



ADAS development

Using AB Dynamics' driving robots

AB Dynamics' robots are used for ADAS testing by:

- The 5 largest automakers in the world
- All 7 official Euro NCAP test labs
- National Highway Traffic Safety Administration (NHTSA) US Department of Transportation



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 Euro NCAP and NHTSA prioritising the fitment of technology to warn drivers of an impending collision, AB Dynamics' robots have been adopted worldwide as the first choice for ADAS testing. AB Dynamics 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 centimetre 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 AB Dynamics' robots enables these test scenarios to be programmed and run quickly and accurately, giving high repeatability and consistent data.

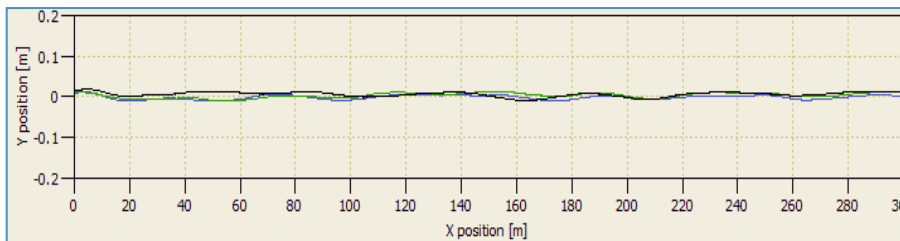
1 – Path following

AB Dynamics pioneered robot path-following using a GPS motion-pack in 2001 and has been the market leader ever since. Any AB Dynamics steering robot can be used for path-following. The company's path-following software has been regularly updated to include all the functionality needed for ADAS testing. AB Dynamics 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	SR Opt 12a	SR Opt 12b	SR Opt 12c	SR Opt 12d
Straight line	Starter pack	Dynamics module	Durability module	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 Euro NCAP AEB procedure requires that test vehicle and the towed target should both achieve a lateral position deviation of $<0.1\text{m}$, easy to achieve with AB Dynamics' path-following.

Paths can be created quickly and simply via a choice of three methods; driving the path manually, using geometric segments or mathematically (e.g. Excel or Matlab).

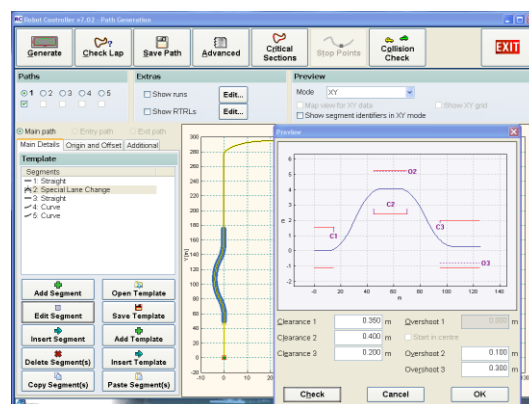
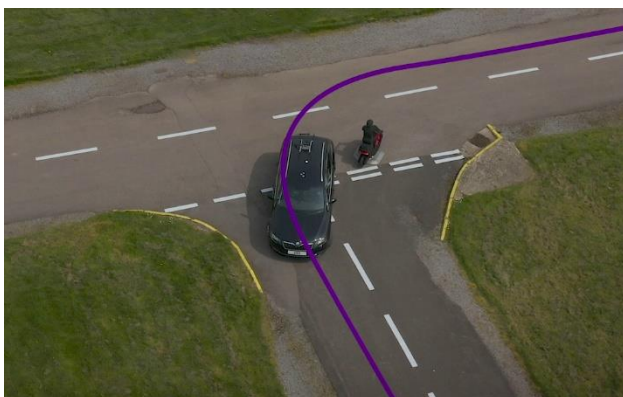


Three path-following runs along a 300m straight line at 80kph.

Maximum lateral deviation was 18mm, less than the measurement uncertainty of the GPS motion pack.

AB Dynamics' path-following: advantages for ADAS testing

- Each path can have a vehicle speed profile (for use with pedal robots)
- Multiple vehicles can be synchronised 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
- Auto-tuning sets up optimal PID parameters for each vehicle in only a couple of minutes



2 – Vehicle speed control

AB Dynamics 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.

