COMMERCIAL VEHICLE SAFETY SUMMIT

Overview of Existing & Emerging Collision Avoidance Systems

umass SAFE
Traffic Safety Research Program

What is a Collision Avoidance System (CAS)?

- A safety system installed in an automobile that monitors the activity of the vehicle as well as objects (such as other vehicles) in front of and around it.
- Some Collision Avoidance Systems only monitor the vehicle's activity, offering warnings when necessary. Others will take control of the vehicle or augment the actions of the driver in order to prevent or reduce the severity of crashes.

Source: https://www.nhtsa.gov/equipment/driver-assistance-technologies

Warning Systems

In 2019, 117,829 CMVs were involved in crashes with other vehicles traveling on roadways in the U.S. 44,001 of these resulted in injuries, and 2,795 resulted in fatalities.

In response, collision mitigation systems have been developed to make drivers more aware of the vehicles around them, and whether they are traveling too close and at too high a speed.

Source: https://ai.fmcsa.dot.gov/CrashStatistics/rptCrash.aspx?rpt=FHEV

Warning Systems (Cont.)

Forward Collision Warning (FCW)

- Monitors the vehicle's speed
- Uses sensors to detect the speed of the vehicle ahead of it
- Uses sensors to detects the distance between the two vehicles
- Warns the driver if their vehicle is too close to the vehicle ahead of it and a crash may be imminent
- **Important:** FCW systems **do not** apply automatic braking or take control of the vehicle
- FCW may use an audio warning, a visual warning or another signal

Source: https://www.nhtsa.gov/equipment/driver-assistance-technologies

Warning Systems (Cont.)

Blind Spot Detection (BSD)

- Uses digital cameras or radar sensors to detect vehicles next to the driver's vehicle
- Warns the driver if there is a vehicle next to the driver's vehicle that the driver would not be able to see
- BSD may use an audio warning, a visual warning or another signal

Source: https://www.nhtsa.gov/equipment/driver-assistance-technologies

Lane Departure Systems

In 2019, the U.S. had 12,727 CMVs that had run off the road. 3,683 of these resulted in injuries, while 264 resulted in fatalities.

Unintended lane departures can result in crashes with vehicles in adjacent lanes, single-vehicle crashes, crashes with fixed objects, crashes with pedestrians, or rollovers. As a result, crash mitigation technologies have been developed to address this deadly issue.

Source: https://ai.fmcsa.dot.gov/CrashStatistics/rptCrash.aspx?rpt=FHEV

Lane Departure Systems (Cont.)

Lane Departure Warning (LDW)

- Uses a digital camera to detect the vehicle's travel lane
- Warns the driver if the vehicle is leaving its current traffic lane
- **Important:** LDW systems **do not** take control of the vehicle
- LDW may use an audio warning, a visual warning or another signal

Lane Keeping Support (LKS)

- Utilizes the LDW sensors
- Unlike standalone LDW systems, LKS will apply automatic braking, acceleration, and/or steering correction, to avoid an unintended lane departure or return the vehicle to its correct travel lane

Source: https://www.nhtsa.gov/equipment/driver-assistance-technologies

Braking Systems

According to a 2017 study by the Virginia Tech Transportation Institute and published by the AAA Foundation for Traffic Safety, the installation of automatic emergency braking systems into all heavy trucks would annually prevent:

