System Identification
Electronic Stability Control (ESC)

Presented by:

Eng. Mahmoud Mokhtar Alsafy

Supervised by:

Prof. Dr. Omar Alfarouq

Overview

- What is ESC?
- History of ESC
- Challenges
- Motivation
- System operation
- Level of Hybrid vehicle
- Advantages and Disadvantages of Traction Control

What is ESC?

- systems designed to improve a vehicle's handling, where the driver might lose control of the vehicle.
- ESC helps to prevent serious crashes,(the best part is that the system works automatically, so you can concentrate on driving)
- Studies indicate that the vehicle crash rate for vehicles equipped with ESC is lower than the average by approximately 30% to 35%.

1. History of ESC

- In 1987, the earliest innovators of ESC, Mercedes-Benz and BMW, introduced their first traction control systems. Traction control works by applying individual wheel braking and throttle to keep traction while accelerating but, unlike the ESC, it is not designed to aid in steering.
- From 1987 to 1992, Mercedes-Benz and Robert Bosch co-developed a system called Electronic Stability Control (ESC)

American company

- GM introduced its version of ESC called "StabiliTrak" in 1997 for Cadillac models.
- Ford's version of ESC, called AdvanceTrac, was launched in the year 2000
- Ford later added Roll Stability Control to AdvanceTrac which was first introduced in Volvo XC90 in 2003.

2. ESC System Challenges

- Some drivers object to some of the disadvantage of ESC. They contend that by making it impossible to explore the dynamic behavior of their cars.

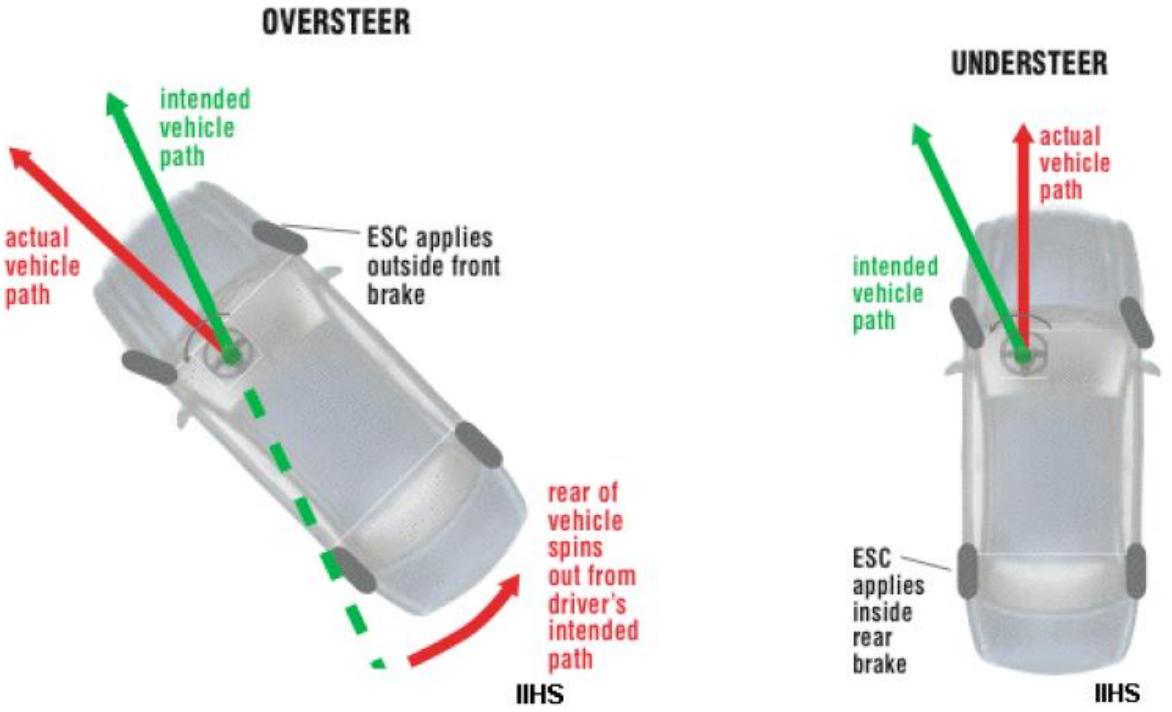
3. Motivation

- Australian research shows that ESC reduces the risk of:

1. Single car crashes by 25%
2. Single 4WD crashes by 51%
3. Single car crashes in which the driver was injured by 28%
4. Single 4WD crashes in which the driver was injured by 66%

