Welcome to the 2018 edition of The Standard, featuring customer stories and case studies from around the world, and covering applications from all parts of the Vicon family. In this edition of The Standard, we have collected stories from the stage to the ice rink, hospitals to VFX studios, and from customers both old and new.

This magazine is about you and your work, celebrating and educating others in what you do, how and why. We are proud – proud of how you use the equipment and the way that it touches people’s lives all over the world, from improving the way that a patient is treated, to the blockbuster films that we see on the big (and small) screen.

Before we dive in, if you would like to have your story or case study featured in the next edition of The Standard, please drop us a line at marketing@vicon.com.

We hope you enjoy reading this as much as we enjoyed putting it together.

Phil & Elicia
For competitive athletes, an injury is almost a given at some point. If the athlete is lucky, the injury will be minor and the recovery time will be short. But for some, serious injuries are the beginning of a lengthy rehabilitation cycle, or even the end of a promising career. But what if it didn’t have to be like that? What if athletes were able to test themselves in order to better understand their individual risks, and prevent injuries from happening in the first place?

An ambitious new study at Auburn University hopes to turn this idea into reality by identifying the root causes of ACL tears and providing a method that offers healthy, incoming athletes an ACL risk assessment before they even step on the court or field. With this information, trainers can create training regimens tailored to individual athletes. This might include additional weight and flexibility training, or even retraining the athlete to avoid making certain movements. From Auburn’s point of view, the more predisposed you are, the more you need to train away the risks.

Working out of the Auburn University Biomechanical Engineering Lab (AUBE), Dr. Michael Zabala, an assistant professor in mechanical engineering, started this process by looking at the root causes involved with ACL injuries, specifically in female athletes involved with soccer and basketball. Each year as many as 200,000 athletes at all levels from recreational to professional suffer ACL tears. Statistically, female athletes are far more likely to have ACL problems — in soccer, three to five times as likely; in basketball, two to seven times.

In order to create a risk assessment for athletes, Dr. Zabala and his team first need to isolate and identify the warning signs. The study currently involves 15 female soccer and basketball players, and that number is expected to grow over time. As part of the study, each athlete annually records a series of movements using high-speed optical cameras designed for motion capture. The goal is to be able to record them while healthy, to create a baseline. If they happen to suffer an ACL tear, they’ll undergo a second set of motion capture recordings after they have recovered and returned to their sport.

By comparing the movements of those athletes that went through rehab alongside their baseline scans — along with the movements of those that played their entire collegiate career without an ACL injury — the team hopes to be able to predict future injuries. Injuries based on the way they move and how their knee is naturally aligned. To do this, the team at Auburn needed cameras capable of capturing the most intricate and exacting details of athletic movement. This led Dr. Zabala to Vicon.

“We’re trying to do this all-inclusive analysis for multiple avenues to try and really wrap our minds around why this is happening, why someone’s at risk.”

To gather the data, Dr. Zabala and the AUBE lab created an enclosed test area measuring 30 feet by 32 feet, lined with 10 Vantage V5 cameras surrounding the interior of the enclosure. Seven of the cameras are anchored at a height of eight feet, while the other three are positioned at waist level, giving a complete field of coverage and multiple angles for each movement. At the start of their season, athletes enter and engage in around 30 exercises that require non-contact movements, like suddenly changing speeds and coming down from a jump at just the wrong angle. These injuries can happen in a game, in practice, or even while walking down the stairs. There is very little margin between an athlete cutting left to right and going on to score a goal, and someone cutting right to left and spending the next six months to a year recovering. Precision matters, which is why the lab selected Vicon.

“We’re trying to do this all-inclusive analysis for multiple avenues to try and really wrap our minds around why this is happening, why someone’s at risk,” said Dr. Zabala. “The reality is that there are probably a lot of different factors that put someone at risk, but if we can understand as many of those as possible, and then ultimately relate those back to the actual injury, then we can start to look at determining who is at greater risk. From there we can look at how to prevent it happening in the first place.”

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One of the reasons Dr. Zabala selected Vicon cameras was that the high-speed motion capture cameras helped to cut down any drift associated with the movement calculations, a problem familiar to most sports researchers who frequently use more portable, but less exact inertial sensors. The lab also uses two force plates as well, to record impact data along with the movements.

Although ACL tears do occur when contact is involved, the majority happen through non-contact movements, like suddenly changing speeds and coming down from a jump at just the wrong angle. These injuries can happen in a game, in practice, or even while walking down the stairs. There is very little margin between an athlete cutting left to right and going on to score a goal, and someone cutting right to left and spending the next six months to a year recovering. Precision matters, which is why the lab selected Vicon.

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There are countless theories on how robots might be used to benefit humanity, but robotics is an expensive field, mostly controlled by private organizations and well-established academic labs with the funds to indulge their experimentation. It’s simply inaccessible to most. That’s where Georgia Tech’s Robotarium comes in.

The Robotarium is the brainchild of roboticist Magnus Egerstedt, a professor at Georgia Tech’s School of Electrical and Computer Science, who realized that advances in swarm robotics were being stunted by a lack of accessibility. Swarm robotics testbeds are rare and almost always private, so Egerstedt set about creating a communal platform with funding from the National Science Foundation and the Office of Naval Research.

The prototype Robotarium used up to 20 custom-built robots in an area roughly 4.2 feet by 3 feet, with a standard camera tracking system overhead. Over the last year, the project has grown in size and scope, and now features up to 50 robots in the swarm. Ongoing improvements will expand that number even further to 100 robots – including fast-moving quadcopters. This led to an upgrade to Vicon’s IR-based motion tracking system.

Vicon’s IR-based motion tracking system was designed to work with high numbers of objects, fast moving and otherwise. On top of a live stream for users to watch, the cameras provide precise position and orientation data information. With dozens of small robots moving at once, standard cameras cannot accurately track each movement, making the data less useful to high-end research.