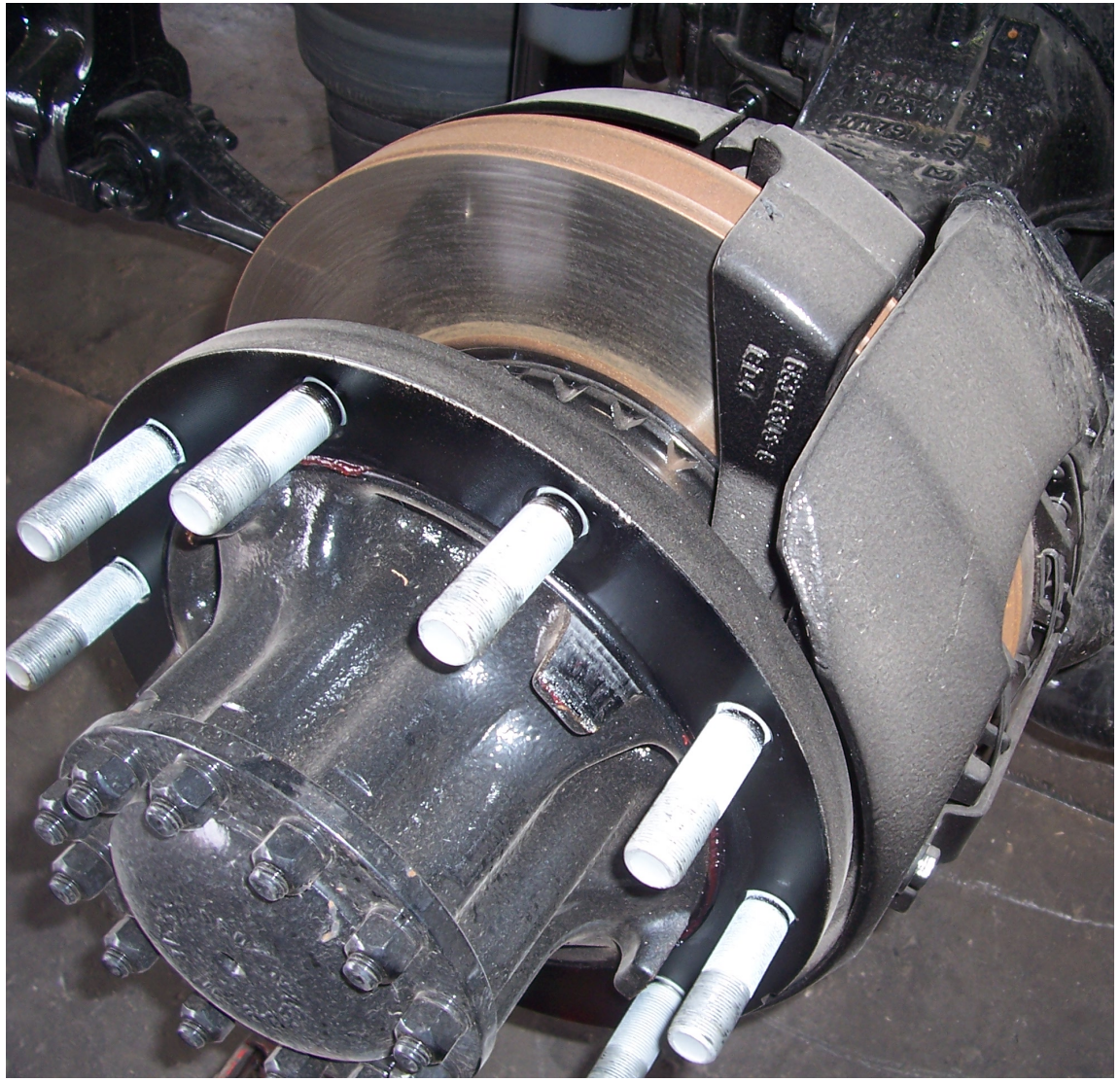
- 5,294 crashes
- 2,753 injuries
- 55 fatalities

Source: https://www.ttnews.com/articles/collision-mitigation-advances

Braking Systems (Cont.)

Automatic Emergency Braking (AEB)

- Monitors the vehicle's speed
- Uses sensors to detect the speed of the vehicle ahead of it
- Uses sensors to detect the distance between the two vehicles
- Warns the driver if their vehicle is too close to the vehicle ahead of it and a crash may be imminent
- Unlike FCW, AEB will automatically apply brakes if the system determines a crash is about to occur and the driver does not respond



Source: https://www.nhtsa.gov/equipment/driver-assistance-technologies

Braking Systems (Cont.)

Dynamic Brake System (DBS)

- Applies additional braking forces if a driver brakes, but not sufficiently to prevent a crash

Collision Imminent Braking (CIB)

- Applies brakes automatically if the system determines a crash is imminent and the driver takes no action

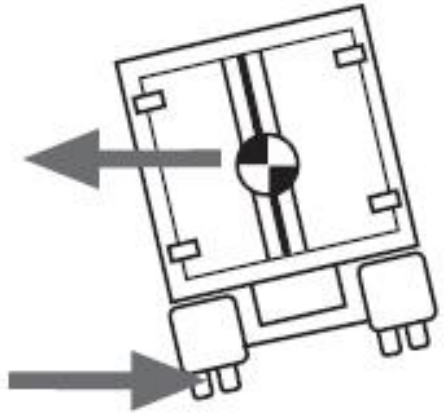
Source: https://www.nhtsa.gov/equipment/driver-assistance-technologies

