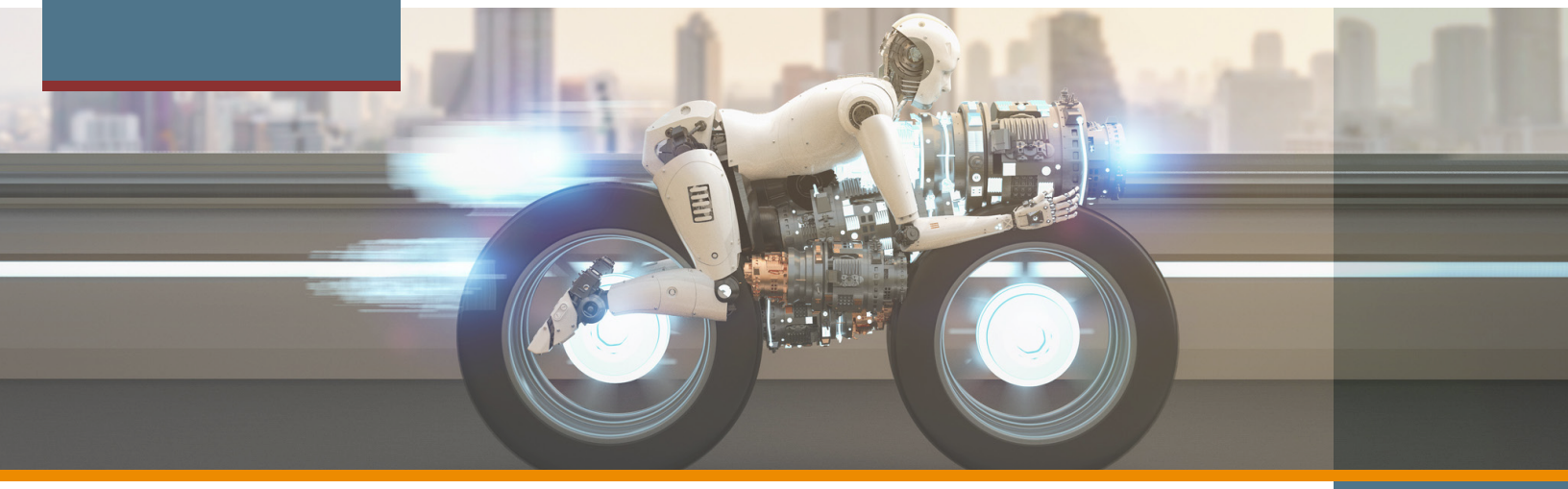
AUTOMATED VEHICLES

Motorcycle Automatic Emergency Braking (AEB)



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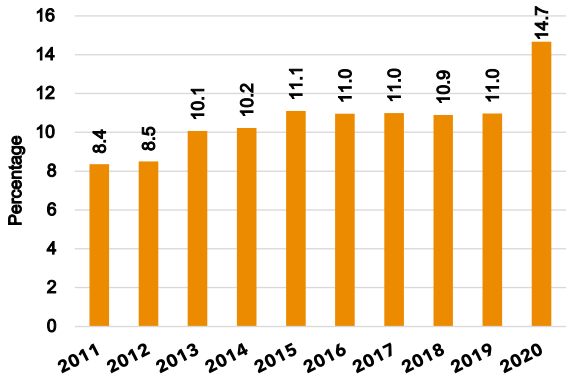
This fact sheet introduces some new Automated Vehicle (AV) technologies for motorcycles which are potentially powerful tools to address the large number of motorcycle crashes. It also reminds motorcyclists and other road users about ways to reduce motorcycle collisions.

