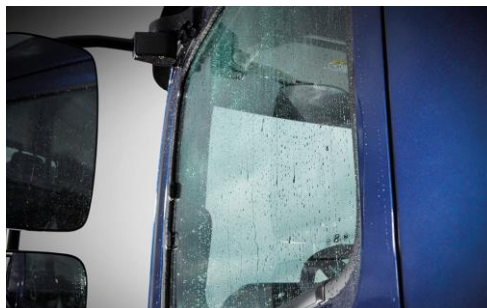
- Mars Auto commits to complying with and exceeding federal, state, and local laws for autonomous trucking. By integrating advanced systems for law adherence, Mars Auto ensures its trucks follow road rules, including speed limits and lane protocols.
- The company ensures all vehicle modifications meet Federal Motor Vehicle Safety Standards, to maintain safety. Mars Auto participates in AV initiatives and collaborates with governmental bodies to foster public trust and transparency in autonomous technology.
- Mars Auto proactively engages with regulators and policymakers, embedding road rules into its technology and advising on autonomous vehicle policies. This approach promotes safe, efficient, and lawful autonomous truck operations.



US truck: Conventional type

- Mars Auto prioritizes crashworthiness in its self-driving trucks, choosing vehicles known for safety. Mars Auto ensures its modifications for autonomous capabilities does not compromise the vehicle's inherent safety, adhering to Federal Motor Vehicle Safety Standards (FMVSS).
- Modifications are carefully made to preserve the vehicle's original safety and performance. Even as Mars Auto advances in autonomous trucking, ensuring the safety of both the technology and the modifications remains a core commitment.

Crashworthiness



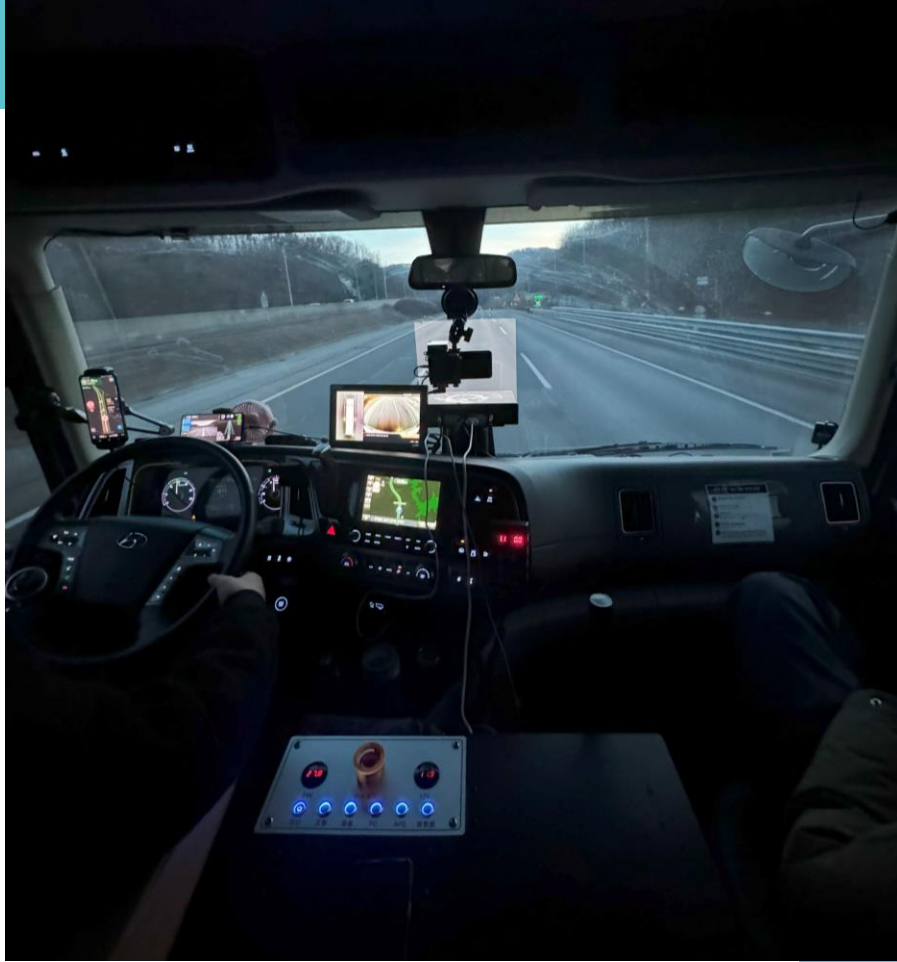
Korea truck: Cab-over type

- Unlike passenger cars whose safety performance evaluations by various national institutions like IIHS, Euroncap, and KNCAP are publicly available, accessing crash test results for commercial vehicles, especially large trucks, is challenging.
- The Hyundai Pavise, a new model released by Hyundai Motor Company in the second half of 2019, equipped with an autonomous driving system, was manufactured in compliance with the safety standards of South Korea's Motor Vehicle Management Act.
- Mars Auto ensures that the installation of cameras (three on the upper center of the front dashboard and four on the top of the chassis cab) does not compromise the vehicle's crashworthiness and is positioned to minimize impact on the safety of other vehicles and pedestrians during a collision.



