The development of the
SRK Generation 8 SUV

With the help of Altair's HyperMesh® for rapid model generation; OptiStruct® for finite element analysis; and RADIOSS® for analysing the physics, recreational motors and motorcycle company, ArciMoto has developed a new-concept Fun Utility Vehicle (FUV), a small and safe all-electric commuter vehicle called the SRK Generation 8.

The SRK Generation 8 from Arcimoto is an all-electric commuter FUV that mimics a motorcycle in fun-factor, efficiency and road-space, while offering stability and protection from the elements.

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

With that in mind, Arcimoto began work on the SRK Generation 8 in January of 2015: an all-electric commuter vehicle that mimics a motorcycle's fun-factor, efficiency and road-space while offering stability and protection from the elements. With the added value that this FUV boasts 230 mpg$_e$ and top speeds reaching 80 mph – 1.02 ℓ/100 km and 129 km/h – the SRK 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 high. 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 and obsess over each decision participate in this process with admirable dedication.

Lack of money coupled with a genuinely new idea is also a challenge in start-ups. Small teams have nothing to correlate an analysis to and no equivalent products to test, so how can they make progress? This is where software-based simulation comes to the fore.

Rear swing-arm design

As the SRK engineering team began evaluated different parts of the FUV, they knew they wanted to retain the original aesthetics – a nice round design with no sharp edges. In order to do this, they needed to use tubular materials rather than square. The concern put forward, however, was its strength: would the structure be strong enough to take on the road with all its perils – grooves, potholes, debris?

HyperMesh®, a premier pre-processor for concept and high fidelity modelling helped to determine the answer. With its advanced geometry and meshing capabilities, this software provided an environment for rapid model generation and allowed the design-
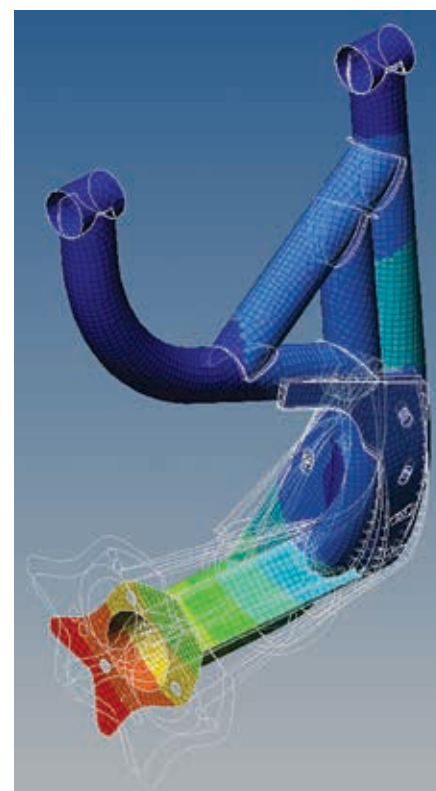
The rear swing-arm modal analysis was done using Altair's OptiStruct finite element solver.

ers to answer their strength queries using OptiStruct® finite element analysis. This was an easy, time- and cost-efficient way of validating the use of the tubular components that aligned with the vehicle design.
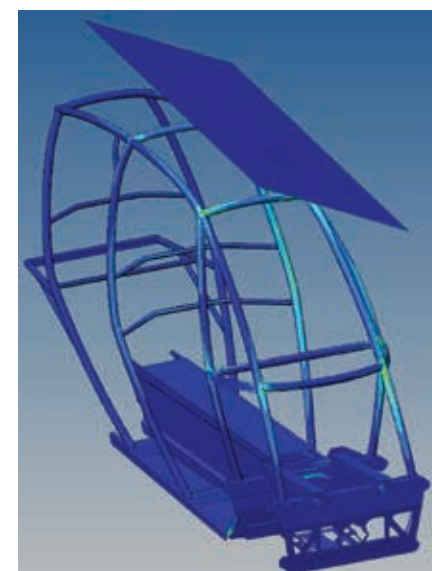
Roof crush analysis

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 the product.

As a part of their exploratory process, for example, the team used the roof crush test guidelines, where the roof has to withstand a load of 3× the weight of the vehicle. For the roof crush work, the team turned to HyperMesh and RADIOSS®.

HyperMesh was used to model the very complex roll cage. Every tube on the roll cage of the vehicle had to meet and be mitred to the next tube by shared nodes.

Altair's RADIOSS solver was used for the roof crush simulations. With RADIOSS, very complex problems involving large deformations, dynamic events, non-linear materials with progressive failure modes, and much more can be solved in a very impressive wall-clock time.

By using the right tool for the physics, repeatable and accurate results were achieved with reduced simulation cycle times, which gave the engineers more time and enabled additional iterations to help drive better design decisions.


A roof crush analysis sequence done using Altair's RADIOSS Dynamic solver; 1: initial loading; 2: Load progressing with increased von Mises stress and deformations; and 3: 100% loading showing stress and the final deformed state.

