GOING OFF-ROAD WITH MICHIGAN BAJA RACING

A COMPETITIVE EDGE WITH THE ALTAIR HYPERWORKS™ SUITE

Team and Competition

Michigan Baja Racing (MBR) is a collegiate race team in the North American Baja SAE intercollegiate competition. The team designs, builds, and tests a new single-seater off-road race car from scratch every year to compete against hundreds of other teams across the United States. The competition consists of a design presentation and other static events. The main dynamic events are acceleration, maneuverability, hill climb*, suspension and traction (S&T), and a four-hour endurance race.

*Sometimes replaced with a sled pull event.

> “Simply put, Altair’s products made it possible for us to design the lightest vehicle while still being able to handle the punishing obstacles at competition. They allow us to be fully confident in our designs before any real-world testing,”
>
> Vishnu Rengaraj
> Testing Director for
> Michigan Baja Racing.

LEFT: 2019 vehicle mid-turn in the Tennessee maneuverability event. Awarded 1st place in every maneuverability course in the 2019 season. **TOP:** Team photo at the 2020 vehicle unveiling. This car sports an all new four-wheel drive system developed to conform with the new 2021 rules. **BOTTOM:** 2017 brake pedal. Analyzed and optimized via OptiStruct.

Their Challenge

To be successful, MBR had to design a vehicle light and nimble enough for the acceleration, maneuverability, and hill climb events, but durable enough to handle the S&T and endurance race. It forces students to find novel solutions to reduce mass while maintaining strength so the vehicle travels as fast as possible for as long as possible. In addition, the quick six month turn-around from rulebook to manufactured vehicle allows for little time to prototype and test. There is no time for a critical design mistake.

Our Solution

Michigan Baja Racing tackled the challenge by leveraging the Altair HyperWorks™ suite. Altair HyperMesh™ was the default preprocessor, with support from Altair HyperCrash™ to set up crash scenarios. Altair HyperView™ was the postprocessor used to view the results.

Linear static analysis via Altair OptiStruct™ was run on every component as a baseline for stress and stiffness calculations. Loads were collected from strain gauge testing, predicted g-loading, and comparisons with prior year designs.

Nonlinear quasi-static analysis from OptiStruct was used in suspension link design to derive reactionary forces from forced displacement. This allowed MBR to predict the forces at the link yields, plastically deforms, fractures, and the failure location.

Full vehicle dynamic crash simulation via Altair Radioss™ was run on the computing cluster at the University of Michigan. This was used to evaluate the current crashworthiness of the car in a frontal, side-impact, and roll-over situation.

Preliminary drag calculations of the roll cage were calculated with Altair AcuSolve™. Results from AcuSolve drove the design towards a more aerodynamic shape rather than a lightweight one. This decision was later validated in Ford's wind tunnel.

Results

The HyperWorks suite saved MBR a lot of design time. Technical support coupled with reliable analysis, allowed them to rapidly prototype multiple designs and test them virtually.. The result was a lightweight product designed in less than a week, with behavior within 5% of what was predicted with Altair's software.

MBR had one of the lightest vehicles in competition, weighing 270 pounds, and had the fastest car with podium finishes in acceleration and hill climb events. This durable vehicle had little to no failures at competition and there were no major structural failures in the 2019 season.