# MotionDesk

3-D online animation of simulated mechanical systems in real time

Highlights

- Tight integration to ModelDesk and ASM
- Enhanced support for all aspects of advanced driver assistance systems (ADAS)
- Sensor simulation technology for developing and testing camera-, radar-, and lidar-based systems
- Large-scale 3-D object library for easy scene creation
- Powerful rendering engine guarantees detailed and realistic visualization
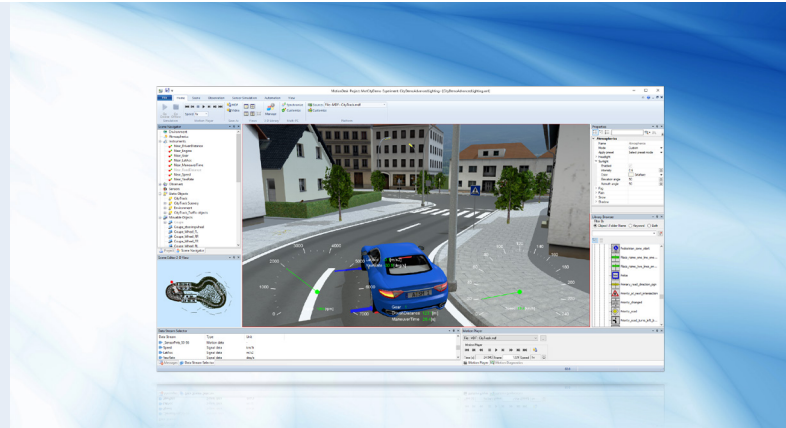
Application Areas

When you develop a mechatronic control system such as an advanced driver assistance system, you need to be certain that it performs correctly. You can do this by running HIL simulations. The best way to understand the behavior of a simulated system is to use animated visualization in realistic 3-D scenes. Combining a simulation system with real-time animation is the ideal way to get the whole picture. Since animations can be recorded and replayed, it is easy to compare different controller development strategies by using overlay techniques. MotionDesk enhances the dSPACE tool chain by visualizing how mechanical objects move in the 3-D world. MotionDesk is the perfect tool to visualize any kind of vehicle dynamics development and driving maneuvers, such as lane change, split-μ, and cornering.

Key Benefits

MotionDesk helps you get more out of your HIL simulator, visualizing your simulation in virtual worlds that exactly represent the simulation scenarios. MotionDesk reads the data from the HIL simulator and displays the animation of the moving objects (vehicle, wheels, steering wheel, etc.) in real time, using the perspectives and render modes that you choose yourself, to give you a clear understanding of how the simulated objects actually behave. You can store the animations as experiment files and record video files to document and illustrate your developments.

Support of Advanced Driver Assistance Systems

MotionDesk provides enhanced support for all ADAS aspects, where the complexity of an action has to be seen to be understood. When an ADAS is tested, the visualization must be realistic enough for object recognition, and a high frame rate is crucial.
MotionDesk's rendering engine guarantees detailed and realistic visualization. Even complex scenes can be rendered at a steady rate of 60 frames per second, and beyond.

For camera-based system tests as well as for radar and lidar developments, MotionDesk comes with valuable features, such as optical path simulations, camera sensor simulations, and ideal point-cloud sensor models. These features support developers of camera, radar, and lidar sensors in their work and simplify the test setup significantly, e.g., by eliminating the need for a simulation box with a camera ECU filming MotionDesk.

Main Features and Benefits

Feature	Description	Benefit
Instant animation	■ Powerful rendering engine ■ Low latency between simulation and animation ■ Intuitive motion model to accurately position the observer in the scene ■ Smart objects for simulating and visualizing state-dependent objects stimulated by the real-time simulation model (e.g., traffic lights, brake lights, direction indicators) ■ NEW: Hardware instancing	■ Detailed and realistic visualization ■ Even complex scenes can be rendered at a steady 60 frames per second ■ Realistic man-in-the-loop simulation ■ NEW: Hardware instancing improves performance while using a large number of the same objects (e.g., trees, street lamps, buildings)
Multitrack mode	■ Visual comparison of simulation run with reference data tracks	■ Parameter behavior studies
Force vector visualization	■ Forces represented graphically, e.g., by arrows	■ You can easily see which forces influence motion and how
3-D scene creation	■ Graphical interactive scene design ■ Scene creation integrated in MotionDesk ■ All done by drag & drop ■ Automatic generation of guard rails, noise barriers and environment objects ■ Automation API for remote-controlling MotionDesk ■ Automatic scene generation based on ModelDesk scenery types like city, highway, country road, alley, etc. ■ Precise definition and visualization of lane lines ■ Support of free lane lines and markings, delineators and safety barriers ■ NEW: Road definition in ModelDesk allows for specifying Z-profiles on junctions	■ Easy, intuitive operation ■ Operation from one tool ■ Fast scene creation and modification ■ Synergy with other tools for optimized workflow ■ Exact representation of lane lines is a necessity for developing and testing lane assistant systems ■ NEW: Realistic simulation of real-world junctions with incoming and outgoing lanes at different height levels
3-D object library	■ 3-D object libraries based on standardized COLLADA file format ■ Imports and migrates VRML2 ■ 3-D object search via keywords and names ■ Grouping 3-D objects ■ Steadily growing library of 3-D objects: cars, houses, trees, etc. ■ Animated characters (optional) ■ International traffic signs (optional)	■ Easy migration from older MotionDesk versions ■ 3-D object libraries can be extended by user-defined objects in COLLADA ■ Better overview of all objects ■ Better scene structures ■ More than 1200 3-D objects available for creating detailed and realistic scenes for various use cases from vehicle dynamics to advanced driver assistance systems and Car2x
Lossless, time-based data acquisition	■ Time-based simulation data acquisition with equidistant time stamps	■ Synchronized replay of recorded animations in real time
Speed control	■ Variable slow- and fast-motion replay	■ You can slow the animation to observe details and speed it up during uneventful sections
Video file generation	■ Animations exported into video files (AVI, MPEG-4, etc.)	■ Archiving and distributing important animations
Multi-PC support	■ Scalable visualization system for interactive driving simulators via Multi-PC Interface Kit or directly with SCALEXIO simulators (p. 407)	■ More views increase realism during man-in-the-loop simulation
Optical path simulation	■ Simulation of optical paths for behind-sensor-stimulation (simulation of visual effects such as lens distortion, chromatic aberration, vignetting in MotionDesk)	■ No need to setup a simulation box with camera ECU filming MotionDesk
Ideal point-cloud sensor model	■ Reflection points of traffic environment with high 3-D angular resolution ■ Different values for each reflection point: Distance, azimuth/elevation angle, relative speed, etc. ■ GPU-based camera sensor models in MotionDesk	■ Basis for development of radar and lidar sensors
Advanced lighting technology	■ Light sources can be attached to all objects ■ Shape, color, and intensity selectable for each light source ■ Different luminance distributions available for all light sources ■ Automatic positioning of the sun based on a simple ephemeris model	■ Ambient light and shadows change dynamically ■ Realistic lighting behavior and visualization (e.g., reflections of brake lights) ■ Simulation of changing light conditions (e.g., sunset, sunrise) and of night drives for the development of adaptive front-lighting systems (AFS) ■ Testing real headlights in real time