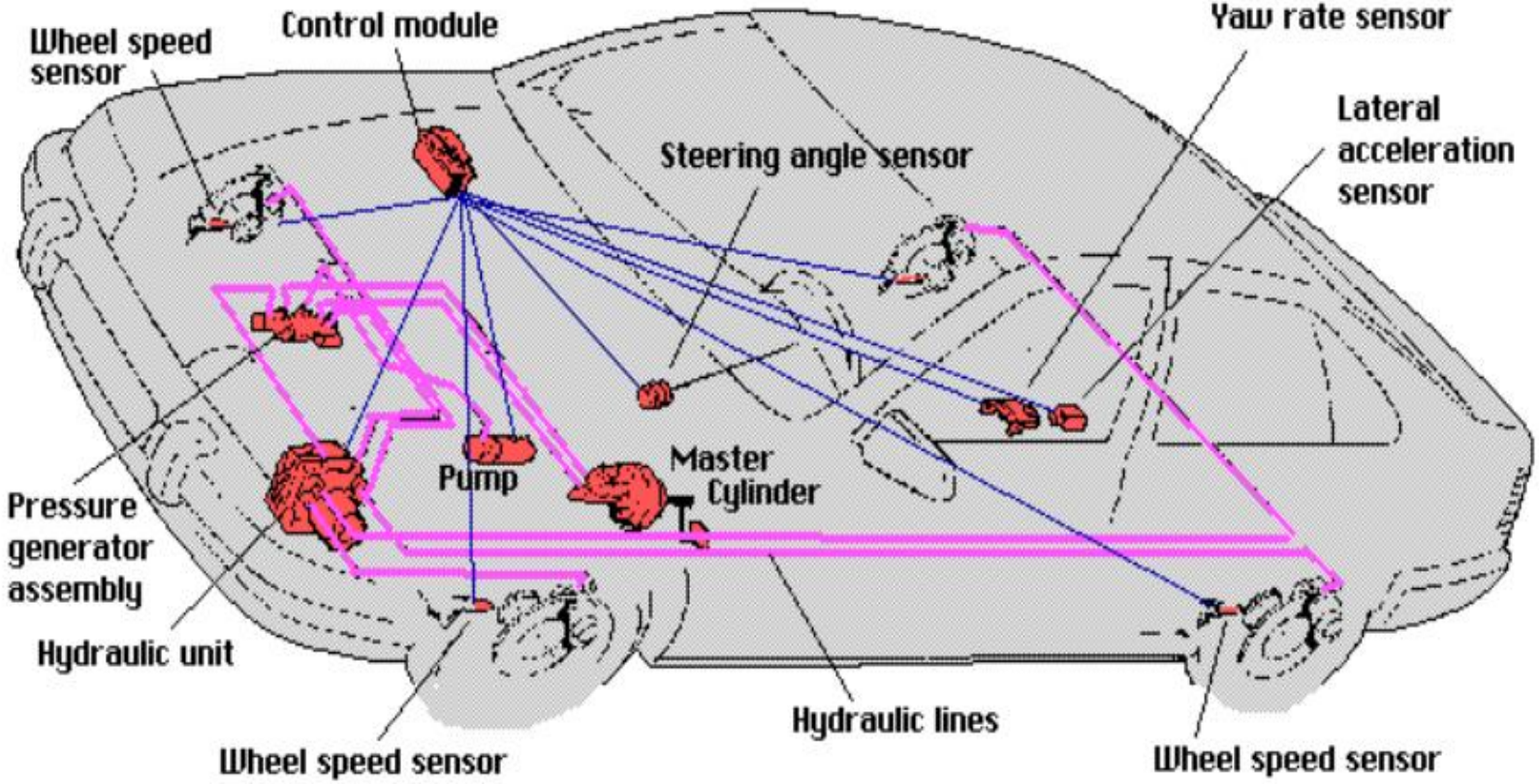
Principle of ESC System Operation

- system which enables the stability of a car to be maintained during manoeuvring and to correct potential understeering or oversteering.



Methods of controlling oversteer and understeer

ESC uses sensors to determine the course the driver desires and the actual course the vehicle is taking



ESC contains three types of sensor

1. **Wheel-speed sensors:** One wheel-speed sensor at each wheel measures the speed of the wheel which the computer can then compare to the speed of the engine.
2. **Steering-angle sensors:** measures the direction the driver intends to aim the car. If it's different than the direction the car is actually traveling, the ESC system will kick in.
3. **Rotational-speed (Yaw) Sensor:** in the middle of the car that measures the side-to-side motion of the vehicle.

