Solution Brochure

Steering System Test Machine (SSTM)

Turning the art of steering development into a science

Introducing the SSTM

Characterise, test and tune steering systems

The SSTM offers a controlled laboratory environment for assessment, characterisation, and optimisation of steering systems in isolation from the vehicle under development. By subjecting steering systems to simulated independent tie rod forces it precisely replicates real world conditions with minimal latency - transforming the art of steering development into a science.

Accelerating steering development

The SSTM is a game changer for steering development by significantly reducing the reliance on prototype vehicles. With the majority of steering development work achievable using the SSTM, you can accelerate the engineering process, identify issues earlier, reduce costs, and deliver an enhanced final product.

By providing objective data and facilitating early integration of subjective feedback, the SSTM streamlines the development cycle and empowers steering teams to achieve optimal results. With the advancement of ADAS and a progression towards steer-by-wire, these tools only become more important.

What is the SSTM used for?

The SSTM is invaluable for OEMs, Tier 1s, testing houses and motorsport teams that need to:

/ Characterise and benchmark full steering systems
/ Subjectively optimise steering feel through driver-in-the-loop testing
/ Tune and optimise EPAS, SbW and ADAS technologies before progressing to track tests
/ Create, assess and improve the correlation of simulated vehicle steering models to physical steering hardware
/ Analyse prototype systems early in the design phase including checking specification and identifying immediate problems without the use of test vehicles
/ Assess the effects of high mileage accumulation on steering feel

How it works

The SSTM consists of two mounting tables with a high resonance frequency of greater than 150Hz. The front table contains two rotary wheel actuators, one either side of the steering system, and the steering rack mount. The rear table houses the steering column mount, the steering robot and the driver chair.

Rotary wheel actuators

In order to best simulate the geometry of a vehicle, the SSTM uses high-frequency, high-torque rotary wheel actuators to replicate tie rod forces as the inputs into the steering system.

Each wheel actuator consists of two individual actuators stacked on top of one another. This arrangement significantly increases the stiffness of the actuation system and offers the flexibility of using both to input large forces or a single actuator to provide precise inputs, providing optimum loading for any situation.

Steering robot

The SSTM uses AB Dynamics' industry-leading driving robot to apply inputs into the steering column. It enables consistent, accurate and repeatable testing to acquire the data necessary to fully characterise and assess a steering system.

Piezoelectric force sensors

Highly accurate piezoelectric load cells to measure the resultant forces from the machine. These precise sensors have a high sensitivity, low temperature coefficient, so are minimally impacted by external influences. These sensors are integrated into the tie rods giving a true tie rod force measurement unaffected by steering angle. For realistic steering feel data the SSTM measures the resulting torque at the steering robot wheel rather than the steering column.

Unique features

The SSTM offers a range of key features that make it the leading steering system testing solution:

/ Dual-sided force control, compensating for artificial forces to ensure accurate tie rod inputs
/ Direct pulse-width modulation closed-loop control providing flexibility and minimal latency
/ Ability to provide high-frequency inputs into the tie rods at more than 40Hz closed loop, enabling it to replicate almost all real-world driving scenarios
/ Exceptional stiffness, with mounting table resonance frequency of 150Hz, for accurate data measurement
/ Steer-by-wire compatibility supports testing of next-generation steering systems
/ Mechanical Hardware-in-the-Loop (mHiL) capable, enabling the physical steering system to bypass the steering model during real-time vehicle simulations
/ Driver-in-the-Loop (DiL) functionality, with quick changeover from driving robot to OEM wheel
/ A comprehensive library of predefined and industry-standard test templates, such as sine wave and fishhook tests

The SSTM solution

- High natural frequency table in excess of 150Hz
- 16kHz direct PWM current control
- Rotary wheel actuators for correct geometry
- mHIL capability enables the physical steering system to bypass the steering model during real-time simulations
- >40Hz dual sided force control
- Easy to use software
- Piezoelectric force measurement
- First year of email, phone and online support included

Use cases - steering future development

Virtual prototyping

As the industry increasingly adopts virtual prototyping for cost-effective development, accurate modeling of vehicle subsystems has never been more important. Steering systems, particularly challenging to model due to friction simulation, benefit from the SSTM's meticulous characterisation, which feeds highly accurate data into digital models. This ensures correlation between the simulation and real hardware, setting the stage for precise virtual prototyping.

The digitisation of steering

Autonomy is driving the digitisation of steering systems and the adoption of EPAS and steer-by-wire technologies. This has significantly increased the amount of software development required for new steering systems.
On top of this, steer-by-wire systems require more stringent safety tests. The result is a significant increase in the workload for engineering teams working on steering systems. The SSTM allows this work to begin sooner, before a prototype vehicle exists, and importantly introduces subjective feedback early in the development cycle.

