ADAMS/Car

SPECIALIZED SIMULATION ENVIRONMENT FOR VEHICLE DESIGN AND TESTING

Current ADAMS/Car products, allow full-vehicle simulation. With add-on modules available now and new capabilities coming soon, users can build, test, and refine their designs using the Functional Digital Car.™

With ADAMS/Car, engineering teams can quickly build and test functional virtual prototypes of complete vehicles and vehicle subsystems. This helps cut time, cost, and risk in vehicle development and improve the quality of new vehicle designs.

Working within the ADAMS/Car simulation environment, automotive engineering teams can exercise their vehicle designs under various road conditions, performing the same tests they normally run in a test lab or on a test track, but in only a fraction of the time.

Virtual prototyping with ADAMS/Car can be applied to almost any vehicle design — everything from compact passenger cars to heavy trucks. The software lets users quickly explore multiple "what-if" design scenarios. Users can animate vehicle or subsystem motion onscreen, display graphs of important parameters, and produce standardized test reports. They can then progressively refine and retest their designs until optimizing vehicle performance.

What used to take months or years to physically design and test can now be done in just days or even hours within the ADAMS/Car simulation environment. Most importantly, the results the software provides are complete and accurate; users can be confident their full-vehicle and vehicle subsystem designs will function properly when they actually do build and test hardware prototypes.

MSC.Software has developed ADAMS/Car with the funding and technical support of many of the world's leading automotive manufacturers. Recognizing that to develop a complete vehicle simulation environment would be impractical for just one software vendor and one user organization to tackle alone, a consortium of automakers including Audi, BMW, Renault, and Volvo teamed up with MSC.Software to sponsor the software's joint development. From this initial group, the roster of ADAMS/Car users has grown to over 30 companies worldwide.

PRODUCT

MSC.ADAMS
Industry–Specific Product

KEY BENEFITS

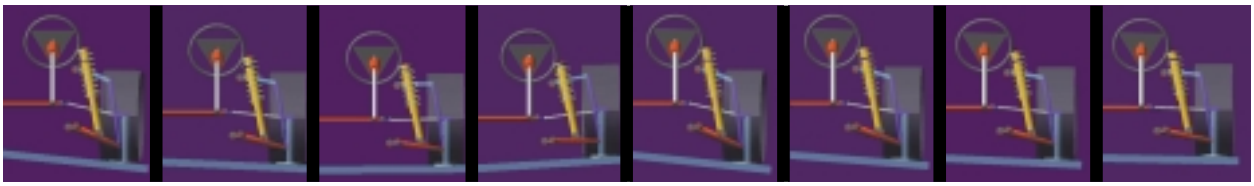
- Reduce risk by having better information at every stage of development.
- Reduce cycle time and costs associated with extensive performance testing on physical mock-ups and test tracks.

TEST RIG SIMULATION

- Single wheel travel
- Parallel wheel travel
- Opposite wheel travel
- Steering motion
- Static loads analysis

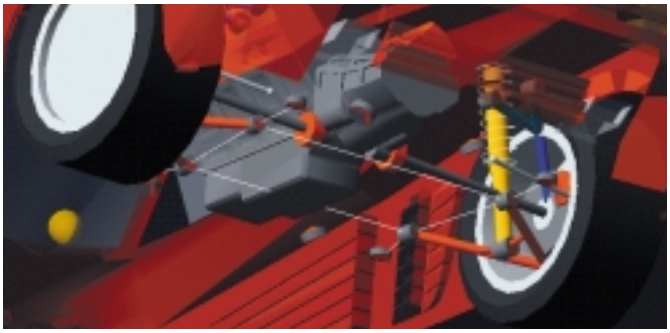
MANEUVERS

- Straight-line accelerating and braking
- Acceleration, braking, and lift-off while cornering
- Steep steer
- Impulse steer
- Double lane change (open loop)
- Swept sinusoidal steer
- Steady-state drift
- Maximum pothole and curb strike
- Data-driven analysis
- ISO lane change at maximal speed
- Consumer's Union test (roll-over stability)
- Closed-circuit driving
- Active vehicle dynamics assessment
- Controlled braking and accelerating while cornering
- Straight-line stability (side-wind, road undulations)



ADAMS/Car provides software for designing suspensions, applying conceptual suspensions, and studying vehicle dynamics. Add-on modules broaden the scope of usage by allowing tire, engine, driveline, and driver simulation. Flexibility, controls, and hydraulics can also be accommodated, along with capabilities for durability and vibrations analysis.

MSC SOFTWARE
SIMULATING REALITY



Template-based modeling simplifies the tasks of suspension design and testing. Templates are available for all major suspension types — both front and rear. Suspension models can include tires, shock absorbers, wheels, control arms, and other components.

The specialized methods and analytical expertise of these companies' engineering organizations have been embedded within the software's interface. Menu selections highlight functions familiar to automotive engineers, so users can quickly become productive with the software with little or no formal training. Users can also easily customize ADAMS/Car's toolbox, icons, menus, and dialog boxes.