“We’re sending data back for world class research. We can’t send our users back stuff that is not precise,” said Dr. Sean Wilson, director of operations at the Robotarium. “The sub-millimeter precision of Vicon is imperative. The ability to separate different robots from one another just by the patterns of balls that we basically just stuck onto the robots is incredibly useful. It makes tracking so much more streamlined.”

The Robotarium is open to anyone who wants to use it for academic or hobby purposes – the team is considering ways to allow commercial research without those groups dominating all the available time. Users can design an algorithm to control the robotic swarm, using the Robotarium’s software, or they can import their own. After a project has been approved which involves a simple check to ensure the purpose of the test is legitimate and won’t harm the robots, users enter a queue and wait their turn. During their turn, users have around 10 minutes to control the robotic swarm within a 12 feet by 14 feet arena. Once the experiment is complete, the robots deactivate just long enough to recharge their 20-minute batteries through inductive charging coils in the floor, before they are reassigned to a new user.

The Robotarium currently has around 300 users from all walks of life, including groups from Stanford, Arizona State and even the Girl Scouts of America, who are using the Robotarium to get girls interested in science, technology, engineering and math (STEM) programs. As user numbers grow, so too does the demand on the Robotarium’s equipment. But rather than seeing that as a limitation, the team at the Robotarium take it as a challenge.

“Swarm robotics is particularly appealing to amateurs, students and hobbyists, or anyone that wants to move beyond simulations in order to test theories using physical robots, can do so at no cost. It’s able to offer this thanks to generous grants, dozens of small, remotely controlled robots and a series of eight high-speed Vicon Vantage cameras, capable of tracking several fast-moving objects at once with precision.

Swarm robotics is particularly appealing to researchers, as it turns a group of robots into a collective entity that obeys simple instructions while performing multiple tasks in parallel. Its very nature allows for an inherent redundancy, as simple (or several) individual robots can fail and the group can still complete the task. Multiple robots can also search an area more quickly and with higher resolution than a single robot.

One day, this capability could aid in diverse situations, from disaster relief and personal defense to construction in inhospitable locations: basically, in any situation where robots would be more effective than humans. But unfortunately, there has been a fundamental bottleneck when it comes to resources and accessibility.

Managing director at Audiomotion Studios.

Tell us a little about Audiomotion

Audiomotion is a VFX facility that specializes in motion capture and provides character animation for video games, VR, film and TV. The company was established in 1997 and is based just outside of Oxford in the U.K. Our facility is equipped with three stages, which are all kitted out with the latest Vicon Vantage V16 motion capture cameras. Audiomotion has worked on many AAA game titles and feature films, such as Gladiators, World War Z, Maleficent and Miss Peregrine’s Home for Peculiar Children. For film series like Narnia and Harry Potter, we’ve provided the movement for the centaurs, minotaurs, fauns and elves you see on screen.

We've had the good fortune to work with some brilliant clients, directors, actors and sports stars over the years. Some of the more well-known being Steven Spielberg, John Boyega, Andy Serkis and Liam Neeson. We’ve also worked with musicians like the Black Eyed Peas, will.i.am and Take That, as well as travelling to various locations to capture sportsmen like Cristiano Ronaldo, Lionel Messi, Harry Kane and Rooney Mc Coy. We've even managed to squeeze a full F1 pit crew into the studio. Although not every day includes a star-studded cast, we've also had some more unusual requests, and characters pulled by horses, dogs and cats have all been captured too.

What made you set up Audiomotion?

Audiomotion was originally set up to supply both audio and motion capped animation to a small group of game developers who saw the potential of the technology. Little did they know how it would evolve into what we see today.

Vicon cameras have been installed at Audiomotion since its very beginning. What sets them apart from other motion capture systems on the market?

We have worked with several generations of Vicon cameras and software over the years, and have seen the progression and innovation delivered by Vicon. We review the market and test other suppliers when we upgrade the studio, and we have always found Vicon to be the most accurate and reliable product available on the market at the time.

This year marks 20 years of Audiomotion – congrats! What’s the key to your success?

The key to our success is down to the knowledge, experience and the understanding we have gained over time, along with our skilled team. Our relaxed, yet professional approach allows us to integrate creative arts and performance with some very precise technology. Our focus is to provide artists the freedom they need, while we capture every nuance of their performance.

How has motion capture changed over the last decade and how have you responded to those changes?

One of the biggest changes has been the ability to live stream actors’ performances directly into game engines. This means we can broadcast the performance in real time for the directors, allowing them to walk around the virtual world, seeing the actor as the CG character in real time. Actors can see themselves as the CG character within the virtual environment like a mirror, which enables them to develop their performance and truly bring the character to life.

What upcoming Audiomotion projects are you most excited about?

We have two major feature films coming out in the next six months, but as always, we’re not able to talk about them just yet. Both will be a high point for the company and crew. We’ll have the popcorn at the ready!
Vicon helps Ninja Theory battle for independence with Hellblade: Senua’s Sacrifice

As the developer of triple AAA games such as Heavenly Sword, DmC: Devil May Cry and Enslaved: Odyssey to the West, Ninja Theory has been a pioneer of performance capture from the beginning.

After 15 successful years of working with big publishers like Sony, Bandai Namco and Capcom, the company made the creative and business decision that its next game would be their first independent, self-published title. The result was Hellblade: Senua’s Sacrifice, a gripping action drama that takes performance capture and the single player action-adventure genre to a new level, without the budget of a major publisher.

"The ethos of Hellblade is that we wanted behind it. Without the budget of a major publisher, we would have to create a game independently, " said Matthews. "We could shoot all of our cinematic scenes there, but still use it as a meeting room. But honestly, over time it’s just turned into a full-on mocap space!"

With the help of Vicon, we’ve been able to not only save a lot on costs, but also give ourselves the flexibility to be able to go into our own boardroom and shoot whenever we like."

"No frills, but plenty of thrills!

Once it was up and running, the development team – 20 people rather than the hundreds usually found on a typical AAA game – were able to explore the potential of on-site performance capture. "Normally we would have a four-week shoot, and we’d need to do everything in that time," said Matthews. "But we doted shooting both the cinematic and in-game animations throughout the entire project."

