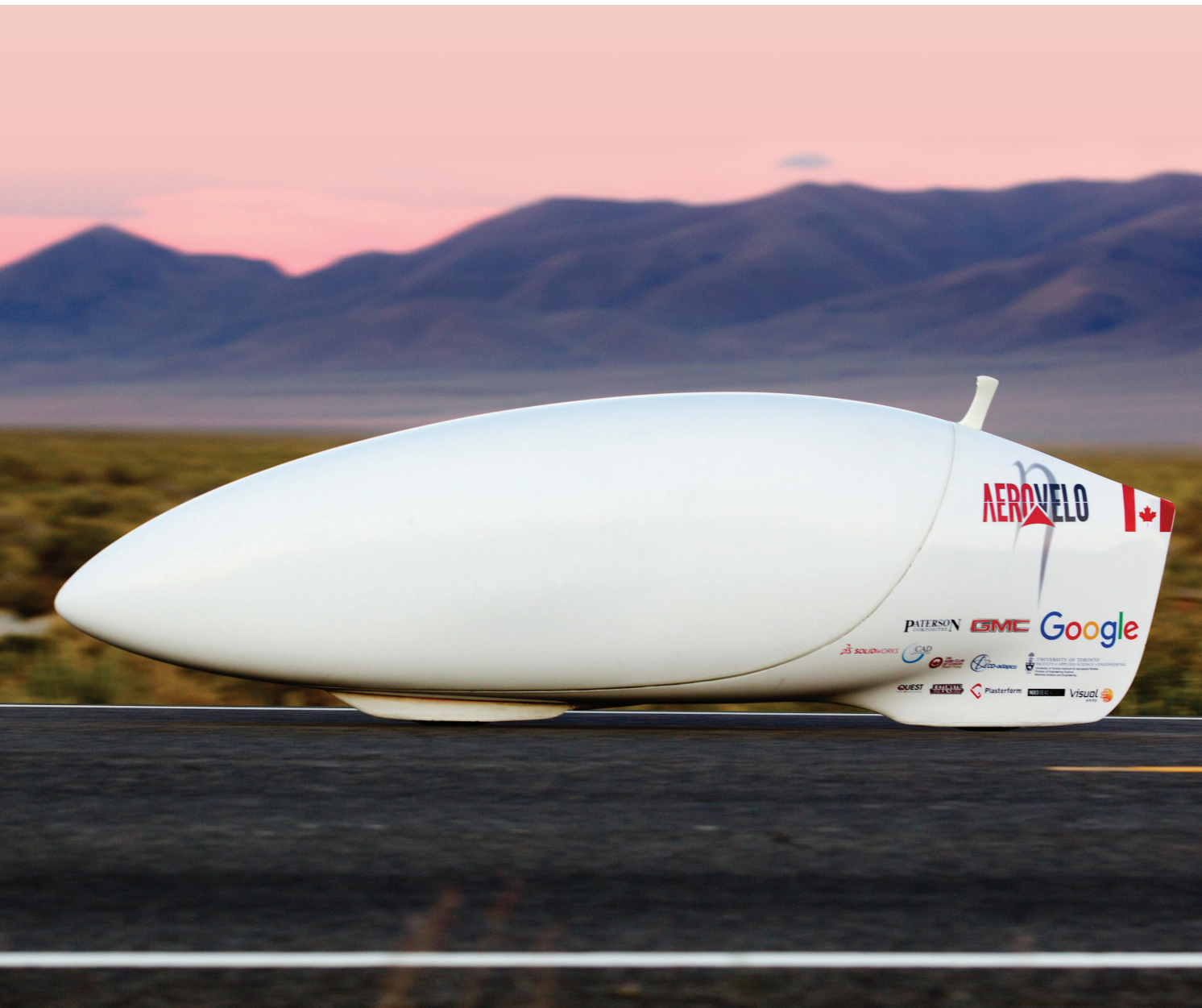


AEROVELO

PUSHING LIMITS OF WHAT HUMAN POWER CAN DO WITH SOLIDWORKS SOLUTIONS



Using SOLIDWORKS Premium design/analysis and SOLIDWORKS Flow Simulation CFD analysis software, Aerovelo's Eta Speedbike broke the previous human-powered speed record in 2015 and broke its own record four more times, culminating in the astounding run at 144.17 km/hr (89.59 mph) in 2016.

Challenge:

Invent, design, and build human-powered vehicles that push the limits of what's possible.

Solution:

Implement SOLIDWORKS Premium design/analysis and SOLIDWORKS Flow Simulation computational fluid dynamics (CFD) analysis software.

