

# Case Study: **HorsePower Hannover**

## Formula Student Team Relies on Multibody Dynamics Simulation

Based on an Interview with Rebecca Berthold, Suspension Simulation Team, HorsePower Hannover e.V.

### Adams in Vehicle Development

The Gottfried Wilhelm Leibniz University's Formula Student Team, based out of Hannover, Germany, aimed for a sustainable and professional approach to the development of their racecars, supported by MSC Software. Therefore, they started using the multibody dynamics software Adams in the 2018/2019 season. This leading automotive industry simulation software enables Team HorsePower Hannover to optimize the suspension design in new ways. As a result, the students were more confident during the technical acceptance procedures: as the test situations were successfully simulated in advance, preventing any nasty surprises.

MSC Software allows Formula Student Teams from all over the world to use the Automatic Dynamic Analysis of Mechanical System, Adams, including the Adams Car module and dedicated templates and databanks adapted to Formula Student specifications. Adams analyses the dynamic behavior of three-dimensional mechanical systems. The first application of Adams at HorsePower Hannover was to review the design decisions for the eH18 racecar. The options and results were convincing, and thus, right from the outset the development of the new eH19 benefited from Adams.



Team HorsePower Hannover

**“We plan to use Adams much more intensively in the future. We organize projects like the co-simulation of suspension and aerodynamics, or the usage of a simplified model for a driving simulator, as research work, so that our successors here in the team can get fully involved right away.”**

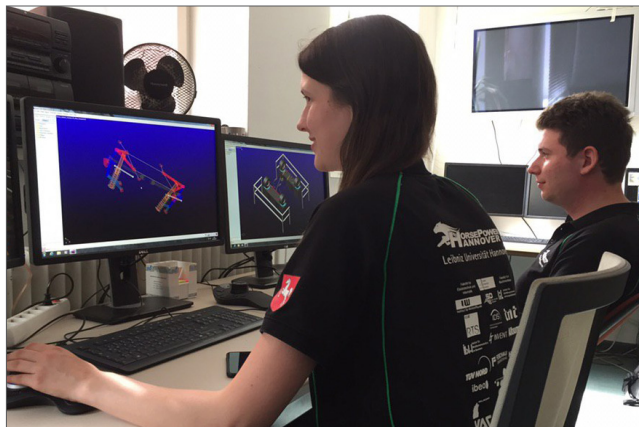
Rebecca Berthold, Suspension Simulation Team, HorsePower Hannover e.V.

### Acceleration and Skidpad Test

For eH19's predecessor, Adams simulation only made it into the concept presentation in the statics part of the Formula Student competition. But starting with the eH19 development, the software is already used in the development phase, to support suspension design decisions. “Things we roughly estimated can now be simulated in a detailed dynamics model,” says Rebecca Berthold, member of the suspension team. “In particular, we were able to study the differences between the behavior in the acceleration test and the skidpad test with its strong lateral accelerations, very well.”

Thanks to simulation, the students gathered a profound knowledge of the behavior of suspension, tires and damping systems. An important aspect of this simulation based analysis was that the model was validated by measurements on a real-life vehicle. When the design data was imported into the simulation software, the model initially consisted of idealized rigid bodies. Spring deflection tests were performed on a test stand.

This allowed manufacturing deviations to be detected and transferred to the model. In addition, it is known how much each part deformed due to the actual loading, material properties are then implemented into the model until the characteristic curves from physical test and simulation are reasonably aligned.



Students Workplace at Gottfried Wilhelm-Leibniz-Universität Hannover

### Avoid “elk-test” failures

One of the many acceptance tests for the student racecars during competition is the tilt test on an inclined plane. “We witnessed another team’s car failing in this test and subsequently steel plates had to be welded under the car to lower the center of gravity – devastating for the developers of a weight-optimized car,” explained Rebecca Berthold. Team HorsePower Hannover was quite sure that their battery distribution around the driver resulted in a sufficiently low center of gravity, but the Adams simulation of the test brought full certainty; the eH19 would not tip over.

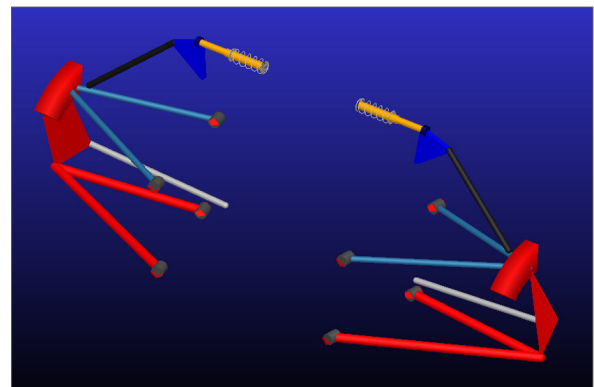
### Key Highlights:

**Product:** Adams

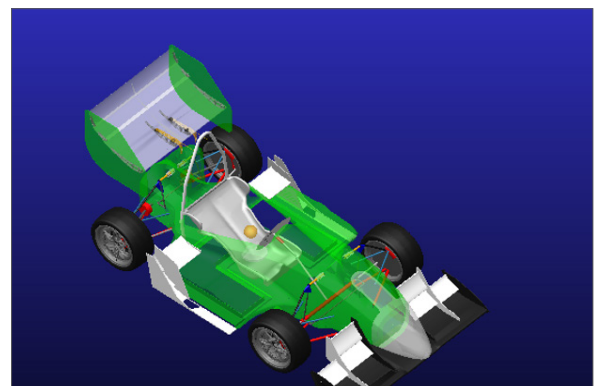
**Industry:** Automotive

**Project:**

- Adjust suspension design of an electric racecar
- Model validation with the help of test curves
- Simulate the Formula Student competition test situation



Front suspension simulated in Adams



Full vehicle eH19 simulated in Adams



Road tests with eH19

## Solution

The University Hannover Formula Student Team realized that multibody dynamics simulation provides a whole new quality of decision making. Suspension design is now based on analyses which would not be possible without advanced software.

A significantly more complex project has been already scheduled as a student thesis. The team has succeeded in creating a very good downforce by optimizing the aerodynamics. Now the vehicle behavior shall be more closely investigated, and improved, by a co-simulation of the suspension and aero packages.

Balancing academics and their Formula student activities are a challenge for the team members. By planning future simulation projects the simulation users from the suspension team want to pass on and deepen the usage of Adams at HorsePower Hannover. "MSC has supported us excellently, we got help by phone at any time," Rebecca Berthold compliments the sponsor. "I would highly recommend to my successors in the HorsePower racing team that they model the vehicle dynamics in Adams. You get a better understanding how the systems work together, avoid a lot of mistakes and are able to optimize the vehicle as a whole."

## About HorsePower Hannover

HorsePower Hannover is a Formula Student Team of the Leibniz Universität Hannover. Since 2009, the team has been building race cars and taking part in the world's largest design competition, the Formula Student.

For more information about HorsePower Hannover, please visit: [www.horsepower-hannover.de](http://www.horsepower-hannover.de)



For more information on Adams and for additional Case Studies, please visit: [www.mscsoftware.com/adams](http://www.mscsoftware.com/adams)