

# THE SEMI-AUTONOMOUS MOTORCAR PROJECT



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We create human-machine interfacing technology that changes lives for the better. In 2014, Ball Aerospace technologies, algorithms and techniques were the first to enable a quadriplegic to control and steer a car at operational speed.

## OVERVIEW

When IndyCar driver Sam Schmidt lost movement in his arms and legs after a devastating car crash in 2000, he never thought he would return behind the wheel. But thanks to an innovative project known as the Semi-Autonomous Motorcar (SAM), Schmidt was able to once again safely operate and control a modified 2014 Corevette C7 'Stingray' under racetrack conditions.

The SAM project inspires disabled people to realize they can be more independent with the help of technology and is a driving force for a new generation of mobility and safety technologies.

## OUR ROLE

As the system interface developer on the SAM project, Ball engineered the human-machine interface and driver guidance system. By combining diverse, commercially-available technology with our own proprietary computer code, we developed a totally novel system in just 292 days.

Despite his injuries, Schmidt has the ability to move his head, which allowed Ball human-machine teaming engineers to use commercial off-the-shelf cameras to monitor his head movements. The cameras focus on tiny, spherical reflectors on a cap he wears. As the driver's head moves, the cameras sense the movement via a change in reflected light. Our computer code then converts the movement into digital signals fed into a system that moves the steering wheel. A pressure sensor in the driver's mouth tells the car to slow down or stop when the driver bites down.

We also engineered the driver feedback system that told Schmidt how much and what type of input he was giving to the car. A graphical user interface display let Schmidt see the car's status and how it was reacting to his movements.

The SAM project is a collaborative venture between Ball, Air Force Research Laboratory, Arrow Electronics, Schmidt Peterson Motorsports and Falci Adaptive Motorsports.

## QUICK FACTS

- Ball's systems engineering on the SAM project is the first to allow a quadriplegic to control and steer a car at speed.
- The driver's three degrees of freedom were converted into a system that enabled safe operation of a car at high speeds. The motion tracking technology used in the car is identical to that used by Hollywood and the gaming industry to do motion capture of human movements.
- After completing his first run in the simulator, Schmidt commented "I'm speechless... and that doesn't happen very often."
- On April 7, 2014, Schmidt got into the SAM Corvette for the first time, and under rainy conditions, completed two laps of the Indianapolis Motor Speedway at 30 mph. The next day, under much better weather conditions, Schmidt drove over 20 laps (50 miles) at speeds up to 63 mph. It had been more than 14 years and three months since the last time he drove a car.



*Ball neuroscientist Dr. Scott Grigsby adjusts Schmidt's mouth braking sensor before a test session in the race driving simulator*