

## On the Road to Success: Team Bath Racing is Driving Innovation with HyperWorks



**TEAMBATH™** UNIVERSITY OF BATH *Racing*

### Key Highlights

#### Industry

Education, automotive, and motorsport

#### Challenge

Performance improvements and weight reduction of student race car wheel center and upright. Design and optimization of components for additive manufacturing with SLM (Selective Laser Melting).

#### Altair Solution

Input Modeling with HyperMesh, Optimization with OptiStruct, both part of the HyperWorks University Programme Suite

#### Benefits

- Upright: reduced weight by 30% while keeping stiffness as before.
- Wheel centers: weight savings of 50%
- Increased racing success

In July 2015, Team Bath Racing (TBR) achieved 4<sup>th</sup> place overall at the Formula Student competition hosted by the Institute of Mechanical Engineers (IMechE) at the Silverstone Circuit in England. Following their most successful race season in history, they ranked 1<sup>st</sup> in the UK, 15<sup>th</sup> in the world, and placed 5<sup>th</sup> and 6<sup>th</sup> respectively at SAE International events held in Austria and Spain. TBR students have earned this result through commitment to their engineering education and being self-motivated to learn innovative design and manufacturing processes.

### An Ambitious Development Plan

Team Bath Racing has always pushed the envelope when it comes to applying

new technologies. Over the years, they made use of advanced materials such as Carbon-Fiber-Reinforced Polymers (CFRP) for their vehicle chassis and in 2015 they produced a number of parts using additive manufacturing (AM). However, these new manufacturing techniques required a new design approach.

In order to learn about the design methodologies used by automotive and motorsport industries, TBR attended the 3<sup>rd</sup> Altair UK Student Motorsport workshop held at the Jaguar Land Rover Motor Heritage Museum in October 2014. After seeing presentations from other student teams about how to use simulation-driven design with Altair HyperWorks, they saw a number of areas where they could improve performance

# Team Bath Racing Success Story

**“Altair HyperWorks is an essential software partner which enabled component design for additive manufacturing. We were pleased with this year’s successes and hope to continue delivering genuinely significant weight savings and shorter development cycles.”**

**Ieuan Guy,**

Team Bath Racing 2015.

and save weight. Specifically, they were interested in Altair’s OptiStruct Finite Element Analysis (FEA) and Optimization solving code for designing components to be manufactured by 3d printing. TBR immediately approached Altair about their widely-offered sponsorship in-kind program and took advantage of their new cloud-based licensing to work flexibly from their personal computers or at their university.

## Strategy for Success

Team Bath Racing comprises of students from the University of Bath’s renowned Mechanical Engineering Department, particularly those studying the Automotive Engineering Course. During the 18-month

design cycle, their car is designed as part of their course projects and extracurricular activities. While TBR receive university support and workshop space, they also increase their engineering understanding and project outcome by building strong relationships with industry sponsors such as BP , Ford, Ricardo, Cosworth, and Altair. In 2015, TBR secured sponsorship from a local company, specialising in research and development of metallic additive manufacture and thus had the opportunity to develop high-value, low-weight components. Specifically, this company uses a process called Selective Laser Melting (SLM) with a Realizer SLM250 machine. The sponsor offered to produce

a limited number of components, so the team carefully chose parts that would benefit most from additive manufacture over traditional machining. The areas where the team saw the best potential for material savings were on their wheel centres and suspension uprights.



*Exploded assembly drawing of the wheel components*



*Additively manufactured wheel center*



*Rendered model of the upright*



*Martin McDonald with old and new wheels*

## **Fit for Purpose, Fit for Manufacture**

In the automotive and motorsport industries, vehicle weight has a direct impact on performance, agility, efficiency, safety, and emissions. Therefore, Team Bath Racing chose weight reduction as a key design target to become more competitive during the highly dynamic race categories at the SAE events. However, they needed a way to do this without compromising safety or performance.

The decision to use Additive Manufacturing presented new technical challenges and innovation opportunities. The students required a method that would help them deliver a functional, optimized design in only 12 weeks. The components they chose had complex loading, and a CAD-FEA iterative process would have been time consuming without guarantees of significant weight reduction. For this reason, they investigated using Altair OptiStruct to get the most benefit from their chosen manufacturing method.

