



# Mobileye AWS™



## Accident Prevention and Accident Mitigation System Effectiveness Report

Mobileye NV Document

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## General

The *Mobileye™* AWS (Advance Warning System) is a driver assistance system for accident prevention and accident mitigation. AWS is based on a camera located on the vehicle's front windshield that watches the road ahead. The AWS utilizes advanced vision technologies for:

- **Lane detection and road curvature calculation** – the AWS detects and measures lane position relative to the vehicle and provides distance to lane marks, detection of lane crossing including lane crossing prediction (by calculating Time to Lane Crossing - TLC) for earlier warnings than received from actual rumble-strips.
- **Vehicle detection** – the AWS detects vehicles ahead, and measures their distance, azimuth, relative speed and Time To Contact (TTC). The AWS uses these calculations for providing continuous headway and potential collision related information. The road curvature calculation provided by the lane detection capability enables to identify which of the vehicles ahead is in the same lane as the “host vehicle”

Its detecting of vehicles and lanes markings allows the AWS to provide the driver with:

- **Forward Collision Warning (FCW)** – alerting the driver of an impending collision with the vehicle ahead (up to 2.7 seconds before collision occurs)
- **Lane Departure Warning (LDW)** – acting as “audible rumble strips”, LDW produces a rumble sound up to 0.5 seconds *before* unintentionally departing from the lane or the road altogether
- **Headway Monitoring and Warning (HMW)** – enables continuous monitoring of the driving distance (headway) kept from the vehicle ahead, and warns the driver when headway decreases to a dangerous level

These 3 features correspond with 3 of the leading causes of road accidents:

1. Rear-end accidents caused by driver inattention
2. Lane departure, and Run Off Road (ROR) accidents
3. Rear-end accident caused by insufficient distance keeping

## Statistics on accidents worldwide

- There are 1.2 M fatalities yearly worldwide due to road accidents - **3242 people a day!**
- According to the World Health Organization, road accident fatalities worldwide are expected to **rise by 67%** by the year 2020.
- Over 20 million people are injured each year in road accidents



- Financial damages of road accidents are ~2% of world GDP.
- In the US, in 2003 there were 6 million accidents, costing \$230 billion; averaging \$38,000 per accident – these statistics have been steady in recent years.

### **Studies and statistics on causes of accident and accident prevention**

- **93% of all accidents** are due to human factor (Driver inattention cited as the primary cause for accidents)<sup>1</sup>
- **Nearly 80%** of all crashes involve driver inattention within three seconds before the event. Examples of types of inattention that increase crash risk<sup>2</sup>:
  - Talking on a cell phone (increases risk by 30%)
  - Dialing a cell phone (increases risk by 300%)
  - Drowsiness (increases risk by 400% and responsible for ~23% of all crashes and near-crashes)
  - Reaching for moving objects, like a falling cup (increases risk by 900%)
- **“One in every five vehicle accidents in Germany is caused by drowsiness at the wheel... momentary drowsiness or inattentiveness is responsible for one in every four accidents on German motorways... In the United States, as many as 40 percent of highway accidents are due to drowsiness at the wheel... The economic loss that such vehicle accidents cause each year is estimated at 5 billion euros (\$6.4 billion) in Germany alone.”**<sup>3</sup>
- Run Off Road accidents account for nearly 20% of road accidents and are responsible for **60% of all road accident fatalities**<sup>4</sup>.
- “In a study done at Volkswagen, an analysis of the pre-crash braking behavior shows that **in severe accidents about 85% of drivers either did not brake at all or not to the full possible deceleration.**”<sup>5</sup>
- Rear-end collision accidents account for about **28% of road accidents**<sup>6</sup>

<sup>1</sup> NHTSA – “The Relative Frequency Of Unsafe Driving Acts In Serious Traffic Crashes”

<sup>2</sup> 100-Car Naturalistic Driving Study – Virginia Tech Transportation Institute and NHTSA

<sup>3</sup> <http://www.siemensvdo.com/press/releases/commercialvehicles/2006/sv-200609-005-en.htm>

<sup>4</sup> Road Safety Fact Sheet - FHWA Safety (2003)

<sup>5</sup> Final Report of the eSafety Working Group on Road Safety – November 2002

<sup>6</sup> <http://www.its.dot.gov/ivi/3DC.html>



### Forward Collision Warning (FCW) systems

- A study by Daimler Benz shows that an extra 0.5 second early warning can prevent 60% of rear-end accidents, and 1.5 seconds will prevent 90% of them.
- A University of Adelaide study showed that in **29% of cases the driver did not attempt to brake at all** before the accident <sup>7</sup> either because they were not aware of the danger at all, or had insufficient time to react.