ADAMS/Car utilizes the core dynamic solver of MSC.Softwares' flagship MSC.ADAMS. MSC.ADAMS is the world's most widely used mechanical system simulation tool, and is recognized as the de facto standard for functional system-level virtual prototyping in the automotive industry.

TEMPLATES SIMPLIFY SIMULATION

Users of ADAMS/Car select from two operational modes:

- A standard interface, which allows users to enter model data at the subsystem and assembly level to modify model parameters (hardpoint locations, spring rates, etc.) without affecting model topology, and run both standard and custom design tests; and
- Template-builder mode, enabling experienced users to build their own design templates from libraries of core and user-defined modeling elements.

ADAMS/Car's template-based modeling and simulation tools greatly simplify the tasks of vehicle design and testing. Users simply supply the required data to the templates, and ADAMS/Car automatically constructs subsystem models and full-vehicle assemblies. This helps assure consistency throughout vehicle design.

To place components such as bushings, bumpstops, and shock absorbers in subsystem models, users select from ADAMS/Car's data libraries. This speeds the modeling process, saving users from having to enter all of the data associated with each component. Standardization and consistency are thus assured.

ADAMS/Car AT A GLANCE

SOFTWARE MODULES

- Suspension Design
- Conceptual Suspension
- Vehicle Dynamics

ADD-ON CAPABILITIES

- Engine Simulation
- Driveline Simulation
- Tire Simulation
- Driver Simulation

INTERFACES TO:

- ADAMS/Controls
- ADAMS/Flex
- ADAMS/Hydraulics
- ADAMS/Durability
- ADAMS/Vibrations

SUBSYSTEM TEMPLATES

SUSPENSIONS

- Double wishbone (SLA)
- MacPherson
- Quad-link
- Twistbeam
- Trailing arm
- Conceptual front/rear

STEERING GEAR

- Parallel link
- Rack and pinion
- Pitman arm
- Conceptual

ANTI-ROLL BARS

- Fully flexible
- Simple (single torsion spring)

GENERAL

- Wheel/tires for handling,durability
- Simple front-wheel drive and rear-wheel drivelines
- Simple powertrain
- Rigid chassis
- Brake (4-wheel disc)

PRECISE SUSPENSION TESTING

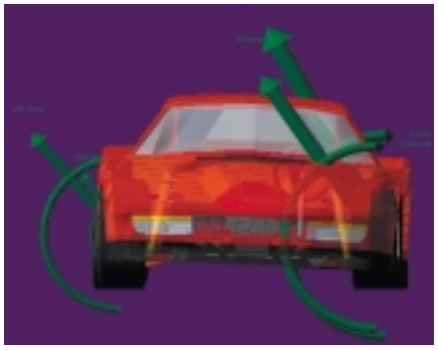
ADAMS/Car's design tools include both front and rear conceptual suspension models, with suspension characteristics defined by toe, camber, and wheel-rate curves and a compliance matrix. These characteristic curves provide the location and orientation of the wheel center for any given wheel height and loading condition. Users can design both compliant and kinematic suspension models, with compliant models including the effects of suspension bushings.

ADAMS/Car provides on the computer the same test results obtained with a physical suspension on a test rig. Users create an initial suspension design with the aid of a template. They can then modify parameters, such as hardpoint locations and bushing parameters, to find the desired characteristics. Acting as a virtual test rig, ADAMS/Car moves the wheel centers to specified locations and applies loads to the suspension.

Conceptual suspension models can be especially useful in the early stages of vehicle development, as initial design concepts are tested and benchmark activities carried out. This minimizes physical testing. With conceptual suspensions, users can find desired vehicle characteristic targets even before the detailed suspension design is known. Also, with conceptual suspensions, users can speed simulation times since the number of equations to be solved is significantly reduced.

Once a desired suspension characteristic has been found, the design engineer and the development engineer first match the suspension characteristics and then further refine vehicle responses. At this stage, virtual prototyping allows the engineering team to change every conceivable design parameter. Whether studying durability, vehicle dynamics, or noise, engineers can use ADAMS/Car to gain early insight into "what-if" scenarios, with cause and effect closely attributed to changes.

ADAMS/Car can also be used to investigate full vehicle maneuvers. This helps save on costly instrumentation and test track time, and minimizes the problems of repeatability associated with physical vehicle testing.



Control actions of a vehicle driver such as steering, braking, accelerating, gear shifting, and clutching for a variety of maneuvers can be simulated with ADAMS/Driver.

