

# TWO AND THREE-WHEEL VEHICLE SIMULATION

Two- and three-wheeler vehicle manufacturers, whether they are existing OEMs, new EV start-ups, or suppliers serving this segment, all have the goal of shortening product development time and getting product to market faster. With Altair HyperWorks™, ride, durability, and vehicle dynamics simulations for two- and three-wheeled vehicles can now be seamlessly performed using an intuitive and easy to use GUI with built-in libraries for vehicle models, analyses, and predicting and optimizing vehicle behavior.



Altair MotionSolve's vehicle and event library for traditional and electric motorcycles, scooters and two-wheelers offers solutions for both internal combustion (IC) and electric engines, as well as leaning and non-leaning vehicles. Using this software, engineers can understand and improve vehicle ride, handling, and durability early in the product development cycle.

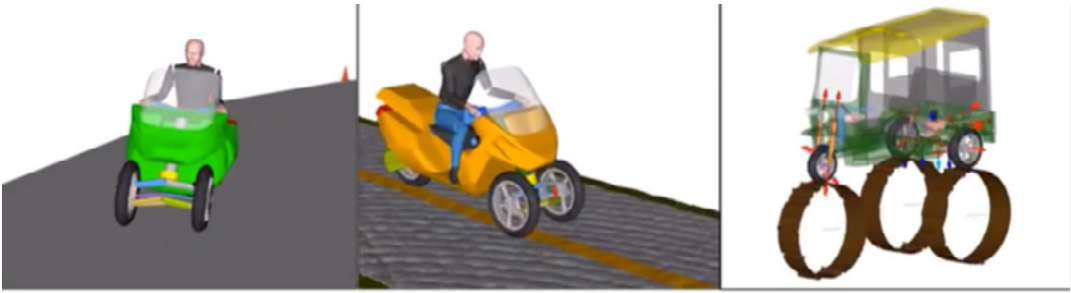
## Challenges of Vehicle Simulation

Two- and three-wheeled vehicles generally have a simpler design structure compared to traditional four-wheel vehicles. However, their inherent nature of instability requires special attention during the design phase, as compared to vehicles such as cars and trucks that are by default, stable. Hence, the software used to simulate these machines with complex behavior call for dedicated functionalities to cater to the needs of simulation engineers.

When engineers design two- and three-wheelers, a lack of access to a more specialized set of functionalities in the software, such as high camber angle tires and leaning driver functions, creates difficulties for engineers looking to view behaviors and responses specific to these vehicles.

## Simulating Two- and Three-Wheel Vehicles with MotionSolve

MotionSolve adds major value to three key areas of vehicle simulation: vehicle dynamics and control, durability, and ride and comfort. Engineers using MotionSolve can evaluate how the vehicle responds to driver inputs, as well as how well the vehicle responds to suspension changes, road inputs, and many other factors. The built-in libraries for motorcycles assist engineers in quickly assembling vehicles with the required topology, running simulations with either pre-loaded or scripted events, and comparing simulation results with actual vehicle data.



**Vehicle Dynamics & Control**

- Rider-machine interactions
- Vehicle stability & control
- Driver/passenger safety

