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VICON - 2017 EDITION



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From larger-than-life video game franchises to interactive technology, The Capture Lab in Vancouver, Canada is the largest motion capture facility in the world. For more than 20 years, it has contributed motion capture, digital doubles, facial animation, and virtual camera services to more than 225 high-end animation, video game, and visual effects productions around the world.

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Upgrade and implementation

The Capture Lab has been using Vicon technology for more than 12 years, with their previous system consisting of Vicon's MX and T-series platforms. "While these platforms have been a real workhorse for

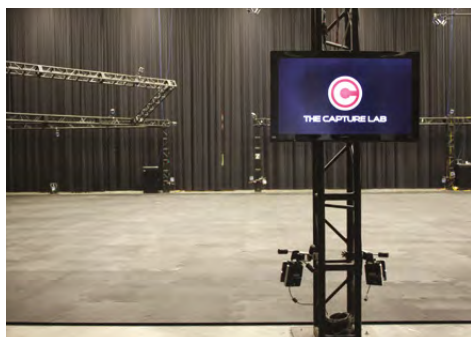
us, we were starting to reach the ceiling on what we could achieve," says Troy Thibodeau, motion capture specialist at The Capture Lab.

After evaluating a number of systems, The Capture Lab chose to upgrade to Vicon Vantage. As the next-generation camera platform, Vantage combines advanced, powerful, and intuitive features, making it easy to use and accessible for the new generation of motion capture applications.

The Capture Lab determined that the Vicon system provided the most robust solution, especially when compared to the other systems they were assessing. "After evaluating several platforms, we saw the value in Vantage – the V16 specifically," says Thibodeau. "The Vantage platform has certainly helped us to keep up with

the high demand from EA. Capturing clean, quality data means that our processing pipelines are streamlined and we can maintain delivery of the large quantity of data required to continue to fuel EA's triple-A titles."

Thanks to the Vantage architecture The Capture Lab is able to augment its capture volume in ways that they simply never could before, allowing them to achieve new and unique capture scenarios. The system also helps the lab achieve more cubic volume coverage from each single camera, which helps during their larger captures. Another reason The Capture Lab chose Vantage is because it ideally fits into the lab's processing infrastructure, and with the massive increase in data quality they can see instantaneous results.



"The Vantage camera is a great piece of technology, superseding the coverage scope and precision marker fidelity of our previous cameras," explains Thibodeau. "You need more than just great hardware to facilitate motion acquisitions and Vicon provides the complete package, with an advanced software suite that is completely customizable and scalable for our unique needs."

Vantage in action

The Vantage system has brought numerous features and benefits to The Capture Lab, including higher fidelity data quality, denser camera coverage using less cameras than their previous system, higher resolving power, easier system maintenance and organization, and overall stability. The Vantage camera feedback has also provided The Capture Lab with greater ease of use – especially with large camera counts.

According to Thibodeau, The Capture Lab's decision to upgrade to Vantage was due in part to its fast and simple configuration into the Vicon platform: "The robustness of Vicon's software and its seamless integration with Vantage have allowed our setup times to decrease, while increasing the amount we can capture, and most importantly, the quality of our data," he says.

"The new Vantage camera uses a standard Ethernet connection schematic with very stable connectivity, which has allowed us to build connection hubs around our studio," Thibodeau says. "With the amount of acquisition that The Capture Lab provides, we're frequently reconfiguring our volume to accommodate new and unique shooting opportunities. With previous camera systems, it would take days to re-cable and reposition our cameras, but with Vantage and our unique connection hubs, we're able to completely reconfigure our volume in a matter of hours!"

The lab was initially enthralled with the amount of coverage a Vantage camera provides, but Troy and his team still continue to find benefits from other features the camera offers as well. "The 'Tap to Select' feature has helped us expedite our camera

aiming times, especially when you've got higher camera counts," he explains. "The Vicon Control app also gives us the ability to monitor the data from anywhere in our studio, and the color coded indication lights and LCD screen on each camera have helped to keep everything organized and alerts us to potential degradations to our captures."

"The Capture Lab has always been a studio that uses visible strobes, but our switch to Vantage marks the first time we've ever used full IR light in any production," Thibodeau says. "We've certainly noticed less fatigue from the actors and direction crew as they're not immersed in intense lighting conditions all day."

The lab also has a dedicated space for capturing range of motion (ROM), and has recently added four Vicon Vue reference cameras to this particular stage. Vue gives the lab extended control while setting up solving skeletons by providing calibrated video overlay of the ROM. As a turnkey solution, the Vue system simply plugs into their stage and provides an instant, synchronized and calibrated video solution. The solution further advances the quality and fidelity of final motion solves by enabling the lab to refine setups with a greater level of control than before.

A partnership built on collaboration

As the motion capture industry has developed, the need for real-time information and feedback during shoots has never been greater. To meet this need, Vicon continues to develop solutions that are powerful, flexible and resilient. "When we made the decision to choose Vicon, we not only brought in a complete hardware and software solution, but we added a valuable partner to the The Capture Lab organization," Thibodeau says. "Vicon has always provided swift feedback, and truly works with us to help resolve issues, and generate new solutions for complex problems. The support is prompt, the people are passionate, and they provide top-tier products and innovations that continue to support us in providing paramount motion acquisitions."