Vicon’s Blade software was used for capturing the motion, as well as initial tidying up and processing, relabelling and filling the data where needed. "The pipeline moved into Autodesk MotionBuilder to construct the scenes, get them in the right location and do a first pass on polishing. Following that, Autodesk Maya was used to bring in the facial animation and carry out a final polishing. Audio also got involved at that stage, with Maya renderers as reference. This was all exported into Unreal Engine to get it triggered in-game, followed by adding lighting and effects."

The game is full of customized animations of specific situations and character motions, developed to replace the typical in-game HUDs that shows health indicators. "When Senua is injured, we wanted the players to understand that through the way she looks and moves," said Matthews. "So we captured all of that. Our animators were able to use the Vicon rig to capture different movements, for instance one day we concentrated on an injured walk, or a little bit of a limp, or tiredness in her walk. Other very subtle animations were created – things like Senua's breathing, or having just a little bit of a limp, or tiredness in her walk."

"The whole game is a battle and a struggle, and we wanted it to feel like that," Matthews explains. "The aim was to make players relate to and engage with Senua at a deep level, so the more realistic and nuanced we could be, the more likely a player would relate to and engage with Senua."

"That’s when we reached out to Vicon. "We explained our situation and said, it’s a small budget and we want to try to create an in-house mocap studio. The response from Vicon was, ‘we would love to help you in doing that’.”

Vicon worked with Ninja Theory to create a studio using a dozen Bonita cameras. "The Vicon guys helped us set up and were on hand to support us,” explains Matthews. “But it was relatively straightforward: just get the cameras out of the box, get them set up, calibrate them, and take it for a spin."

"In the spirit of our DIY nature of putting this together, the cameras are attached to wardrobe poles from IKEA, while all the lighting that we have in our mocap space is actually ceiling tile lights from Amazon,” he adds. "We’ve managed to put together an entire mocap space for an absolute fraction of the cost of flying out somewhere – or the equivalent of what it would cost for four or five days in a UK studio."

"We had to convince people internally that we could use it for two purposes,” said Matthews. "We could shoot all of our cinematic scenes there, but still use it as a meeting room. But honestly, over time it’s just turned into a full-on mocap space!"

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"So not only do we have the studio on hand 24/7, but we also had our actress in five days a week,” laughs Matthews. "She could take a break from making our trailers and development diaries, to try out different movements or scenes. We might say to Melina ‘in this scene, there are flames all around you, and you need to be coughing because of the smoke’. We had the ultimate flexibility to capture whenever we wanted, and to try things out.”

There is a section in the game where Senua is moving through waist high water, and she’s having to move hanging bodies out of the way. “We ended up hanging all of our shoes from the ceiling so we could capture her wading through moving objects,” says Matthews. "You wouldn’t be able to do that easily in a mocap suit, and if you did, it would be very expensive.”

"There’s absolutely no compromise there,” he says. "The shooting volume that we’ve got is certainly comparable to any of our other games – we’ve not had to make any compromises, but we’ve saved a lot of money."

"Our noble aim when we set out was, if we can make Hellblade work as an independent AAA model, it could prove something to the industry. Not only can we continue to make the games we want to make, but our fans want us to make, and they make successful, but other developers who find themselves in a similar situation to us can also do so. And players will get more diversity and creativity in their games too.”

Behind the Scenes: Hellblade Shoot Setup
https://youtu.be/gj5L9BD0ipg

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Independent thinking

Matthews claims that the quality of the data captured in the boardroom studio has been as good as, if not better than, anything that Ninja Theory has used on any of its previous projects.

Vicon Standard
Vicon helps the Royal Shakespeare Company bring the Tempest to life

Based on Stratford-upon-Avon, the Royal Shakespeare Company is one of the world’s most renowned theater companies.

The last 12 months have been transformational for Auckland, New Zealand, headquartered IMeasureU (IMU), by Matt Clarke, former MEASUREU CTO & new Business Development Director, Vicon.

In July 2017, the respective company synergies in the biomechanics research, via simple and seamless data lines of communications between our two organizations, quickly enabled trusted and open relationships between our two businesses.

Besse, IMU Chief Scientist and founder of the Human Performance Lab at Stanford University, says, ‘This is biomechanics in the wild.’

Coaches have long recognized the high performance and injury prevention value in movement efficiency and training load optimization, but have been constrained by the limitations of technology in getting accurate, actionable insights from the field that still allow athletes to move in their natural unencumbered environment.

Conversely, biomechanics researchers have long known that their expertise could add value to athletics programs. IMU, backed by Vicon’s in-house research and development function in Auckland, Thor and Mark, who met at the Auckland Bioengineering Institute and Auckland University, retain strong links with academia.

It’s via these links that Vicon and IMU will be on the leading edge of wearable biotechnology, for example, the machine learning work we are doing with the U.S. and Australian military to automatically identify and characterize different activities and movements in military sport, and clinical settings.

With IMU Step and IMU/Vicon data sync due for release early 2018, and a whole bunch of other research, sport science and clinical applications in the pipeline, I’m genuinely excited about what lies ahead for Vicon and IMU customers in 2018 and beyond.

‘IMU Step will bring about new understanding of biomechanics as we move outside the lab and obtain accurate measurements in the real world.’

Known for performing the works of Shakespeare and his contemporaries, the organization puts on around 20 productions a year, regularly tours the UK and internationally, and has produced the multi-award-winning Matilda. The Musical.

Vicon’s optical camera system was used to monitor the position of screens used to communicate the image of the world do not connect the dots between the two cohorts.

The IMU and Vicon teams were excited and proud to announce Vicon’s acquisition of IMeasureU in July 2017. The respective company synergies in the biomechanics research market, both Vicon and IMU’s traditional core businesses, are clear. Customers will save huge amounts of time and money when conducting their research, via simple and seamless data synchronization of their indoor motion capture system and outdoor inertial system, Vicon has the enviable reputation as the gold standard in motion capture technology, and native integration of indoor and outdoor data capture will serve only to enhance this. Besides bridging the gap between the lab and the field, another key tenet of the acquisition is Vicon and IMU’s combined ability to bridge the gap between biomechanics researchers and athletes. It has never ceased to amaze me that universities with some of the smartest scientists and greatest young athletes in the world do not connect the dots between those two cohorts.