Feature	Description	Benefit
NEW: Terrain generation and long-road support	■ Creation of road geometries with varying elevations on the basis of real satellite and elevation model data ■ Generation and real-time simulation of extremely long roads and road networks (thousands of kilometers and more)	■ Realistic simulation of the terrain to embed roads and road networks ■ Dynamic loading of the road segments ensures stable and high performance
NEW: Sensor simulation modules	■ Windows® console application ■ Generated sensor raw data is provided by HDMI ports or via a shared memory interface ■ Support of camera features and effects, such as Bayer pattern, lens distortion, chromatic aberration, vignetting, and shadow calculation as well as simple and advanced lighting ■ Postprocessing API	■ No performance loss caused by unnecessary user interfaces and supporting processes ■ Easy transmission of sensor data to ESI units and virtual ECUs (V-ECUs) ■ Allows for using all MotionDesk visualization features to address the requirements for the calculation of an optical path and realistic lighting scenarios ■ External interface to extend the functionality for customers (e.g., probabilistic model on sensor output)

Order Information

Product	Order Number
MotionDesk (Offline simulation with Simulink® and VEOS, hardware access)	■ MOTIONDESK
Add-on: MotionDesk Animated Characters	■ MOTIONDESK_ANIM_CHAR
MotionDesk Multi-PC Interface Kit	■ MotionDesk Multi-PC Interface Kit
MotionDesk Sensor Simulation Module Camera	■ MOTIONDESK_SENSOR_CAM

Relevant Software and Hardware

Software			Order Number
Included	Blockset	■ MotionDesk Blockset to extend Simulink®	–
Required	Integrated development environment	■ MATLAB®/Simulink/Simulink® Coder™ (formerly Real-Time Workshop®) from MathWorks®	–
	Operating system	■ www.dspace.com/goto?os_compatibility	–
Optional	dSPACE Simulator interface	■ Real-Time Interface	■ RTI
	SCALEXIO interface	■ ConfigurationDesk	See p. 55
	VEOS	■ Platform for PC-based offline simulation	See p. 119

Hardware			Order Number
Required	Recommended PC system	■ Please visit our website at www.dspace.com/go/mdhwrequ	–
	dSPACE Simulator (PPC board)	■ DS1006 Processor Board (p. 494) ■ DS1007 PPC Processor Board (p. 500)	■ DS1006 ■ DS1007
	MicroLabBox hardware	■ Support for MicroLabBox	See p. 333
	MicroAutoBox hardware	■ Support for MicroAutoBox II[1]	See p. 342
	SCALEXIO	■ Support for SCALEXIO	See p. 407
Optional	MotionDesk Multi-PC Interface Kit	■ 10 megabit/s Ethernet card for each connected PC	■ MotionDesk Multi-PC Interface Kit

[1] *Various MicroAutoBox variants are available. Please contact dSPACE for advice on which variant you need.*

Functionality at a Glance

3-D Animation of Simulated Mechanical Systems

- Lossless, time-based data acquisition with time stamps
- Synchronized replay of different simulations in multiple tracks
- Replay function with faster/slower replay speeds
- Up to 500 movable objects
- Data acquisition from DS1006 Processor Board, DS1007 PPC Processor Board, MicroLabBox and MicroAutoBox II
- Data acquisition from running Simulink simulations
- Runs on the host PC (p. 175), separate PCs (p. 176), or VEOS (p. 118)
- File-based recording and analysis of motion data
- Video file generation (e.g., AVI, MPEG-4) to export MotionDesk's animations to high-quality video files
- Intuitive operation

- Support of multichannel visualization with highest graphical requirements (p. 176)
- Precise definition and visualization of lane lines
- Support of free lane lines and markings, delineators and safety barriers
- Optional: Import of road networks and predefined sceneries from dSPACE ModelDesk's Road Generator
  - Examples: country roads, tree-lined roads, and urban areas
  - Automatic 3-D scenery generation in MotionDesk, including road embankment or border area, tree spacing, reflector posts, street lights, building types, etc.
 - Fine adjustments in MotionDesk's 3-D Scene Editor

Realistic Visualization

- Connection of objects and model data streams via drag & drop
- Simulation of changing weather conditions like rainfall, fog, and snow
- Simulation of different light conditions and shadows
- Freely configurable observers that can follow movable objects with different behaviors

- Various rendering techniques (wire frame, flat shading, Gouraud shading, textured)
- Render modes selectable for whole scene and for individual objects
- Driver camera with realistic viewpoint (smooth follow behavior)
- Scene statistics

Everything You Need in One Tool

MotionDesk is easy to handle. You can perform all the important operations, such as 3-D scene creation, in one tool, mainly by drag & drop.