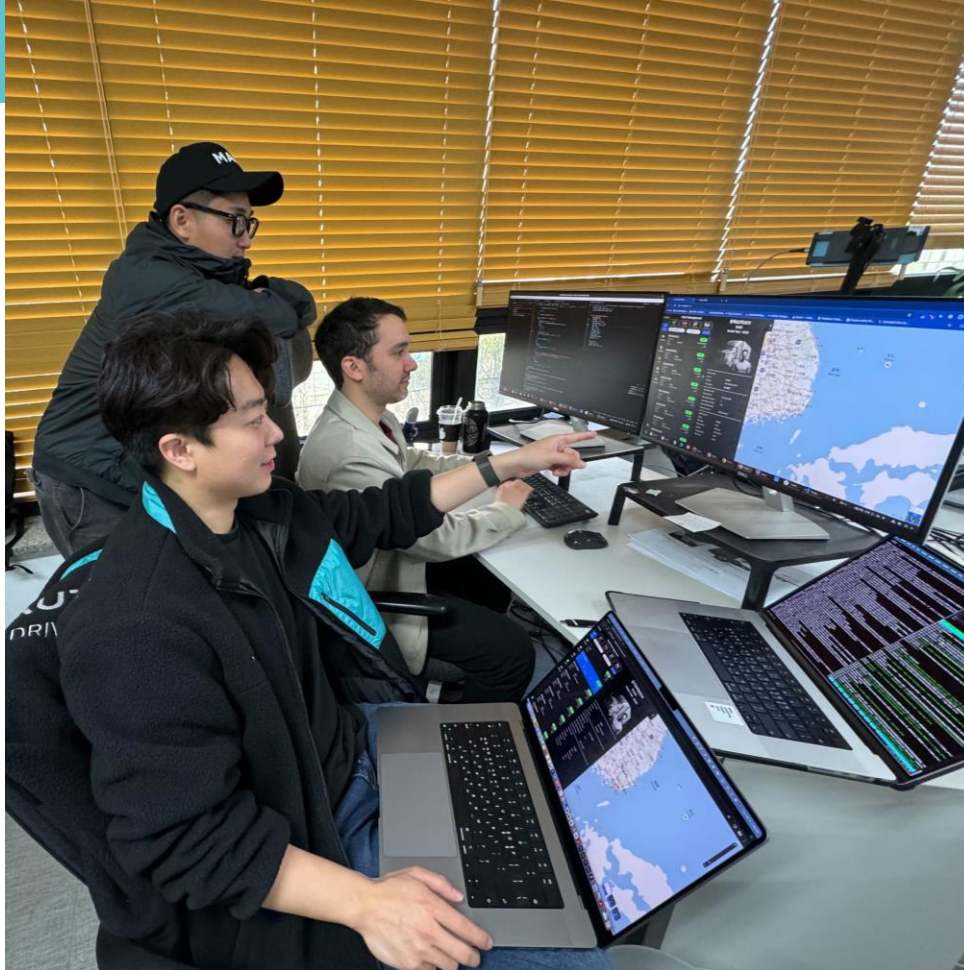
Rapid response from the scene and control center

- Mars Auto's post-crash behavior protocol ensures immediate, comprehensive actions are taken in the event of an incident to maximize safety and facilitate swift recovery. Upon detecting a crash, the autonomous system initiates a predefined fallback procedure, aiming to minimize risk. This includes moving the vehicle to a safe location, activating hazard lights, and notifying Mars Auto's operations center for prompt support. Redundant systems will ensure these actions are completed even if primary systems fail.
- Simultaneously, Mars Auto engages with emergency responders, providing essential information for safe interaction with the autonomous vehicle. A hotline for first responders and the public ensures direct communication with the company for any concerns related to the vehicle's post-crash and regular operations. Mars Auto's vehicles are equipped with features that allow first responders to easily identify the operational state of the autonomous system for added safety.



Training program tailored for trucking

- Mars Auto's training program is essential, even for drivers with commercial vehicle driving experience.
- Operating class 8 heavy-duty trucks for long-haul trucking presents unique challenges. These trucks, weighing 33,001 to 80,000 pounds, are about 3 times larger and over 10 times heavier than standard passenger cars.
- Operators undergo 4-week extensive training to deeply understand the characteristics and handling of heavy-duty trucks, ensuring safe and efficient operation.



Advanced measures for safe trucking

- Mars Auto's vehicle cybersecurity strategy emphasizes robust protection and continuous improvement to safeguard its self-driving trucks from potential cyber threats. Drawing from industry and government standards, Mars Auto has developed a cybersecurity program that matures alongside its technology. Key to this strategy is minimizing data entry points and isolating critical functions from external communications, effectively reducing potential attack vectors.
- By maintaining a proactive stance on cybersecurity, Mars Auto regularly updates its vehicle platforms with the latest security enhancements. The company invests in advanced security measures to stay ahead of evolving cyber risks. Furthermore, Mars Auto refers to ISO 21434 guidelines to assess cybersecurity risks continuously and develop robust controls, ensuring a comprehensive and dynamic approach to safeguarding its autonomous systems.
- To protect against both digital and physical cyber threats, Mars Auto implements encrypted communications, service isolation, and secure monitoring of system events. Special attention is given to the physical security of the system's hardware, with measures in place to restrict unauthorized access and tampering.



Complete data accumulation

- Mars Auto's data recording approach is meticulously designed to enhance autonomous trucking technology through comprehensive data analysis and safety improvement.
- Firstly, our system gathers operational data from everyday trucking activities. This strategy allows for targeted improvements in safety regulations compliance and vehicle maintenance, as well as in-depth analysis of disengagements to refine autonomous driving features.
- Secondly, Mars Auto employs a robust data-logging system that captures a wide array of data, including raw sensor information and vehicle operational states. This ensures a thorough documentation process that not only aids in reconstructing events.
- Finally, the continuous improvement of our autonomous system is a key focus, with data recording playing a central role. All collected data—ranging from sensor feeds to vehicle control data—is analyzed and utilized to refine the autonomous driving software, ensuring Mars Auto stays at the forefront of autonomous trucking technology.

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