Dr. Besier, along with IMU co-founder and head of development, Mark Finch, finds vicon’s in-house research and development function in Auckland, Thor and Mark, who met at the Auckland Bioengineering Institute and Auckland University, retain strong links with academia.

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The first example of this is IMU Step, which consists of low frequency, high efficiency, synchronized sensors on each ankle, which collect data on each step that an athlete takes. That step data is then analyzed via scientifically validated algorithms in the cloud and presented back to athletes and coaches as actionable insights via mobile/desktop/web apps. The IMU Step solution was built to help running-based sports like basketball, cross country, field hockey and American football to better manage lower limb load and reduce injury risk.

‘Being able to measure and monitor the impact loads of every step during training and competition provides an unprecedented ability to understand and act upon an individual player’s load profile.’

Alongside their collaboration with Intel, the RSC worked closely with leading production company and Vicon customer The Imaginarium Studios, as motion capture technology featured heavily throughout the performance, allowing the production team to create digital characters live on stage, in order to seamlessly combine classical theater with contemporary technology. Vicon’s optical camera system was used to track the whereabouts of moving objects on stage – some of which were held by the actors themselves.

‘The biggest challenge for us was making sure that the worlds integrated correctly, as this theatrical production of The Tempest included technology which had never been used on stage. By bringing in the expertise of Vicon and the use of their motion capture cameras, the performance was further enhanced and greatly added to the audiences’ experience,’ said Ben Griffin, Vicon’s Head of Studio at The Imaginarium Studio.

Opening in Stratford-upon-Avon Using Vicon’s cameras and object-tracking software, Tracker, marking the Royal Shakespeare Company were able to capture and track various objects such as the tambourine, on stage. It also allowed them to monitor the position of screens used to project virtual characters like Ariel. This meant that the production team could automate the projection of animated visual elements onto the moving objects on stage to provide the audience with a Pepper’s ghost effect. With precision tracking capabilities, the Vicon system maximized the impact of this illusionary experience. Tracker data also enabled the augmented reality aspects of the production and allowed magery to be projected onto screens in real time.

‘Certainly, the RSC haven’t done anything like this before and to my knowledge it has never been done to this scale or this ambition on the stage,’ says Pete Griffin, production manager at the RSC. ‘I think for most of the production team, being able to apply cutting-edge technology to a live environment.’

The set-up was complex and required a bespoke software solution, which saw a collaboration between Vicon and d3 software. Using the data generated by Tracker, the team were able to drive d3’s software using the positional/angle protocol – an industry standard that is used to drive interactive effects and lighting on stage.

The d3 system with Vicon integration ‘performed robustly and reliably for the whole run in Stratford – 62 performances, which amped up expectation, from my point of view, is still pretty impressive, given how hard we were pushing the tech,’ Griffin reports.

Taking a final bow at the Barbican With a long-standing relationship with one of London’s most iconic theaters, it was only right that the cast of The Tempest took their final bow at the Barbican. As the Barbican stage is larger and wider (proscenium arch format) than that of the thrust stage of the Royal Shakespeare Theatre, this final performance required a slightly different technical set-up in order to utilize the acclaimed cutting-edge technology.

Typically, cameras would be placed farther away in order to extend the tracking area of a space. However, with limited auditorium space at the Barbican, this wasn’t an option for the production team, who instead utilized Vicon’s Vero cameras. As the Vero cameras have a wider field of view, it was easy for technicians to place the cameras around the stage and continue to track the movements as they happened on stage. This afforded the team a greater level of control over the capacity to efficiently track movements at a very low latency. The Vicon cameras and Tracker software ensured that the performance finished its successful run and set the stage for future use of motion capture technology in theatrical performances.

The RSC production is now available to buy on DVD (www.rsc.org.uk).
Inside Boeing's Drone Laboratory:

Why you should be using Vicon Motion capture technology for drone tracking and control.

Lululemon's New Bra Took Two Years of Research to Create.

Engineers studied the ways breasts move to craft the perfect sports bra.
Javanmard in the pipeline, the company create human characters that looked and performed like real people. Before adopting a mocap system, the team had no prior mocap experience, and they approached the technology with a fresh perspective. "It was important for us to broaden our knowledge of the technology in order to ensure that it can be used to its full potential," said Nemati. “We wanted to be able to create realistic animations and support young creatives within the industry, and to attract and nurture home-grown talent throughout the area, it needed to stand out. Although animation is still a relatively new industry in Iran, Raymon Media elected to invest in up-to-date technology in order to ensure that it can offer high-quality content that rivals the best studios around the world.

"We looked at a couple of other systems as well as Raymon Vicon, but two factors really stood out to us when making that final decision," said Nemati. "First, there was a significant level of support offered to us by Vicon's local distributor ASG Co. Having a presence on the ground was very important and certainly helped during the procurement process – especially the reassurance of support once the system was installed. The second factor was the superior quality of the Vicon system and software." Raymon Media chose Vicon Vantage cameras, investing in a 24-camera Vantage 16 system. At 16 megapixels, the Vantage is the world’s most powerful mocap camera, able to deliver the highest-quality data and tracking capabilities that Raymon Media needed, along with speeds of up to 120 fps. Powerful analytics and intelligent system updates also came as standard, ensuring optimum performance during capture sessions.

"After testing the Vantage system, it became clear just how accurate the tracking data was. Additionally, Vicon’s Blade software allows us to easily create and overlay images onto CG environments," explains Nemati. "The system has provided us with high-quality results within a reasonably short amount of time."

Raymon Media's newly installed Vantage system is now the largest mocap studio located in eastern Tehran, the studio sits on a large, 154-square-meter mocap volume. But as the team had no prior mocap experience, it was vital that they received the right advice to help them to create and maximize the best capture volume for their requirements. After looking at all the options, Raymon turned to Vicon.

