Objective test driving

Why robots can do it better

ABD Application Note AN6018 – Issue 1

Your job: determine whether '**A**' performs better than '**B**' in a given set of circumstances.

'**A**' and '**B**' could be:

complete cars / tyres / brakes / damper settings / ESC programs or any of hundreds of other vehicle parameters

To determine the differences between '**A**' and '**B**', you need to ensure that all other variables are kept constant while you are testing. Test procedures are generally written to ensure that all of the ambient and vehicle conditions are maintained constant, but it is vital not to overlook the central factor – **how is the car being driven?**

If a human driver is asked to perform a manoeuvre 10 times, he will drive differently every time. This is true of even the most experienced test driver.

You can remove some of this variability by repeating the test many times and by post-processing, but **the best way to improve driver repeatability is to replace the driver with a robot.**

Since 1997 ABD has been supplying robots to its clients around the world for use in vehicle dynamics testing. ABD can supply robots to control the vehicle's steering, pedals and even the gear-shift.

For more information, read on…

17 of the top 20 most successful* vehicle manufacturers in the world use ABD robots to develop their vehicles.

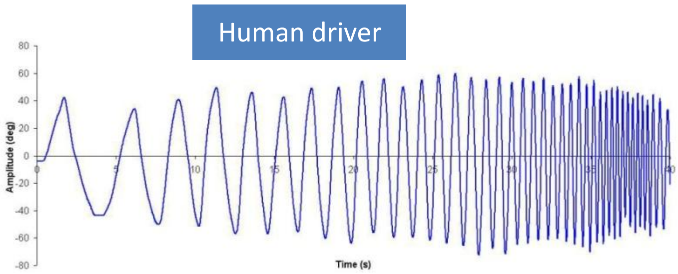
* by global sales volume, 2009

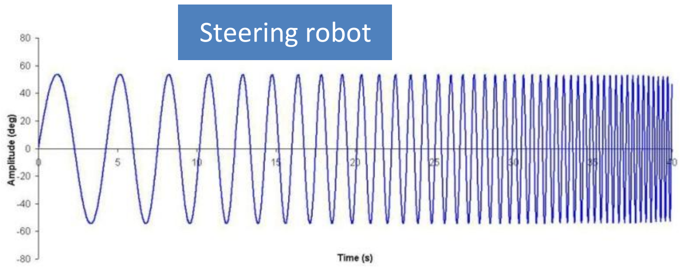
What are the five key benefits of using robots?

1 Accurate inputs

One requirement is common to all objective dynamics tests: good results and successful analysis are dependent upon accurate inputs. **Expert drivers** can achieve better accuracy than most, but even **they are no match for a machine**.

Steering: Sine-sweep test



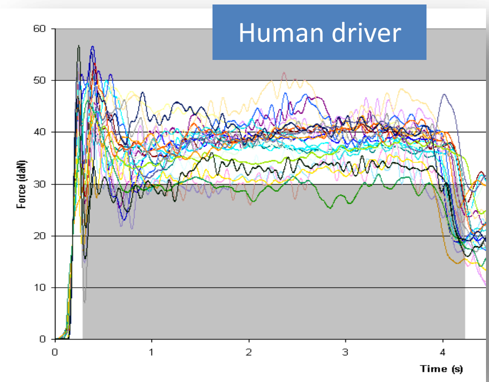


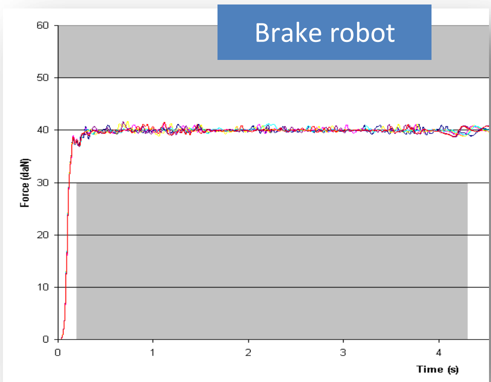
This is a classic example of a steering test used to analyse the vehicle's dynamic response across a frequency range. The resultant yaw and lateral acceleration levels in the test provide valuable information to the dynamics engineer about the vehicle.

In this example, the requirement was for constant amplitude (54^{o}) with frequency increasing from 0.2Hz to 3.5Hz.

The robot data exhibits much better control of amplitude, frequency sweep and the required sinusoid shape.

Braking: Force step test





The brakes on modern cars are highly complex systems with mechanical, electronic, hydraulic and software elements. In order to develop and assess these systems there are many braking tests used today. The force step test appears at first glance a simple one; to apply a step load of 400N to the brake pedal, causing the vehicle to decelerate from 130kph to zero. After the initial step, the force must neither exceed 500N nor fall below 300N during the braking period.

