

## Originating a safe Fun Utility Vehicle (FUV)



Safe, fun and efficient. Arcimoto SRK - On The 101



### Key Highlights

#### Industry

Recreational Motors, Motorcycles

#### Challenge

Create:

- An optimized platform that offers 3-wheeled stability
- A space frame enclosure to protect
- A rear swing arm that handles the load requirements and also follows the visual design of the vehicle

#### Altair Solution and Benefits

HyperMesh® provided an environment for rapid model generation allowing Arcimoto to answer queries by helping them perform the analysis in OptiStruct® in an easy, time efficient manner.

Using RADIOSS® for the physics helped Arcimoto achieve repeatable and accurate results, reduce simulation cycle times and allow for evaluating multiple design scenarios thus enabling better design decisions.

Arcimoto (Nasdaq: FUV) was founded in 2007 with the mission to build products that catalyze the shift to a sustainable transportation system. The Arcimoto (pronounced ar-key-moto) name means “Future I Drive” and that is their aspiration: to devise new technologies and patterns of mobility that together raise the bar for environmental efficiency, sustainability and affordability.

With that in mind, they began work on the SRK Generation 8 in January of 2015; an all-electric commuter vehicle that mimics a motorcycle in fun-factor, efficiency and road-space while offering stability and protection from the elements. With the added value that this FUV boasts 230MPGe and top speeds reaching 80mph - this becomes a really interesting option for urban dwellers.

### Small vehicle, big safety concerns, small budget

When a company is in start-up mode, the stakes are higher. Not only is there pressure on the founder to push the vision and generate interest (both in the marketplace and with investors) but also on those making that vision a reality. The people that create each version, test each element, obsess over each decision to take part in this process with an admirable dedication.

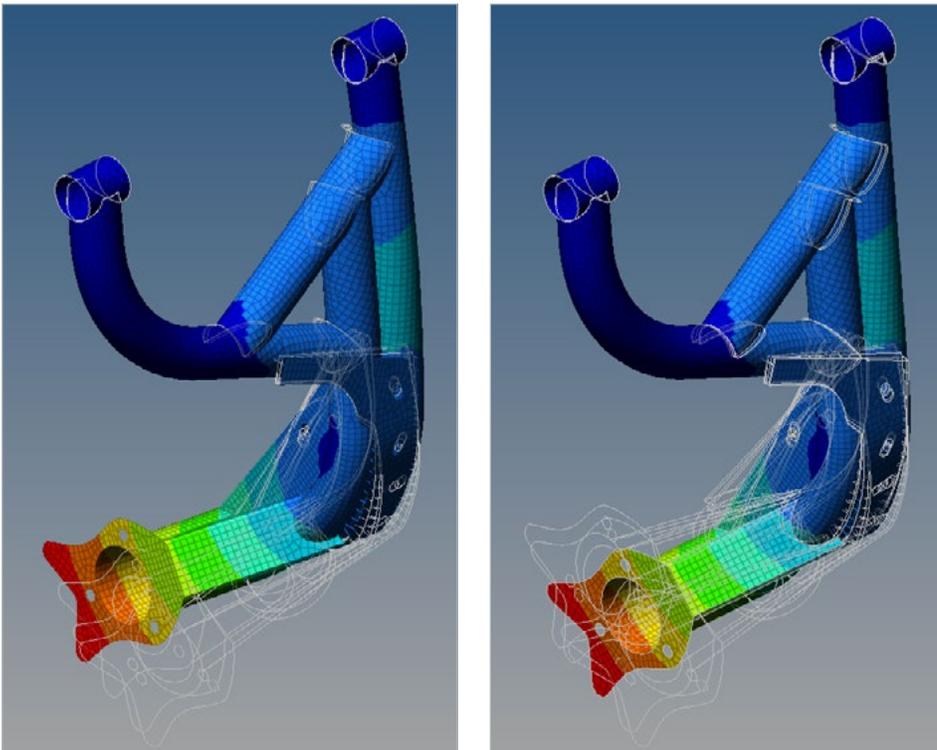
Lack of money coupled with a truly new idea is also a challenge in start-ups. Small teams with nothing to correlate an analysis to, nothing to test – how does this work? This is where simulation comes in.

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"Altair's support has been good for decades. Now that I have a significant time zone difference, my colleagues and I have been using the *create a support request* option instead of calling, and have found that people give well thought out and helpful answers."

**STEPHANIE MOORE-FULLER**

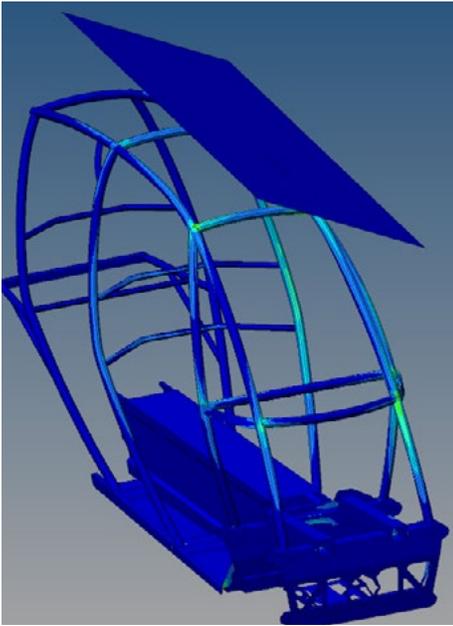
MECHANICAL ENGINEER, VEHICLE STRUCTURE AND SAFETY ARCIMOTO, INC.