ESC II – Functions and Components

Hydraulic-electronic control unit with sensitive pressure control
MK60E
MK25E

Actuation unit with vacuum booster

Steering wheel angle sensor

Wheel speed sensors

Interface to drive-train management

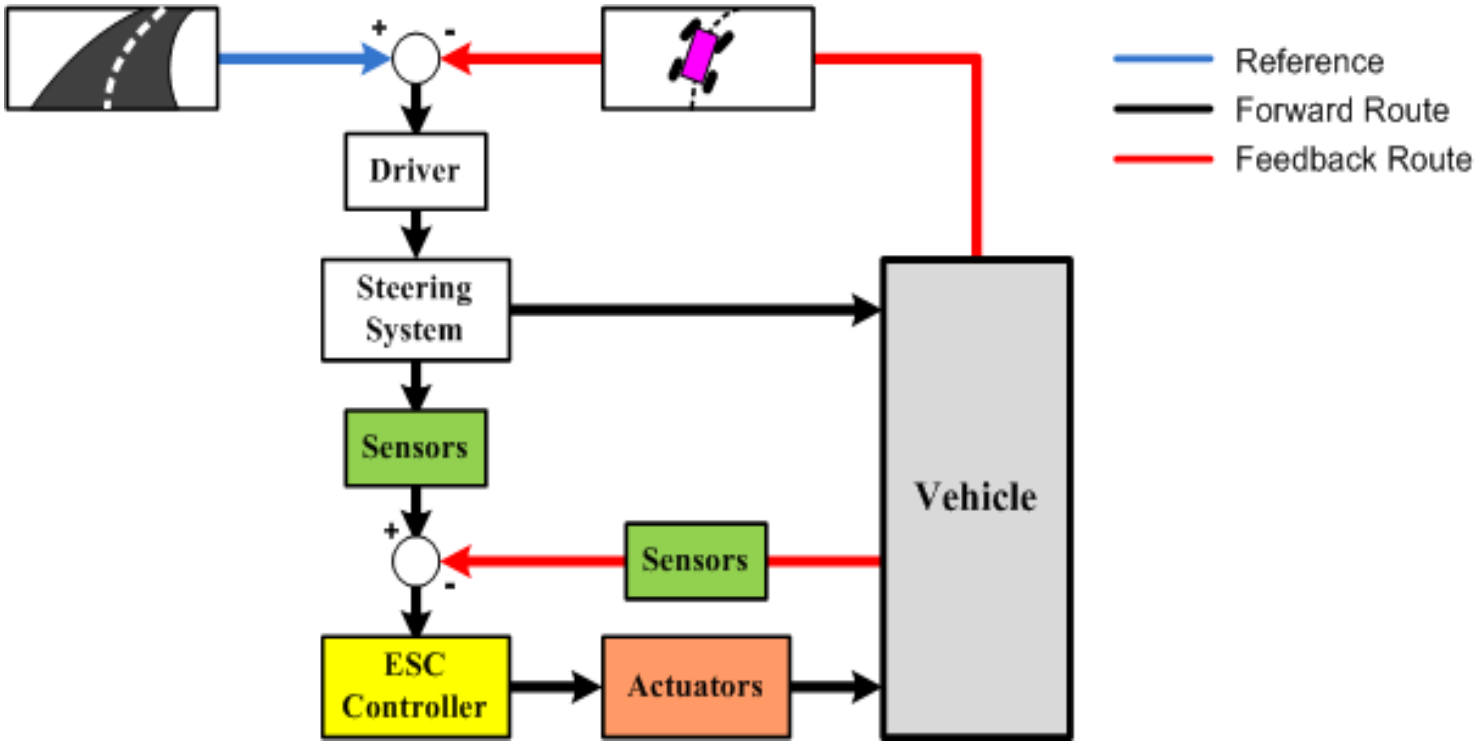
Optional: variable dampers

Interface to active steering system

Yawrate sensor and lateral acceleration sensor (cluster)

How does ESC work?