Once the model was up and running, they were able to run several different thicknesses to 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 yet another edge in the messaging they intended to take to market – safety that had data to back it up.
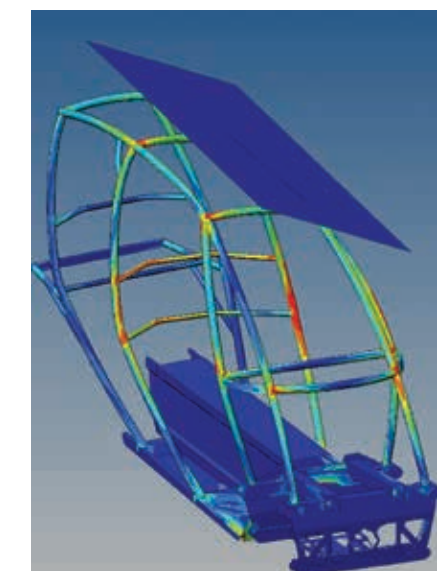
Organic experience and software simulation

To improve safety, strength and stiffness –
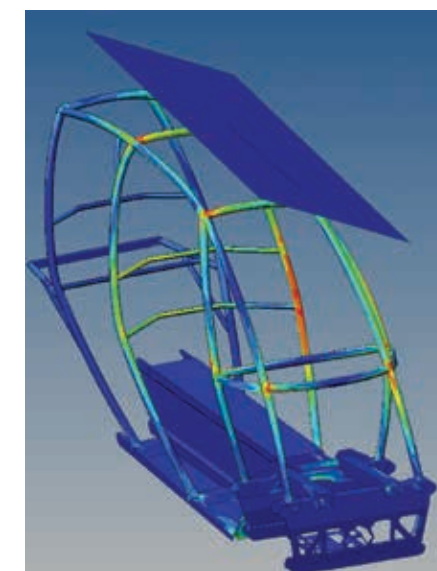
over and above what is required for a typical motorcycle – Arcimoto also raised the bar by bringing in Stephanie Moore-Fuller, a mechanical engineer specialising in automotive structures and crash analysis.

She, in turn, chose software that enabled her team to quickly and efficiently perform linear and nonlinear analysis on a variety of load conditions.

Describing Altair's ongoing service support for these processes, Moore-Fuller says: "Altair's support has been good for decades. Now that I have a significant time zone dif-

ference, my colleagues and I have been using the 'create a support request' option instead of calling, and have found that Altair's people give well thought out and helpful answers."

The end result? "Stable, agile, and an absolute joy to drive: experience the thrill of a motorcycle on every trip to the grocery store. Instant torque accelerates you from 0-60 mph in 7.5 seconds and the SRK's optimal centre of gravity and balanced platform design make it an extension of your will to move, up to a top speed of 80 mph," reads the review on *CleanTechnica*. ❑

Inspire 2018 accelerates pace of innovation

On February 1, 2018 Altair announced the release of Inspire 2018 simulation-driven design software. Available through its solidThinking channel partner network and directly to its HyperWorks user community, Inspire 2018 marks another milestone in Altair's leadership in generative design, optimisation and simulation.

"Inspire 2018 enables designers and engineers to leverage simulation in new and inventive ways to accelerate the development of high-performance, innovative products," says James Dagg, CTO for User Experience at Altair. "Inspire integrates well into large manufacturing enterprises for rapid simulation and lightweighting insights, and has an intuitive user experience that is ideal for small and medium-size businesses with little or no simulation experience."

Applied at the very beginning of clean-sheet design programmes and for design exploration of current production parts, Inspire simulation-driven design software allows designers and engineers to:
• Rapidly assemble and simulate dynamic

mechanical systems to automatically resolve loads on system components for optimisation and analysis.
• Generate weight-efficient design proposals unique to specified conventional or additive manufacturing processes with Altair's industry-leading topology optimisation technology.
• Simulate the performance of competing design concepts for static loads, normal modes and buckling.
• Directly export Inspire CAD geometry to 3D printers to produce high-performance, quality parts.
Andy Bartels, Inspire programme manager explains: "In order to stay competitive while pushing the innovation envelope, simulation must drive the entire design process from the early concept design phase all the way through to production. We continue to add tools to make Inspire more beneficial to its users in each step of the design process."

Added capabilities in Inspire 2018 now enable users to:
• Generate optimised **lattice** and mixed

solid-lattice structures, visualise simulation results in 3D, and export lattice designs in .stl file format for 3D printing.
• View and interactively assign loads to load cases and import/export design loads in .csv file format with the new Load Cases Table.
• Design for additive manufacturing with overhang shape controls to help reduce overhangs and create more self-supporting structures.
• Automatically optimise the fit of PolyNURBS CAD geometry to generate design results with the new PolyNURBS Fit Tool.

"Inspire 2018 is available immediately to clients as an application software download and later this year as a cloud-based offering," says Dagg. "Branded as Inspire Unlimited™, the cloud offering of Inspire will include additional functionality such as secure data management, team collaboration tools, and on-demand high-performance computing (HPC)."

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