- Scene Navigator
- 2-D scene view
- New rendering kernel
- 3-D library
- Property grid
- Instruments
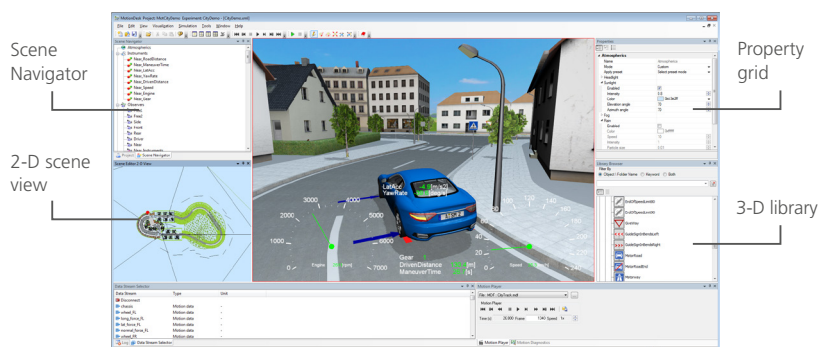
Preparation of HIL Tests via Offline Simulation

You can use VEOS, dSPACE's platform for PC-based simulation, to set up models, layouts and tests in an early phase before the HIL tests. With VEOS, you can configure and validate models, layouts and tests on a standard PC, without any HIL hardware.

MotionDesk, like all other dSPACE software for HIL simulation, interacts with VEOS just like with a HIL simulator. MotionDesk is perfect for visualizing simulations, and as soon as the HIL simulator is available, simulation runs can be started without unnecessary delays.
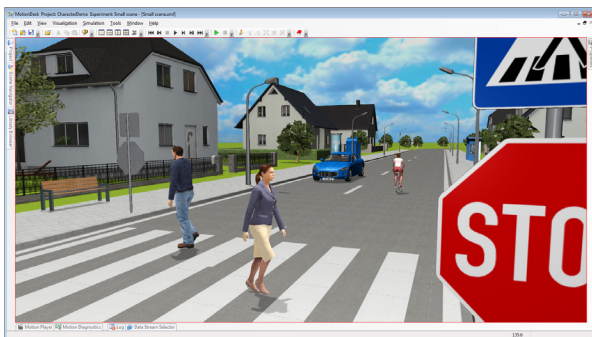

Scene Navigator

2-D scene view

Property grid

3-D library

Optimized for Driver Assistance Systems

MotionDesk provides enhanced support for all aspects of advanced driver assistance systems (ADAS), where the complexity of an action has to be seen to be understood. When camera-based ADAS systems are tested, the simula-tion must be realistic enough for object recognition, and a high frame rate is crucial. MotionDesk can simulate changing weather conditions, such as rain and snow, and offers highly realistic shadow visualization.

Pedestrian Detection

A critical part of ADAS systems is the real-time detection of pedestrians via camera. Pedestrians are hard to recognize, especially in cities or obscure corners, where colors, forms, and motion make precise detection much more difficult than on a highway. ADAS pedestrian detection uses neural networks which are trained on the basis of real data. This means that pedestrian detection also recognizes road users through their motion behavior and draws important conclusions on the road users' possible motion trajectories.

To test pedestrian detection systems via simulation, MotionDesk provides the Animated Characters module which includes animated pedestrian models that show realistic human appearance, behavior and motion. Besides this, the Animated Characters module also visualizes animals and wheeled persons, such as wheelchair users and cyclists. This way, sensitive pedestrian detection systems do not need to be tested completely on test tracks. They can also be tested in the laboratory through visualization with MotionDesk – it's flexible and tests are fast to reproduce. Thus, MotionDesk makes an important contribution towards achieving the next level of required safety standards on pedestrian detection (such as NCAP).

International Traffic Signs

MotionDesk lets you extensively test traffic sign recognition and visualization. It includes the complete German traffic sign catalog and all the most important traffic signs from China, Japan and the United States, with more than 700 traffic sign models.

With this comprehensive library, you can conveniently and quickly test the functionality of ADAS systems in different countries and for different road characteristics.

V2X Systems

MotionDesk supports the development of V2X systems, such as collision avoidance, intersection management, and other communications-enabled vehicular safety systems.
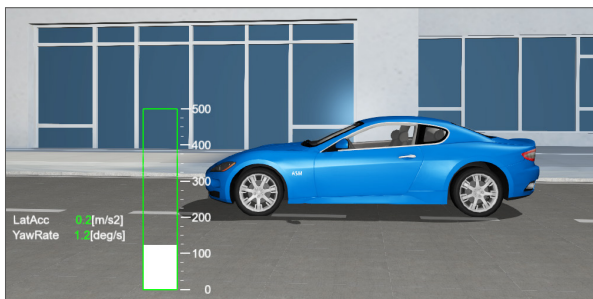

Instruments

MotionDesk has several instrument types for observing the values of simulation variables. In MotionDesk's Scene Viewer you can attach instruments to movable objects or give them static positions in a scene. You can also specify several instrument properties such as the size, position and color. The following instrument types are available:

- Numeric instrument, e.g., showing forces that affect the vehicle
- Gauge instrument, e.g., speedometer or engine speed
- Bar instrument, e.g., showing the filling level
- LED instrument, e.g., selected gear or indicator
- Panels for logical grouping of instruments
- Multistate Text and Multistate Picture for conditional display

The instruments can be placed inside or outside the vehicle.

Multistate Picture instruments and Multistate Text instruments, especially useful for V2X applications, such as emergency vehicle warning.

You can group instruments in panels, which can be collapsed or expanded. Panels, including all their properties, can be reused from any observer, making it possible to single-source instrument definitions.

Testing Camera-Based Systems

Testing camera-based ADAS usually requires a simulation box with a camera ECU, which films the animated scenes rendered in MotionDesk. However, with MotionDesk's sensor simulation feature, the test setup is different. Optical devices such as lens and sensor as well as the optical path are part of the simulation in MotionDesk. A cinema-like setup with a monitor and a lens system between monitor and camera ECU is no longer necessary for the test setup. The video data rendered in MotionDesk is inserted into a digital interface between the imager and the microcontroller of the camera ECU. To feed the camera ECU with MotionDesk data using optical path simulation, a physical interface is required.