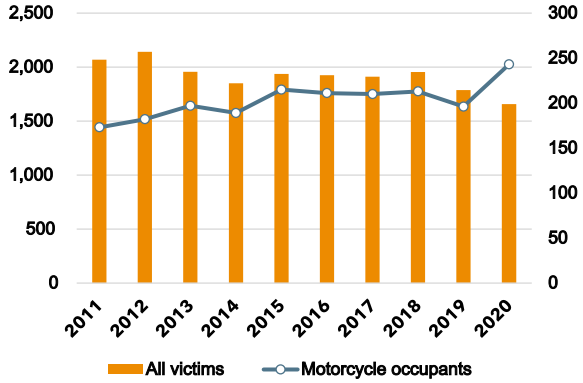
Research shows that riding a motorcycle is the most dangerous mode of transportation for a variety of reasons. One of the main reasons they are more dangerous than passenger vehicles is because a car with four wheels is more stable than a motorcycle. Also, a motorcycle cannot provide the kind of occupant protection as a car; there is no cabin, roof, airbags, or seatbelts to protect and secure the rider. When a motorcycle crashes or stops suddenly, momentum continues to propel the rider at the speed they were travelling. If the motorcycle and rider avoid colliding with an object, they are still likely to be thrown from the bike, often suffering serious injuries on impact with the road, other vehicles or roadside objects.

Collision trends involving motorcycles

The latest data regarding motorcycles involved in fatalities in Canada continues in an upward trend.

Licenced riders & motor vehicle registrations of motorcycles 2014-2021 (in thousands)





Source: TIRF National Fatality Database

Your brain is your vehicle's most important safety feature.

Since 2014, there continues to be an increase in the number of licenced riders and registrations of motorcycles, as indicated in the chart below.

Year	Licenced Riders/ Registrations
2015	709
2016	716
2017	730
2018	739
2019	748
2020	749
2021	816

Source: Statistics Canada, CANSIM Table 405-0004

There could be several reasons for this, but a major factor has no doubt been the increased cost of fuel which makes riding a motorcycle a more affordable option. In addition, the cost of insurance is considerably less for motorcycles which increases the appeal particularly for new and younger riders. However, the previously mentioned risk factors are exponentially greater in this instance when combined with the lack of experience among new drivers/riders on the road.

What is AEB?

Automatic Emergency Braking (AEB) is an active safety system enabled without driver intervention. AEB is often paired with Forward Collision Warning which is also an active safety feature. Forward collision warning systems scan the road ahead while you drive and warn you if you are about to hit another vehicle or object. If you do not react to the warning in time, the automatic emergency braking system may engage to quickly slow down your vehicle or may even bring your car to a stop. Forward collision warning is discussed in this AV fact sheet - **tirf.ca/download/essential-vs-non-essential-adas**

How does it work?

AEB systems use sensors to detect obstacles in a vehicle's path. These braking systems use artificial intelligence (AI) to sense a potential collision with obstacles ahead and automatically apply the brakes to reduce the severity of the collision and where possible, avoid it entirely. Some more advanced systems may also detect pedestrians, cyclists, or large animals.

When the system detects an obstacle such as a stopped vehicle, it will activate braking to reduce the car's speed or bring it to a stop.

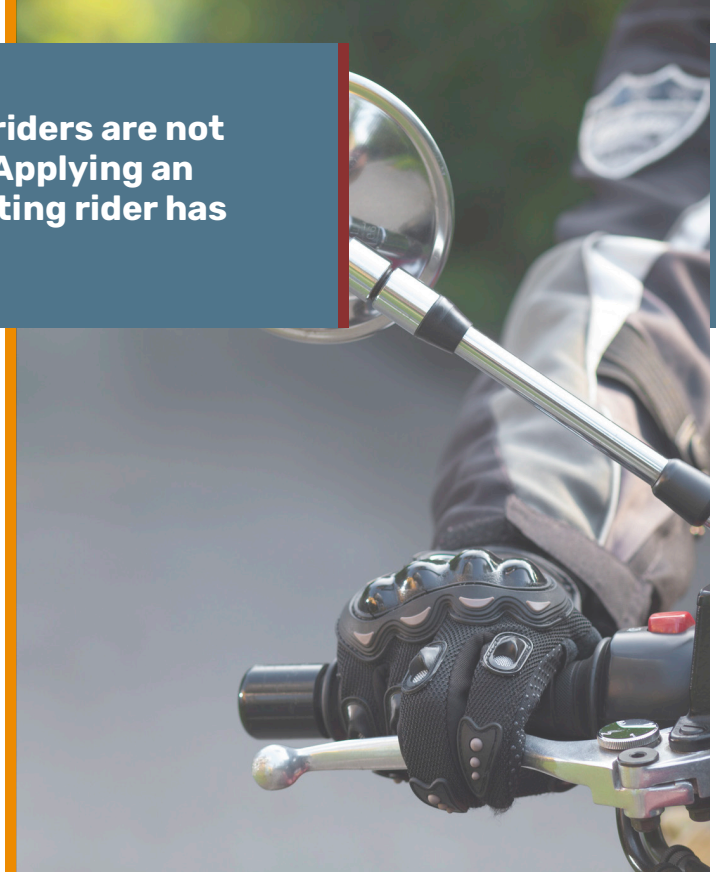
What is the difference between AEB and ABS on motorcycles?

AEB systems monitor the vehicle's surroundings using sensors and cameras to detect obstacles. The system triggers an audible and/or visual display warning to the rider about a potential collision, and if the rider is late to respond, it automatically applies the brakes. ABS detects the wheel lock-up via speed sensors on the wheels.

Automatic Emergency Braking (AEB) – from cars to motorcycles

In the automated community, AEB is not considered a new technology. It has been available on some models in the United States since 2006 and about twenty automakers agreed to make automatic braking standard by 2022. History has proven that motorcycle technology is usually not far behind automated technology. For example, anti-lock

Unlike automobile drivers, motorcycle riders are not secured to a motorcycle by a seatbelt. Applying an emergency brake force to an unsuspecting rider has some obvious dangers.



brakes and traction control were first implemented on automobiles but are now commonly seen on motorcycles. AEB technology appears to be following the same pattern.

Honda filed a patent for AEB on motorcycles (February 2017). The system is similar to AEB on cars which use forward-facing radar and a camera to determine a potential frontal collision. Considering the dynamics of a motorcycle and rider, there are some adjustments necessary to ensure the rider's safety. Unlike automobile drivers, motorcycle riders are not secured to their vehicles by a seatbelt. Applying an emergency brake force to an unsuspecting rider has some obvious dangers. It could even result in a separation of the rider and the motorcycle. Honda plans to mitigate these potential side effects. One way is to check if the rider is already applying the brakes before an impact is sensed, if so, emergency braking force could be applied. If not, the system could apply only the rear brakes, preventing a nosedive scenario.

Motorcycle Automated Braking Systems (MABS)

MABS adjusts the braking pressure to prevent the wheel from locking and assists with maintaining the stability of the motorcycle. In many circumstances, MABS has been shown to reduce braking distance. Motorcycles with MABS technology have been shown to be involved in fewer crashes on the road.

Motorcycle Automatic Emergency Braking (MAEB)

Recently, AEB has been indicated as a potential safety application not just for passenger cars and heavy goods vehicles, but also for motorcycles and powered two-wheelers (PTWs). Motorcycle AEB (MAEB) was designed to produce autonomous deceleration in case of an inevitable collision. Previous studies limited MAEB to the case of a PTW travelling along a straight path, as the activation of AEB was considered hazardous for a leaning vehicle. However, a recent study conducted by the Accident Research Centre of Monash University in Victoria, Australia extends the applicability of MAEB to cornering scenarios.

How does it work?

In a simulated environment, the MAEB consisted of a virtual obstacle detection device, triggering algorithms that identify inevitable collision states, and an automatic braking device. When an inevitable collision is detected for the host PTW and at the same time the rider is applying some braking force, MAEB deploys enhanced braking which assists the rider in reaching the maximum feasible deceleration. ABS consisted of control algorithms for the automatic braking device that stabilized the vehicle along the curved path. The complete system named MAEB+ was tested using detailed computer simulation reproducing real-world crashes.