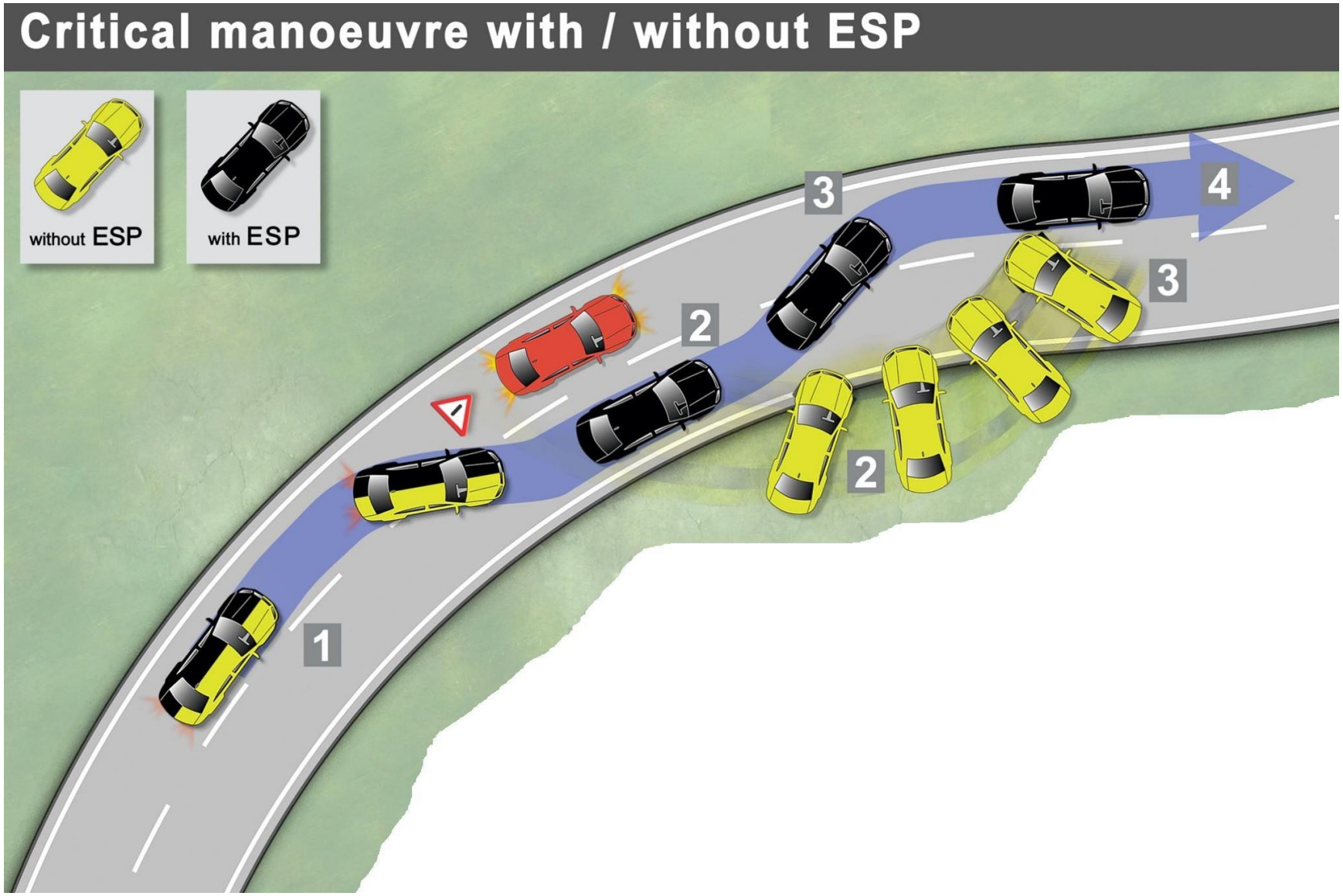
- ESC works by using a number of intelligent sensors that detect any loss of control and automatically apply the brake to the relevant wheel, putting your car back on the intended path.



Comparing between with and without ESC

Vehicle without ESC	Vehicle with ESC
Vehicle approaches an obstacle	Vehicle approaches an obstacle
Vehicle goes off course, enters oncoming traffic lane and driver loses control	Vehicle threatens to break away. ESP intervenes and restores full steerability
Counter steering causes the vehicle to go into a skid	Counter steering results in threat of renewed breakaway, ESP intervenes again
Vehicle isn't stabilized	Vehicle is stabilized