According to Thibodeau and his team, Vicon has been a great partner; always listening to their needs and communicating with them to provide the best solutions. "Working with Vicon, we have iterated and improved almost every aspect of our motion capture shoots," he says. "The end result is the most robust capture system we've ever used – one that's easy, feature rich, and provides the highest of quality."

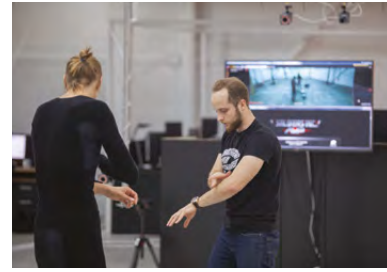
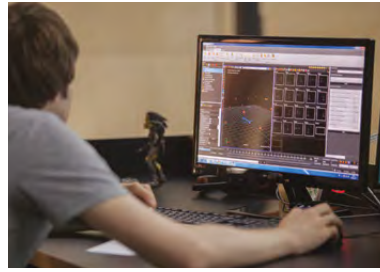
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Bringing Alien vs. Predator to life for Plarium's Soldiers, Inc



With over 180 million registered users for its social and mobile games, Plarium is used to providing entertainment on a large scale.

When they hooked up with Twentieth Century Fox to create the Alien vs. Predator (AVP™) event for Plarium's hit Facebook game, Soldiers, Inc., the games developer knew that it would have to bring something special to the party.

The Massively Multiplayer Online (MMO) strategy game is set in 2019 in the fictional realm of Zandia where foreign powers, multinational companies and underground criminal organisations are all fighting to locate rare minerals in a starving and depleting state. The AVP addition to Soldiers, Inc. ran for 90 days and included two separate Alien and Predator campaigns at 12 missions each.

Marketing the event called for Plarium to create a powerful cinematic trailer featuring the characters from the game. This had to adhere closely to the look of the Twentieth Century Fox film series. The quality bar was thus set high and a high level of realistic CG animation was required.

"Mostly, the hard work on the video, concerned the animation of the Predator," adds Vyacheslav Lisovsky, Head of Video Production Department. "Very specific animation was required, such as the character's hand movements, so it was better for us to work with mocap for this purpose."

Planning for capture

"We made the decision a year ago to buy a motion capture system," explains Lisovsky. "Previously we were animating everything by hand in 3D. We got in touch with Vicon to find out the best system for our purposes — to create realistic animation for cinematics and visual assets for trailers."

"We looked at a couple of different companies before we looked at Vicon, but

one of the things that we found attractive about them was that they were so responsive to our questions," says Nicholas Day, Creative Director at Plarium. "They told us what size of space we'd need, what lighting was best, even what sort of materials to build the room out of, and what levels of reflectivity do we have to work with."

"Bonita was a nice model to start with as it gave us just perfect quality for simple animations - for walking or movement," says Lisovsky. "There are higher-end models like Vantage, which have higher resolution and are able to handle more space than we have, but the Bonita was the best choice for us to begin with."

Taking on the Predator™

"We were working with a limited license from Fox, so the actual time we had from conception to the finished video was two months" says Nicholas Day. "Up until then this would not have been something we would have tried, because there would have been no way to realistically do this with key frame animation to get the level of quality we would need." In one sequence the team wanted to animate the Predator's arm, as it pushes wrist-mounted buttons. A local actor was brought in and instructed in how the Predator moves, using footage from the movies.

"We didn't capture the fingers, but we captured the micro movements as the right hand hits the left hand and the whole body reacts," Lisovsky recalls. "We took the top five takes, the ones that really hit the target, not from technical side, but based on the pacing, style and the way the actor was moving."

As lead animator, Lisovsky used the mocap data straight from Vicon's Blade software, rather than resort to an intermediate

retargeting application like Autodesk MotionBuilder or IKinema.

"I built my own workflow using Blade and Maya Reference System," Lisovsky explains. "I uploaded a few skeletons and was able to retarget the mocap data directly to the Predator rig in Maya - the data was that clean."

"The animation took two weeks from shooting to final animation. If we were to do this by hand, with key frame animation, it would have taken us a month or maybe more, so motion capture offered a huge speed increase."

Sound investment

Simultaneously, the Plarium team was working on sound design and also trying to add a score to the trailer. The benefits of the Bonita motion capture system could be seen here too.

"The fact that we had these data points for the animation meant that we could pre-rig it and show loosely where everything was going to be, before we actually came to the final rendering," says Nicholas Day. "So we were able to get the composer and the sound FX studio involved much earlier, in a way that we couldn't previously do with keyframes."

"To be honest, Fox was really blown away by the trailer," concludes Day. "They seemed pretty impressed that we'd done it all in-house, in such a short space of time."

"It's great that we can make marketing content and trailers, but with mocap we have the technology now to actually do really cool in-game rendering, to actually use it in projects," he adds. "We're going to make the games pop out a bit more, and make them feel more personal to the player."

The Digital Design Studio (DDS)



The Digital Design Studio (DDS) the team behind the regeneration of an icon – Meet Amy Johnson.



