ADAS development

using ABD driving robots

ABD Application Note AN6311 – Issue 3

ABD – the market leader for ADAS

ABD robots are used for ADAS testing by:

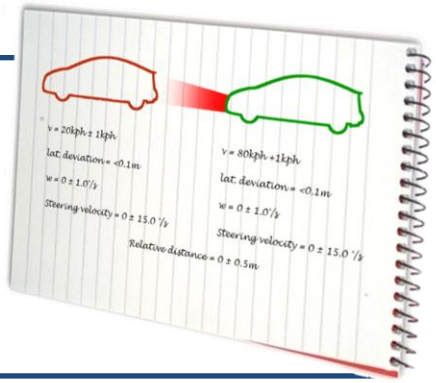
- the **5 largest automakers** in the world
- **All 7 official EuroNCAP test labs**

Advanced Driver Assistance Systems (ADAS) are now fitted to many mainstream cars, and testing them requires particular equipment and capabilities, often including the ability to control relative position between vehicles. With both EuroNCAP and NHTSA prioritising the fitment of technology to warn drivers of an impending collision, ABD robots have been adopted worldwide as the first choice for ADAS testing.
ABD also supplies controllable soft targets (vehicles and pedestrians) for use in ADAS testing.

ADAS testing checklist:

Can you:

- **1** - drive along a defined path with cm accuracy? ☑
- **2** - precisely maintain a vehicle speed profile? ☑
- **3** - brake at a fixed rate of deceleration? ☑
- **4** - control the relative distance in x and y between two vehicles? ☑
- **5** - trigger an event when multiple conditions are met? ☑



ADAS testing typically involves creating complex scenarios with multiple vehicles (or soft targets) to see whether the vehicle's own systems detect an imminent crash. Using ABD robots enables these test scenarios to be programmed and run quickly and accurately, giving high repeatability and consistent data.

For more information, read on…

ABD robots - solutions for ADAS testing

1 Path-following

ABD pioneered robot path-following using a GPS motion-pack in 2001 and has been the market leader ever since. Any ABD steering robot can be used for path-following. ABD's path-following software has been regularly updated to include all of the functionality needed for ADAS testing. ABD now offers a range of path-following software modules, enabling customers to save money by purchasing only the features that they require.

SR Opt 12SL
Straight-line

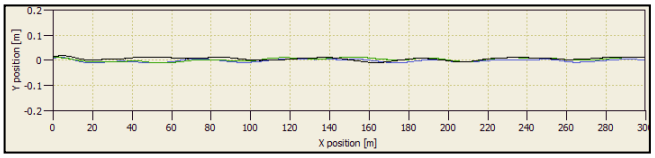
SR Opt 12a
Starter pack

SR Opt 12b
Dynamics module

SR Opt 12c
Durability module

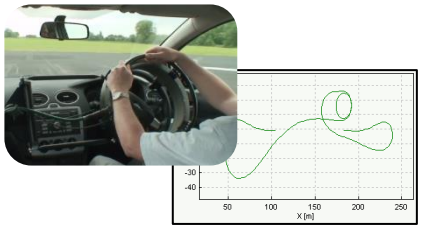
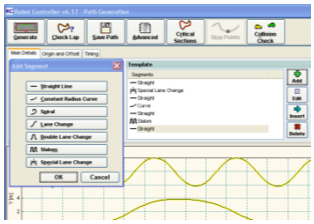
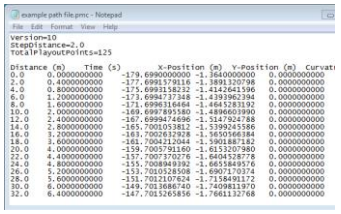
SR Opt 12d
ADAS module

Path-following allows complex manoeuvres to be repeated with unrivalled precision, but it can also be used for very simple functions such as driving in a straight line. The EuroNCAP AEB procedure requires that test vehicle and the towed target should both achieve a lateral position deviation of <0.1m, easy to achieve with ABD path-following.



Three path-following runs along a 300m straight line at 80kph. Maximum lateral deviation was 18mm, less than the measurement uncertainty of the GPS motion pack!

Paths can be created quickly and simply, via a choice of three methods:

Driving the path manually	Using geometric segments	Mathematically (e.g. Excel or Matlab)
		

ABD path-following: advantages for ADAS testing

- Each path can have a vehicle **speed profile** (for use with pedal robots)
- Multiple vehicles can be **synchronized** using GPS time
- Paths can have multiple **stop points** and holding times
- **Virtual Guide Rails** can be used to suspend path-following control in a specified corridor, allowing the vehicle's own systems (e.g. LKA) to provide guidance.
- ABD's **auto-tuning** sets up optimal PID parameters for each vehicle in only a couple of minutes.

