ADASKY
DRIVEN TO SAVE LIVES

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THERMAL IMAGING CAMERAS "SEE" WHEN OTHER SENSORS FAIL

A Mandate for Thermal Imaging Technology on Every Vehicle Would Save Lives

In 1968, seat belts became mandatory in the United States. The regulation appeared 10 years after research on the use of seat belt restraints proved significant reductions in automotive fatalities. Three decades later, front air bags were mandated following another 10 years of research proving the benefit. By 2022, another safety feature, Automatic Emergency Braking (AEB), will be adopted by all major manufacturers on all new vehicles. Unlike the lifesaving benefits of seatbelts and airbags, current AEB systems are limited in effectiveness. Existing AEB technology faces challenges in mitigating or preventing accidents with Vulnerable Road Users (VRUs) and even more critically, the systems are not effective at night or in inclement weather. One additional sensor would overcome this critical limitation, a thermal imaging camera.

STUDIES SHOW CONCERNING GAPS IN CURRENT ADAS/AEB SYSTEMS

Despite significant improvements to vehicle safety technology and designs, each year more than 38,000 Americans are killed and about 4.4 million people are injured seriously enough to require medical attention in vehicular crashes, or as pedestrians hit by motorists[1] .

Recent statistics are sobering. A Governors Highway Safety Association (GHSA) report found the number of pedestrians killed in motor vehicle crashes in 2019 was 6,590, an increase of approximately 300 deaths compared to 2018. This is the largest number of pedestrians killed since 1988 and the highest fatality rate per 100,000 people since 1997.

Moreover, GHSA said increases in pedestrian fatalities occur largely at night. From 2009 to 2018, the number of nighttime pedestrian fatalities increased by 67 percent, compared to a 16 percent increase in daytime pedestrian fatalities. Separately, the U.S. National Highway Transportation Safety Administration (NHTSA) reports that 75 percent of all pedestrian deaths occur at night[2].

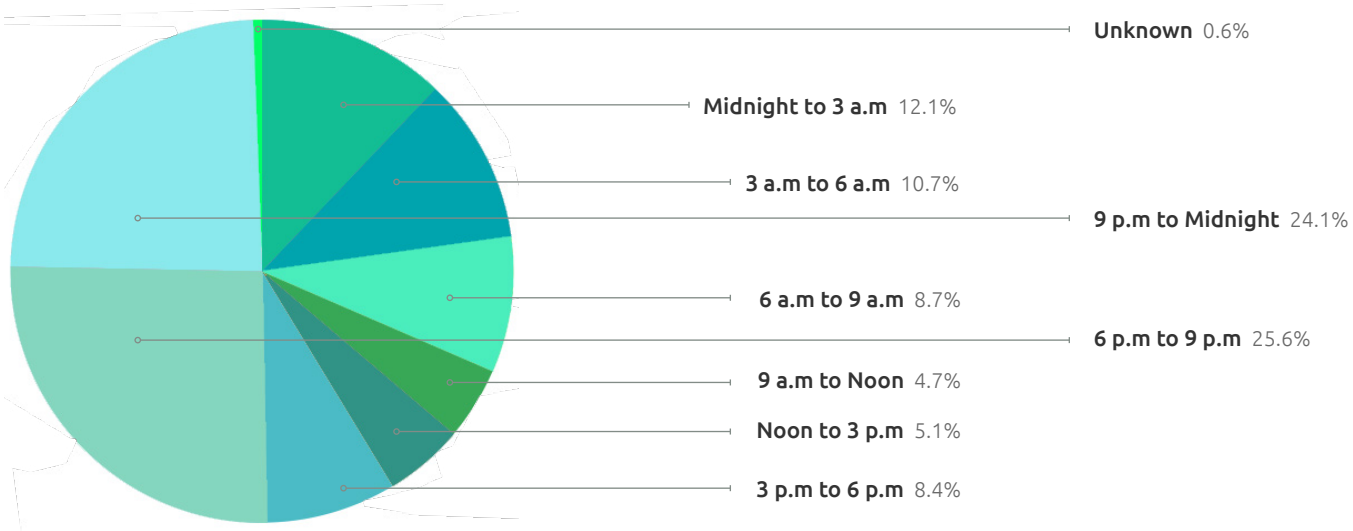
These statistics understate the impact on society as a whole. In 2018, there were an additional 137,000 pedestrian injuries[3] and an