"For us, the challenge was guaranteeing a high-quality, full-performance capture rig for our studio space," Nemati adds. "The Vicon team used their knowledge and expertise to design the space and deliver a system that’s easy to use. They familiarized us with the whole motion capture process, teaching us how to set up the system, position and calibrate the cameras, capture the data simultaneously, giving Raymon Media a full-body capture of up to seven people. The studio is capable of full-performance, high-quality measurements of robot and engineered parts, including Salto's velocity based on the pose data. It..."
For Canadians, hockey is more than just a pastime – it’s a way of life. From a young age, many Canadians learn to skate. It can become as natural as walking to some, but the reality is that skating – and especially hockey – can take its toll.

Over the years, there have been several attempts to document the physical effects of skating and hockey can have on the human body. But there has always been an obvious and prohibitive obstacle: how do you conduct delicate, scientific research in the cold, on ice?

The Ice Hockey Research Group (IHRG) working out of McGill University in Montreal, Canada, found the answer to exactly that question when it turned to Vicon.

Mocap on Ice

The IHRG was created to evaluate the ergonomic and mechanical function of skates, sticks and protective equipment – in respect to performance and safety when used by people on the ice. A research partnership with Bauer Hockey Ltd. and the Natural Science and Engineering Research Council of Canada (NSERC) provides both financial and testing materials, which has led to the development of a unique graduate biomechanics program focused on how people use and react with ice hockey equipment.

The problems with using sophisticated tools to track skaters on ice are numerous. The cold temperatures and humidity can wreak havoc on delicate equipment over time, and attempting to create a temporary, portable solution typically involves placing hazardous wires and objects directly on the ice. Previous studies have attempted to recreate the movements of a hockey player using synthetic ice of a skating treadmill, but these lacked the validation of what it is actually like on the ice. It also limited the strides of people on skates, which on ice tend to be around five meters.

In 2014, Dr. David J. Pearsall, IHRG Director and Associate Professor of Kinesiology and Physical Education at McGill University, decided to risk it and try Vicon’s motion capture (mocap) cameras and software, equipment that carried a reputation for durability. The IHRG team began by creating a synthetic ice rink in order to get a sense of where the cameras needed to be placed and positioned. Once they were confident of their configuration, they prepared for the real thing.

“The Vicon setup on the ice replicated the in-lab configuration on a larger scale,” explains Philippe Renaud, IHRG Research Assistant. “This included extra safety measures, such as added weights to tripods for greater stability, and suspended cable bridging over the skating ice path, plus special gloves to type on the computer in the cold. It worked out really well.”

The Vicon system initially consisted of T-Series cameras running Nexus software, which were placed on and around a rink. Once the team knew where everything was going, they still needed to be able to get in and out quickly. According to Pearsall, the process was similar to a pit crew team in motor racing.

“Ice time is costly,” said Pearsall. “We can’t leave the cameras set up permanently, so we have to set up, test and take everything down within three to four hours. Everyone knows their jobs. We’ve got it down to a fine art.”

The indoor ice rink’s cold temperatures and high humidity were challenging for the cameras. There was the fear that the reflection from the ice would obscure marker tracking, but the equipment had no issues. The study represents a major achievement in 3D mocap, as the team was able to expand its range and calibrate a large 15m × 3m × 2m capture volume on the ice to record skating kinetics, with high intratrial reliability. They did run into an issue, but the team was able to turn to Vicon application engineer John Potter, who Shell says, “saved her project.”

“It wasn’t the cameras’ fault at all – the cameras did exactly what they had to do,” she says. “But having the Vicon support through the study was really invaluable. I can’t praise the support team enough for what they did. I might still be labeling my data if it weren’t for them!”

Vicon Standard

The Ice Hockey Research Group
Braves the Ice with Vicon to Study the Effects of Hockey

Hitting the Ice

The first on-ice study that the IHRG conducted compared the skating start biomechanics of male ice hockey players with different levels of skill and experience. Since then, the HHRG completed and published a second study, authored by Jaymee Shell, a masters graduate student at McGill University at the time. Shell studied the biomechanical differences between male and female players to identify potential factors that may be implicated in lower body injuries.

“As reported in prior running research, frontal plane differences between genders in hip and knee movements exist,” said Shell. “We wanted to look at male and female ice hockey players and see if similar lower body kinematic differences existed or were greater.”

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Following Shell’s publication, the IHRG decided to incorporate some of her methods and include female athletes in more of its studies.

Speeding Ahead

Soon after Shell completed her study, the IHRG upgraded their system to include a Vantage and Vero optical camera, bringing the total number of cameras to 18. Soon after the upgrade, the IHRG expanded their studies to include puck shots, which brought with it the added risk of a puck bouncing back and hitting a camera. To compensate, target nets were placed far enough back out of the capture area to reduce the risk of any collisions.

The team later added a Bionita camera alongside the Vantage to overlay the video with stick figure motions, making it easier to communicate their findings with others. EMG and force sensors were later introduced, all synchronized through Vicon software.

“To date, we’ve achieved a 15-meter FOV over the ice surface,” Pearsall explains. “In skating, when you’re at full speed, you can do 15 meters in two strides. As well, the increased pixel count and resolution of the Vantage cameras helps maintain the resolution needed to track the full body marker set.”

The IHRG’s success has also led to studies in other fields beyond hockey, including working with groups to better understand how footwear performs on snow and ice. With the help of the Vicon cameras, the team is able to collect more data than ever before, which could prove to be invaluable to people that consider the ice a second home.
Hip Hop Heritage creates a digital afterlife for British breakdancers

Arts charity uses Vicon motion capture to preserve the signature moves of a pioneering generation of UK B-boys long after their originators have stopped spinning.

Video can show you a great move, like a slam or a head spin, but you can’t analyse it clinically, as you can with mocap.

Recreating a dance revolution
On top of that, there simply isn’t a lot of content. Aside from June 1985 documentary Electro Rock, very little contemporary footage exists of 1980s British B-boy technique, with its unique fusion of the then-cutting-edge New York style and older British genres such as Northern soul and jazz fusion.