To achieve a realistic simulation of the camera sensor and the optical path, the following visual effects that generally occur in camera-based systems can be simulated directly in MotionDesk:

- Chromatic aberration (the lens fails to focus all colors to the same point resulting in colored edges around objects)
- Vignetting (darker image corners compared to the image center)
- Lens distortion (image deformation caused by the optical design of the lens)

Camera sensor in MotionDesk without lens profile (left) and with lens profile (right). When the lens profile is added to the sensor, MotionDesk shows typical visual effects occuring in camera-based systems, such as chromatic aberration, vignetting, and lens distortion.

Typical applications include:
- Lane departure warning systems
- Lane keeping assistant
- Traffic sign recognition
- Autonomous emergency braking

Developing Radar and Lidar Sensors

In the context of ADAS and autonomous driving, radar and lidar technology are gaining more and more importance – it is assumed that only the combination of these technologies with camera-based systems can provide ADAS and autonomous vehicles with the required reliability. When equipped with radar and lidar sensors, the vehicle receives information on distances, speeds, etc., which is crucial for detecting the vehicle's environment reliably.

MotionDesk's ideal point-cloud sensor models form the basis for the development of radar and lidar sensors.

When using these models, reflection points of the traffic environment are shown in the vehicle's field of view while it is driving through a scene in MotionDesk. Different values, such as distance, azimuth/elevation angle, and relative speed, can be assigned to each reflection point. The vehicle's field of view is freely configurable up to 180°, the resolution can also be adapted as needed. In the future, radar and lidar sensors will be implemented by raytracing-based simulation to achieve a higher coverage of development and test use cases.
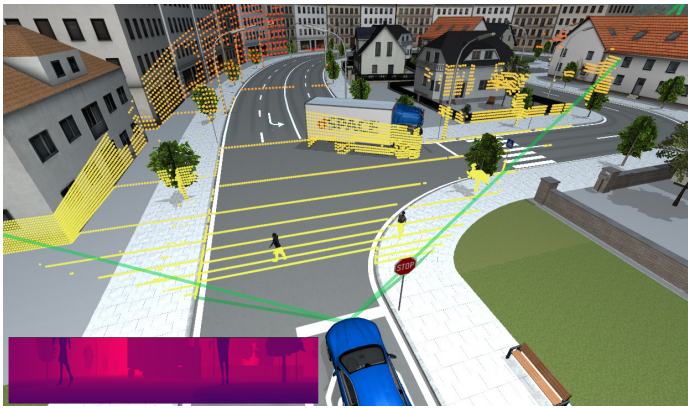

A vehicle with ideal point cloud drives through a MotionDesk scene. Different values, such as distance, azimuth/elevation angle, and relative speed, can be assigned to each reflection point.

Advanced Lighting Technology

To achieve realistic visualization, MotionDesk has a powerful visualization engine that lets you model complex lighting behavior and allows for additional test scenarios, such as night drives. You can change the shape, the color, and the intensity of all light sources involved in the model, such as headlights, street lights, and the ambient light. The light sources can be attached to all objects in the model, allowing for a well-lit, fine-tuned and realistic visualization of environments.

For real-time tests of real headlights, the vehicle can be equipped with different headlight models for simulations in MotionDesk – simply by loading different luminance distributions of the corresponding headlight. The versatile configuration options also let you simulate changing lighting conditions, such as sunsets and sunrises, with a simple ephemeris model to automatically place the sun accordingly. The ambient light and all shadows change
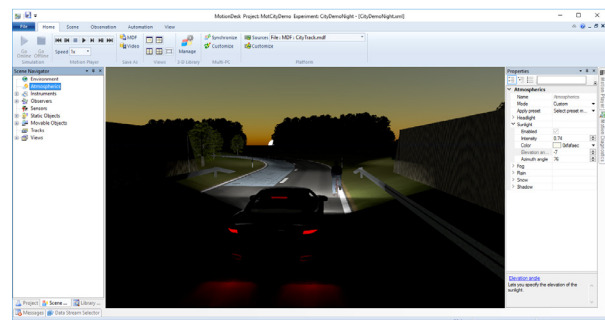
dynamically depending on the selected values for the light sources. In this way, you can easily visualize the effects of different lighting conditions, which is especially important in low light conditions. Night drives can be simulated with ease, which is especially helpful for the development of adaptive front-lighting systems (AFS).

3-D Authoring: Creating a Virtual World

Automatic Scene Generation from ModelDesk

ModelDesk and MotionDesk work together hand-in-hand in a tool chain. ModelDesk's Road Generator (p. 291) lets you define scenes for the automatic generation of 3-D sceneries in MotionDesk.

ModelDesk's Road Generator is the graphical user interface for defining road networks and sophisticated road features. Roads can be assembled from geometric segments or imported. The road design interacts closely with MotionDesk to define the environment. The Road Generator is ideal for creating complex traffic scenarios for the development and test of advanced driver assistance systems (ADAS). For example, you can define country roads, tree-lined roads and urban areas, and completely parameterize them with a road embankment or border area, tree spacing, reflector posts, street lights, building types, and so on.

Fine adjustments can be done afterwards in MotionDesk and its integrated 3-D Scene Editor.

A scene defined in ModelDesk and automatically generated in MotionDesk.

Manual Scene Generation in MotionDesk

In addition to automatic scene generation in ModelDesk, you can always design or modify scenes yourself. You can use the integrated 3-D Scene Editor to modify scenes for running 3-D animations of simulated data or create completely new scenes.

MotionDesk gives you a complete 3-D authoring package so that you can create and modify virtual worlds easily. You can choose objects from libraries and import 3-D data from 3-D CAD applications. The comprehensive library of 3-D objects lets you set up scenes very fast by simply selecting and positioning the objects. A 3-D Library Browser helps you find the objects you need, for example, by keyword search. Expanding the library is easy, as the 3-D object geometries are described in the COLLADA standard. Road geometries for automotive applications can be generated automatically, using vehicle dynamics models such as the dSPACE ASM Vehicle Dynamics Simulation Package.

