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January 26, 2021

James Owens
Deputy Administrator
National Highway Traffic Safety Administration
1200 New Jersey Avenue S.E., West Building
Washington, D.C. 20590

Subject: Department of Transportation (DOT), National Highway Traffic Safety Administration (NHTSA), Advance Notice of Proposed Rulemaking (ANPRM), 49 CFR Part 571 [Docket No. NHTSA-2020-0106] RIN 2127-AM15, Framework for Automated Driving System Safety

Dear Deputy Administrator Owens,

FLIR Systems, Inc. (FLIR), founded in 1978, is a world-leading technology company focused on intelligent sensing solutions for defense and industrial applications. Our vision is to be “The World’s Sixth Sense,” creating and advancing technologies to help professionals make better, faster decisions that save lives and livelihoods.

For almost two decades, FLIR has been selling thermal cameras into automotive for ‘night vision’ which presents a thermal image in a display for the driver to help identify people and animals. Over the last few years, FLIR has combined artificial intelligence with a fused visible, thermal and radar sensing system to provide industry leading Automatic Emergency Braking (AEB) for *real driving* situations, especially nighttime. This expanded use of thermal imaging greatly increases the value and capability of the technology and has the potential to save thousands of lives each year. The Uber accident in Arizona, where the self-driving car killed a pedestrian at night, and the more than 6,000 pedestrians killed each year by cars (75% at night) give witness to the need for such technology.

AAA’s October 2019 independent study of current leading AEB systems shows the significant gaps in safety, in both day and night conditions¹, for the newest ADAS equipped vehicles (one vehicle even claims to be full self-driving capable). To resolve this gap, FLIR sees thermal imaging being adopted by many robo-taxi companies now, but we see significant reluctance in adoption by OEMs. This is because the AEB testing standards in place today are written such that OEMs/Tier One systems can pass the tests easily, as they are based on well-lit ideal driving conditions. It is well known that the current testing parameters do not accurately replicate how most pedestrians are being killed by vehicles, in dark lighting situations with little to no visibility beyond the headlights.

FLIR believes that a reliable Automatic Emergency Braking (AEB) system (or fully autonomous vehicle) should include thermal imaging cameras in addition to visible cameras. Visible cameras encounter too many situations that will seriously risk the lives of pedestrians in ADAS enabled vehicles and self-driving vehicles. Additional testing standards and procedures need to be added to the protocols in place today

¹ <https://www.aaa.com/AAA/common/aar/files/Research-Report-Pedestrian-Detection.pdf>



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so that challenging lighting conditions continue to expand technology achievement, such as nighttime, sun glare, shadows, tunnels, fog, headlight glare, etc.

Over the last year, FLIR engaged with VSI Labs (VSI) to develop and test the world's first fused AEB sensor suite that employs a thermal camera, a radar, a visible camera, and a convolutional neural network (CNN). Developing AEB systems with thermal camera technology can reduce human injuries and deaths significantly as revealed by our testing. FLIR strongly recommends that testing standards be improved so various challenging lighting conditions are included (note: Euro NCAP's nighttime scenarios include lamps). Without these improved testing standards OEMs/Tier One suppliers will continue to field ineffective systems which can pass the testing standards, but do not appreciably improve the increasing problem of pedestrian deaths.

Our comments were developed to provide NHTSA with data and technical recommendations pertinent to NHTSA's effort to develop a framework for ADAS and automated driving system safety. Comments were prepared with support from FLIR's engineering teams, who have extensive knowledge and research on advanced driving system safety, including, most recently, a round of testing based on the Euro NCAP testing protocols for standard AEB positive detection.² Our testing results show that our system can address challenging lighting conditions and performed significantly better than the leading AEB systems available today. If the testing standards do not improve to include real world driving situations, then the OEMs / Tier One Suppliers will continue to field ineffective systems at saving pedestrian lives in the interest of saving cost.

FLIR Systems, Inc. appreciates NHTSA's efforts and the consideration of our comments related to the ANPRM. For related questions, please contact Colton Hotary, via email colton.hotary@flir.com, or 571-217-4831.