Our intense learning and research environment exploits the interface between science, technology and the arts to explore imaginative and novel uses of advanced 3D digital visualisation and interaction technologies.

The DDS has completed a large portfolio of projects with business and industry in Scotland, the UK and Europe, centred on our expertise in real-time 3D visualisation, 3D sound, modelling, motion capture and animation. In particular, the DDS has built a reputation for world leading work in 3D visualisation for heritage, as well as for work in a number of flagship projects. The DDS works on a wide range of motion and 3D data capture and visualisation projects for commercial and industrial clients. The DDS sound dubbing studios are regularly used for network television and film productions, as well as within the DDS' own visualisation projects.

At DDS we have used Vicon systems for motion capture within a number of our commercial projects. When we first purchased our system in 2009, we set out to equip our new customised offices at Pacific Quay in Glasgow with the best equipment available. The Bonita camera setup was ideally suited for its head tracking capabilities which also allowed 3D content to be viewed through our projection system on to what was one of the largest Active Stereo projection screens in Scotland at the time (12m wide by 8m tall). Due to

the system's ease of use and easy camera calibration, we found that we were easily able to reconfigure our capture area for a variety of projects and client requirements ranging from large battle scenes to intimate character driven interactions. We recently used our system to assist in the creation of the recent Warhammer 40k: Dawn of War 3 trailer and capturing sports movements like football, golf and training scenarios. We have also used the system in projects for large manufacturing organisations to help them assess safe working spaces in restricted areas as part of their work on Human Factors Analysis.

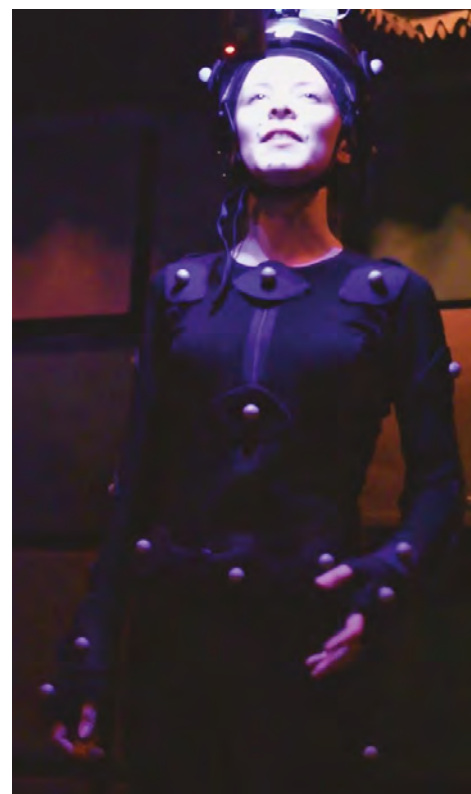
Our most recent use of the Vicon system has been in a project for The University of Hull. The Hull University staff within the HIVE (Hull Immersive Visualisation Environment) facility had become aware of the 10 Character Stations we had created for the Battle of Bannockburn Visitor Centre. They were impressed by the quality of our work and commissioned us to create two sets of interactive characters to be used to support two important events occurring in Hull in 2016/17 which they are involved in promoting. The first of these was The Amy Johnson Festival marking the 75th Anniversary of the death of Amy Johnson, the first woman to fly solo from England to Australia. The second and larger project is in preparation for Hull becoming the UK's City of Culture 2017, and this project is to create a virtual, William Wilberforce, the Hull born emancipator of slaves who was a leading politician and one of the main activists responsible for the eventual abolition of slavery in Britain in the early 19th Century.

In both of the projects undertaken we used our Vicon system along with the close integration into our Autodesk pipeline to capture the motions of our performers and visualise the characters at a speed which has helped us to help our client to meet their own tight deadlines. Pre-rendered sequences continue to be delivered for these projects and will be installed on large screens around Hull to engage with the public visiting the City and tell the story of the exciting life of both Amy Johnson and

William Wilberforce in an informative and engaging way.

By using our Vicon system we have been able to offer our clients robust motion capture data with the most minimal level of clean-up. By using the benefits available through the Vicon Blade and Autodesk MotionBuilder integration effectively, we are able to work closely with our clients and this provides us with the opportunity to visualise their data in a virtual environment at the time of capture.

We are scheduled to be producing more interesting character work for additional clients in the near future and we are looking forward to working on these exciting projects and continuing to get the best possible use from our Vicon system.





Lucile Packard Children's Hospital Stanford helps prevent youth injury with Vicicon



More than 46.5 million children participate in sports each year in the United States alone, and school and recreational sports club teams are becoming more popular.

Because of this, we're seeing today's athletes getting younger. But this is also leading to more injuries in children.

According to the Center for Disease Control, more than 2.6 million children aged 19 and under are seen in emergency departments for injuries related to sports and recreation each year. With the substantial cardiovascular and musculoskeletal benefits of participating in sports, reducing orthopedic injury risks is a key goal for the Motion and Sports Performance Lab at Lucile Packard Children's Hospital Stanford, which is working hard to find new ways to evaluate and improve each athlete's unique set of factors.