TIRE AND DRIVER SIMULATION

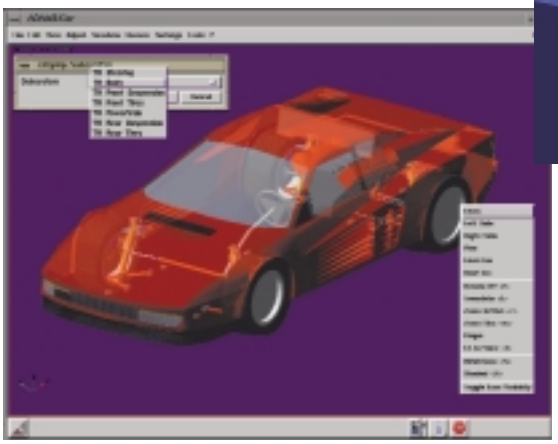
ADAMS/Driver is an optional add-on module that can be applied within the ADAMS/Car environment. It enables users to simulate the control actions of a vehicle's driver: steering, braking, accelerating, gear shifting, and operating the clutch. Using these controls allows the vehicle maneuver to be defined. When used in conjunction with ADAMS/Tire — another optional add-on module — the ADAMS/Driver software allows users to study 3D driving effects such as banked curves, hills, and bumpy roads.

ADAMS/Driver is especially valuable when used to optimize vehicle designs with feed-forward and feedback control systems including anti-lock brakes, four-wheel drive, four-wheel steering, driver assistance systems, and integrated vehicle dynamics controls. The software is based on and incorporates IPG-Driver, a dynamic simulation tool developed by the German software company IPG.

A subset of ADAMS/Driver capabilities, called ADAMS/Driver-Lite, is the default driver model for all closed-loop events, and is a standard feature of ADAMS/Car products.

The ADAMS/Tire option lets an engineering team easily model the forces and torques acting on a tire moving down a roadway or over irregular terrain. Users can simulate large-displacement dynamic vehicle behavior during any maneuver.

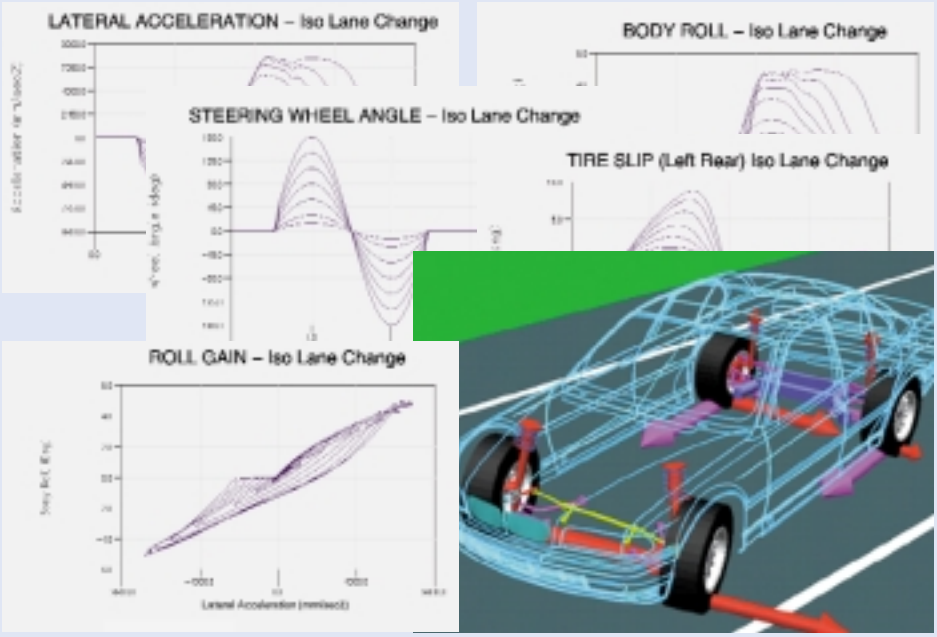
Users select from among six tire models for performing handling and durability studies, based on their product design and testing requirements. ADAMS/Tire models accept input data ranging from simple tire characteristics — used, for example, with the Fiala and University of Arizona models — to extensive and detailed tabular tire test results utilized in the Smithers model and the Delft (Pacejka "Magic Formula") model.



The specialized methods and analytical expertise of leading automotive engineering teams have been embedded within ADAMS/Car's interface. Users can easily customize the software's toolbox, icons, menus, and dialog boxes to precisely fit the ways their engineering teams work.

MEASUREMENTS FOR PLOTS

- Ackerman angle, error, and percent
- Anti-dive
- Anti-lift
- Camber angle and compliance
- Caster angle and moment arm
- Dive
- Fore-aft stiffness
- Ideal steer angle
- Kingpin inclination angle
- Lateral camber compliance, deflection compliance, and steer compliance
- Front swing-arm angle and length
- Lift
- Outside turn diameter
- Ride rate and steer
- Roll angle, camber coefficient, caster coefficient, center height, and steer
- Scrub radius
- Side angle, swing-arm angle, and length
- Spindle vector
- Steer angle
- Suspension roll rate
- Toe angle
- Total roll rate
- Turn radius
- Wheel load, rate, and travel



ADAMS/Car users can see and study the operational behavior of their designs in high-speed animation, or they can study simulation results in plots. Plots can be automatically generated in user-defined formats, thanks to ADAMS/Car's plot configuration file.

MSC.Software, the leading engineering software, systems and services provider, helps over 9000 companies worldwide develop better products faster. Number one in the product simulation market, MSC.Software products enhance and automate the product design and manufacturing process reducing development costs, time to market and warranty costs.

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