Respectfully Submitted,
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² [Test Results: AEB Fused with Thermal Can Save Lives](#)



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V. Questions and Requests

A. Questions About a Safety Framework

Question 1. Describe your conception of a Federal safety framework for ADS that encompasses the process and engineering measures described in this document and explain your rationale for its design.

- *FLIR Response: The design and implementation of Sensing, Perception, Planning, and Control will be essential and obvious to any company creating an ADS vehicle. FLIR recommends that the constraints needed from NHTSA should be focused on standards to achieve safe, efficient travel and allow the engineering ingenuity to unfold as it will and let the best technologies win. Competition among technologies is the healthiest way to prevent unintended, or intended, monopolies to develop and allow the best ideas and proven solutions to prevail.*

Question 2. In consideration of optimum use of NHTSA's resources, on which aspects of a manufacturer's comprehensive demonstration of the safety of its ADS should the Agency place a priority and focus its monitoring and safety oversight efforts and why?

- *FLIR Response: The key to safety, missing currently, are testing standards that include all driving conditions such as darkness, fog, glare from headlights or sun to name a few. These conditions can lead to pedestrian accidents and deaths, animal strikes and other collisions.*

Question 3. How would your conception of such a framework ensure that manufacturers assess and assure each core element of safety effectively?

- *FLIR Response: Currently, there is a strong system in place with IIHS and other testing agencies that have a great responsibility to test and evaluate vehicles before they are on the road and meet applicable standards. Once the additional standards are developed for ADS vehicles, it will be essential for these new vehicles to have a unique testing requirement enforced for vehicle safety and the addition of digital navigation and driving safety.*

Question 4. How would your framework assist NHTSA in engaging with ADS development in a manner that helps address safety, but without unnecessarily hampering innovation?

- *FLIR Response: If a standard is set then industry will have the opportunity to develop the most robust system with any existing new technology at their disposal. This will allow for the multiple technologies to be tested and perfected to form the best and most reliable suite of sensors and technology.*



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Question 5. How could the Agency best assess whether each manufacturer had adequately demonstrated the extent of its ADS' ability to meet each prioritized element of safety?

- *FLIR Response: Testing standards should be as difficult and complex as real-world driving conditions. Drivers must navigate black ice, slippery wet roads after a long dry spell, snow, rain, fog, complete darkness, people occluded by a bush in a shady intersection or median and more. The testing should give consumer confidence that the cars are safe. One would not put their baby in an ADS car that received a three out of five star rating while driving at night. Consumers deserve the right to make that choice because the testing was robust enough to show that weakness and the rules ensured OEMs must disclose the truth about their cars abilities and weaknesses. Consumers currently see 'pedestrian detection' on the option list of their car, but don't realize that the current capability is only a daytime feature and doesn't work at night when it is most needed.*

Question 6. Do you agree or disagree with the core elements (i.e., "sensing," "perception," "planning" and "control") described in this document? Please explain why.

- *FLIR Response: We agree that these are the core element, and believe it is important for creating a platform to test against.*

Question 7. Can you suggest any other core element(s) that NHTSA should consider in developing a safety framework for ADS? Please provide the basis of your suggestion.

- *FLIR Response: It will be important to also have a reporting system, similar in function to a black box or dash camera function, as part of the complete system. There is a great deal of learning to come from car behavior as well as a capture of outcomes, good and bad to develop norms, expectations, and improvements.*

Question 8. At this early point in the development of ADS, how should NHTSA determine whether regulation is needed versus theoretically desirable? Can it be done effectively at this early stage and would it yield a safety outcome outweighing the associated risk of delaying or distorting paths of technological development in ways that might result in forgone safety benefits and/or increased costs?

- *FLIR Response: Regulation is needed to inform consumers of what the ADS can or cannot do and what core element it complies with. Consumers currently believe their ADS systems have been vetted and should keep them safe in a variety of common scenarios at any given driving time. Recent testing by FLIR, AAA, and IIHS have shown this to be a false sense of reality, particularly on dark roads at night.*



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Question 9. If NHTSA were to develop standards before an ADS-equipped vehicle or an ADS that the Agency could test is widely available, how could NHTSA validate the appropriateness of its standards? How would such a standard impact future ADS development and design? How would such standards be consistent with NHTSA's legal obligations?