The Motion and Sports Performance Lab opened in August 2016 and focuses on three distinct areas: injury prevention, objective return to sports, and sports performance and enhancement. "There are high-skilled orthopedic surgeons at

Stanford, but my job is to keep all these kids away from them as much as I possibly can," says Michael Orendurff, PhD, Director of the Motion and Sports Performance Lab.

The Motion Sports and Performance Lab tries to "prehab" kids, a form of strength training that aims to prevent injuries before they actually happen. The lab works with 11 athletic trainers that travel out in the field and meet with athletes, coaches, parents and schools to train kids and teach them ways to help prevent injury, specifically ACL risk, which Dr. Orendurff says is one of their main areas of focus. "We have baseline data from their pre-participation exam and can follow their progress with multiple assessments of their athletic performance," says Dr. Orendurff.

"Our athletic trainers identify individuals who may benefit from an evaluation in the Motion and Sports Performance Lab and the

lab can use the data that we produce with patients to help recommend the appropriate intervention, whether it's surgery, rehab or time off," continues Dr. Orendurff. Whether athletes are trying to prevent injury or are going through rehab after an injury has already occurred, the lab will prescribe specific training protocols, interval work, weight lifting, or plyometrics to teach the athletes how to do the work and then try to implement that with their coach or parent.

Trusted mocap technology

Helping Dr. Orendurff and his team combat youth injuries is the very same technology that brings animation to life – motion capture. Vicicon technology offers the very best quality data measurement and outstanding motion capture analysis that the Motion and Sports Performance Lab needs to evaluate and recommend appropriate intervention for young athletes.

The investment at the lab is Dr. Orendurff's seventh Vicon system. "I know all the different motion capture systems that are out there," he says. "Having worked with so many of them, it's the ease of use, accuracy, and the process throughput that drove me toward the Vicon system once again. I know the software well, and it's constantly improving and changing for the better."

The lab invested in a 20-camera Vicon system with 16 and 5 megapixel Vantage optical cameras, and two Vue video cameras. With a space 55 feet long and 40 feet wide, the Motion and Sports Performance Lab's volume space is one of the largest Michael's worked with. "It's a big space," he says. "To put that into perspective, I can get five or six strides on each side as someone runs through the volume – it's great! We have two Bertec and three AMTI Optima force plates, and they were set up easily and work seamlessly with the Vicon system."

Vicon Vantage has been intelligently designed to work cohesively with each of its components to provide real-time information to the system operator. Crucially, it continuously monitors its performance with a host of new sensors giving the user visual feedback through the on-board camera display both in the software and on Vicon's Control app. "I especially like the 'bump' feature – letting me know if a camera has been hit during an athletic maneuver – it saves the data we might have lost otherwise."

Vicon Vue enables seamless calibration between optical and video volumes, ensuring the optical and video views are perfectly aligned to capture the finest of details, something that Michael's lab needs with the types of evaluations they perform on athletes. Vicon Vue is the industry's first full high definition synchronized video camera, providing clear and precise video footage in the mocap volume.

Benefits of industry-standard technology

Having been in the industry for more than 25 years, Michael has worked with Vicon technology since 1992. He has run four different labs and has encountered various challenges with each of them, one being the size of the space. Not having enough space or having cameras positioned in ways that aren't conducive to what's needed to be captured makes it difficult to collect all the appropriate data.

"There's a lot of trunk flexion in the movements the athletes perform in the lab," explains Dr. Orendurff. "For example, we'll have people do sprint starts or cutting, and when you lean forward doing those movements, the cameras that are

positioned high around the room prevent you from seeing the pelvic or chest markers or the front of the body." The large space at the Motion Sports and Performance Lab has allowed Dr. Orendurff to place Vicon cameras six inches off the floor. Having the cameras positioned this way helps the team capture the trunk and pelvic markers in the flexed position, enabling them to capture more precise lower extremity movements during testing and evaluations.

Youth athletes to adults

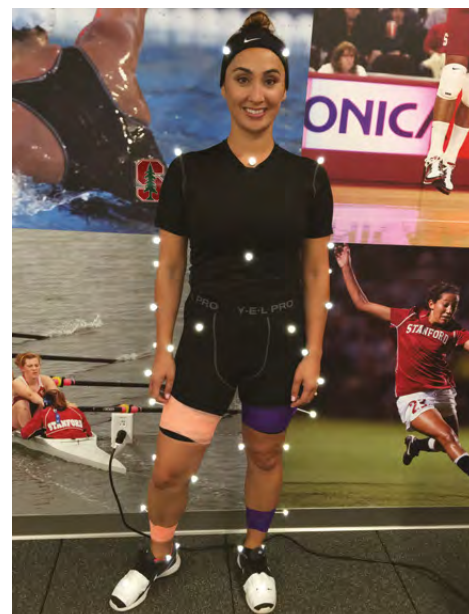
The lab has also been working with wearable sensors in the field, putting sensors on athletes to determine how hard they're training, what they're doing, if they're over training, and what their problems are. "We have a group, the Young Athletes Academy, which is a group of kids from different schools and club sports teams from around the Bay Area," explains Orendurff. "We have about 16,000 kids who play various sports in the academy. We provide free pre-participation exams for them and look for weaknesses like musculoskeletal, cardiovascular and cardiopulmonary issues. We basically want to make sure that no one is going to have a catastrophic injury."

