SOLIDWORKS

BATTLEBOTS

BATTLEBOTS
TOP BATTLBOTS TEAMS CHOOSE SOLIDWORKS SOLUTIONS FOR ROBOT DEVELOPMENT

Case Study

The captains of top BattleBots fighting robot teams—BiteForce, HyperShock, Witch Doctor, and SawBlaze—have two things in common: They each got started in robotics design and engineering, and building competitive combat robots, at an early age; and they all choose to use SOLIDWORKS solutions for designing, engineering, and manufacturing each season's robots.

DASSAULT SYSTEMES

Challenge:
Quickly develop fighting robots—typically in just one month—to compete on the reboot of the popular "BattleBots" competition and television show.

Solution:
Use SOLIDWORKS design, simulation, visualization, product data management (PDM), and PCB design solutions.

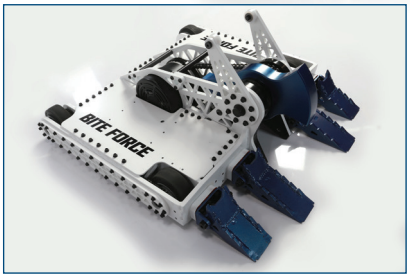
Results:
- Used SOLIDWORKS solutions within all top teams
- Mentored young robotics designers more easily with easy-to-learn SOLIDWORKS
- Tapped variety of SOLIDWORKS specialized design and engineering tools
- Added personality and color to robot designs using SOLIDWORKS 3D design

Paul Ventimiglia, captain of three-time BattleBots champion Team BiteForce, was 13 years old when he built his first fighting robot and 14 when he fought his first match. Team HyperShock Captain Will Bales was 12 when he first competed in BattleBotsIQ. Team Witch Doctor Captain Andrea Gellatly was a high school student when she fought her first match, and Team SawBlaze Captain Jamison Go got his start in the amateur, underground circuit of miniature fighting robot competitions while still in middle school. In addition to getting involved in robotics development and battling robot competitions while quite young, the leaders of these fan-favorite BattleBots teams have something else in common: They all choose to use SOLIDWORKS® design and engineering solutions for quickly developing each season's fighting robot.

Ventimiglia, who also uses SOLIDWORKS tools to develop robots for the high-tech industry at his company, Aptyx Designs, says that he got interested in robotics at an early age because he wanted to build animatronics for movies and television after seeing the special effects in movies like "Jurassic Park," "Star Wars," and "The Terminator." Now, the combat robot champion is helping to inspire the robotics designers and engineers of tomorrow through his volunteer work as a mentor to FIRST® Robotics teams.

"I got sort of hooked in that [FIRST], because it's a great program in terms of competition, robotics, and using engineering in a competitive way. I think it's a great way to learn a lot really quickly, and teach a really broad spectrum of skills in terms of design and brainstorming, initially doing detailed work, in SOLIDWORKS, for example … and then actually getting those parts made by yourself, and by external shops all within days, and not months, and then testing out your ideas."

All four of these BattleBots team leaders cite the ease of use and range of design and engineering tools, which different teams have used in various ways, as the reasons why they prefer to use SOLIDWORKS solutions for developing robots and for inspiring young people to get involved in competitive robotics and careers in engineering.



Team BiteForce has leveraged SOLIDWORKS design and engineering tools to develop robots that have won the Giant Nut championship more than any other team.

"I got sort of hooked in that [FIRST], because it's a great program in terms of competition, robotics, and using engineering in a competitive way. I think it's a great way to learn a lot really quickly, and teach a really broad spectrum of skills in terms of design and brainstorming, initially doing detailed work, in SOLIDWORKS, for example … and then actually getting those parts made by yourself, and by external shops all within days, and not months, and then testing out your ideas."