Roll Stability Systems

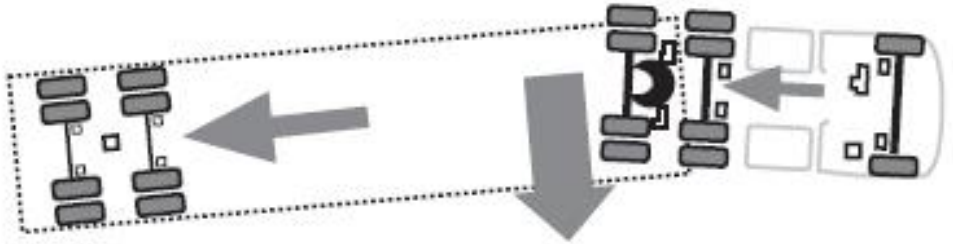
In 2019, 3,168 CMVs experienced rollover crashes in the U.S. Of these, 1,130 resulted in injuries, while 38 resulted in fatalities.

During that same timeframe, 1,200 CMVs experienced jackknife events in the U.S. 190 of those resulted in injuries, and 15 resulted in fatalities.

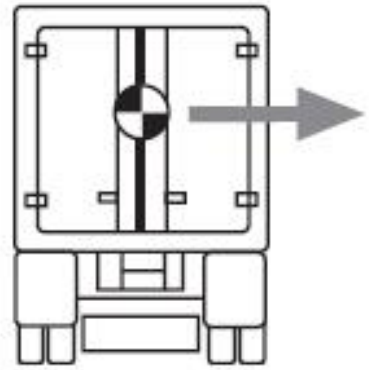
Roll Stability Systems have been developed to address the transport conditions that can lead to rollovers and jackknifes.



A Real World Example Of How The RSP System Operates:
Excessive speed for road conditions creates forces that exceed the threshold at which a vehicle is likely to rollover on a higher-friction surface.



The system automatically reduces engine torque and applies the service brakes (based on the projected rollover risk) to reduce the vehicle speed, thereby reducing the tendency to roll over.



Source: https://ai.fmcsa.dot.gov/CrashStatistics/rptCrash.aspx?rpt=FHEV

Image Source: https://mitchell1.com/shopconnection/on-a-roll-truck-roll-stability-systems/

Roll Stability Systems (Cont.)

There are two types of rollover events:

- Tripped Rollover: Occurs when the vehicle leaves the roadway and encounters a “tripping mechanism,” such as a guardrail or curb, or when the vehicle drives over soft soil or a steep slop
- Un-Tripped Rollover: Usually occurs when the driver performs manual collision avoidance actions while traveling at highspeed. Primarily an issue with top-heavy vehicles, such as large trucks

Source: https://www.safercar.gov/Vehicle-Shoppers/Rollover/Types-of-Rollovers

Roll Stability Systems (Cont.)

Electronic Stability System (ESC)

- Sensors monitor vehicle speed, direction, driver input and motion
- Automatically administers measures such as selective braking to reduce instability that would result in an un-tripped rollover, or a loss of control (LOC) incident such as skidding or jackknifing

Source: https://www.fleetequipmentmag.com/stability-control-systems-can-help-control-tractor-trailer-rollover-risk/

Emerging Technologies

NHTSA is in the process of evaluating various emerging technologies to improve roadway safety.

Emerging Technologies (Cont.)

In 2019, 1,213 CMVs were involved in crashes with pedestrians in the U.S. Of those, 847 resulted in injuries, and 330 resulted in fatalities. Pedestrian Automatic Emergency Braking (PAEB) systems are in development to address this deadly issue.

Source: https://ai.fmcsa.dot.gov/CrashStatistics/rptCrash.aspx?rpt=FHEV

Pedestrian Automatic Emergency Braking (PAEB)

- Uses forward-facing sensors
- Warns the driver and/or automatically applies brakes when a pedestrian has been detected and a crash is impending.

Source: https://www.nhtsa.gov/equipment/driver-assistance-technologies

Emerging Technologies (Cont.)

Vehicle-to-Vehicle Communication (V2V)

- Will enable vehicles to receive and transmit automated, omni-directional messages to other V2V connected vehicles, creating 360-degree recognition of all other vehicles on a roadway
- Receive and transmits messages up to 10 times per second
- Transmission and receiving range of 300 meters
- Capable of detecting hazards obscured by weather, traffic and terrain

Source: https://www.nhtsa.gov/equipment/driver-assistance-technologies

Thank You

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