Comparing between with and without ESC



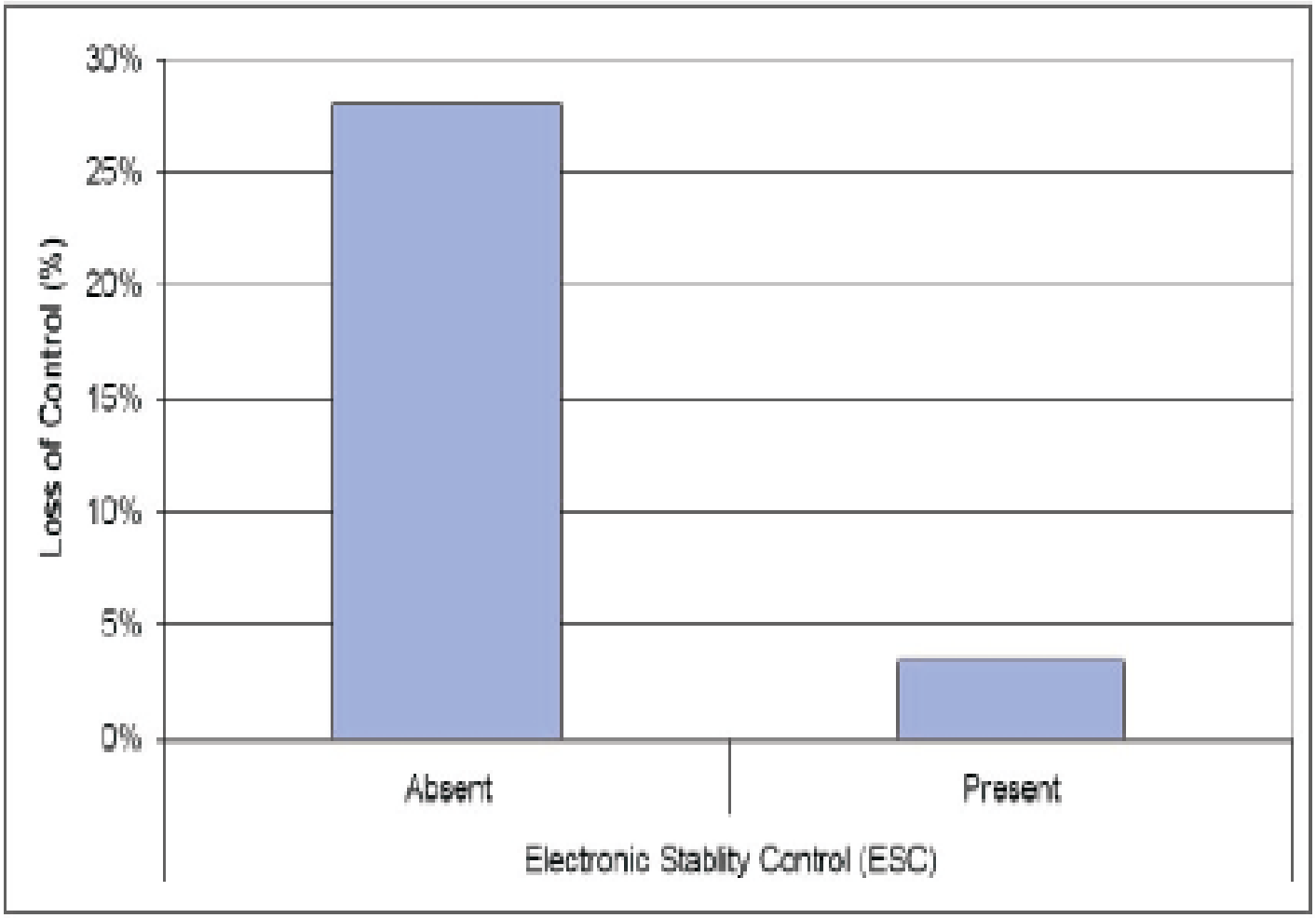
Testing the ESC System Performance

- consists of a 24-foot-diameter.
- The motion consists of a 64-foot by 64-foot X-Y.
- six degree-of-freedom motion hexapod.
- 330 degrees of yaw.
- Four high frequency vibration actuators.

National Advanced Driving Simulator(NADS)

- Is capable of producing realistic animation of busy traffic situations
- Three-dimensional objects that vehicle may encounter.
- high-density multiple-lane traffic.
- Time-of-day and atmospheric effects.

Effect of ESC System on Vehicle Loss of Control



Is ESC different to Antilock Braking (ABS) and Traction Control?

- ABS and Traction control are integral components of an ESC system
- ABS and Traction Control only work in the driving direction
- ESC = (ABS + Traction Control)
- **ESC builds on the advantages of ABS and Traction Control:**

1. improves the dynamics of the vehicle.
2. providing stable driving behavior in all directions

Disadvantages

- does not take over control from the driver (the operator will be always in the loop)
- ESC is an in-built car safety feature that is only available in certain models and is not available as an option feature.