— Paul Ventimiglia, Team BiteForce Captain

DESIGNING FIGHTING ROBOT IN JUST ONE MONTH

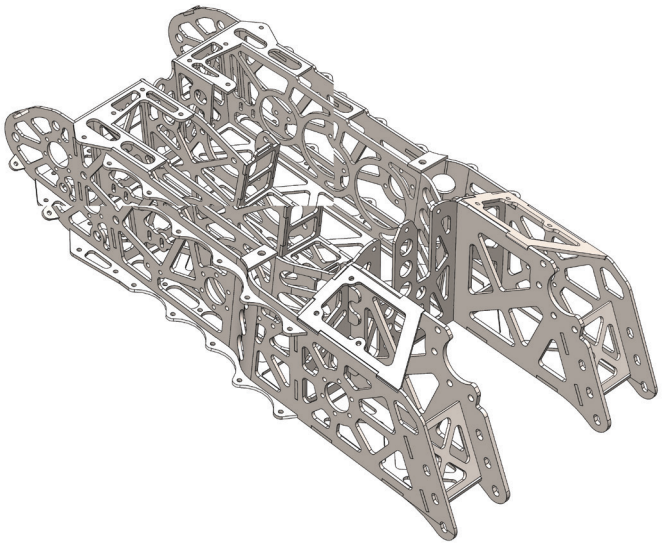
Due to the aggressive BattleBots schedule, teams have roughly one month to complete design work in order to meet production deadlines. Team HyperShock Captain Bales says that completing design work on the robot in such a short time frame, working after hours and on weekends, is the primary reason the team continues to use SOLIDWORKS. "Early on, I bought my own personal license of SOLIDWORKS to conduct the design work on HyperShock, but with a dozen team members and a substantial amount of real CAD work to do, acquiring additional licenses via the sponsorship [from Dassault Systèmes SOLIDWORKS] has been a big help," Bales notes.

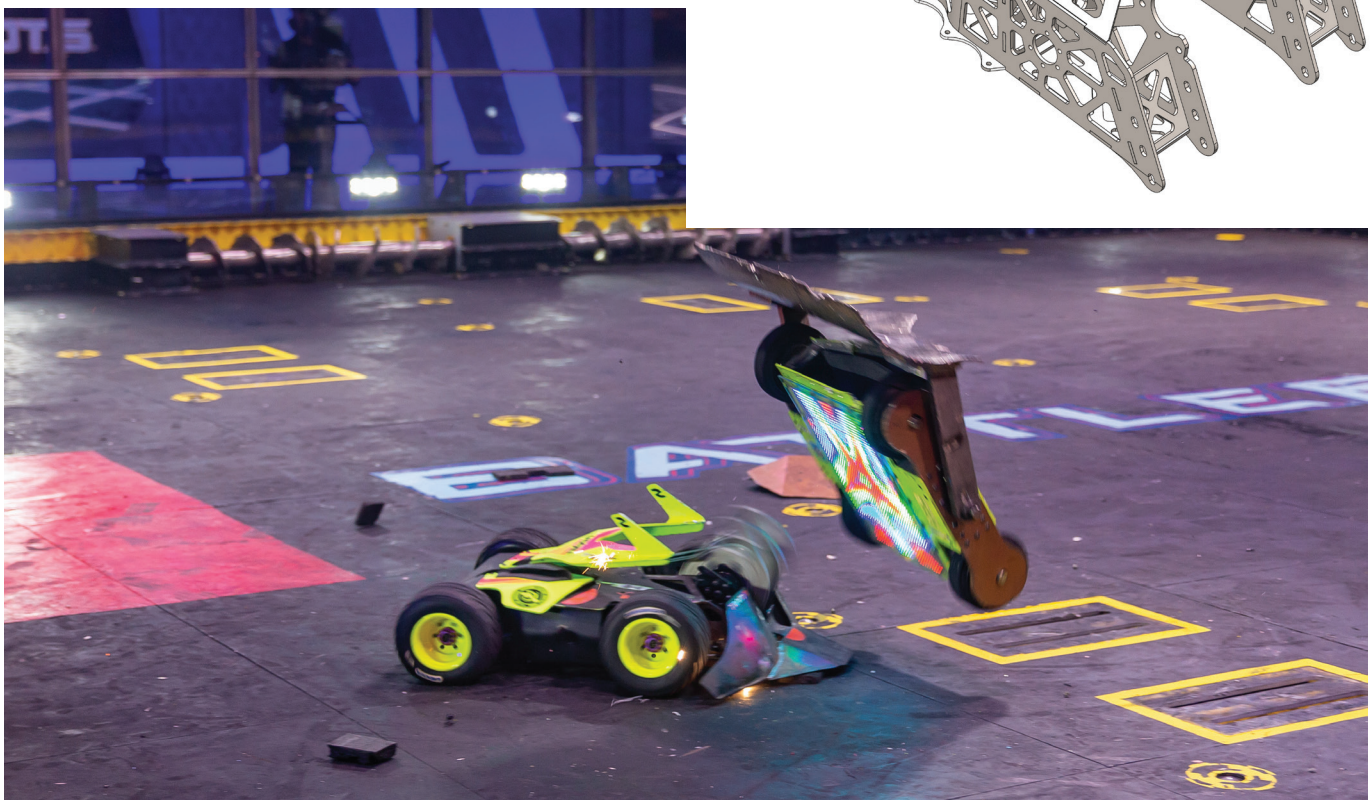
"Every version of the HyperShock robot has been designed in SOLIDWORKS," Bales continues. "In addition to the design speed that we have realized using the software, SOLIDWORKS is truly an industry standard data format that our vendors and suppliers work with regularly, which helps to minimize delays in production and assembly."