But it's not just kids that benefit from the lab. One of the first patients the lab saw was actually an adult. "We had a pediatrician who usually is the one who sends kids to the lab come in because he had some knee problems," explains Orendurff. "It was good – he came in to experience first-hand what his patients will go through when he refers them to the lab."

Support that goes the distance

The initial experience to get the Motion and Sports Performance Lab up and running didn't go as smoothly as hoped, but once Vicon entered the picture, all of the puzzle pieces began to fit into place. "Getting the Vicon system and our lab set up went fantastic," Orendurff says. "I have to say, my standards are pretty high, and it's still really fantastic. Vicon came out and did the install after they rushed the order due to previous unforeseen complications."

Vicon staff were on-hand at the lab for two days to help Michael with the install. On the first day, they started working with the cameras, using the Control app to quickly aim and calibrate them. "By the time the second day came, we were already collecting data and working on marker placement," Orendurff explains. "I've never had an install go that smoothly. It was a far cry from my previous experience with another motion capture company. Vicon are always there helping us refine our workflow. They're instantaneously responsive to everything that we want and need from them. We collected our first patient – a VIP from



Stanford – on the third day we had the Vicon system. It was flawless and everyone was extremely impressed."

Youth athletes in good hands

Vicon technology is essential to the lab to consistently deliver the quality data capture required to help youth athletes prevent major injury and improve their performance. "I'm amazed how many overuse injuries I see in young children that I would normally see in people in their 20s or 30s," says Dr. Orendurff. "Sports are great, but rest is really important for athletes' bodies, and that kind of intervention is really the focus of what we're doing at the lab. Now we have the data to convince athletes, parents, physicians and coaches, and it's really helping to keep kids healthy and active."



Melanie Golding
@melgold6



Thank you @Vicon for a great couple of days, our new #Vantage system is up and running #biomechanics



Dyson cleans up robotics with Vicon's motion capture



There are few names that are as synonymous with innovation as Dyson.

The company has become a watchword for invention and improvement ever since its founder and chief engineer, James Dyson became frustrated by his vacuum cleaner's performance and took it apart to invent the world's first bagless vacuum cleaner.



Today, its vacuum cleaners, hand dryers, bladeless fans, heaters and more are sold in over 70 countries with design quality at the heart of its success.

The Challenge:

A key area for future Dyson technology is robotics. The company began working with Imperial College's Prof Andrew Davison in 2005 and in 2014 announced a new £5m robotics lab based at the college. The unveiling of Dyson's 360 Eye robotic vacuum cleaner is just the start of exploring future robot technology development for the home and beyond, in both the Imperial College facility and in Dyson's R&D laboratory at their Malmesbury headquarters.

Enabling robots to work in the real world, through improved vision and computer processing power is no easy feat. It might sound easy to navigate a house. But every home has different furniture, curtains, flooring - all laid out differently and liable to be moved. High-performing domestic robots therefore need to undertake complex tasks while adapting to a constantly changing environment - something many existing products on the market simply can't do.

Chris Smith, Dyson electronics test systems leader, takes up the story: "At Dyson we encourage our engineers to test ideas rather than spending lots of time thinking

hypothetically. That means we do lots of testing and validation particularly around robotic behaviours. We need to be able to test for every user interaction we can think of."

When Dyson began planning for a new advanced robotics laboratory at its Malmesbury headquarters they started looking at new motion capture systems to further increase their understanding of machine behaviours. Much of the motion capture work takes place in the development testing phase to test the implementation of designs and software before products go into home trialling tests.

Vicon technology has given them the opportunity to get real-time and more accurate data as well as gain greater insight into measurements that were not previously obtainable with the original system such as heights, pitches and rolls. The Bonita family of cameras can capture speeds of up to 250 fps, which means Dyson can easily and precisely capture fast moving objects and track multiple items in the laboratory workspace. The robot testing team combines the motion capture technology with optical recording and a daylight simulator (which replaces the role of the sun) to ensure the lab is always at its optimal set up and closely resembles real-world conditions.

The Benefit:

The cameras have been vital in helping the team test the robot behaviours. It's used to test overall cleaning patterns such as where the robots go and how they got there. They have also used it for testing and improving navigation systems. Finally it's also used for tracking control, to ensure the robotic cleaners take the most efficient cleaning paths, and object tracking the robot's ability to detect and navigate around obstacles in the home.

Mike Aldred, Dyson Robotics lead, said: "Motion capture has allowed us to split and co-develop testing so we can help the robots to better understand 'where they are' and behaviours 'what they do with where they are'. The Vicon technology allowed us to test extremes - it meant we could work out how much tolerance the robots will take

before they break. We've been able to take them to high speeds to test safety, evaluate reaction times for movements and even look at what happens if they fail at speed."