Integrated 3-D Scene Editor

- 3-D editor for assembling a scene from 3-D objects
- Interactive graphical scene design
- Scenes observable from any viewpoint
- Easy, intuitive mouse navigation through scenes
- Open, extendable 3-D object library
- Geometry objects in COLLADA standard (VRML2 geometries imported into the 3-D object library by 3-D Library Manager)
- dSPACE object library of miscellaneous objects for building a virtual world: ground plates, sky domes, houses, trees, etc.

- Library of generic objects and robotics objects
- Custom library of 3-D objects
- 3-D Library Manager for importing and coloring objects
- Object library management by grouping or by keywords
- Positioning, rotating and scaling 3-D objects in any direction (graphically via mouse, or by editing the property values)
- Wide range of textured, real-time-capable objects for vehicle dynamics simulation: chassis, wheels, roads, etc.
- Each object can have its own render mode

Assembling a Scene Manually

To add objects to a scene, just drag the objects from the 3-D object library to the scene and move them to the correct positions. For very realistic animations, you can use atmospheric settings such as light and fog to reduce the visibility range and obscure objects that are far away.
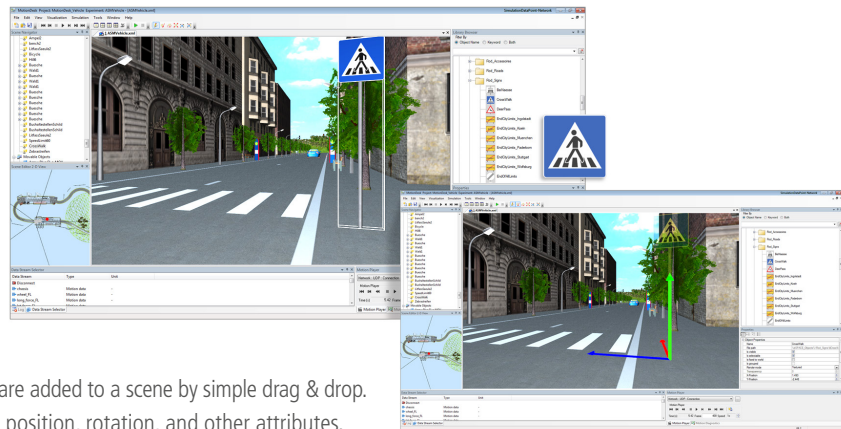
3-D objects, like the traffic signs shown here, are added to a scene by simple drag & drop. Then you can edit them to modify their size, position, rotation, and other attributes.

Authoring at a Glance

- 3-D scenes assembled from 3-D library objects by drag & drop
- Templates for complete sceneries
- Comprehensive automotive object libraries
- International traffic signs (optional)
- Import customized 3-D objects and graphics

Animation with MotionDesk

Once created, a 3-D scene comes to life in MotionDesk. dSPACE Simulator or SCALEXIO provide the motion data and MotionDesk moves the 3-D objects in the scene accordingly. For example, when a car is simulated, the motion of the chassis is displayed with four individually rotating wheels, including force vectors visualizing the forces between road and wheel. In MotionDesk, you can adjust the transformations, scalings, colors, and render modes of the objects.

Automation API

MotionDesk can also be remote-controlled from other tools, such as dSPACE's ModelDesk, via a publicly available automation interface. External tools can create a scene and add objects to it, start or stop the simulation, and switch to full screen mode.

NEW: Terrain Generation and Long-Road Support

The MotionDesk terrain generation feature lets you create road geometries with varying elevations on the basis of real satellite and elevation model data. This enables a realistic simulation of the terrain in MotionDesk. MotionDesk's long-road support makes it possible to create extremely long roads and road networks and simulate them in real time – you can drive thousands of kilometers and more. Since the road segments are loaded dynamically, only a section of the entire geometry is loaded to the memory at a time, which ensures high performance and stability.

Terrain model generated from satellite images and digital elevation data with embedded road based on GPS data and generated by ModelDesk.

Resulting visualization from driver's perspective including enhancements such as delineator posts and barriers.

NEW: Z-Profiles on Junctions

A more realistic mapping of real-world junctions is achieved by using Z-profiles. These can be specified in ModelDesk beforehand and allow for visualizing junctions with lanes at different height levels.

Multitrack Mode

Three different strategies for a driving maneuver lead to three different simulations. You can visualize the three simulations together in one animation by using a different color for each simulation. Multitrack mode lets you replay several simulations synchronously. Animations can be overlaid via rendering techniques.

Main Features

- Synchronized replay of several simulations
- Transparent overlaying of objects
- Equidistant time stamps

Typical Applications

- Parameter behavior studies
- Reference comparisons

Comparisons

The multitrack mode in MotionDesk is a smart way to visualize simulations, allowing you to integrate several simulations in one single animation. The method is ideal for reference comparisons and in all cases where strategies for a particular maneuver need to be assessed. For example, different vehicle dynamics strategies can be compared with one another in the specification phase, and later, actual results can be tested against a reference. This is also an ideal way to document results visually.

Technology

To replay several simulations synchronously, MotionDesk offers two important features:

- Time stamps for simulation data
- Several replay tracks

You can synchronously replay any simulations that are recorded on the same time basis. The animated objects can be cloned as required and assigned to different tracks. You can also give the objects different colors and render modes so that the individual simulations are clearly distinguishable.

Track Generation

The tracks are created in MotionDesk's Scene Navigator. Track generation automatically creates clones of the movable objects and observers in the scene.

Data Sources

Tracks can receive their data from different sources:

- Online simulation
- Simulink offline simulation
- Stored simulation (MDF files)

If simulations from different sources need to be compared, they all must use the same time basis.