Using SOLIDWORKS design solutions, HyperShock developers can quickly conduct design iterations, share files easily, work on subsystems concurrently, and collaborate effectively, even when located thousands of miles apart. "With SOLIDWORKS, it's easier to communicate and collaborate," Bales explains. "We've been using the software so long and have become so proficient using it that we can push our production deadlines out and literally iterate right up to the very last minute, which definitely gives us an edge."

"While SOLIDWORKS Simulation tools are helping us optimize our robot designs for strength and weight, SOLIDWORKS Visualize rendering capabilities allow us to improve the robot's appearance. Creating a fighting robot that looks good is a part of our team dynamic and aesthetic. The robot design has to be unique, interesting-looking, and a tough fighter. SOLIDWORKS helps us achieve those goals."

Will Bales, Team HyperShock Captain



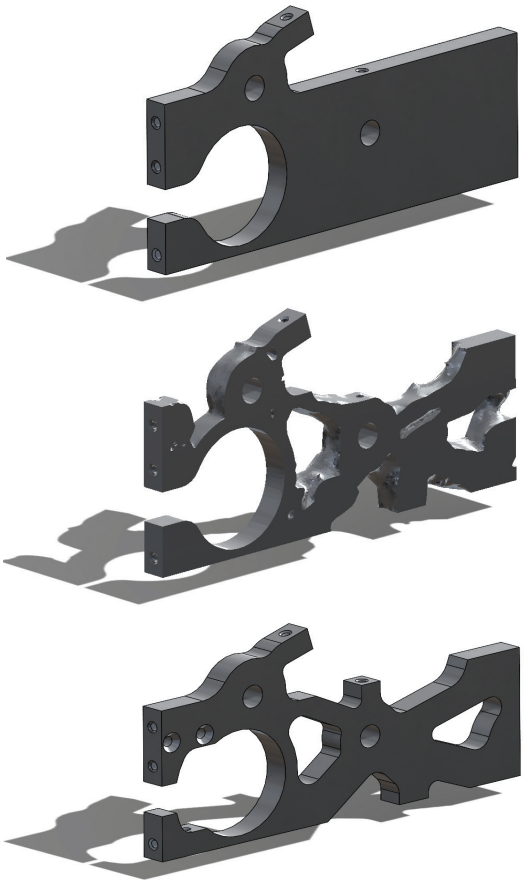


BALANCING STRENGTH, STIFFNESS, AND WEIGHT WITH TOPOLOGY STUDIES

In addition to SOLIDWORKS design tools, BattleBots teams leverage a range of integrated simulation, visualization, printed circuit board (PCB) design, and product data management (PDM) solutions. For example, an important SOLIDWORKS Simulation tool that Team Witch Doctor is using on the next version of the Witch Doctor robot is topology optimization. The team plans to use topology studies to better balance the relationships between weight, strength, and stiffness on the robot. "The first thing we do when we arrive at the competition is to weigh the robot, because if we don't make it under the 250-pound weight limit, we can't compete," says Michael Gellatly, Team Captain Andrea Gellatly's husband and the lead designer/driver on the team.