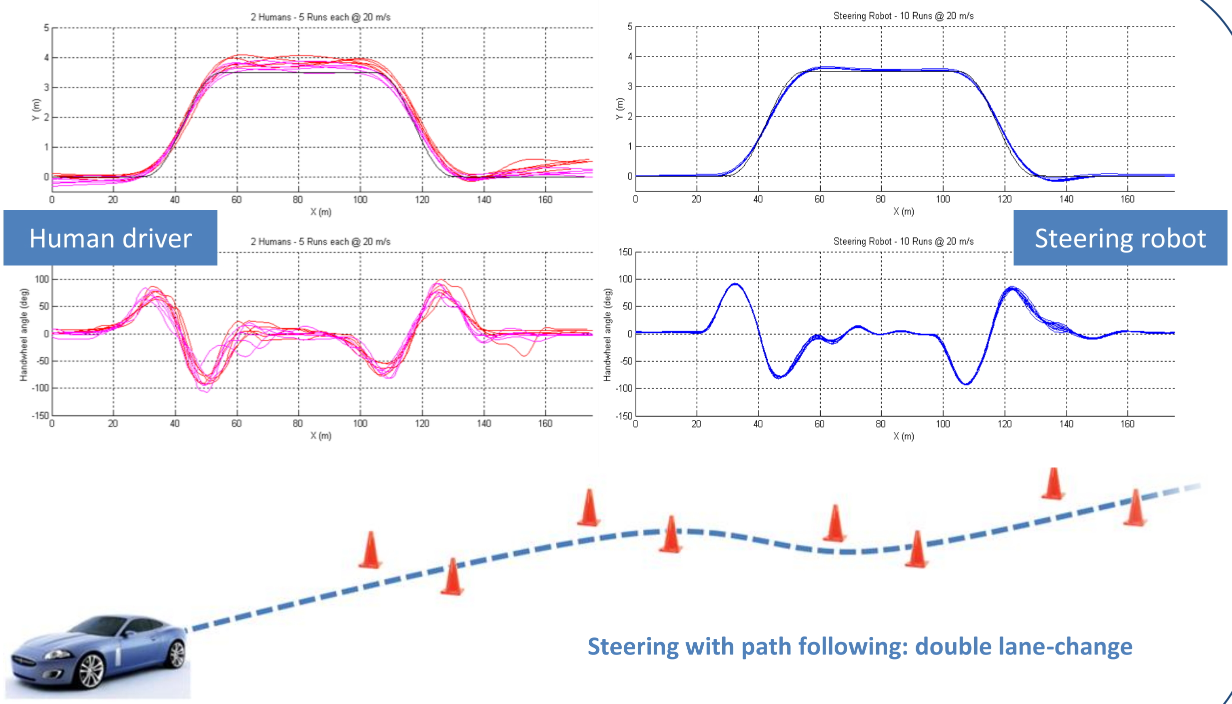
However, the violent deceleration (up to 1g) which results from the braking makes it difficult for the test driver to hold the force to within the limits required. The above data was recorded in a particularly difficult vehicle.

As can be seen, the brake force applied by the human driver regularly went outside the permitted boundaries, whereas the brake robot was able to follow the test specification closely.

2 High repeatability

Input repeatability is of **paramount importance** when making comparative tests. For the comparison to be meaningful the inputs must be the same, and the **only way** to guarantee the repeatability of your dynamics tests is to use a robot.

In the example below, a **double-lane change** was driven 10 times by a human driver and then 10 times by an ABD steering robot with path-following. Statistical analysis showed the robot gave between 5 and 10 times better repeatability.



3 Time and cost saving

Without using robots, it is generally necessary to repeat a test 5, 10 or more times simply to obtain data of acceptable quality. Using a robot, this is no longer necessary! The **brake force step** test on the left is a good example; **the human driver spent a whole day** trying to achieve the required braking profile, and from 27 attempts he only succeeded in performing 3 acceptable runs.

Using the **brake robot** it was possible to achieve **five perfect runs in a matter of minutes**! This represents a huge saving in testing time, which in turn translates to cost-savings in terms of labour, proving-ground time and equipment availability, while allowing you to get your vehicle to market faster.

4 Compliance with test standards

Increasing numbers of internationally-mandated tests specifically require the use of robots. Examples include the NHTSA **fish-hook** test and the UN Reg 13-H / FMVSS126 **sine-dwell** test, both of which specifically refer to the use of a steering robot. Future test standards will increasingly require the use of robots to ensure compliance.

5 Remove the driver from harm's way

DTS Driverless Test System

Some types of vehicle testing can be **unpleasant or dangerous for the test driver**. Examples include:

- Roll-over testing can cause serious driver injury
- Durability testing can cause driver fatigue and possible long-term health problems
- Mis-use testing can cause back problems and other health conditions
- Testing of collision avoidance systems can put the driver at risk of a high-speed collision
- Aggressive brake testing can cause back, hip and other joint problems.

ABD has now supplied 7 full driverless test systems (DTS) to vehicle manufacturers and they are in use around the world to perform tests including those listed above with **no driver in the vehicle!**

ABD robots have been in use around the world for more than 10 years – an essential tool for vehicle development

Customer list, robots:

Aisin, Audi, BMW, Bosch, Bridgestone, Chrysler, Continental, Daihatsu, Daimler, Delphi, Eaton, FAW, Ford, Fraunhofer Institute, GM, Goodyear, Haitec, Hankook, Hochschule München, Honda, Hyundai, Hyundai Mobis, IDIADA, Indian Institute of Technology, International Truck, IAV, IPW, Iran Khodro, Israel MOD, Jaguar-Land Rover, JARI, JTEKT, KATRI, Kia, MagnaSteyr, MAN, Mando, Mazda, Mercedes-AMG, Michelin, MIRA, Mitsubishi, Nexteer, Nissan, NTSEL, PSA, Renault, Renault Samsung, RWTH Aachen, Scania, SEAT, Subaru, Suzuki, Tata, Thatcham, Toyota, TST, TRW, Tsinghua University, TŰV, UTAC, VW, Volvo, WITPIS

The SR30 steering robot, BR1000 brake robot and AR1 accelerator robot (configured here for the Driverless Test System)

For more information contact:

Anthony Best Dynamics Ltd
Holt Road, Bradford on Avon,
Wiltshire, BA15 1AJ England
Tel: +44 (0) 1225 860200
Fax: +44 (0) 1225 860201
Email: sales@abd.uk.com
Web: www.abd.uk.com
Videos: youtube.com/user/abdynamics

Or contact your local ABD representative: