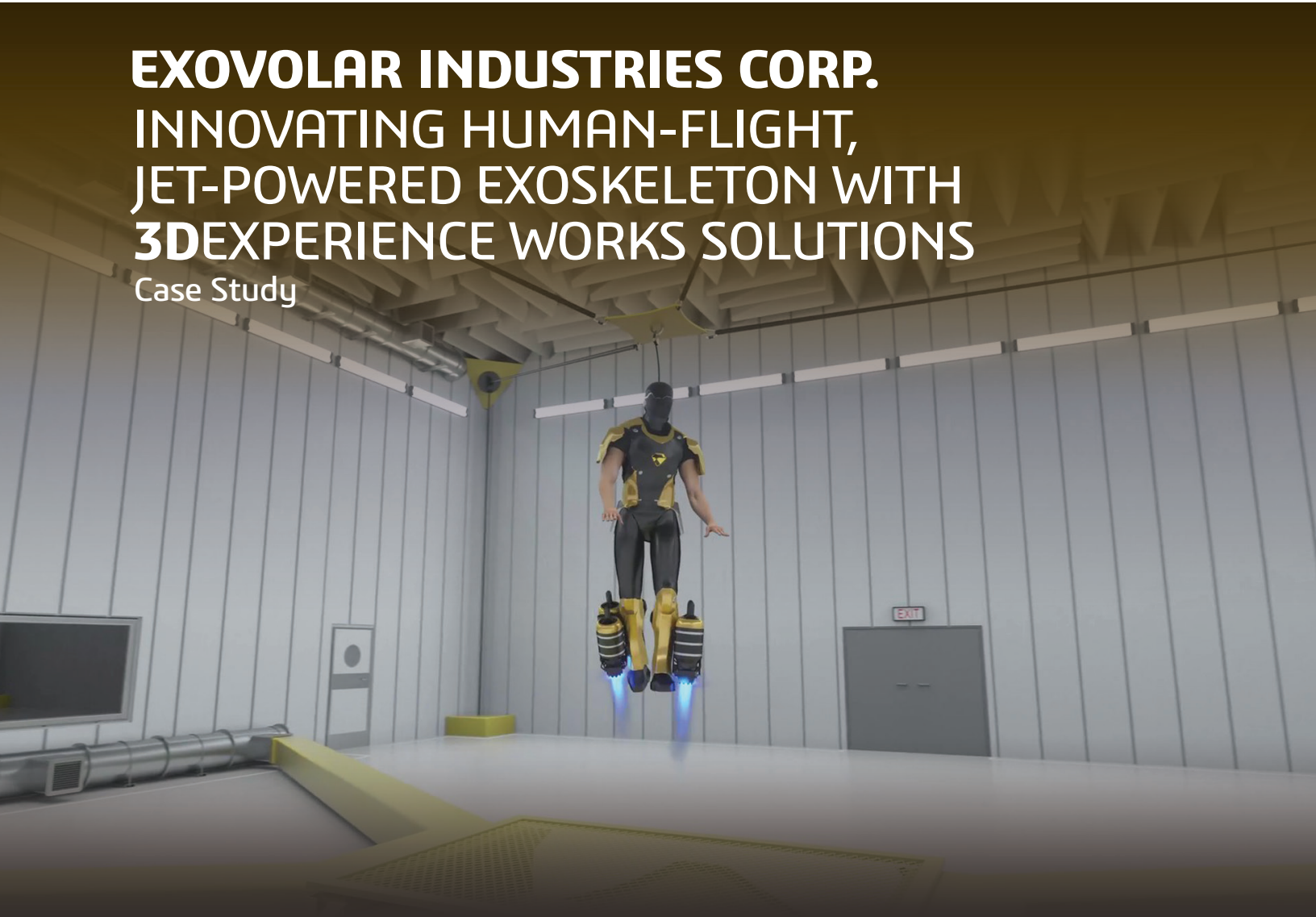


# EXOVLAR INDUSTRIES CORP. INNOVATING HUMAN-FLIGHT, JET-POWERED EXOSKELETON WITH 3DEXPERIENCE WORKS SOLUTIONS

Case Study



Exovolar leveraged SOLIDWORKS for Entrepreneurs and 3DEXPERIENCE Works solutions to develop its jet-powered exoskeleton, which, unlike previous jet pack designs, utilizes the legs for flight and navigation, leaving the hands free to complete tasks while the user is in a hovering position.

## Challenge:

Develop a safe, jet-powered exoskeleton that enables humans to fly and hover with hands free in order to complete tasks while hovering.

## Solution:

Utilize SOLIDWORKS for Entrepreneurs and 3DEXPERIENCE Works solutions, including SOLIDWORKS Premium design, SOLIDWORKS Simulation Topology Studies, SOLIDWORKS Flow Simulation computational fluid dynamics (CFD) analysis, Collaborative Business Innovator, Collaborative Industry Innovator, 3D Creator, and Collaborative Designer for SOLIDWORKS.

## Results:

- Optimized jet nozzles with flow simulation
- Reduced part weight via topology optimization
- Secured patent for thrust vector nozzle
- Realized automated, transparent data management

Exovolar Industries Corp. aims to augment human mobility by using the legs to make flying as simple as walking. The combination of jet engines, an exoskeleton, and the company's patented thrust vector nozzle allows the legs to support and move the human body in the sky. The brainchild of CEO, Lead Mechanical Engineer, and Founder Guanhao Wu, the Exovolar jet-powered exoskeleton is unlike previous jet pack designs because the exoskeleton utilizes the legs for flight and navigation, leaving the hands free to complete tasks, repair structures, or carry a weapon while the user is in a hovering position.

According to Wu, the company is planning on making variations to the design to support different requirements, ranging from making repairs to offshore wind turbines, to painting the side of a Navy ship, to taking an entertaining stroll through the air. "Prior to our concept, working on structures other than buildings that are in the air required suspending someone on a work platform, or using a hovering helicopter, which is extremely expensive," Wu explains. "Although drones are being used for lots of applications, there are tasks that are too complicated for drones to complete and require a person with their hands free to hover in place to accomplish. Our product will be lightweight and durable, and cost significantly less than helicopter rentals."

When the company was founded in 2019, Wu chose to use the SOLIDWORKS® for Entrepreneurs suite of product development solutions to complete initial research and development on the Exovolar flying exoskeleton. "When I founded Exovolar, there were other companies working on jet pack and jet suit solutions, but I believed that I could make this type of personal flight system and make it autonomous," Wu recalls. "I had

learned how to use SOLIDWORKS software before founding the company and decided to use it for R&D and early development because it is easy to use and provides a complete range of integrated design and engineering solutions."

When the COVID-19 pandemic hit in 2020, Wu decided to add 3DEXPERIENCE® Works solutions, including Collaborative Business Innovator, Collaborative Industry Innovator, 3D Creator, and Collaborative Designer for SOLIDWORKS. "We initially wanted to try out the 3DEXPERIENCE platform to see how it works," Wu recalls. "However, once we started using it, we discovered just how much easier data management is on the cloud-based 3DEXPERIENCE platform. It's so much easier to maintain revision control and manage design data on the platform that we simply cannot go back to the old way of managing data locally."



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— Guanhao Wu, CEO, Lead Mechanical Engineer, and Founder

## OPTIMIZING PATENTED JET NOZZLES WITH FLOW SIMULATION

One of the primary technical challenges in developing a flying exoskeleton that utilizes jet engines strapped to a person's lower legs like boots was optimizing the shape of the patented thrust vector nozzle on the jet engines to provide the power and stability required to lift a person off the ground. Maintaining a stable, uniform hover with the flying exoskeleton is imperative to making its use autonomous and practical for industrial and military applications.