## **A Suite Solution**

Fortunately, OptiStruct was part of Team Bath Racing's HyperWorks Computer-Aided Engineering (CAE) suite from Altair. They could use the same topology optimization and concept-design methods as the vehicle light-weighting experts in the

automotive industry.

For the wheels and uprights, TBR created an input model in HyperMesh, Altair's solver-neutral FEA pre-processor: a design space was created, loading scenarios were applied, and manufacturing constraints were given. For the topology optimization, the team set a stiffness objective with constraints on responses such as volume fraction, mass, displacement, and stress. They generated optimized designs which placed material only where it was essential for transferring the desired loads.

The final upright design which featured thin walls combined with hollow internal structures was manufactured by selective laser melting (SLM) from maraging steel. TBR achieved an impressive 30% weight reduction on the part while maintaining the same stiffness as their previous year's upright. This allowed for a considerable safety factor and the prototype component survived extensive testing and three entire competition runs.

A similar methodology was used to design the wheel centers of TBR's composite wheels where the students achieved a 50% weight savings. This led to an overall performance increase due to decreasing component mass while maintaining stiffness of the parts. By performing analysis and optimization using

HyperWorks, TBR saved on development time and gained a detailed understanding of the structural integrity of their components.

## **A Winning Combination**

Using Altair HyperWorks in combination with additive manufacturing methods contributed directly to Team Bath Racing's exceptional racing season. The impressive weight savings was achieved in their very first year of sponsorship from Altair and it allowed the team to climb to 15<sup>th</sup> in the world while maintaining their position as the best UK team.

TBR's performance shined at the Silverstone competition which welcomes teams from around the world including Australia, Germany, Turkey, France, Ukraine, India, and 49 other teams from the UK. The new wheels were both visually impressive and capable of performing throughout rigorous events. They were featured in a number of articles after being in the spotlight at the Silverstone Formula Student event.

To learn more please visit:  
[www.teambathracing.com](http://www.teambathracing.com)  
[www.altairuniversity.com](http://www.altairuniversity.com)  
[www.altairhyperworks.com](http://www.altairhyperworks.com)  
[www.altairnlighten.com](http://www.altairnlighten.com)

Visit the HyperWorks library of  
**Success Stories**  
at [www.altairhyperworks.com](http://www.altairhyperworks.com)

## About Altair

Altair empowers client innovation and decision-making through technology that optimizes the analysis, management and visualization of business and engineering information. Privately held with more than 2,600 employees, Altair has offices throughout North America, South America, Europe and Asia/Pacific. With a 28-year-plus track record for high-end software and consulting services for engineering, computing and enterprise analytics, Altair consistently delivers a competitive advantage to customers in a broad range of industries. Altair has more than 3,000 corporate clients representing the automotive, aerospace, government and defense, and consumer products verticals. Altair also has a growing client presence in the electronics, architecture engineering and construction, and energy markets.

## About HyperWorks®

Performance Simulation Technology

HyperWorks is an enterprise simulation solution for rapid design exploration and decision-making. As one of the most comprehensive, open-architecture CAE solutions in the industry, HyperWorks includes best-in-class modeling, analysis, visualization and data management solutions for linear, nonlinear, structural optimization, fluid-structure interaction, and multi-body dynamics applications.

[www.altairhyperworks.com](http://www.altairhyperworks.com)



**Altair Engineering, Inc., World Headquarters:** 1820 E. Big Beaver Rd., Troy, MI 48083-2031 USA  
Phone: +1.248.614.2400 • Fax: +1.248.614.2411 • [www.altair.com](http://www.altair.com) • [info@altair.com](mailto:info@altair.com)

Altair®, HyperWorks®, RADIOSS®, HyperMesh®, BatchMesher™, HyperView®, HyperCrash®, HyperGraph®, HyperGraph®3D, HyperView Player®, OptiStruct®, HyperStudy®, HyperStudy®DSS, MotionView®, MotionSolve®, Altair Data Manager™, HyperWorks Process Manager™, HyperForm®, HyperXtrude®, GridWorks™, PBS Professional®, and e-Compute™ are trademarks of Altair Engineering, Inc. All other trademarks or servicemarks are the property of their respective owners.