"It helps us gauge how the robots will act in different scenarios such as on different types of carpet" says Aldred. "If you've got a shagpile carpet rather than a traditional household carpet it means we can really understand exactly how the cleaner sensors would react, and how their movement could affect cleaning ability in order to give us a better sense of the error model. Having real-time data allows us to test, see the results and immediately react to them."

The results from the testing haven't thrown up major surprises but when things did go wrong it has helped them confirm that their thinking was on the right lines. For example it helped the team to analyse when slips or traction in carpets were caused by bumps - so the robotic cleaners were able to make a decision on what to do next. It's helped bring together what the robot thinks it's doing closer to what it's actually doing.

Improved accuracy of data has also reduced having to repeat tasks with the number of cameras also allowing Dyson to scale up their test area for more scenarios. Aldred adds "Taking out the need to repeat tests means we have to do a lot less iterations. Previously we conducted about 100,000 tests and now we've rapidly reduced the amount of tests meaning we are between 25-100 times quicker depending on the tests we are doing."



The gait-lab of the future



Over the past 20 years the technologies and techniques available to clinical gait analysis have vastly improved.

Frans Steenbrink - Motekforce Link BV

There is an ever-growing body of literature showing its usability in various populations, such as cerebral palsy, stroke and orthopedic patients.

Based on clinical gait analysis, a patient's pathological walking condition can be identified, a well-defined treatment protocol can be planned, and the effect of the intervention can be monitored. Unfortunately, the availability of clinical gait analysis for patients remains restricted to highly specialized [academic] medical centers. Gait labs require a significant amount of space (~77m² on average), which may present challenges in most hospitals and are often left unused for 70% of the time generally only used for assessment and not treatment. The potential for clinical gait analysis is huge, but its field of application is still far too narrow.

Over the past years, rehabilitation technology used for clinical gait analysis has taken a giant leap forward; evolving from primarily scientific setups in research labs to applied research facilities and even certificated medical products. Motekforce Link BV (Amsterdam, NL), in close collaboration with Prof. Jaap Harlaar (VU Medical Center, Amsterdam, NL) and his team, have developed a force instrumented, dual-belt treadmill for clinical gait analysis. In this Gait Real-time Analysis Interactive Lab (GRAIL), patients walk on an enlarged treadmill (walking surface 2mx1m) while Vicon cameras collect motion data. The treadmill can run in a self-paced mode (i.e., it reacts automatically to the changes in pace of the subject), which allows the subject to walk naturally while placed in a speed-matched Virtual Reality (VR) environment with 180° field of view projection. This allows endless natural walking in a realistic environment within the footprint of the treadmill. All gait parameters (i.e., spatio-temporal parameters, joint kinematics, joint kinetics and estimated muscle forces) are calculated using the Human Body Model and are available in real-time.

This treadmill based set-up allows for continuous recordings during walking, which is not typically a priority in conventional gait analysis. For example,

in one minute, over 30 full gait cycles can be collected, allowing for analysis of means, variations and changes over time. As all data is available in real-time and can be projected on the screen, predefined parameters of the gait pattern can be assessed directly, which can potentially be used for tuning prosthetic alignment in lower limb amputee patients.

Although for many patients and clinical users this steady state gait analysis will be sufficient, recent studies indicated the benefit of more challenging environments to examine functional gait. The treadmill can be mounted in a robotic frame (CAREN), enabling fast and dynamic pitch and sway of the complete walking surface. This unique concept, together with the interactive VR system, facilitates various types of visual, mechanical and cognitive perturbations during gait. This perturbed functional gait analysis might be a more sensitive and revealing way to assess movement pathologies. Moreover, it enables training for specific real life challenges such as slips and trips, which has tremendous implications for practical implementation.

The option of real-time feedback on any gait parameter provides unique possibilities for gait retraining modalities through a gaming medium. Specific examples of available applications include gait retraining after stroke, gait retraining to treat knee osteoarthritis, dynamic alignment of prosthesis and orthoses, obstacle avoidance for fall prevention, and cueing applications for patients with Parkinson's disease. With more potential applications still to be developed, this kind of clinical gait analysis and training will enhance clinical practice in rehabilitation, neurology and orthopedics.

Close collaborations between medical centers, academia and industry will enhance the use of [functional] gait analysis in routinely clinical practice by allowing co-production of the technology and techniques. As an example, Motekforce Link currently collaborates with the VU Medical Center to develop and evaluate a real-time feedback protocol to enhance information gained from clinical gait analysis of children with Cerebral Palsy which can also be effective in functional gait training.



Prof. Philip Rowe (Strathclyde University, Glasgow, UK) and his team have also been developing uses of the technology in many project areas, including a protocol to assess falls risk in the elderly, based on various types of perturbation, or to develop biomechanical feedback programs for training. Together with Motekforce Link, Prof. Rowe is setting up a consortium to evaluate orthopedic arthroplasty patients, focusing on function restoration post-surgery. Strathclyde, Motekforce Link and Vicon teamed up during the International Society for Biomechanics in July 2015 in Glasgow to run "the ISB Experiment." Over three conference days, 69 subjects walked in six different conditions, equaling 414 full gait analyses performed!

