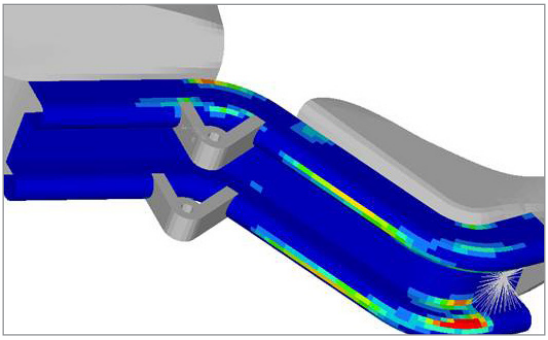
National Composites Centre

Composites Driving Innovation: Development of a Sit-Ski as an Advanced Technology Demonstrator



The National Composites Centre (NCC), established by the University of Bristol, is an open-access, industrial-scale, state-of the art non-profit UK facility for technology development in the manufacture of advanced composites. With a mission to accelerate the growth of UK industrial output by enabling design and manufacturing enterprises to deliver winning solutions in the application of composites, the facility has doubled in size since it first opened in August 2011. The NCC is the primary composites catapult facility in the UK and serves as an integral part of the UK's composites initiative since the government launched its Composites Strategy in November 2009.

Mono-Ski or Sit-Ski: Developing a Cross-Catapult Technology Demonstrator

Simulation plays a key role in the design, analysis and validation of complex systems and structures in composite product development. It is of primary importance to the industry, especially in considering the use of composite structures at an architecture/system level.

Recently the NCC, in collaboration with the Manufacturing Technology Centre (MTC), Advanced Manufacturing Research Centre (AMRC) and University of Warwick (WMG) worked on a collaborative project to develop a Cross-Catapult technology demonstrator; the Mono-Ski or Sit-ski, a device for sports that uses adaptive equipment on mountain slopes, designed for individuals with lower extremity limitations.

The team worked together for the design and manufacture of the Sit-ski to understand the performance of existing Sit-skis, build kinematics models of the suspension behavior, and design a system that aimed to showcase the Catapult Centre's technologies and capabilities while delivering performance improvements for the skiers.

NATIONAL COMPOSITES CENTRE

Industry
Sporting Goods, Composites

Challenge
Development of an advanced technology demonstrator (Sit-ski) with composites

Altair Solution
Simulation-driven design for assessment of performance and structural reliability before a single tool or component was manufactured

Benefits
- Reduced development time to less than 3 months
- Design of a 15% lighter, innovative product

Simulation in the Design Process

The Centre uses simulation tools all the way through the development cycle; from micro-mechanical material modelling to conceptual design, detailed structural analysis and manufacturing process simulation. They also understand the importance of cost and manufacturability in the product development process and use simulation to help make better decisions in shorter timeframes.

Composites were used extensively in the new Sit-ski design with the Altair HyperWorks™ suite being utilized throughout the development process. Altair MotionSolve™ was used to model the kinematic behavior of an existing coil-over suspension system with 4-bar linkage and compared to the new composite leaf spring and damper concept. Altair HyperStudy™ was used in conjunction with Altair MotionSolve to optimize the kinematic behavior and assess the positions and sizes of various structural and suspension elements (including sizing of the spring using Non-Linear FE).

"One of the key successes from using a combination of Altair software products was the ability to carry out an entirely virtual assessment of performance and structural reliability before a single tool or component was manufactured."

Altair OptiStruct™ was used to perform detailed sizing of the laminates in the spring and chassis elements along with the use of the morphing capabilities in Altair HyperMesh™ to optimize the geometry.

Altair Inspire™ and Altair Evolve™, also included in the Altair HyperWorks simulation suite, were used as a convenient means of visualizing the full assembly and producing images for the reports and presentations.

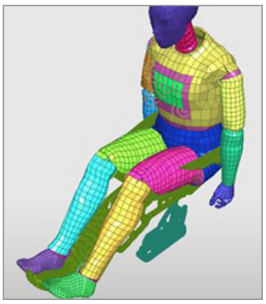
Promising Potential

"One of the key successes from using a combination of Altair software products was the ability to carry out an entirely virtual assessment of performance and structural reliability before a single tool or component was manufactured. The whole process from concept to manufactured assembly took less than 3 months and would not have been possible without the help of the virtual design tools." said Andrew Patterson, Engineering Capability Lead for Conceptual Design & DFX at the National Composites Centre, the Overall Technical Authority for Sit-ski Systems Integration and Assurance.

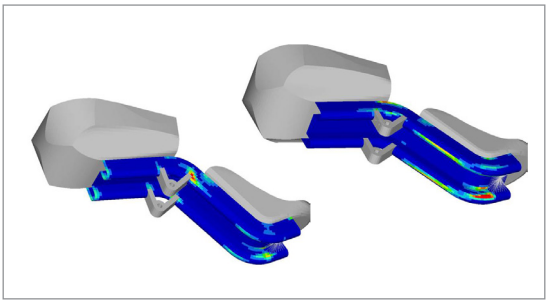
Physical testing carried out at the component and assembly level validated the models, demonstrating good correlation with the predicted response of the spring component and overall kinematic behavior of the assembly.

The resultant initial design of the Sit-ski is about 15% lighter than other similar devices available on the market, including some fairly substantial topology-optimized aluminum brackets used to ensure sufficient safety factors and fitment of the suspensions components. The skiers felt that the device was different, are excited by its potential, and would like to see it developed further.

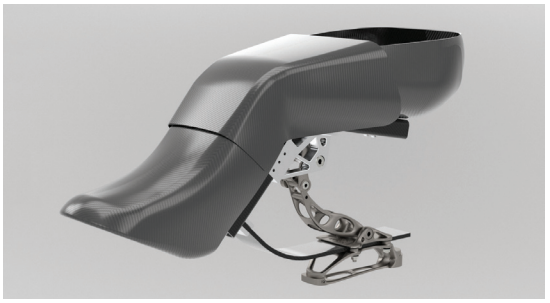
Concept sketch from October 2016 workshop



Dummy model positioned in correct seating position



Composite chassis free-size optimization with Altair OptiStruct



Final design – rendered Image from solidThinking Evolve

Full-scale structural test

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