Maneuver Comparisons

MotionDesk's multitrack mode makes maneuver comparisons easy and clear. It synchronously replays multiple simulations that have been assigned to different tracks. One track acts as the reference, playing either online, offline, or stored simulations. Each of the other tracks synchronously replays data from previous simulation runs. These tracks also contain clones of the moving objects defined for reference. Synchronized replay makes it easy to pick the best strategy for your control application.

Braking on a Split-µ Surface

The same maneuver is shown with and without Electronic Stability Program (ESP). MotionDesk displays the two different simulations in one animation.

The red car and the yellow car are on track at the beginning of the maneuver. The red car is equipped with ESP, the yellow car is not.
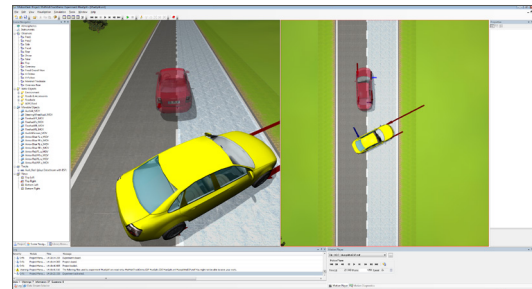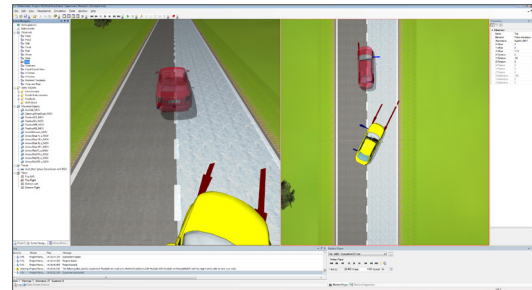
Both cars brake on a partially slippery surface (split-µ). The yellow car starts skidding and turning.
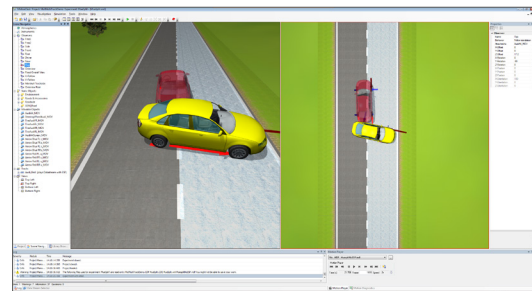
At the end of the maneuver, the red car is still on track, but the yellow car turned around the yaw axis.

# MotionDesk Blockset: Model and Animation

Prepare for Animation

This blockset lets you run animations as early as the control design stage. You can perform the usual ECU-based simulation and animation, and also check behaviors very early and create references. MotionDesk is therefore the ideal tool to visualize certain features and their results at the very beginning of a project.

The Blockset at a Glance

- Interface between simulation platform and MotionDesk
- Visualization of PC-based Simulink simulations
- Visualization of real-time simulations
- Support of simulation platforms: DS1006, DS1007, SCALEXIO, MicroLabBox, MicroAutoBox II, VEOS, and Simulink
- Transformation blocks for easy description of the 3-D objects' positions and orientations

- Single communication block with dialog pages to easily configure data transfer
- Fast model initialization in Simulink
- Fast computation for real-time execution
- Kinematic chains (e.g., robot kinematics or wheel motion in relation to the vehicle) created by connecting transformation blocks in Simulink
- Ready-to-use demo models for vehicle and robotics
- Easy connection of existing vehicle models via kinematics block
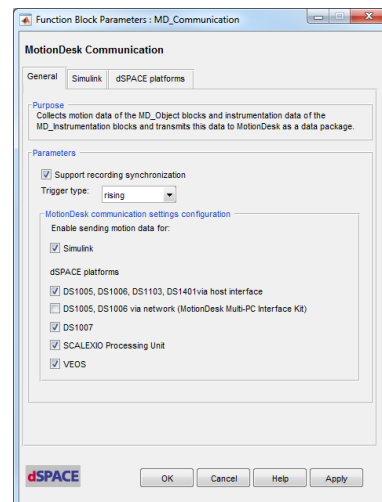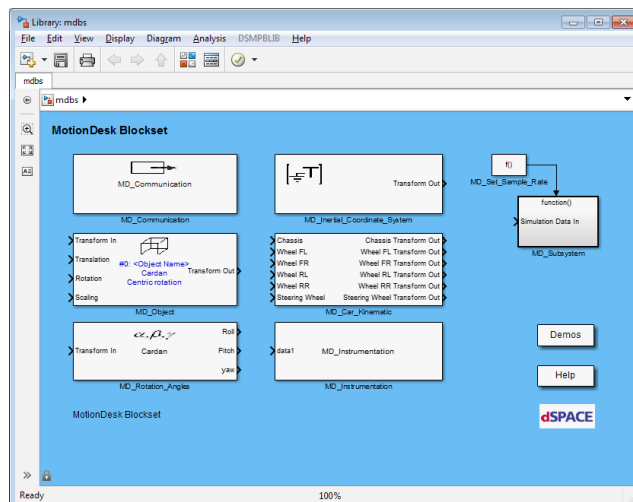
Special blocks collect the motion data and time-stamp it in MotionDesk.

# Connect 3-D Objects and Models

Six Degrees of Freedom

Real-time models in Simulink use state variables, such as a wheel's steering angle or position in relation to the suspension. In contrast, 3-D animation requires a system with 6 degrees of freedom to determine the objects' positions and orientations in the 3-D world. The MotionDesk Blockset lets you transform the state variables into these 6 degrees.

Transform State Variables

The MotionDesk Blockset provides Simulink blocks that prepare the real-time model for 3-D animation and make the data streams available in MotionDesk. During Simulink simulations and real-time simulations, the Simulink blocks directly transform state variables into the required 6 degrees of freedom. This graphical form of programming obviously makes the interconnections between the real-time model and the 3-D objects extremely tangible, and modifications are easy to carry out.