"Last season, we were over weight by four pounds and had to cut away sacrificial pieces to make weight. With SOLIDWORKS topology optimization tools, we learn where we can cut material and weight that not only doesn't sacrifice strength and stiffness, but actually improves both. We've cut five pounds from our current design while strengthening the robot in key areas.

"We probably go through more than 20 iterations on each robot before the competition to improve our robot every year," Michael adds. "For example, we used SOLIDWORKS multi-body sheet metal tools to develop the rib cage on our robot, which has become a signature Witch Doctor trait. We came up with roughly 20 ways to do the ribs before settling on our final version. With SOLIDWORKS, we can iterate quickly and continue to iterate until our application is accepted and it's time to build the robot."



BattleBots Team Witch Doctor relies on SOLIDWORKS design, simulation, and visualization solutions to develop, improve, and add personality to each robot that competes in the popular "BattleBots" television series. As shown in the progression, Team Witch Doctor leveraged SOLIDWORKS Simulation topology studies to optimize an existing part (image one) to cut weight without sacrificing strength. Team Witch Doctor then refined the suggested geometry (image two) to produce the final, lighter, yet just as strong part design (image three).

"Last season, we were over weight by four pounds and had to cut away sacrificial pieces to make weight. With SOLIDWORKS topology optimization tools, we learn where we can cut material and weight that not only doesn't sacrifice strength and stiffness, but actually improves both. We've cut five pounds from our current design while strengthening the robot in key areas."

— Michael Gellatly , Lead Designer/Driver

GIVING SENSORS TO BRUSHLESS MOTOR WITH SOLIDWORKS PCB

Using the printed circuit board (PCB) design tools of SOLIDWORKS PCB software, Team SawBlaze has improved the responsiveness of the brushless motor used for the robot's spinning weapon by designing a unique, sensor-laden PCB that transforms a sensorless brushless motor into a motor that spins up faster than the same motor without the sensor board. "When we're in the midst of battle, we need our spinning weapon to have a very fast response rate while withstanding the shock of collision, because you just can't waste seconds when you are in a BattleBots fight," Go points out.

"Our weapon's brushless motor was designed to only run sensorless, so I used SOLIDWORKS PCB to develop our own sensor board, which resulted in a 60 percent reduction in our motor's spin-up time," Go continues. "I was able to develop the first version of our sensor board in less than a week and ultimately improve our weapon performance. SOLIDWORKS gives us all of the tools and functionality that we need to move quickly and design accurately."

"Our weapon's brushless motor was designed to only run sensorless, so I used SOLIDWORKS PCB to develop our own sensor board, which resulted in a 60 percent reduction in our motor's spin-up time. I was able to develop the first version of our sensor board in less than a week and ultimately improve our weapon performance. SOLIDWORKS gives us all of the tools and functionality that we need to move quickly and design accurately."

- Jamison Go , Team SawBlaze Captain

Focus on BattleBots

Headquarters: BattleBots Arena
Mare Island
Vallejo, CA 94590
USA
Phone: +1 707 336 2687

For more information
www.battlebots.com

Using SOLIDWORKS PCB design tools, Team SawBlaze was able to improve the spin-up performance of its primary weapon by designing a unique, sensor-laden PCB that transforms a sensorless brushless motor into a motor that spins up faster than the same motor without the sensor board.

DASSAULT SYSTEMES | The **3DEXPERIENCE®** Company

Americas
Dassault Systèmes
175 Wyman Street
Waltham, Massachusetts
02451-1223
USA

Europe/Middle East/Africa
Dassault Systèmes
10, rue Marcel Dassault
CS 40501
78946 Vélizy-Villacoublay Cedex
France

Asia-Pacific
Dassault Systèmes K.K.
ThinkPark Tower
2-1-1 Osaki, Shinagawa-ku,
Tokyo 141-6020
Japan