[1] https://www.nsc.org/road-safety/safety-topics/fatality-estimates#:~:text=In%202019%2C%20an%20estimated%2038%2C800,2%25%20decrease%20over%202018%20figures

[2] https://brightfleet.com/blog/2019/01/nhtsa-pedestrian-safety-statistics/

[3] https://www.cdc.gov/motorvehiclesafety/pedestrian_safety/index.html#:~:text=In%202017%2C%205%2C977%20pedestrians%20were,one%20death%20every%2088%20minutes.&text=Additionally%2C%20an%20estimated%20137%2C000%20pedestrians,crash%2Drelated%20injuries%20in%202017

2018 NHTSA pedestrian fatalities vs time of day



https://cdan.dot.gov/query

estimated $871B in costs due to hospital bills, insurance costs and other expenses[4].

This data illustrates how AEB systems using current technology (CMOS camera and radar) are simply not sufficient. We have to do better not only at night but in the daytime as well, when visibility is ideal.

Thermal imaging cameras, a technology that has existed for many decades, combined with the current AEB sensor suite, can detect VRUs in a much more comprehensive and safe manner. The addition of a thermal imaging camera paired with these other sensors would significantly increase the detection scope and responsiveness capabilities of AEB technology.

THE TIME IS NOW TO OVERHAUL VEHICLE SAFETY RATINGS AND TESTING STANDARDS

The introduction of AEB on all vehicles provides a crucial opportunity to address the limitations of these systems. In an almost unprecedented action of unity between the auto industry, safety advocates and NHTSA regulators, every automaker has pledged to equip all new vehicles sold in the U.S with AEB by 2022[5] without a law mandating this action. AEB has proven to improve on a human's ability to stop in time in certain circumstances. However, while it is a good start, there is, as previously noted, evidence of poor AEB performance, specifically when it comes to detecting pedestrians at night. In fact, an October 2019 AAA report showed **AEB is only effective about 40 percent of the time during the day and 0 percent of the time at night**[6]. The AAA report also indicates that drivers must never rely on an AEB system to prevent a collision with a pedestrian. Instead, AEB systems are a backup of last resort. To that end, the AAA report concludes it is the driver's responsibility to prevent collisions by staying alert, paying attention and taking corrective action as early as possible. Interestingly, and despite poor results in night scenarios, all test vehicles earned 4 to 5 stars in NHTSA NCAP safety ratings.

This is concerning due to the systems failure to perform properly in critical situations.

Since 2014 AEB systems have been evaluated in Europe[7], as part of the Euro NCAP safety rating and major limitations have been demonstrated in the following scenarios:

- Pedestrians close together
- Pedestrians in the dark, at night or while in a tunnel
- Pedestrians partially occluded behind a vehicle or large object
- Children, the most vulnerable road users

5-star safety rating scoring systems indicate the degree of safety features and performance relative to other new vehicles in the market. These are based on a variety of crash test methodologies conducted by dedicated agencies such as NHTSA and IIHS in the United States, and Europe's Euro NCAP. None of these tests include severe visibility scenarios of any kind, such as harsh weather or glaring, or high driving speeds, failing to reflect the real-life scenarios where the most fatal

[4] https://www.cdc.gov/motorvehiclesafety/costs/index.html#:~:text=2014%20NHTSA%20study%20shows%20motor,million%20in%20direct%20medical%20costs
[5] https://www.nhtsa.gov/press-releases/nhtsa-iihs-announcement-aeb#:~:text=Twenty%20automakers%20pledged%20to%20voluntarily,front%2Dto%2Drear%20crashes
[6] https://www.aaa.com/AAA/common/aar/files/Research-Report-Pedestrian-Detection.pdf
[7] https://cdn.euroncap.com/media/30700/euroncap-roadmap-2025-v4.pdf

New Car Assessment Program Pedestrian Testing Protocol

accidents take place.

Nevertheless, there are encouraging developments. The auto industry and safety advocates are starting to take notice of the potential of thermal imaging cameras. The 2019 AAA report catalyzed a renewed interest in thermal cameras, stating: "Warm-blooded organisms emit radiation within this part of the EM spectrum; thermal imaging can therefore create images of people and animals regardless of lighting conditions. Additionally, thermal imaging remains effective in adverse weather such as rain, snow and fog."