Results

In the simulation, MAEB was able to assist the rider in reducing the motorcycle speed prior to impact with higher deceleration compared to baseline MAEB and in maintaining the stability of the motorcycle. However, the potential benefits of the proposed system, expressed in terms of impact speed reduction or avoidance of fall events, cannot be directly correlated with actual benefits for the rider in terms of injury mitigation. In fact, risk curves expressing the level of injury for the rider as a function of kinematic quantities (such as impact speed) are not currently available for riders.

Significance of results

Previous studies showed that MAEB would typically apply to situations where the motorcycle is travelling along a straight path.

Why are motorcyclists most vulnerable?

Motorcyclists are increasingly referred to as Active Road Users (ARUs), alongside pedestrians and cyclists. Of this group, motorcyclists are the most vulnerable. They are all vulnerable because they are not protected by a heavy metal body. However, the difference with motorcyclists is that they are typically moving much faster than the other ARUs.

Safe riding tips

One of the most significant contributing factors to motorcycle collisions is inexperience. Over time, riders learn how to avoid crashes. Many of these collisions can be avoided when riders use the proper safety gear, obey local laws and follow the rules of the road.

The following tips will help you stay safe on the road:

- **Ride defensively.** Many motorcycle crashes occur when drivers merge into a motorcycle's path because they simply do not see the motorcyclist. Always stay alert and wear brightly coloured gear noticeable to drivers.
- **Avoid reckless riding.** Speeding, especially while turning, is another major cause of motorcycle crashes. Attempting risky manoeuvres such as weaving between cars can also lead to dangerous crashes.
- **Maintain your lane.** Lane splitting is the practice of riding a motorcycle between lanes of slow-moving or stopped traffic moving in the same direction. It is sometimes called lane sharing, white-lining, filtering, or stripe-riding. This allows riders to bypass traffic congestion, save time, and not have to make sudden stops behind stationary vehicles. For safety reasons, it is illegal in most provinces.
- **Ride sober.** If you are riding a motorcycle avoid using alcohol or drugs which impair driving skills.
- **Stay vigilant.** Be extra careful at intersections. This is the most common place for motorcycle crashes to occur. Motorcycle riders executing a left turn are frequently struck by oncoming cars.
- **Watch out for slippery surfaces.** Snow, rain, ice, and loose gravel can all cause a motorcycle to lose traction.
- **Wear protective gear.** This includes a DOT-approved helmet, eye protection, over the ankle footwear with nonslip soles, long pants, a heavy jacket, and full-fingered gloves. Wearing motorcycle leathers will add an additional level of protection against injuries.

How other road users can help keep motorcyclists safe

Safe riding practices and cooperation from all road users reduce the number of fatalities and injuries on our roads and highways. But it is especially important for drivers to understand the safety challenges faced by motorcyclists such as size and visibility, and motorcycle riding practices like downshifting and weaving to know how to anticipate and respond to them. By raising motorists' awareness, both drivers and riders can help keep each other safe while sharing the road. These tips for drivers can help keep motorcyclists safe:

- Check specifically for motorcyclists before changing lanes or turning.
- Look twice because motorcycles are smaller and harder to spot, particularly in blind spots.
- Always check mirrors, signal & shoulder check before changing lanes.

For more information on Motorcycle Safety visit **tirf.ca/road-safety/motorcyclists** Road User Safety section.

[1] Transport Canada **https://tc.canada.ca/en/road-transportation/driver-assistance-technologies/forward-collision-warning**

[2] Autonomous emergency braking for cornering motorcycle – **https://www-esv.nhtsa.dot.gov/proceedings/24/files/24ESV-000220.PDF**

Want to learn more?

Visit **brainonboard.ca/av-curriculum** to learn more about automated vehicles.

Traffic Injury Research Foundation

The vision of the Traffic Injury Research Foundation (TIRF) is to ensure people using roads make it home safely every day by eliminating road deaths, serious injuries and their social costs. TIRF's mission is to be the knowledge source for safe road users and a world leader in research, program and policy development, evaluation, and knowledge transfer. TIRF is a registered charity and depends on grants, awards, and donations to provide services for the public. Visit **www.tirf.ca**.

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