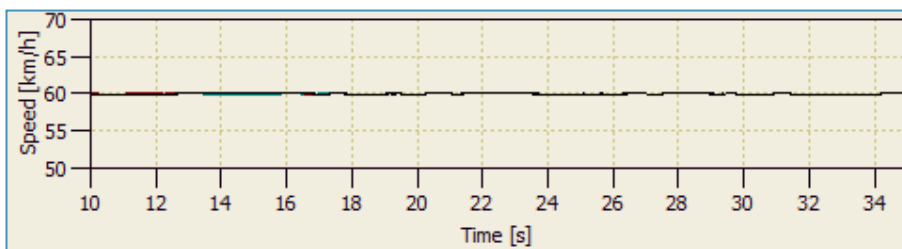
Like all robots manufactured by AB Dynamics, it has been designed such that the driver can still drive the car manually, which is a major advantage for preparing tests and manoeuvring the vehicle.

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



Other pedal robots from AB Dynamics are also suitable for use in ADAS testing:

Accelerator Robot, AR1 - Rotary Brake Robots, RBR500 & RBR1500 - Brake Robots, BR1000 & BR1000HS

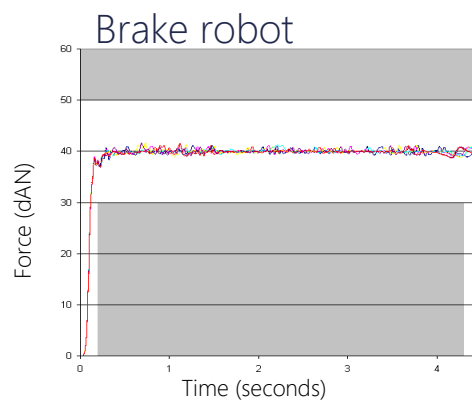


Vehicle speed data from three runs, with a speed command of 60kph. Maximum speed error is 0.12kph.

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 are 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.



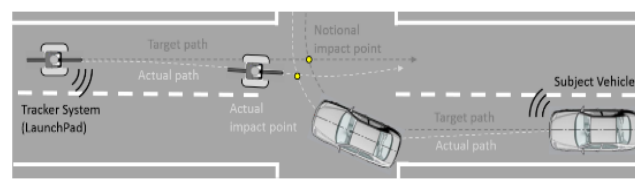
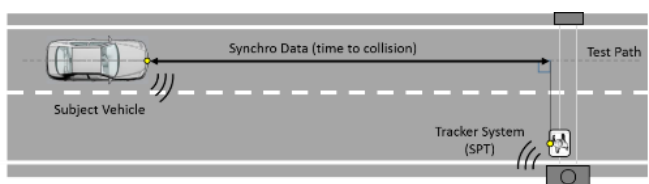
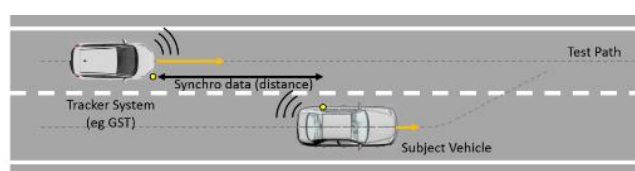
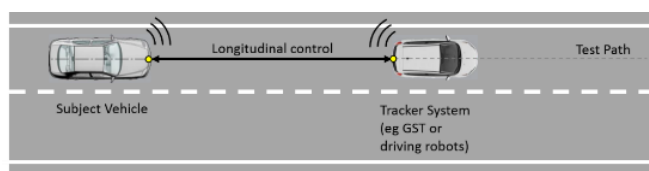
4 – Vehicle-to-vehicle control

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

	AB Dynamics 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	Awaiting development by Racelogic
Typical test applications	Forward Collision Warning Cut-in scenarios	Forward Collision Warning	Forward Collision Warning

AB Dynamics' patented Synchro technology 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 AB Dynamics' GST and LaunchPad platforms.



5 – Configurable triggers

AB Dynamics 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.

Guided Soft Target (GST)

LaunchPad

Soft Pedestrian Target (SPT)

