



# FIT FOR PURPOSE

BOA IS USING ITS VICON SYSTEM TO CREATE NEXT-GENERATION FOOTWEAR



Sports technology brand BOA's Performance Fit Lab has two key challenges to contend with: the diverse range of sporting disciplines it analyzes and the high volume of tests that it performs. Thanks to a combination of BOA's Vicon system and an integration with The MotionMonitor that ties it to other performance analysis tools, the company's biomechanists are managing their high output levels and delivering performance insights for a variety of athletes.



Kate Harrison, Ph.D.  
Manager of Biomechanics Research at BOA



Eric Honert,  
Senior Manager at BOA

BOA was founded in 2001 by snowboarder Gary Hammerslag. His goal was to apply the engineering expertise he had acquired while designing medical solutions to elevating the performance of snowboard boots. The result was a 'Fit System' that improves the way footwear conforms to the foot using a dial and metal wiring to replace conventional lacing. In the two decades that have followed, BOA has partnered with brands designing footwear across fields ranging from trail running to golf to medical bracing.

While the technology was born of Hammerslag's intuition, the BOA Fit System is now informed by the work done in the company's Performance Fit Lab at its headquarters in Denver, Colorado, USA. The 200 Sq.ft space knits together a Vicon motion capture system, Vicon Blue Trident inertial measurement units (IMUs), force plates, force insoles and a dual radar system with integration of The MotionMonitor, which delivers data in real-time.

A critical part of the lab's design is its adaptability. It includes an instrumented treadmill, a ski treadmill

and a golf bay. "It really has the flexibility to be doing tests across multiple segments in a given week, because we don't have to reconfigure everything," explains Kate Harrison, Ph.D. manager at the lab.

That adaptable setup enables the lab to study disciplines including running, agility movements, workwear, hiking, golf, cycling, skiing and snowboarding, basketball, badminton and tennis. Eric Honert, a senior manager at the lab, was excited by how fast this data could be integrated with their system. "I was awestruck," he says.

## A TIGHTLY INTEGRATED WORKFLOW

BOA conducts over 400 hours of elite athlete performance testing each year. It typically turns around a 10 person study in three weeks, and it will have two or three studies running in parallel, meaning the lab has to perform upwards of 850 tests per year.

Having BOA's Vicon system integrated with its other technologies is an important factor in hitting those demanding targets. "That integrated partnership means that everything is





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just so seamless and efficient,” says Harrison. “It’s great being able to use Vicon through The MotionMonitor and integrate with our other equipment, and the post-processing is so smooth. The live data visualizations make it easy to make sure the data quality is great as you’re collecting it. Compared to other experiences I’ve had with motion capture it’s just so much more streamlined and efficient, which has been awesome. That’s been really critical for us.”

The MotionMonitor is a 3D motion analysis platform that collects real-time data from multiple types of movement measurement hardware. Innovative Sport Training, the maker of The MotionMonitor, has been partnered with Vicon since 2008 and provided BOA’s movement analysis hardware and software in a turnkey system. BOA’s Vicon data streams into The MotionMonitor live, and the biomechanical models are built from there. In many cases this avoids the need for multiple templates and enables a subject to be set up in two to five minutes, helping to streamline BOA’s high-volume workflow.

“We’ll place clusters of markers on individual segments and then digitize the joint centers,” explains Honert. “It helps in terms of post processing—you don’t have to do some sort of calibration afterwards to get those joint centers.”

“I would associate a process this streamlined with a clinical setting, where you’re doing one thing really fast, but where you can’t change your model to ask a different question and the system is more plug and play,” says Harrison. “The combination of the streamlined and efficient nature of our setup with the ability to do all the different types of testing we do here is pretty incredible.”

The level of support that BOA has received from both Vicon and The MotionMonitor has also been important in maintaining the lab’s high level of throughput. “The support has been awesome,” says Harrison. “Having a company like Vicon that you can get on the phone the same day as you have a problem to troubleshoot is great. With the number of tests that we’re doing we just can’t afford to be down for a week, so being able to get immediate hardware support has been critical.”



### MEANINGFUL RESULTS

“The first study we did in the lab was into agility and speed, studying court athletes from basketball, tennis, badminton etc, and looking at how effectively they could change direction and how fast they were in various types of footwear,” says Harrison. “We found that by improving the fit of a shoe we could, for example, change how efficiently they changed direction by up to nine percent. We saw some really meaningful improvements in those agility sports, and that was a really nice foundation to build from.”

Other headline improvements the team have found in athletes wearing BOA-enhanced footwear include 1.5 percent improvements in speed with the same exertion; seven percent reduced ankle rotation velocity and increased stability; and three percent improved connection to the midsole and heel hold.

“1.5 percent doesn’t sound like that much,” says Honert. “But for these high-performance athletes, that could be the difference between making the podium and not making the podium.”

While the size and flexibility of BOA’s lab offers the team a wide range of options for the diverse set of movements they capture, they have begun to take their tests further afield. “We’ve started extending our testing beyond the lab,” says Honert. “We recently went out to a local trail here and we had athletes run a one mile loop in different shoes and monitored them with Vicon’s Blue Trident IMUs. We’ll also do snow testing, looking at different ski and snowboard boots.”

### GETTING PRACTICAL

The team at BOA has been able to publish results in areas of sporting performance that have barely been touched by serious motion analysis. “There’s so little research and testing on sports like snowboarding, because it’s so difficult to do,” says Harrison. “We’re getting to share so much with the scientific community on things that haven’t really been explored before, like ‘how do you even biomechanically define performance in snowboarding?’ Being able to help progress those fields has definitely been a cool aspect of what we’re doing.”

All of that knowledge is being acquired with practical applications in mind. The work Harrison, Honert and their colleagues are doing in the BOA Performance Fit Lab is about improving the products BOA is creating. “We’re really integrated with the rest of the company,” says Honert. “Our work informs BOA’s design and development to create solutions that change how footwear fits for the athlete, really enabling superior performance.”

In the future, BOA hopes to extend the work it’s doing out in the field. “When we bring people into the lab we get a really great snapshot of how they’re performing over 30 seconds, for example,” says Harrison. “But so much of performance is determined over the longer term—how people are performing at the end of a marathon, for example. Hopefully these tools will allow us to capture a much greater volume of an athlete’s movements over the course of a day or a week. That will open up more avenues for research.”

“As the technology becomes more accessible, that will allow people to go outdoors into these ecologically valid scenarios to really test how footwear works in realistic settings,” Honert adds. “That’s what we’re really trying to do—create these realistic tests to see how our footwear performs in those real-world scenarios.”



For more on the innovative work being done by BOA, visit: <https://www.boafit.com/>

To learn more about The MotionMonitor visit: <https://www.innsport.com/>