The benefits of the SSTM

Start development earlier

The SSTM provides you with accurate, actionable data without the requirement for a prototype or mule vehicle. This means development can start as soon as steering hardware is available.

Identify issues sooner

The SSTM enables thorough testing of the steering system in isolation of the other sub-systems of a vehicle. This makes it easier to identify potential issues with the steering system before investing in track time and wasting valuable access to a prototype vehicle.

Reduce development cost and time to market

By frontloading engineering in the laboratory, instead of at the track, the development of a steering system can be significantly accelerated whilst also reducing cost. Engineering teams can be more confident that when they progress to track testing they will have a more mature solution, making the most of track time and access to limited prototype vehicles.

Ensure safe testing

Additionally, the SSTM rig ensures safer testing in a controlled lab environment. By eliminating the need for high-risk on-track testing, you can focus on refining and optimising steering systems with the utmost safety, ultimately delivering a reliable and secure steering solution to end customers.

Lower whole-life costs

Unlike alternatives on the market, the SSTM is an electromechanical machine, rather than hydraulic. This means lower infrastructure costs, lower maintenance costs and lower whole-of-life costs. As well as being cheaper to run, the solution is clean, reliable and quiet.

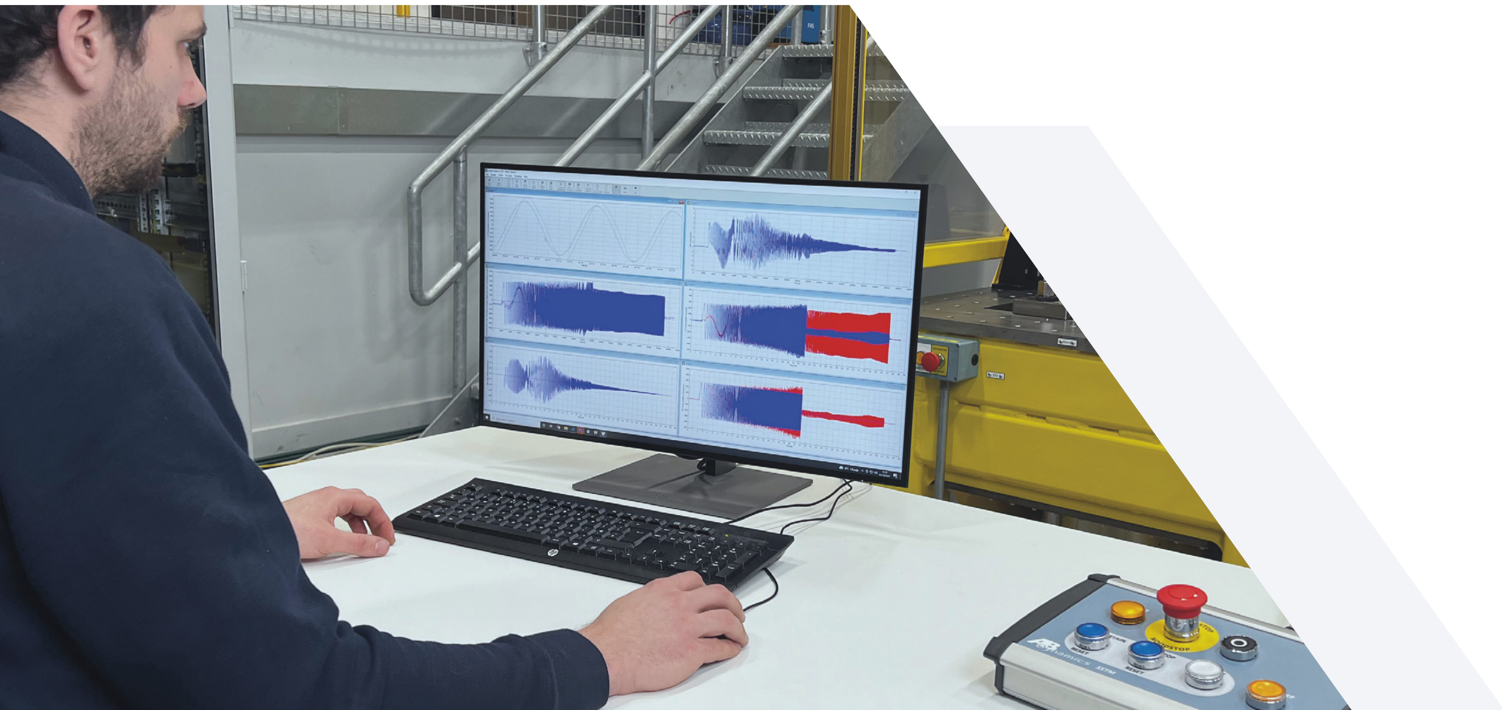
Simulation agnostic

The SSTM has been designed to operate with all the major simulation packages and real time hardware solutions. This means the machine can be easily integrated with whatever simulation toolchain is already being used by your department.