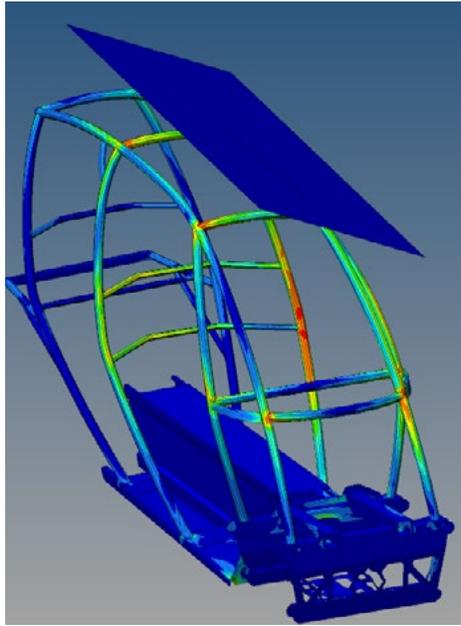
Rear swing-arm modal analysis using Altair's OptiStruct finite element solver.

### Example A: Rear swing-arm

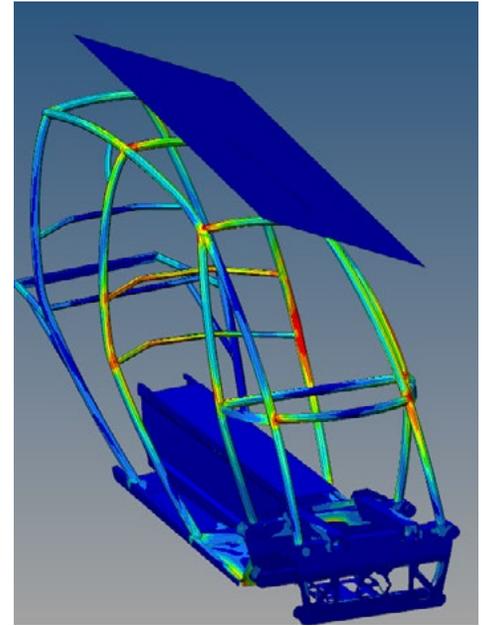
As the SRK engineering team evaluated different parts of the FUV, they knew they wanted to keep with the original aesthetics – a nice round design, no sharp edges. In order to do this, they would need to use tubular materials rather than square. The concern put forth: was it strong enough to take on the road with all its evils (grooves, potholes, debris)? HyperMesh®, a premier pre-processor for concept and high-fidelity modeling helped with this. With its advanced geometry and meshing capabilities this software provided an environment for rapid model generation and allowed them to answer that query by helping them perform the analysis in OptiStruct® in an easy, time efficient way thus validating the desire to use a component that aligned with the vehicle design.



Roof crush analysis with Radioss Dynamic solver - initial loading.



Load progressing with increased von Mises stress and deformations.



100% loading with stress and final deformed state.

## Example B: Roof Crush Analysis

Because this is a new breed of vehicle, the team felt it was important to consider cross-industry tests that would reinforce their commitment to outstanding motorcycle safety thus instilling confidence within the marketplace for their product. For example, the team used the roof crush test guidelines, where the roof withstands a load of 3x the weight of the vehicle, as a part of their exploratory process.

For the roof crush work, the team turned to HyperMesh and RADIOSS®. They used HyperMesh to model a very complex roll cage. Every tube on the roll cage of the vehicle had to meet and be mitered to the next tube by sharing nodes.

They used Altair's RADIOSS solver for the roof crush simulations. With RADIOSS, very complex problems involving large deformations, dynamic events, non-linear materials with progressive failure models, and much more can be solved in a very impressive wall clock time. Using the right tool for the physics, achieving repeatable and accurate results, and reducing simulation cycle times gave the engineers more time and iterations to help drive better design decisions.

Once the model was up and running, they were able to run several different thicknesses and compare against the baseline created which gave them confidence in their design and its ability to withstand the weight of the test. This exercise provided them yet another edge in the messaging they intended to go to market with – messaging that had data to back it up.

## The right combination of organic experience and software simulation scenarios

Arcimoto raised the bar by bringing in a mechanical engineer specializing in automotive structure and crash to improve safety, strength and stiffness - over and above what is required for a typical motorcycle. She, in turn, chose a software that enabled her team to quickly and efficiently perform linear and nonlinear analysis on a variety of load conditions. Solid team decisions, backed by valid testing.

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**Success Stories**  
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## About Altair

Altair (Nasdaq:ALTR) is focused on the development and broad application of simulation technology to synthesize and optimize designs, processes and decisions for improved business performance. With more than 2,000 employees, Altair is headquartered in Troy, Michigan, USA and operates 69 offices throughout 24 countries. Altair serves more than 5,000 customers across broad industry segments.

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## About HyperWorks

HyperWorks is the most comprehensive open-architecture simulation platform, offering technologies to design and optimize high performance, efficient and innovative products. HyperWorks includes modeling, analysis and optimization for structures, fluids, multi-body dynamics, electromagnetics and antenna placement, model-based development, and multiphysics. Users have full access to a wide suite of design, engineering, visualization, and data management solutions from Altair and its technology partners.

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