Docket Management Facility, M-30
US Department of Transportation
1200 New Jersey Avenue SE
West Building, Ground Floor
Room W12-140
Washington, DC 20590-0001

Attention: Docket No. DOT-NHTSA-2020-0106

Dear Sir or Madam:

Mandatory implementation of effective PAEB systems is covered by the notice of proposed rulemaking (NPRM) published at 88 *Federal Register* 38632 published Jun 13, 2023. In this notice, NHTSA requests comments on the proposed rule. Owl Autonomous Imaging, Inc. (Owl AI) respectfully submits this letter commenting on the requirements for testing PAEB systems for compliance with the proposed rule.

Owl AI markets a product intended to provide data needed by Pedestrian Automatic Emergency Braking (PAEB) systems in vehicles to avoid collisions with pedestrians. The Owl AI system detects pedestrians and measures their distances from the vehicle using a night vision technology that detects the thermal radiation emitted by the pedestrians. The efficacy of this technique has been demonstrated during testing supervised by NHTSA [1].

Sensing Methods

Reliable protection of pedestrians depends on sensors located on vehicles which can quickly separate the pedestrians from the background and determine their distances from the vehicles. Currently, most of these sensors are video cameras and radar units designed for automotive use. Unfortunately, recent testing [2] has demonstrated that while PAEB systems using these sensors work well in daytime, they are considerably less successful at night. Bright street lighting can mitigate poor nighttime performance but this need only points out the weakness of sensors that depend on active lighting. Not only is lighting often impossible to provide but it is ineffective in the presence of smoke, fog, and rain.

Unlike cameras and radar units, and unlike LiDAR, which has been proposed as a possible addition to the sensor arsenal, thermal imaging does not require that the pedestrian be illuminated. Instead, thermal imaging captures infrared radiation emitted by every object with a temperature above absolute zero. Live beings, including pedestrians, emit radiation in the 8-14μm band (so-called long wave infrared or LWIR) that can be easily distinguished from other objects. Attachment No.1 explains infrared radiation in more detail and Attachment No.2 shows typical images of pedestrians in common settings.

Validation Requirements

While preliminary testing has demonstrated the efficacy of thermal imaging in pedestrian detection, formal testing of PAEB systems, as would be required by the proposed rule will depend on the availability of test equipment that accurately represents the appearance of pedestrians not only to visible cameras and radar but to the new thermal cameras provided by Owl and others.

In the proposed rule, the requirements for pedestrian mannequins to be used with cameras and radar are included in detail in paragraph VIII A. However, subparagraph 5 in this section indicates that NHTSA is not currently prepared to include specifications for mannequins that can be seen by thermal imagers in the rule. We would like to suggest that the rule take a slightly different position.

Mannequin Thermal Signature

Mannequins with thermal signatures similar to those produced by human pedestrians have already been produced. Some of these, including the mannequins in the Owl tests, had external heated blankets to simulate skin temperature in the test environment but 4Active Systems, the company referenced at the beginning of paragraph VIII A, has already manufactured a mannequin, the 4Active HT, which incorporates a five-zone heating system, Attachment No. 3 is the operating manual for this mannequin.

In this same paragraph, the proposed rule mentions the standard ISO 19206-2:2018 covering pedestrian mannequins. While this edition of the standard does not include a specification for heated mannequins, the committee responsible for ISO 19206 has already announced that it will convene a meeting later in 2023 to consider the requirements for a heated mannequin specification and is actively soliciting new members who are experienced in thermal imaging. Thus, it can be expected that sometime before the proposed rule goes into effect, ISO 19206-2 will include a specification for pedestrian mannequins intended for use with thermal detection systems.

Proposed Rule Modification

As paragraph VIII A 5 states, insufficient study of the requirements for an appropriate heated pedestrian mannequin have been done to support inclusion of a specification in the rule. We believe, however, that given the existence of thermal testing underway for over five years with the support and financing of several manufacturers of automobiles and autonomous vehicles, and the growing interest from both standards bodies and manufacturers of pedestrian mannequins, NHTSA should include in the proposed rule the following requirement:

> "In order to provide vehicle manufacturers the broadest portfolio of detection options in PAEB systems, the protocol for PAEB testing shall include, by the date this rule becomes effective, the use of pedestrian mannequins that produce thermal signatures representative of real-world pedestrians in the applicable test environments."

We believe the this is a feasible requirement because sample mannequins with extensive test data already exist and because the organizations have already acknowledged the need to include thermal imaging in their documents.

Respectfully yours,

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[1] – Owl Nov 2022 video - https://youtu.be/wQ5VdMJPOvw

[2] – NHTSA nighttime test video - https://youtu.be/liQxaeGPHJg

Attachment No. 1 – Owl white paper on infrared
Attachment No. 2 – Owl white paper on HD/VGA
Attachment No. 3 – 4ActiveHT manual