Specifications

Applied loads: rack actuator	Peak actuator torque (1 motor per actuator)	750Nm (6kN for 0.125m lever arm)
	Peak actuator torque (2 motors per actuator)	1500Nm (12kN for 0.125m lever arm)*
	Maximum duration for peak torque	15s (whether 1 or 2 motors per actuator)
	Maximum continuous torque (1 motor per actuator)	250Nm (2.0kN for a 0.125m lever arm)
	Maximum continuous torque (2 motors per actuator)	400Nm (3.2kN for a 0.125m lever arm)
Applied loads: force control	Force control bandwidth (-3dB)	>40Hz
	Actuator asymmetry: magnitude	±3%
	Actuator asymmetry: phase	<±2°
	Phase lag	<5ms
Displacement control	Bandwidth	>3Hz
Steering Robot (SR35)	Maximum continuous steer torque	15Nm (Max Peak 50Nm)
Steering Robot (SR60)	Maximum continuous steer torque	30Nm (Max Peak 60Nm)
Constant velocities	Peak rack actuator velocity (no load)	5rad/s
	Peak steer robot velocity (no load)	40rad/s
Recommended room	Dimensions	6m x 7m x 4m
Machine dimensions	Size	2.8m x 2.3m x 1.8m
	Weight	3.5 tonnes
	Table surface height	800mm (excluding grout thickness)
	Maximum vertical ground loading	-0.03N/mm2
Electrical requirements	Power	3 phase - 27kVA

* For shorter duration contact us at info@adynamics.com



Options and upgrades

Static driving simulator option

With the integration of our driving simulator technology combined with rFpro's simulation environment and visuals, the SSTM becomes a highly advanced driving simulator with the steering hardware fully incorporated. This offers a multitude of benefits especially for ADAS development in Hardware-in-the-Loop (HiL) and Driver-in-the-Loop (DiL) testing.

The seamless setup of the steering system and the driver chair to achieve correct vehicle-matched geometry ensures a highly immersive environment for test drivers to subjectively assess the real steering system in simulation.

By conducting complex simulated scenarios in the lab, you can save significant setup time and costs typically associated with track testing. With the AB Dynamics toolchain integrated, the SSTM provides the ultimate test bench for ADAS development, empowering you to optimise steering system performance with unmatched precision and efficiency.

Hands-off testing option

The demand for hands-off testing has increased significantly with the introduction of autonomous systems. The SSTM can be provided with an optional hands-off control package that compensates for the inertia in the robot steering system to test under simulated hands-off conditions.

By enabling the complete test system to remain connected and synchronised throughout, the entire test programme can be automated. Unlike clutch alternatives, the disconnect is smooth and accurately controlled making the disconnect more representative.

The hands-off testing function can be used to assess and improve automated functions, such as collision avoidance systems, lane keeping and changing assist and self-parking systems.

Warranty and support

The SSTM is installed with a one-year Silver support package, which includes software upgrades and remote technical support via email, phone and online. The machine also comes with a 12-month warranty, which can be upgraded to 24 months.

AB Dynamics offers worldwide support through a network of rigorously trained specialists. We have SSTM support teams located across Asia, Europe and North America. All purchases come as standard with installation, calibration, training and support.

About AB Dynamics

When you choose a solution engineered by AB Dynamics, you're benefitting from proven hardware, trusted software, 40 years of knowledge and experience, plus unrivalled service and support. Our range of automotive testing, verification and validation solutions encompass dynamics, suspension and steering characterisation, durability, advanced driver assistance systems and autonomy.

We pride ourselves on delivering solutions that enable the development of safer, more enjoyable, efficient, and eco-friendly vehicles. As a key partner to the global automotive industry, our customers include the top 25 vehicle manufacturers, Tier 1 suppliers, test facilities and autonomous vehicle developers.

As part of the AB Dynamics Group of companies, we offer a wide range of vehicle autonomy, simulation, and testing solutions. As a group, we enable customers to develop and test vehicles in laboratory and virtual environments, validate on the track before finally evaluating vehicles in the real world on public roads.

www.abdynamics.com
info@abdynamics.com

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