To rectify the situation, Jones turned to one of the stars of Electro Rock: former London All Star Breakers member – and, in Jones’s estimation, “probably the best-known breakdancer of that era” – Dolby D (David Bramsche). Along with former Kyle Minogue rapper Jazzy P (Pauline Bennett) and Yorkshire-based dancer 10 Tonn (Shane Fenton) and Sammy (Sammy Palmer), Dolby D was one of four UK breakdance pioneers recorded during a two-day shoot at Wolverhampton’s New Arts Centre theater in April 2015.

The shoot, overseen by Vicon support manager Bob Dimmock, used an array of 10 Bonita B10 cameras to record the dancers’ moves, resulting in over 25 usable takes per dancer, averaging 15 seconds in length. Vicon staff then processed the data in Blade, Vicon’s motion-capture software, and later in Shdgun, Blade’s successor.

“Using Shdgun gave us a big advantage and delivered clean, usable data automatically in one pass,” says Dimmock.

Bringing data to life
Meanwhile, in 2017, Martin Jones secured funding from Artfest, the University of Wolverhampton’s arts festival, to take the cleaned data a step further. Working through local producer Ben Field, Jones collaborated with DJ artist Christian Daren of Ananchthonis to turn the live recordings into an animated digital version of Dolby D performing his signature moves.

To maintain fidelity, Darkin stuck closely to the processed data. “I was surprised at how sharp it was,” he says. “What people call clean-up is often you as an artist making your guess at how the movement works. But this project wasn’t just about getting something that looked good: I was about cataloguing what someone does with their arms and legs when they do a certain move.”

To test the data, Darkin imported it to 3ds Max via MotionBuilder, assigning it to a basic CATRig. For the final animation, the data was retargeted to a stick Poser figure. Darkin adjusted the figure’s face to match that of Dolby D, making further adjustments within ZBrush, before exporting the rigged character to 3ds Max. The facial textures are based on reference photos of the dancer, composited in Photoshop to create a diffuse map.

Spinning and windmilling forever
We’re commemorating what [the originators of those moves] achieved as dancers. Through motion capture, we’ve captured their essence, and through the archive, we’re giving them an afterlife so that they can carry on forever.

Expanding Possibilities: Vicon Brings New Options to Brazil’s Nove de Julho University

The use of motion capture in the medical field is becoming more and more common, especially when it comes to issues related to movement.

Could you tell us a little about the project you are using Vicon on?

Using Vicon high-speed mocap cameras and Nexus software, the team specializes in clinical and investigative practices in movement analysis for musculoskeletal disorders. Methods of application range from analysis and clinical research. The focus of the research is on motion analysis, biomechanics, functional assessment and musculoskeletal disorders. The project began in 2013, with some of the results having been released as published papers, but patient care and research are ongoing.

What were the main benefits of using Vicon?

Besides the quality of the cameras and software, having the ability to integrate and study several areas all related to rehabilitation. The laboratory does not focus only in one area of knowledge, and we are integrating different professionals into the project. That allows us to provide assistance to many more patients that have been able to make the analysis of movement apply to different areas of knowledge using the Vicon system.

What are the specific goals of the project?

The laboratory has three lines of research in full development. All lines of research are in collaboration with professors and researchers at the UNINOVE, under Prof. Daniel Alves Gonçalves, Prof. Fabiano Politi and Prof. João C F Correia.

The first line of research uses motion capture to record the kinematic model in order to evaluate movement patterns with temporomandibular joint dysfunction (TMD). That has led to a working model that is currently being used to test the effects of TMD.

The second focus is to create a model to quantify the movements of the scapula, upper limbs and trunk for patients with shoulder dysfunction. The model is currently being validated. Final validations of the model will be performed in order to validate the effects of scapular dyskinesia and to evaluate the effect of lead progression on muscle strengthening in patients with shoulder pain.

The third and largest of the focuses involves the analysis of different clinical tests and different functional tasks of patients with patellofemoral pain. This project uses the associated Plug-in-Gait and OFM models to quantify major clinical tests involving motor control and biomechanical changes in patients with patellofemoral pain, and is also being used to identify in which functional task is most sensitive to differentiate patients from healthy women.

What is the biggest challenge you’ve faced?

The main challenges of the projects were to validate the models showing that they are reproducible, and that they can be used to identify the movement dysfunctions, and to quantify the effects of the treatments offered to the patients. These challenges were solved with exhaustive reproducibility studies of the models.

What is the project’s timeline?

The project continued in 2015 and are in constant development. Some results have already been published, but patient care and research are ongoing.

The data, recorded by Vicon’s mobile capture unit, and shown in the recent ‘Afterlife’ exhibition at Wolverhampton Art Gallery, preserves the signature moves of pioneering 1980s UK breakdancers, if not at the peaks of their careers, then at least within head-spinning distance of them.

Going beyond photography
The project was masterminded by Hip Hop Heritage founder Martin Jones: a former entertainment agent, organizer of the World Street Art Championships, and manager of breakdance crew Wolverhampton B-Boys, whose members included future drum and bass pioneer, Goldie.

In 2014, Jones’s photos of the 1980s UK B-boy scene became the core of a national archive, currently held at Dudley Archives and Local History Service. But when Wolverhampton B-Boys member Keião ‘Kiddo’ Anderson mentioned that his movement had been captured at Loughborough University, Jones began to explore mocap as an additional funding route from Artsfest, the University of Wolverhampton’s multidisciplinary approach, with three groups each using mocap technology to improve the lives of patients.

Located in São Paulo, Brazil, the Nove de Julho University is one of South America’s largest private higher education institutions. The school features five campuses and a dedicated research center, including the human movement analysis laboratory (NAPM). The lab is currently working on a major project featuring a multidisciplinary approach, with three groups each using mocap technology to improve the lives of patients.

Professor Paulo R G Lucarelli, a full researcher and professor in Masters and Doctoral Programs in Rehabilitation Science at the Nove de Julho University, discussed the multidisciplinary approach to clinical research and the role Vicon played to make it a reality.