**Durability**

- Component loads
- Component fatigue life
- Component damage

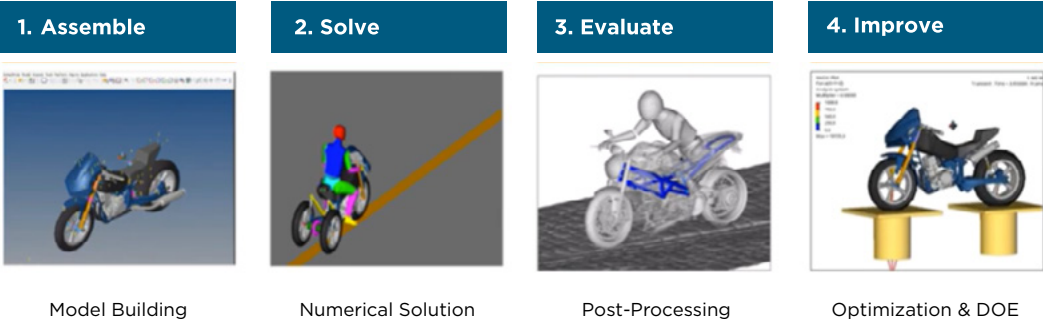
**Ride & Comfort**

- Vehicle response to road
- Rider response to road
- Active systems behavior

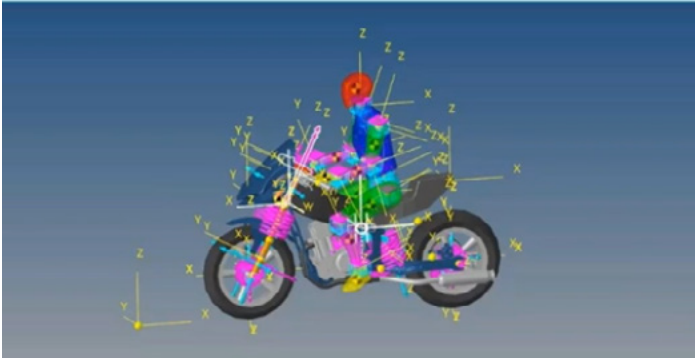
With MotionSolve, all key areas of vehicle simulation are addressed within the platform.

**The Altair MotionSolve Vehicle Dynamics Workflow**

Altair’s new solution guides users through a series of pre-defined steps, from model assembly to analysis and design optimization. MotionSolve provides a library of sub-systems that can be applied during the vehicle design stage for quick and convenient vehicle assembly. After assembling the vehicle and entering driver characteristics, the option is available to either create or apply a pre-defined event for the driver to perform.



After running the model through the state of the art solver and obtaining simulation results, users can post-process the results to view animations, plot signals of interest to understand the behavior of the vehicle, and save design iterations as templates to be reapplied for future analyses. Further, the parameters of the model can be selected as design variables to perform DOE, stochastic, and optimization studies.



Assembly of a motorcycle model using MotionSolve.

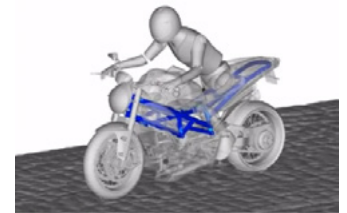
Altair's leading simulation tools are directly integrated with MotionSolve, providing users with a unified and complete solution for multi-body system simulation of leaning and non-leaning vehicles.

- Altair MotionView allows users to create and visualize vehicle models
- Altair HyperStudy performs optimization on vehicle design
- Altair HyperView post-processes data for result review
- Altair HyperWorks Unlimited leverages MotionSolve using cloud or on-premise HPC for instant insight access: [Learn More](#)
- Altair SimLab executes modeling and multiphysics
- Altair OptiStruct can run structural analysis, durability analysis, and topology optimization on components and vehicle structures based on loads derived from vehicle dynamics simulation

### Altair MotionSolve in Action

#### Rough Road Durability Simulation for a Three-Wheeler

During the design phase, a three-wheeler was simulated to predict durability loads acting on the components of the vehicle. After creating the vehicle and driving it on a virtual measured road, MotionSolve was used to accurately capture tire-terrain interaction, compute component loads and stresses, and assess equipment durability early in the design process.



#### Two-Poster Event Simulation for Two-Wheelers

To test for the durability of vehicle frames, two-poster event simulation can be performed within MotionSolve to understand how ground loads will affect a motorcycle frame. By conducting this type of test, engineers are able to gain insights as to how loads will impact suspension, and then how a bike's suspension will interact with the frame. With these insights, engineers can predict the fatigue life of a frame to upgrade its design.



Example of rough road durability simulation on a two- and three-wheel vehicle.



[Learn how motorcycle manufacturing company Royal Enfield uses Altair's simulation technology to improve the structural performance of their motorcycle builds.](#)

### Working with Altair

The motor vehicle industry is evolving at an unprecedented pace; a transformation driven by simulation. As a product development partner to the world's largest OEMs and suppliers, Altair works to accelerate product development, enhance passenger safety and experience, all while optimizing vehicle fuel economy and durability. Altair's tools are also driving electrification efforts forward, enhancing performance and energy efficiency while ensuring a sustainable future. Our technologies are changing the way vehicles of all types are designed.

For more information about Altair MotionSolve, visit [altair.com/motionsolve](https://altair.com/motionsolve)



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