2

Vehicle speed control

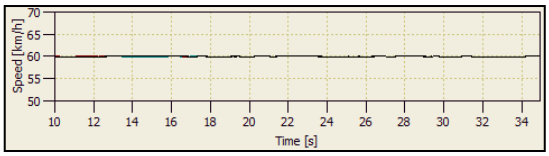
ABD offers a range of pedal robots which can be used to control the speed of a vehicle accurately. Pedal robots can be combined with a steering robot or may be used on their own if only longitudinal control is required.
Speed feedback may be taken from a range of sources, including motion packs, GPS devices, wheel encoders and the vehicle CAN bus.

Combined Brake and Accelerator Robot (CBAR)

The CBAR is the most popular pedal robot for ADAS testing worldwide; a compact but powerful actuator which controls the vehicle's throttle and brake pedals. Like all of ABD's robots, it has been designed such that the driver can still drive the car manually, which is a major advantage for preparing tests and manoeuvring the vehicle.

The CBAR can be upgraded for use in Driverless Testing and to add a clutch actuator for use with ABD's gearshift robot.

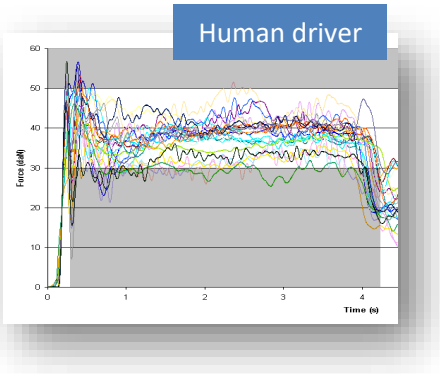
ABD's other pedal robots are also suitable for use in ADAS testing: ***AR1***, ***RBR500***, ***BR1000***, ***BR1000HS***, ***RBR1500***.

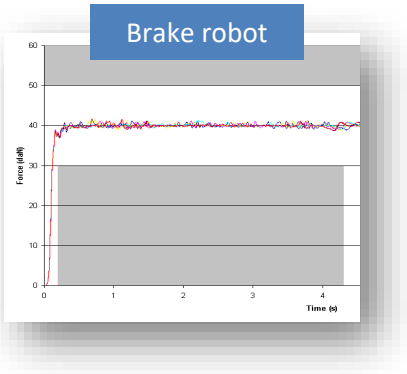


Vehicle speed data from three runs, with a speed command of 60kph. Maximum speed error is 0.12kph. This data was recorded while a steering robot was performing a sinusoidal input, resulting in lateral accelerations of up to 0.3g.

3 Accurate braking

Using a brake robot or a CBAR, it is possible to achieve consistent accurate braking inputs such as are required for Autonomous Emergency Braking (AEB) and Forward Collision Warning (FCW) tests. A range of control modes is available, including pedal travel, pedal force and vehicle deceleration. Using a robot enables far more accurate and repeatable braking than can be achieved by a human driver.





Brake force control (to 400N) from 130kph to zero. Violent deceleration and a long-travel brake pedal made this almost impossible for a human driver, but no problem for a brake robot.

4

Vehicle-to-vehicle control

The accurate synchronisation of more than one vehicle is key to many types of ADAS development testing. ABD offers a number of routes to vehicle synchronisation, as summarised below:

	ABD Synchro	RT-Range	VBOX ADAS
Longitudinal control	Yes – Gen Opt 19a	Yes – Gen Opt 19a	Yes – Gen Opt 19a
Lateral control	Yes – Gen Opt 19b	No	No
Path-following compatibility	Yes	Yes	Not yet – awaiting further development by Racelogic
Typical test applications	Forward Collision Warning Cut-in scenarios Pull-out scenarios Intersection scenarios Curved path scenarios	Forward Collision Warning Cut-in scenarios Pull-out scenarios	Forward Collision Warning

ABD Synchro has some notable advantages relative to other car-to-car measurement systems:

- can be used with any compatible motion pack (even using different motion packs in each vehicle)
- car-to-car intersections can be created with a combination of robot-driven and human-driven vehicles, with the robot-driven vehicles' course being adjusted automatically in real-time for errors by the human driver.
- well-suited for use with ABD's Soft Crash Target Vehicle and Guided Soft Target products.

5 Configurable triggers

The ABD Robot Controller software has an extensive array of triggering options which are essential for many types of ADAS test. Users can configure events to begin at the precise moment when one or two trigger conditions are met, or after the trigger condition(s) being true for a period of time.

Other ABD products for ADAS testing:

ABD also supplies a range of controllable soft target systems which can be synchronised with robot- or human-driven vehicles, to reduce the risk of damage to test vehicles when performing ADAS testing.

Soft crash target vehicle

see specification SP6010

Guided soft target

see specification SP6011

Soft pedestrian target

see specification SP6030

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