How long have you been using Vicon?

I’ve been a Vicon customer since 2001. Vicon helped me to start my career in gait analysis. I continued to use Vicon cameras and software as I expanded my other fields, including foot, upper limbs (scapula) and jaw movements. I chose Vicon because of the quality of the products and an excellent relationship with the Vicon support team.

The QA team was always willing to help me, to advance my project, and the software was always updated to the best possible situation. Vicon has always been up-to-date, and the product is always improving and evolving, with the best quality and resolution.

The main line of research in the project is to analyze the movements of the jaw from healthy women.

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For more than 40 years, the institute has integrated the best of science and education into innovative care for all types of spine conditions. Focusing on the head, neck and lumbar regions, TBI’s team of physicians can address everything from chronic lower back pain to scoliosis in growing children. But to do so, they need as much information as possible.

Data lies at the heart of good treatment decisions, whether it is surgical or non-surgical care. This is why TBI built an advanced motion capture lab, supported by a generous grant from a New York investment firm that specializes in orthopedics, Vsicogiosi Brothers. The genesis of the lab began two and a half years ago at the hands of Dr. Ram Haddas, for whom the lab arose he explored several solutions, including a Vicon system where patients rate discomfort on a scale from 0-10. EMG data can help to quantify pain and motion. The pain that patients feel and how it’s measured is a critical part of the assessment and treatment process. It is regularly measured by a highly subjective rating system where patients rate discomfort on a one to ten scale. However, everyone has a different perception of pain, depending on a whole host of factors. Vicon and integrated EMG data can help to quantify pain and motion to establish more objective criteria.

Physicians can compare, for example, what a patient says with how fast they’re walking or how fast they’re walking. Sensory substitution and EMG data can help to quantify pain and motion to establish more objective criteria.

The TBI system consists of ten 16-megapixel Vantage cameras set up throughout a 900 square foot lab. The setup features five cameras in the back and five in the front, alongside two Bonta video cameras, one in profile, so doctors can see a patient’s gait from the side, and the other positioned in front – this particular camera is critical to assessing the pain scale. The camera records fine facial movements like an eyebrow or lip twitch, which occur when a patient experiences pain. The camera is used as a sort of psychological test, helping to identify the correlation between pain and motion.

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Medical in motion

Due to its global reputation and proximity to nationally renowned medical centers in Texas, the Texas Back Institute motion lab is extremely busy. In the first year, 100 patients visited the lab, and that number doubled in the second. Patients come to obtain analysis for a wide range of issues, including chronic pain, degenerative disc disease, osteoporosis, spinal stenosis, fractures and sacroiliac joint pain. Candidates for surgical procedures generally undergo testing one week before their operation for a baseline study, then return for a short-term follow up. They then finish with a final visit about a year after surgery.

Rather than focus on treadmill analysis, patients walk freely in the lab, as is more accurately mimics real-world movement conditions. Surgery is traditionally based on static imaging, but as soon as patients start to move, things change. The Vicon system allows physicians to see precisely how patients enter their gait cycle, and it enables analysis of joint angles and movements. When the spine is engaged, the lumbar, neck, thorax and head can all be affected.

A full body marker set includes a total of 41 markers. The TBI surgical team has also developed a spine model, adding nine additional markers. After the cameras are calibrated, the team collects data on gait, speed and cadence, measuring every joint angle – including the ankle, knee and hip – in three dimensions and at 100 frames per second. Electromyography (EMG) data measuring electrical activity produced by the muscles is also fully-integrated within the Vicon software platform. This provides physicians with a full picture of how much muscle energy a patient is expending in the gait cycle, the degree of saving in lumbar balance tests, lifting and balance details and more.

With height, weight and other measurements, the team can also calculate a patient’s exact center of mass and displacement. During a one-minute test, physicians can track the extent of displacement of the center of mass of a scoliosis patient, which averages almost a full meter, while a non-affected person moves only 20-25 centimeters.

These advances are all made possible for the first time thanks to the Vicon equipment and the TBI lab. Dr. Haddas also recently developed a new method for quantifying dynamic balance testing in spine disorder patients. After testing is complete, all data is processed using an auto-labeling technique. Reports are then generated for physicians.

“We know pain inhibits motion. Before treatment or surgery, patients tend to take shorter steps, and they adopt a wider stance to accommodate loss of balance.”

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“Is for every patient to be completely healthy and equal to someone who requires no surgery at all.” A lofty goal, but one that everyone involved is extremely proud to be a part of.

Take a closer look at the TBI Lab: https://youtu.be/BjNZ3n-Z2Zw

The sophisticated features of the Vantage system, including the onboard sensors within the cameras that detect excessive heat or movement, have also made the entire process simpler and more efficient. This comes in handy when someone bumps a camera, which can happen frequently in a lab environment. If this happened in the past, capture would need to stop and the whole system would need to be manually recalibrated. Now, recalibration is quick and done with a single click.

Reports generated by the lab help with patients’ diagnosis and establishing controls, pre- and post-surgery for both the short and long term. For surgical patients, one-year reports can be compared not only to pre-surgery reports, but also to healthy control subjects. Part of Dr. Haddas’ goal is to educate the medical community – physicians, physical therapists and the medical insurance industry – about how mocap-aided human motion studies can be used to better diagnose, treat, rehabilitate and track spine conditions. But the ultimate objective, says Dr. Haddas, “is for every patient to be completely healthy and equal to someone who requires no surgery at all.” A lofty goal, but one that everyone involved is extremely proud to be a part of.
In 2012, Teletón Rehabilitacion Infantil, one of Uruguay’s leading rehabilitation centers for children and teenagers, came up with an idea to help better serve its patients. Since its founding, we have managed to help more than 4,000 children and teenagers. Why did you choose Vicon? Because Vicon is a company with a long history in motion capture and life sciences. Ultimately, the software’s flexibility allows us to do what we need, and the hardware produces quality, precise data. The integration of third party hardware has also been helpful. Other leading hospitals frequently use Vicon as well, which is convenient. What have the biggest challenges been? We wanted to make the most out of Nexus, so learning all of the features took a lot of time and energy – not because the software is difficult to use, but because it is very flexible and it lets you do almost whatever you want. The support team helped us a lot with this.