THERMAL CAMERAS CLOSE THE GAPS IN ADAS SYSTEMS

Thermal imaging cameras have clear advantages over current sensing modalities, however the application in vehicles has been very limited and is used as a luxury feature rather than a safety technology. This is due to the previous generation of thermal cameras having several limiting factors; primarily, the large size, high power consumption, low resolution, poor reliability, poor image quality, and high manufacturing expense.

Traditional thermal camera suppliers had limited new competition due to significant barriers to entry noted above. With very little outside pressure, current suppliers have not had to innovate or reduce pricing, and in fact, enjoy significant pricing leverage in today's marketplace. High pricing has relegated thermal cameras to a very small selection of premium vehicles branded as night vision systems with annual volumes of around 120,000 units – less than 1 percent of the current new vehicle market. Moreover, these older systems cost the consumer between $2000 and $2500.

Moreover, despite the high price point, these sensors do not help vehicles avoid crashes and only warn the driver of an on-coming

ADASKY's LWIR thermal sensor "Viper"

object. Thermal cameras developed a reputation in the automotive industry as being too big and expensive to consider as a standard feature on all vehicles. As we have seen with many common consumer and automotive devices, advancements in technology will drive the size and cost of thermal cameras to competitive levels in a similar manner to CMOS cameras or automotive radar systems. Thus, making this life saving feature accessible to the masses.

ADASKY, developer and manufacturer of intelligent thermal sensing systems, cracked the code that has kept thermal imaging cameras on the sidelines over the past 40 years, with its long wave infrared (LWIR) camera, "Viper". This revolutionary technology brings high quality shutterless thermal sensing to automotive, eliminating constraints such as size, cost and power. Viper cameras always "see"; even during heavy snow, fog, rain, shadows, blinding lights and most importantly, complete darkness - never missing a beat.

Why is this so important? Thermal cameras work passively by sensing the amount of heat (via electromagnetic radiation) emitted from every object, living or inanimate. Each object emits a unique thermal signature that allows for differentiation to a very high degree of accuracy (±0.05°C), and with Viper, a high resolution, grayscale 14-bit video image can be achieved. Incredibly, thermal imaging cameras are the only technology that can sense and classify living beings (pedestrians, bicyclists and animals) far enough in advance to allow for the automated vehicle or human driver to safely react at night.


Data from ADASKY's "Viper" with multiclass object detection

In fact, thermal cameras can detect objects up to 984 feet (300 meters) and classify living beings around 656 feet (200 meters), day or night. Typical vehicle low-beam headlamps combined with a CMOS camera might be able to detect an object around 262 feet (80 meters) but cannot determine if the object is alive. This crucial differential can be the difference between life and death. **At 70 MPH (113 KPH), the Viper camera will identify a living being a full six seconds before the camera or radar will detect and classify an object, never going "blind" by pausing to recalibrate**. Recent automated vehicle crashes, some of which tragically claimed the lives of drivers and pedestrians, could have been prevented if thermal cameras were part of the sensor suite.

Through recent industry testing and experimentation, thermal cameras applied to AEB systems have shown very promising results, a 100 percent success rate in collision avoidance regardless of lighting conditions was achieved[8]. These studies provide conclusive evidence that thermal technology must be included in ADAS and AEB systems.

CONCLUSIONS

The auto industry has always taken safety very seriously and the track record shows they have risen to the occasion when required. The voluntary adaptation of AEB systems is an excellent first step, however, it's just the start.

Evidence of poor performance at night, and even during the daylight hours, of current AEB systems, unequivocally demonstrates that improvements need to be made. Thermal cameras need to be employed and are the only logical next step to ensure driver and pedestrian safety.

WE CANNOT AFFORD TO USE INSUFFICIENT SAFETY SYSTEMS; PEOPLE'S LIVES DEPEND ON IT.

ABOUT ADASKY

ADASKY, developer and manufacturer of thermal sensing systems, turns night into day with "Viper", a revolutionary intelligent, high-resolution LWIR thermal camera, designed for vehicle perception and safety systems at all levels of automation. Viper, the only automotive-grade shutterless camera in the market, can see what other sensors cannot, night or day, and is not limited by blinding lights or harsh weather - making roads safer for all.

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[8] https://www.flir.com/oem/adas/putting-thermal-aeb-to-the-test/