Within a year of ISB we now have six such systems within the NHS in the West of Scotland, showing both the clinical potential of these methods and the ease of implementation they have within clinical services. We boldly feel that we stand on the brink of a transformational change in the role of clinical gait analysis.





Hiroshima University discovers the truth behind the 'pregnancy waddle'

During pregnancy, a woman's body changes dramatically, and thanks to a research team from Hiroshima University, the unique way mothers-to-be walk has been analysed for the first time.

Dr. Koichi Shinkoda and his team have used Vicon T-Series cameras and NEXUS software to study how pregnant women adjust their daily movements, like rising from a chair or changing direction while walking – confirming that the 'pregnancy waddle' does in fact exist.

With accidental falls causing 10-25% of trauma injuries during pregnancy, the research team conducted the study in order to gain more knowledge around the movement patterns of pregnant women – in order to develop guidelines to prevent falls.

The study comprised of eight pregnant women with a mean age of 34.4 (SD 5.9) years, a mean height of 160.3 (SD 4.1) cm, and mean pre-pregnancy body mass of 55.4 (SD 6.6) kg, who formed the maternal group. Seven nulliparous women with a mean age of 29.3 (SD 2.4) years, a mean height of 156.5 (SD 5.6) cm, and a mean body mass of 52.4 (SD 7.6) kg also volunteered for the study and formed the control group. The maternal group was examined on the following three occasions: between the 16th and 18th weeks of gestation (Exam 1), between the 24th and 25th weeks of gestation (Exam 2), and between the 32nd and 33rd weeks of gestation (Exam 3).

Previous movement analysis studies almost exclusively used men of European descent to create mathematical models of the human body. One study in 1996 used pregnant women in Canada, but due to the imaging technology available at the time, the data has become vastly outdated.

"Biomechanics studies like ours, of how humans move, are valuable for many things, like making our built environments safer or designing mobility skills," said Koichi Shinkoda, Ph.D., Professor in the Graduate School of Biomedical and Health Sciences at Hiroshima University.

The maternal group were examined on three occasions using 24 infrared reflective markers which were attached to the lower trunk and lower extremities of the women. The lower edge of the 10th rib defined the top edge of the lower trunk segment, and the greater trochanter defined the bottom edge of the lower trunk segment. This segment division was based on previous studies involving Japanese individuals and was chosen to enable comparisons across studies.

Standing posture was captured using eight T10 cameras while the subjects were standing comfortably and looking straight ahead. The coordinates of the markers were identified using Vicon NEXUS motion analysis software, and during the movement tasks, 35 markers were placed on the women according to the Plug-in-Gait Full Body Model. The centre of the bottom edge of the posterior surface of the lower trunk segment was defined as the origin of the coordinate system, and the left-right, antero-posterior, and vertical axis of the lower trunk segment were defined as the x, y, and z axis, respectively. The coordinate system was orientated so that the right was positive and the left was negative.

The moment of inertia of the lower trunk segment about the y axis was significantly larger in pregnant women at Exam 3 than in the control group. The result in this study indicated that the moment of inertia was affected by the change of body mass during pregnancy. Thus verifying the scientific community's current understanding of why pregnant women walk differently. Even during the first trimester, a pregnant woman's centre of mass is farther forward, causing them to lean backwards while standing, and bend their hips less while walking. This combination can cause a pregnant woman to trip over her toes and more easily lose her balance.

"Prior to our study, there were almost no theory-supported models of the movement of pregnant women. This model is just the start of our goal of contributing to a safe and comfortable life before and after childbirth for pregnant women," said Yasuyo Sunaga, a doctoral student in Shinkoda's lab and first author of the recent research paper.

"We want to find the ideal way for new mothers to carry their baby, what exercises are most effective to return to non-pregnant fitness, and what physical postures are best for work in the home or office. Now that we have the appropriate data, we hope to apply our model and make it possible to problem-solve these concerns of daily life," said Sunaga.

[Read the full study.](#)

Animated war story told through the eyes of Vicon's Cara



Emotional and thought provoking, the animated film 25 April tells the story of six individuals caught in the turmoil of WWI during the famous battle at Gallipoli.

Noted as the first animated film to focus on the conflict, the film's authentic storyline was taken from the real-life war diaries of five soldiers and a nurse, which were then turned into interviews. With the help of Vicon's Cara facial motion capture system, the film's actors were able to fully immerse themselves into their roles, giving the animated film a very human reality and story that transcends time.

Producer Matthew Metcalfe was first to introduce the visionary idea of telling the war story through an animated film, and famous graphic novelist Colin Wilson helped create the design of the characters. A true labor of love for everyone involved, the entire project took two years to complete.

Award-winning director Leanne Pooley directed the film, bringing the six interviews together into one cohesive storyline. "For a director, it was a fantastic project to be involved in," she says. "The animation allowed us to turn boats into birds and blood into flowers." Premiering at the 2016 Toronto International Film Festival, 25 April has received praise across the globe, including at the Annecy International Animated Film Festival.

Capturing the essence of 25 April with Cara
Shooting and production was completed at the award-winning character animation company Flux Animation in Auckland, New Zealand. The six actors who played the nurse and five soldiers formed the backbone

of the movie, while Vicon's Cara played a vital role in bringing their characters to life. Capturing every minuscule emotion, Cara enabled the animation to be as realistic as possible, allowing the audience to connect with the characters.

