A HIGHER LEVEL OF PERFORMANCE FROM DRIVER TRAINING SIMULATION TO AUTOMOTIVE ENGINEERING TEST DEVELOPMENT
Unsurpassed innovation and technological expertise combined with close customer collaboration make Moog a leader in the design and development of high-performance motion systems.

With global manufacturing and a worldwide support infrastructure, Moog has become a trusted partner of the world’s leading manufacturers in aerospace, automotive, defense and medical industries. As a result we have supplied thousands of motion platforms to the marketplace, offering reliable system solutions that are highly supportable and add significant value for our customers.

The proven technology expertise of Moog combined with the world class performance of Moog Actuators, Servo Drives, real-time controllers and application software deliver long-lasting solutions to meet your vehicle simulation challenges today—and tomorrow.

Our total focus on meeting your unique driving simulator requirements means you can rest assured you’re using the most suitable, flexible and highest performance equipment available anywhere.

The application of the latest vehicle development techniques has become a cornerstone for creating successful new designs, ensuring shorter time-to-market, managing increased regulatory pressures and maintaining cost efficiencies.

Wherever development engineers are pushing the limits of design and driver training, Moog Driving Simulators are a must.
FROM DRIVER TRAINING TO VEHICLE DEVELOPMENT

Until recently driving simulators were used mainly for driver training (truck, bus, car, motor) and HMI (Human Machine Interface) investigation. Due to a dramatic improvement in simulation software, vehicle models and computer performance, driving simulators have become a viable tool to reduce development time and costs while improving the design of vehicles and components.

Moog can supply complete customized systems for these applications with integrated simulation software as a turn key solution.

With deliveries to world leading automotive suppliers and manufacturers, such as Daimler, Ferrari, Dallara and others, Moog plays a leading role in designing and delivering high performance driving simulators adapted to your specific requirements.

ADVANTAGES OF DRIVING SIMULATORS

Vehicle development

By receiving immediate human feedback early in the development process, the vehicle model is improved and by using hardware-in-the-loop (HIL) engineers receive behavioral feedback about components and subsystems much earlier. As a result, engineers gain faster confidence in design options, which reduces the number of design alternatives, iterations and prototypes.

The simulator makes it possible to accurately measure the effect of certain design choices. The new car model is loaded into the simulator and the driver can then evaluate it. The procedure can be used for assessing aerodynamic behavior, fuel consumption and suspension set-up.

The use of a simulator allows for objective benchmarking and refinement of models in a confidential and controlled manner, and is safer and faster than driving prototype vehicles on a test track.

Driver training and car tuning

In racing, Moog driving simulators help to optimize the car settings prior to the race. As a result, fewer training laps are needed to reach the optimal settings. Even race tactics can be discussed, prepared and trained while using the simulator.

WATCH OUR VIDEO

To view our drive simulator video, click on the play button below or scan the QR code.

“Thanks to the driving simulator we are able to reduce the number of prototype tires to 2-3” (tire manufacturer)

“The adjustments done in the driving simulator allow us to drive the first training laps with optimal settings” (race car manufacturer)

“In the driving simulator, we are able to optimize specific driving experience (sportive, classic...) much quicker than on the test track” (car manufacturer)
Over the years, Moog has delivered a variety of motion systems for different types of driving simulation projects. Depending on the requirements, a driving simulator features a 6-DOF motion base and more with or without lateral rail and/or lateral rail, yaw or tilt table.

6-DOF motion system
The electrical motion system consists of six moveable supporting legs and realizes six degrees of freedom (DOF): The top platform moves in x, y and z directions, and rotates over all three axes (pitch, roll and yaw).

6-DOF motion system with lateral rail
The motion system can be mounted on a lateral rail, which increases the fidelity in long corners and lane changes because of stroke limitations of the actuators.

6-DOF motion system with yaw table
The motion system can also be mounted on a yaw table, which allows the simulator to turn up to 360 degrees in yaw direction. This is used to simulate city driving where sharp 90 degree turns are common. When no motion system is used this can quickly result in motion sickness.

A high performance driving simulator in many cases uses simulated driver controls. Moog offers control loading solutions as part of the driving simulator to simulate the force feel of steering, braking and gear shifting.

The technology is widely used for decades in flight simulation for flight controls. The principle of control loading as part of the driving simulator is briefly explained in the overview below.
**MOOG MOTION CUEING AND REPLICATION SOFTWARE**

Moog is unique in offering two user modes for driving simulators. The first is motion cueing for human in the loop testing and the second is the playback of recorded drive files. Users can switch between these two modes.

**Motion cueing**

The role of motion cueing in vehicle simulators is to enhance the simulation realism. Engineering hardware and human-in-the-loop (H2IL) testing solutions in a driving simulator is an area in which Moog has over 20 years experience, since we pioneered advanced cueing technology. Using the customer’s vehicle and test track model, Moog can achieve enhanced fidelity through advanced platform kinematics and optimized motion cues.