What have the main benefits of this system been? It helped to create a more reliable infrastructure and a superior technology base. It has also been a big time saver and helped us avoid repetitive work. Creating our own pipelines and the ability to adapt the user interface has been a huge help as well. It is also nice to work with the world-leading company of motion capture.

Development in Motion Capture: Are the Life Science and Entertainment Markets Out of Sync?

Out of Sync. Jealous. This is how I would describe the Life Sciences (LS) and Entertainment (ENT) markets for motion capture. By Alex Muri, Asia Pacific Group Manager, Vicon and Managing Director, Lokemas

Virtual Reality

The Life Sciences market is peering over the partition at its flashy colleague, thinking how exciting their life must be, meeting movie stars and attending premieres. Meanwhile, the Entertainment market struggles through their morning coffee wishing they had a regular 9–5 job like the more stable Life Science market. You would think our customers from different markets are poles apart. I think they are just out of sync. What is important for the Entertainment market, right now is almost the least important thing for the Life Science market, but in the next period that changes.

I have always loved the line from the Simpsons, “Very few cartoons are broadcast live, it’s a terrible scar on the animator’s wrists.” And I have always thought that it sums up our LIFE SCIENCE customers... Very few papers are published in real time.

Traditionally, the difference has always been real time. Real time is/as/was of the utmost importance to the Entertainment market and the Life Science market couldn’t care less. Now the advances in real time requested by the Entertainment market are really driving advances in the Life Science market. Now that we have created games for the Entertainment market with Vicon Shogun, the Entertainment market is really interested in the biomechanics advances from the Life Science market to solve their animation skeletons. One market’s advances have always driven the other, but just out of phase. The Vicon staff and I know best what all our customers are doing, and when we can leverage all of this information it is truly one of the most satisfying moments of my job (Poking Buck at Da Dong in Beijing is a close second). One of those moments for me was at the ISB conference in Brisbane earlier this year. We wanted to take the real world question of, “What if we immersed an athlete into a Virtual Reality scenario to measure their ability under changing game situations? Think that sounds pretty easy? Just an extension of Wii Sports? Not exactly. The hard part was making sure we didn’t change the athlete’s behavior, but kept the software to measure at biomechanics lab levels. We were able to combine Life Science standards perfectly with an Entertainment application and make it valid for both.

We took third-party information from force plates and EMG systems and we Vicon Lock+ synced with the Vicon motion capture data in Nexus, overlaid synced HD video from the Vicon Vue, used the Vicon real-time SDK to pipe the information to the Unreal Game Engine to control the game world, or data streamed live in the same world space as the real world, displayed this in real time through the Vive VR headset, and displayed force vectors and biomechanical data in real time through a game engine, but most importantly making the goal of immersing an athlete into the game situation while still maintaining the situation as ecologically valid.

The advantage of using a game engine is being able to change the athlete’s perspective, all at the press of a keyboard. The Life Science community is able to leverage advances in programming and tools created for game engines like The Killing Floor or Batman Arkham City.

It is truly mind-blowing that a game engine that was developed to kill virtual creatures

Out of Sync. Why? The Life Science and Entertainment markets have always been out of sync. Traditionally, Life Science has driven the Entertainment market. However, with the advent of Virtual Reality and the desire for immersive experiences, the Entertainment market is now driving advances in the Life Science market. This shift in focus means that Life Science companies must adapt their technology to keep up with the Entertainment market, which can be a major challenge. The Life Science market is still very focused on research and development, while the Entertainment market is more focused on immediate results and entertainment. This can lead to a disconnect between the two markets, as they have different priorities and goals.

What are the main benefits of this system? The system allows for a more reliable infrastructure and a superior technology base. It has also been a big time saver and helped us avoid repetitive work. Creating our own pipelines and the ability to adapt the user interface has been a huge help as well. It is also nice to work with the world-leading company of motion capture.

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The Virtual Reality community has always been a driving force in the development of motion capture technology. They have pushed for real-time data and immersive experiences, which has led to advances in the Life Science market.

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In my article published in the 30th Anniversary edition of "The Standard," I took a look back at the achievements and progress made over the 30 years Vicon had been in business.

The closing paragraph concluded, "for Vicon motion capture in whatever form it takes." Given the recent events at Vicon, with an acquisition and a move for the head office after 32 years in our original location, this latest edition of "The Standard" provides a good opportunity to update you on the future for Vicon.

Since the 30th Anniversary edition article in 2014, we have been very busy with new product launches in our core passive optical technology area. We have refreshed and grown our entire camera range and launched a new game-changing entertainment software, Vicon Shōgun, to very enthusiastic market response.

With the recent acquisition of IMeasureU, we have the opportunity to bring a non-optical capture modality into our offering. Inertial systems have the advantage of being able to capture data unencumbered by the laboratory, studio or the requirement to have line of sight to cameras in the field. The power of using Vicon optical technology coupled with native inertial devices will bring many advantages to our customers. In addition, the IMeasureU technology has the capability of delivering outcomes to coaches who are helping injured athletes return to play through the implementation of cloud technology, tablet-only system control and user-specified dashboards. I strongly believe that these techniques will also benefit our Vicon customers in the longer term.

And finally, a few words about our recent move. Vicon HQ has been located in Botley, a suburb of Oxford, UK since the company’s beginnings in the early 1980s. But over recent years it was becoming obvious that it was no longer suitable for our needs. Throughout the late summer, Vicon UK moved to a ground up refitted, world class facility in Yarnton, close to Oxford. The facility has vastly improved and expanded production facilities, with four motion capture volumes that can be combined in several ways up to a single 14m x 26m x 6m volume for large scale captures and testing.

We continue to be inspired by you, our valued customer family, and are committed to bringing new technologies to enhance and complement the use of motion capture, whatever the requirement.