Coordinate Transformation

- Simulink blocks for 3-D coordinate transformation
- Convenient setup of kinematic chains
- Euler or Cardan angle interpretation
- Transformation from rotation to translation, and vice versa
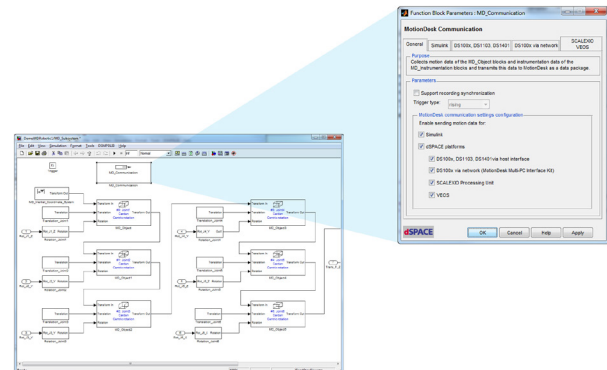
Connection to 3-D objects, data collection and transfer to MotionDesk: all done in the Simulink blocks and dialogs.

Maneuver Synchronization with Multitrack Support

The blockset supports maneuver synchronization with all data sources (dSPACE real-time hardware, VEOS, and Simulink simulation). At the beginning of a maneuver, you can reset time stamps used for the animation to zero without affecting the current simulation time. This provides convenient handling when new maneuvers start. In MotionDesk, you can also synchronize animations to certain events – which is useful if you want to watch the animation only at a certain speed or milestone.
Special blocks collect the motion data and time-stamp it in MotionDesk.

Typical Application: Automatic Driving Maneuvers

Control and Visualize

One typical application scenario is the visualization of auto-matic driving maneuvers calculated by dSPACE Simulator or SCALEXIO. ControlDesk is used to control and monitor the simulation. ControlDesk and MotionDesk can run on the same PC, since there is no need for interactivity with low latency requirements.


Data Transfer

MotionDesk visualizes the simulation results in a 3-D scene. dSPACE Simulator or SCALEXIO calculates the absolute positions and orientations of the movable objects for the visualization. Data for ControlDesk and MotionDesk is transmitted from dSPACE Simulator or SCALEXIO to the host PC via dSPACE link boards or via network commu-nication. To display ControlDesk and MotionDesk on two separate monitors, the graphics board must have two connectors (dual head).

Further Application Fields

MotionDesk supports a broad variety of applications. All simulations can be visualized elegantly by importing the appropriate 3-D objects. Outside of the automotive field, further typical applications for 3-D animation include robotics and flight simulation.
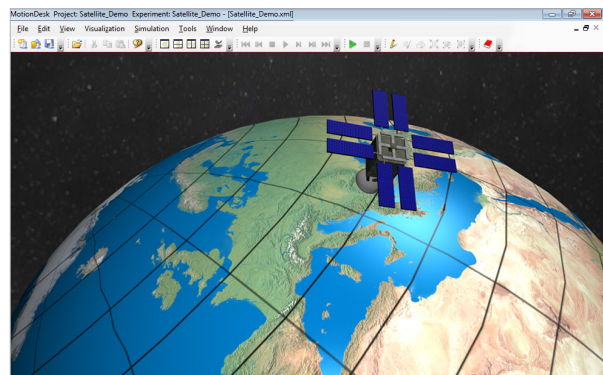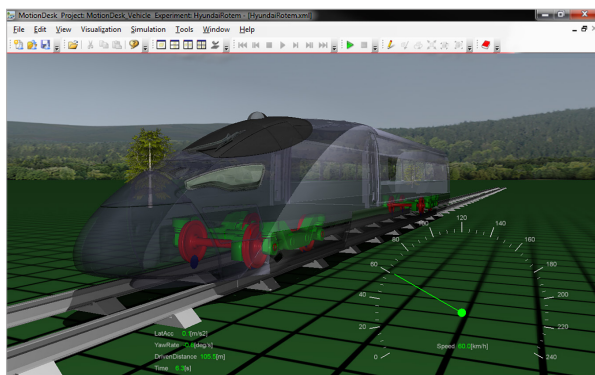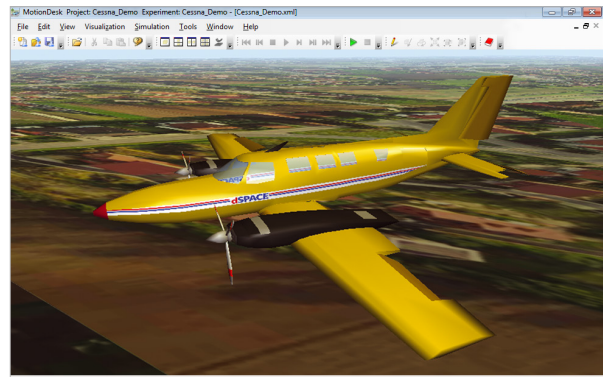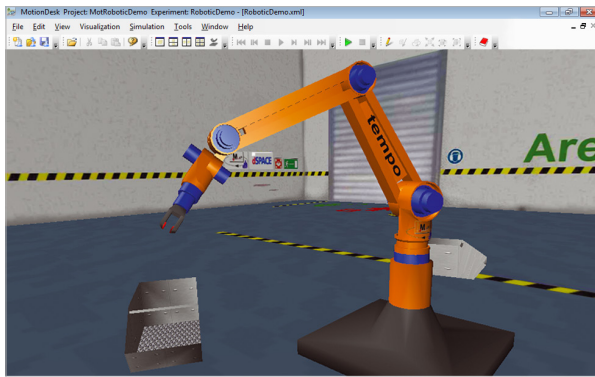
MotionDesk on Multiple PCs

Improved Visualization

MotionDesk is ideal for applications in which a human driver controls a virtual car. Such tests are important if you want to run not only a suite of automated tests, but also interactive tests. The driver feedback obviously has to be highly realistic, which requires a high frame rate and low latencies. For even greater realism, MotionDesk provides scalable visualization for interactive driving, for example, displaying different views of the same scene at the same time. ControlDesk and MotionDesk run on separate PCs, which improves the visualization performance and provides the full functionality and performance of both tools. Moreover, you can add any number of MotionDesk PCs to set up a driving simulator with several screens for the most realistic visualization.