**Replication**

Moog Replication uses state-of-the-art algorithms to replicate time history files. The software helps develop drive files to match desired target data. The convergence towards the optimal drive file is achieved at incomparable high speed, dramatically reducing the test preparation time.

Once the drive files have been iterated, they can be used in a sequence to develop specific tests.

The software also offers the possibility to switch between drive files and different vehicle types to evaluate ride and comfort.

Moog Replication makes simulation of vehicle movements (as recorded on the test track using iteration) easy and fast to use.
EXPERIENCE

DALLARA IMPROVES RACE CAR PERFORMANCE AND TRAINS DRIVERS

Dallara Automobili based in Varano Melegari, Italy, provides design, engineering and support for some of the world’s most competitive car racing teams.

The customer’s need
Dallara had been looking for a way to effectively shorten product development time and reduce the cost of testing and driver training compared to track testing.

The solution
Moog delivered a high performance driving simulator for race car test and simulation. The driving simulator was specially developed for test and simulation in motorsport. For this application, very low latency and high acceleration and velocity are required in order for race car drivers to experience the most accurate feel of the car’s behavior. For the 6 DOF motion system, Moog designed new actuators that feature high stiffness at reduced weight in order to meet stringent frequency response specifications. The integration of a Moog control loading system to simulate the force feedback during steering, the special shape and construction of the dome, and the high quality visual system also helped improve the fidelity of the system.

The result
Since the driving simulator was delivered, Dallara has experienced a range of benefits from using the Moog Test System including saving training time and costs, eliminating potential problems and safety concerns with using a racetrack, enabling better evaluation of design choices and providing early feedback in the development process.

Dallara saves considerable time and money without compromising training quality. Training in the simulator helps Dallara to optimize the car settings prior to the race. As a result, fewer training laps are needed to reach the optimal settings. Even race tactics can be analyzed, prepared and trained while using the simulator. Another advantage is that a simulator is available every day, all day, whereas training on the race track is bound by time limitations. Other important benefits are that the simulator eliminates possible problems associated with a racetrack and improves safety.

In addition to the advantages of driver training, Dallara has reduced its design and development time for car parts, bodies and complete models. The simulator makes it possible to accurately measure the effect of certain design choices. The new car model is loaded into the simulator and the driver can then test it. The procedure can be used for assessing new aerodynamic parts, springs and shock absorbers, and testing how tire behavior and degradation changes with the level of fuel. A simulator verifies driving aspects of a car design just as a wind tunnel does this for aerodynamics.
Daimler stands for pioneering automotive innovation for more than 125 years. With an average number of seven patents each day, they secure their leading technological position on a consistent basis.

The customer's need
To continue their product development tradition, Daimler sought a solution to realize high performance and realistic drive assessment with expert drivers. Daimler turned to Moog to create the solution.

The solution
Moog supplied the Motion System and Software for a dynamic driving simulator. The electrical motion base, consisting of six moveable supporting legs, has six degrees of freedom (DOF). The top platform moves in x, y and z directions, and rotates over all three axes (pitch, roll and yaw). The entire motion system is mounted on the lateral rail, which adds the simulation of sideways movements such as lane changes that a hexapod on its own cannot simulate because of stroke limitations of the actuators. The Moog motion system is driven along the rail using linear motors. Inside the dome there is a Mercedes-Benz car model where test drivers look at a 360° projection screen showing real-life traffic scenes, with moving pedestrians, oncoming traffic and buildings. The complete motion system is controlled by Moog real-time software. From the driver’s input to the pedals and steering wheel, the Daimler vehicle models calculate position, velocity and acceleration data. Moog software translates this information to movements in the hexapod and lateral rail to ensure the driver’s sensory expectations are matched. Consequently, driving the simulator feels just like driving a normal car.

The result
Moog’s motion control expertise is part of the successful development of this dynamic driving simulator which will support the latest generation of test, research and assessment Daimler utilizes to develop its future car models and systems.

VEHICLE SIMULATION IN OTHER CONTEXTS
Moog also offers other systems that simulate vehicle movement. Two examples are the Ride and Comfort Test System and the Fuel Tank Test System. The first system enables evaluation of the ride and comfort of a car, while the second captures liquid-sloshing effects during a simulated car ride.

Both systems are delivered with Moog Replication software, which enables users to replicate recorded drive files and play them out in the test lab.

Our expertise and experience can assist you in the process of selecting the right system to accommodate your needs in vehicle simulation.
TAKE A CLOSER LOOK

Moog solutions for driver simulation are only a click away. Visit our Web site for more information and the Moog facility nearest you.

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