Benefits:

- Smashed human-powered bike speed record
- Set four additional human-powered bike speed records
- Designed, built, and tested human-powered bike, helicopter, and ornithopter
- Blended computational results with acquired knowledge to improve aerodynamics

Co-founders Todd Reichert and Cameron Robertson established AeroVelo to make the impossible—human-powered flight and human-powered speeds approaching 100 mph—possible. Combining Reichert's passion for athletics and aerodynamic design and Robertson's passion for structures and materials, AeroVelo is committed to inspiring public interest in science, technology, and environmentally conscious engineering. The company has undertaken a series of human-powered vehicle projects that have attracted a diverse, passionate group of individuals with a desire to do something incredible. The core of the design teams has been primarily engineering students from the University of Toronto—Reichert and Robertson are both alumni—and young professionals, but the projects would not have been possible without the extended network of a community of volunteers, friends, and family.

AeroVelo also needed 3D design and engineering tools to invent, design, and build the human-powered bike, helicopter, and ornithopter (an aircraft that flies by flapping its wings) that represent the company's body of work. According to Vice President/Structures Robertson, AeroVelo needed 3D CAD and computational fluid dynamics (CFD) analysis software not only to create these vehicles, but also to take them into the record books.

"It would not have been possible to effectively design vehicles like the human-powered bike without 3D CAD," Robertson explains. "The timelines and budgetary constraints that we work under are not really feasible without the speed, power, and automation that come with computational tools. We also work closely with students from the University of Toronto and need a common development platform to communicate and manage the work."

Because the founders had used SOLIDWORKS® software, and SOLIDWORKS is the CAD software taught at the University of Toronto, the combination of SOLIDWORKS Premium design/analysis and SOLIDWORKS Flow Simulation CFD analysis software was the obvious choice.

"I'd always found SOLIDWORKS to be easy to use, and the students who work with us know it," Robertson says. "We also liked the fact that SOLIDWORKS Flow Simulation software integrates inside the modeling platform."

FAST DESIGN, EVEN FASTER DESIGN CHANGES

AeroVelo first developed the Snowbird human-powered ornithopter, which sustained altitude and airspeed for 19.3 seconds in 2010, becoming the world's first successful human-powered ornithopter. Next came the Atlas human-powered helicopter, which won the AHS Igor I. Sikorsky Challenge and its \$250,000 prize in 2013, thanks to its record-breaking 64-second flight. AeroVelo upped its use of SOLIDWORKS tools for its next challenging project: the development of the record-setting Eta speedbike.

"SOLIDWORKS enables us to design the vehicle quickly and then make necessary design changes even more quickly," Robertson explains. "For example, we used SOLIDWORKS to modify and relocate the derailleur and shifter—using SOLIDWORKS tools to determine the best locations. We were able to get the composite faring design close to optimal, using tools like zebra stripes and surface curvature indicators, and SOLIDWORKS CFD performance analysis, and then we built and hand-finished it to dial it in."

FLOW SIMULATION IMPROVES AERODYNAMICS

As part of its efforts to advance the technology beyond that of the prior human-powered bike speed record holder, which had dominated the Battle Mountain World Human-Powered Speed Challenge for the previous 15 years, AeroVelo decided to leverage SOLIDWORKS Flow Simulation CFD analysis software to take its bike to a new level. "With SOLIDWORKS Flow Simulation, we gained important insights and developed key innovations that helped us make a huge leap in terms of faring aerodynamics," Robertson stresses.



"With the help of SOLIDWORKS computational tools, we've come close to 90 mph and should be able to reach at least 92 mph after refinements. Breaking the 100 mph barrier is possible, but it is a huge challenge and may require a longer road, a more powerful rider, some form of heat energy recapture from the rider, or active/intelligent faring components that adapt to airflows on their own to reduce drag."

— Cameron Robertson, Vice President/Structures

"Although other teams use CFD analysis, we decided to blend our CFD results with actual experience, using them more as a guide," Robertson notes. "We used SOLIDWORKS Flow Simulation pressure profiles to pursue our aerodynamic strategy. Laminar flow is definitely better for performance than turbulent flow, and we want as much laminar flow as possible. However, creating a faring shape that achieves an extended run of natural laminar flow is a very delicate and finesse-oriented design task, for which SOLIDWORKS Flow Simulation software helped."

QUEST TO GO 100 MPH PEDDLING A BIKE

Using SOLIDWORKS design and CFD analysis tools to improve the performance of its Eta speedbike, AeroVelo broke the previous human-powered speed record of 133.78 km/hr (83.13 mph) in 2015. Since then, the company has refined and improved the bike design, which has allowed AeroVelo to break its own record four more times, culminating in the astounding run at 144.17 km/hr (89.59 mph) in 2016.

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Focus on AeroVelo

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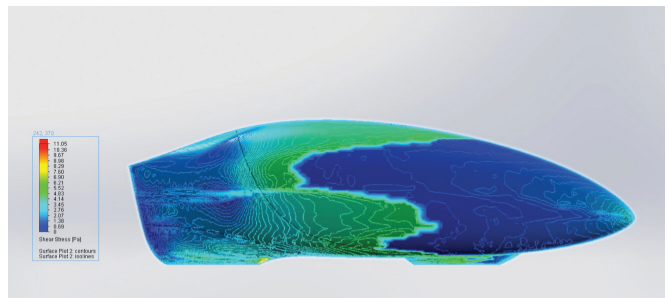
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