Typical Application: Interactive Tests by Man-in-the-Loop

A typical application example is man-in-the-loop simulation, where the human driver sees multiple screens in an interactive driving simulator.
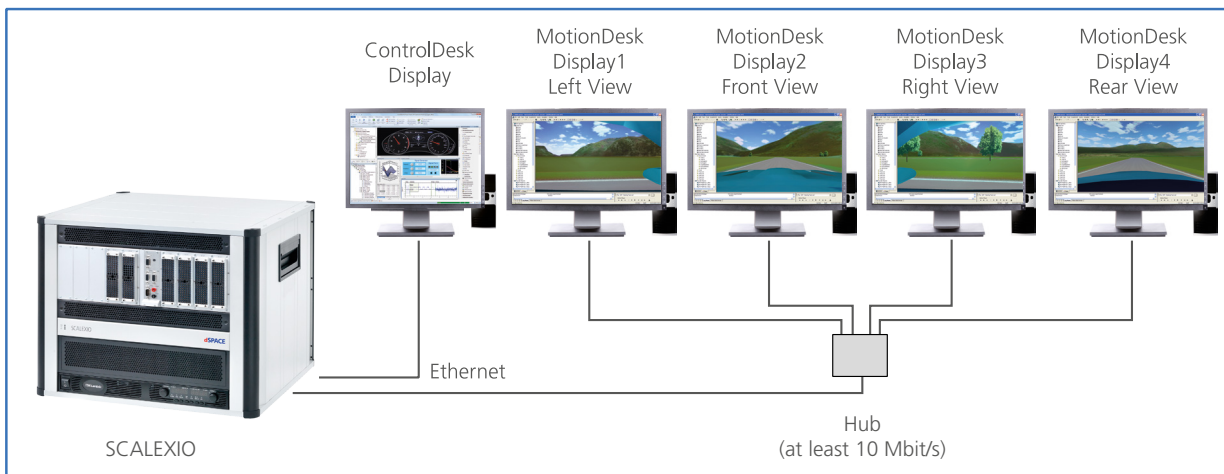
A typical multi-PC setup (SCALEXIO) with MotionDesk: The human driver can see different views of the same scene simultaneously for greater realism.
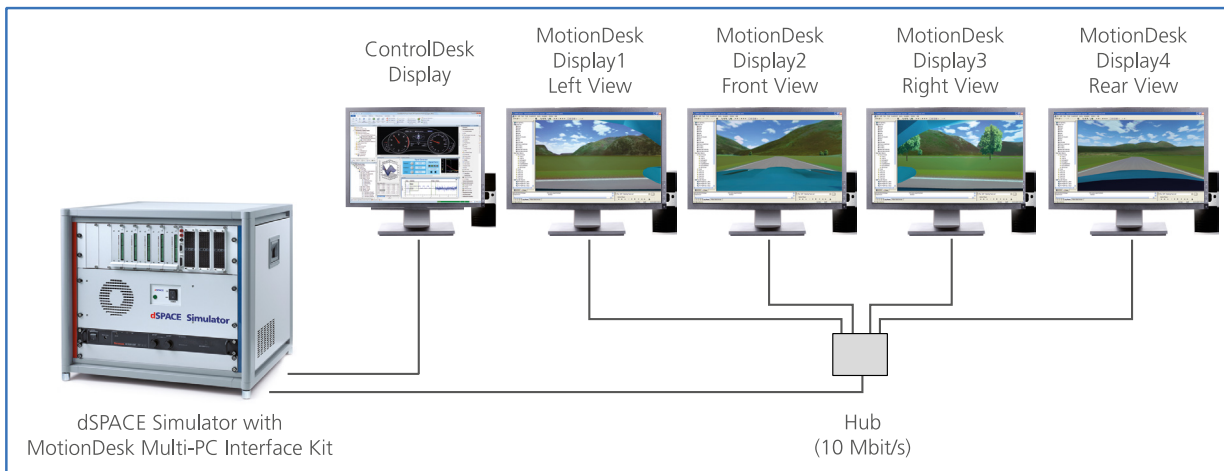
The same multi-PC setup with a PHS-bus system (for example, dSPACE Simulator). This requires the MotionDesk Multi-PC Interface Kit.

MotionDesk Multi-PC Interface Kit

Scalable Performance

- Required only for systems based on peripheral high-speed (PHS) bus technology
- Extension to MotionDesk for highest graphical requirements
- ControlDesk and MotionDesk run independently on different PCs

- Full ControlDesk functionality and maximum MotionDesk performance at the same time
- Scalable number of MotionDesk PCs for multichannel visualization (e.g., for interactive test drives)
- Smart solution for setting up driving or flight simulators
- Synchronized animation start/stop on all MotionDesk PCs

Connect Multiple PCs

The MotionDesk Multi-PC Interface Kit is an extension to MotionDesk that enhances visualization performance and allows the same experiment to be visualized from different points of view – and from different PCs. A typical application is man-in-the-loop: You cannot get the most realistic impression of the simulation unless the driver sees different perspectives of the scene, such as the front view, side view, and rear view.

Network Connection

The MotionDesk Multi-PC Interface Kit allows multi-faceted visualizations by letting you connect any number of MotionDesk PCs in the real-time data stream. The hardware is installed in your dSPACE Simulator. The connection to the MotionDesk PCs is via Ethernet, so you only need an Ethernet card in the PCs for high-speed data transfer and minimum latencies.

Hardware Details

- ISA bus board for providing the real-time data (DS1006 supported)
- Ethernet connection between PCs

Software Details

- Programmable via a network sender block (included in MotionDesk Blockset)

System Requirements for MotionDesk Multi-PC Interface Kit

Same as MotionDesk, plus
- dSPACE Simulator (DS1006)
- 10 Mb/s Ethernet card for each connected PC

Software Requirements for MotionDesk Multi-PC Interface Kit

- MotionDesk for each PC