- *FLIR Response: The nation and foreign regulatory bodies turn to NHTSA as an authority in road and automotive safety that is committed to putting drivers, pedestrians, and other vulnerable road users first and are developing standards that ensure that ADS systems and vehicles are as safe as possible for the drivers, riders, and VRUs. Testing by AAA and IIHS independently support our statement that existing visible camera-based systems do not effectively work at night and there is affordable technology already available that can solve the problem. Only through test protocols that replicate real life situations will vehicle manufactures deploy improved systems.*

Question 10. Which safety standards would be considered the most effective as improving safety and consumer confidence and should therefore be given priority over other possible standards? What about other administrative mechanisms available to NHTSA?

- *FLIR Response: FLIR recommends prioritizing pedestrian detection, specifically in Automatic Emergency Braking systems, which are currently on millions of vehicles and will begin to be available on all new vehicles starting in 2022. However, testing should ensure that AEB pedestrian detection is not a feature that only works in well lighted situations and specifically is able to work at night when most pedestrian deaths occur, if not by 2022, in the near future.*

Question 11. What rule-based and statistical methodologies are best suited for assessing the extent to which an ADS meets the core functions of ADS safety performance? Please explain the basis for your answers. Rule-based assessment involves the definition of a comprehensive set of rules that define precisely what it means to function safely, and which vehicles can be empirically tested against. Statistical approaches track the performance of vehicles over millions of miles of real-world operation and calculate their probability of safe operation as an extrapolation of their observed frequency of safety violations. If there are other types of methodologies that would be suitable, please identify and discuss them. Please explain the basis for your answers.

- *FLIR Response: Vehicles, roads, and cities are getting smarter every day. There are digital solutions for edge and cloud computing to be part of the solution.*

Question 12. What types and quanta of evidence would be necessary for reliable demonstrations of the level of performance achieved for the core elements of ADS safety performance?

- *FLIR Response: A system of reliable and trusted testing agencies that are sophisticated enough to comprehend the complexities, capabilities, and possible failures of ADS vehicles will be essential to have consumer trust and reliability that safety is coming first.*



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Question 13. What types and amount of argumentation would be necessary for reliable and persuasive demonstrations of the level of performance achieved for the core functions of ADS safety performance?

- *FLIR Response: Extensive testing protocols that accurately emulate real driving conditions are necessary. Testing should not be constructed to match the capability of the vehicle; they should be constructed to match most accurately the real-world driving situations that the technology and needs to solve.*

B. Question About NHTSA Research

Question 14. What additional research would best support the creation of a safety framework? In what sequence should the additional research be conducted and why? What tools are necessary to perform such research?

- *FLIR Response: OEMs and Tier One Suppliers need to be challenged to develop systems that can withstand testing all systems at night, in light glare, and other common and complex driving situations. Analyzing traffic accident data and reporting that data, as well as creating testing protocols that replicate those driving scenarios is necessary. AEB-p systems that only work a small percentage of the time, such as only during the day while manually activated by the driver, should not be allowed to be advertised as a feature. A basic level of performance should be mandated before acceptance as a feature, otherwise the consumer could be misled as to the capabilities of the technology in their vehicle.*

C. Questions About Administrative Mechanisms

Question 21. Should NHTSA consider an alternative regulatory path, with a parallel path for compliance verification testing, that could allow for flexible demonstrations of competence with respect to the core functions of ADS safety performance? If so, what are the pros and cons of such alternative regulatory path? What are the pros and cons of an alternative pathway that would allow a vehicle to comply with either applicable FMVSS or with novel demonstrations, or a combination of both, as is appropriate for the vehicle design and its intended operation? Under what authority could such an approach be developed?

- *FLIR Response: Considering the sophisticated technology being developed for ADS it would be interesting to consider ADS vehicles being connected to a virtual reality system that challenged their neural network and decision making, rather than just real-world testing. Various simulation companies could create a virtual testing protocol that is part of the basic acceptance criteria before even real-world testing begins.*