"Flying the exoskeleton is a bit like riding a hoverboard because the unit is controlled by the feet, providing stability and balance while using computerized thrust vectoring in the jets to autonomously control thrust and thrust angles," Wu says. "Using SOLIDWORKS Flow Simulation software, I was able to optimize the shape of the thrust vector nozzle for the four jet engines—two for each leg—without having to build a physical prototype by conducting a thermal/flow simulation. SOLIDWORKS Flow Simulation revealed that the convergence of the nozzle created a backfire into the engine. With this

information, I was able to modify the thrust vector nozzle to improve the flow and eliminate backfires.”

### REDUCING WEIGHT VIA TOPOLOGY OPTIMIZATION

Exovolar also utilized SOLIDWORKS Simulation Topology Optimization tools to reduce the weight of some of the flying exoskeleton’s parts. With SOLIDWORKS Simulation Topology studies, Wu was able to automatically generate optimized component geometry to satisfy a given goal—such as balancing the weight-to-stiffness ratio, minimizing mass, or minimizing maximum displacement—based on the specific design space, loads, and geometric constraints, including those imposed by the manufacturing process.

“SOLIDWORKS Simulation Topology Optimization capabilities helped me to design lighter, stiffer, stronger parts without having to undertake a lengthy, iterative, trial-and-error design process,” Wu notes.

### MANAGING DATA TRANSPARENTLY IN THE CLOUD

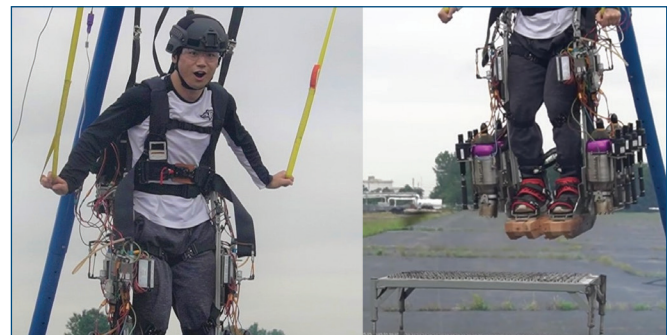
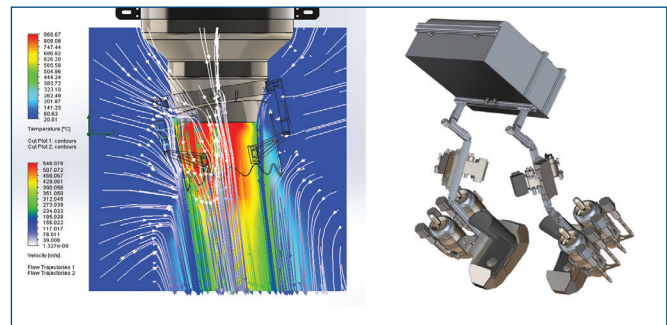
By adding the cloud-based 3DEXPERIENCE platform to its existing SOLIDWORKS implementation, Exovolar was able to improve data management efficiently and affordably using the platform’s automated, transparent data management capabilities. “The main reason that we wanted to push development into the cloud was to have some version control,” Wu points out.

“Working out of local folders can get really messy, even when working alone,” Wu adds. “As development of the flying exoskeleton advances, we’ll need effective data management and revision control to support additional users and our future growth. The combination of SOLIDWORKS design software and the 3DEXPERIENCE platform provides us with all of the design and engineering capabilities that we need, with the added benefit of transparent data management and security in the cloud.”

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Using SOLIDWORKS Topology Optimization studies to reduce weight in several components and SOLIDWORKS Flow Simulation tools to optimize the shape of the patented thrust vector nozzle for the four jet engines—two for each leg—Exovolar was able to complete its first hovering test without undue rounds of prototyping by simulating design performance and optimizing the design in software.

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