*AWS provides a Forward Collision Warning to the driver **2.7 seconds on average before colliding with the vehicle ahead**. The average driver takes 0.66 seconds to press the brakes <sup>8</sup>. Thus, on average, the AWS enables the driver a critical **2 seconds of actual braking!***

### **Empiric evidence of effective accident reduction**

#### LDW – Rumble Strips

- “A New York study showed...on the New York State Thruway. **ROR crashes were reduced 88 percent**, from a high of 588 crashes in 1993 to 74 in 1997. **Total injuries were reduced 87 percent**, from a 1992 high of 407 to 54 in 1997. **Fatalities were reduced 95 percent**, from 17 in 1991 and 1992 to 1 fatality in 1997.” <sup>5</sup>
- “After Delaware DOT installed centerline rumble strips on U.S. Route 301--a two-lane, undivided rural highway with a high fatality rate--the **head-on collision rate decreased 90 percent**, and fatalities decreased to **zero**. These dramatic safety improvements were achieved despite a 30 percent increase in traffic.” <sup>9</sup>

#### Headway Warning

- “... drivers tend to overestimate their headway and consequently drive with short and potentially dangerous headways...” <sup>10</sup>
- “...IVCAWS (in-vehicle collision avoidance warning systems) are a useful tool for educating drivers to estimate headway more accurately... after a relatively short exposure to the system, drivers were able to maintain longer and safer headways for at least six months...” <sup>10</sup>

<sup>7</sup> <http://casr.adelaide.edu.au/speed/vol-1.html>

<sup>8</sup> ISO-15623 for FCW Systems

<sup>9</sup> Rumble Strips - Corporate Research & Technology - FHWA

<sup>10</sup> Effects of an In-Vehicle Collision Avoidance Warning System on Short and Long-Term Driving Performance - Avner Ben-Yaacov, Masha Maltz, and David Shinar, Ben-Gurion University



- "...In the U.S., rear-end collisions represent approximately 30% of all car crashes on public roads [NHTSA, 1999]. One of the major causes of such accidents is the failure of the following car to maintain the proper distance from the lead car. In most cases, failure to maintain safe headway can be attributed to driver inattention and/or misjudgment of distance [Knipling et al.,1993]..."<sup>11</sup>

### **Mobileye AWS abilities and behavior**

Mobileye is the winner of the *2006 Entrepreneurial Company of the Year Award in the Automotive Industry* by Frost & Sullivan, who have stated:

"The passenger cars in Europe are likely to be factory installed with the vision-based LDW starting from 2007 and **at least five car platforms are expected to be installed with this system supplied by Mobileye in 2007**. By 2010, all major vehicle manufacturers are expected to introduce the vision-based safety systems in the market. **Mobileye has got a head start over its competitors, since its system is capable of performing functions such as forward collision warning, headway warning and LDW in addition to the video-accident recording option.**"

"Market participants have advocated the cost and life saving potential of the LDW system and fleet owners are beginning to realize the value in utilizing the LDW system. **Mobileye is expected to launch its product for the truck aftermarket shortly. Currently, the aftermarket system supplied by other market participants offer only the LDW function. However, by providing more functions over and above the LDW function, for the same price as the companies' competitors, Frost & Sullivan expects Mobileye to capture a large chunk of the truck aftermarket.**"

**Driver response time** is crucial when attempting to avoid a road accident. Mobileye AWS provides a distracted driver with early warnings that give them more time to react and regain control of the situation which otherwise would end in a certain accident.

It has been demonstrated already that LDW systems can dramatically reduce the amount of accidents in commercial fleets.

Surmounting the abilities of its competitors', *Mobileye AWS* supplies not **one**, but **three** types warnings in road scenarios that are responsible for **more than 65% of all road accident fatalities**.

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<sup>11</sup> Effects of an In-Vehicle Collision Avoidance Warning System on Short and Long-Term Driving (Avner Ben-Yaacov, Masha Maltz, and David Shinar, Ben-Gurion University)



### **Overview of Mobileye AWS driver assistance warnings**

- LDW (Lane Departure Warning) – the AWS produces a Lane Departure Warning when it detects an unintended deviation of the vehicle towards the lane boundary/marking. It then generates an LDW Audio and Visual alert approximately 0.5 seconds before the crossing the lane marking (only if the respective turn signal is not turned on).

#### *Lane Departure accidents account for 60% of all road accident fatalities!*

- FCW (Forward Collision Warning) - A Forward Collision Warning alerts the driver of an upcoming rear-end collision with the vehicle ahead. The AWS calculates the Time To Contact (TTC) from the car ahead, and identifies an imminent collision scenario with the vehicle ahead generating an FCW alert. The issued FCW alert continues as long as the dangerous condition persists; until the driver reacts by pressing the brakes or by steering away from the vehicle ahead. AWS generates an FCW alert approximately 2.7 seconds on average before imminent collision with the vehicle ahead

#### *Rear-End accidents account for approximately 28% of all accidents*

- HMW (Headway Monitoring and Warning) – Research has shown that drivers have difficulty in estimating safe headway. HMW assists the driver in keeping a safe driving distance from the vehicle in front, reducing a priori the chances of a rear-end accident. The AWS Headway Monitoring feature helps the driver acquire better driving habits and improve their estimation of sufficient headway using a clear digital display of their kept headway in seconds. Should the driver fail to keep a safe distance, the Headway Warning will remind them, using a single chime along with a car icon on the display that changes its color to amber and then to red as the headway decreases.

*“Highways Agency research suggests that tailgating contributes to 29% of all injury accidents in the UK.”<sup>12</sup>*

### **Summary**

Mobileye AWS is the ONLY Automotive Aftermarket system worldwide to include **Forward Collision Warning, Lane Departure Warning, and Headway Monitoring and Warnings** in one system.

Unparalleled in effectiveness and in cost, Mobileye AWS makes *road travel safer for anyone, anywhere.*

<sup>12</sup> www.fleetnewsnet.co.uk – article from 9 October 2006