According to Javier Estevez, motion capture technician at Auckland University of Technology, choosing actors that could portray the emotions of the stories was paramount to the success of the film. "Six actors were specifically cast for not only their voice, but also their performance," he explains. "I believe the output was successful because Cara was used at its best, to port an entire personality, not just a performance."

The actors were shot solely in motion capture, wearing the Cara headset every day. "We were initially worried about shooting it this way and whether it would have an impact on the truthfulness of the performance, but Vicon's Cara headset helped the facial features truly come to life," Pooley explains.

Cara captured and tracked the actors' facial movements with extreme accuracy while giving them freedom of movement and expression. "By the third recording, we were very confident it would work as expected," Estevez says. "Even though we were a small team, Cara is versatile and robust, and we were able to adjust everything to our needs."

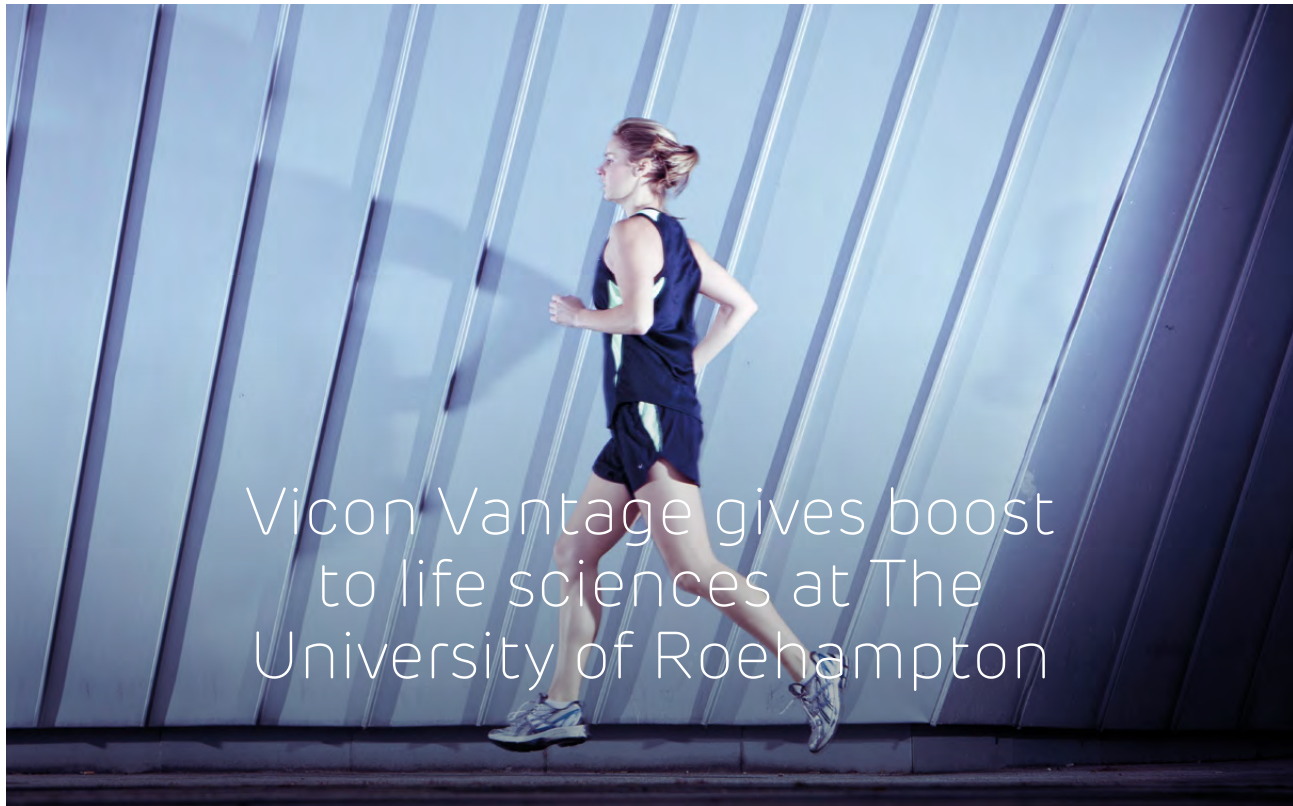
The Cara rig carries up to four high-resolution cameras to capture every facial movement of the actors. Whether quivering lips or flickering eyes, the most minuscule movements were captured allowing the audience to forget they're watching an animated movie, and instead become invested in the emotion and humanness of the performance.

From the big screen to the classroom and beyond

25 April has been embraced around the world, having been sold in Australia, New Zealand and Turkey, and is looking to new markets for distribution. The film is also being used for educational purposes.

25 April's storytelling of the battle at Gallipoli is groundbreaking in the world of film animation, telling an old story in a new way. Pooley credits Cara for making the film a reality: "The motion capture is largely responsible for why the film worked. We were the first in the world to use the Cara headset on a movie (even before Star Wars), and the results are absolutely astounding." Vicon continues to be a game changer in the world of mocap, breathing life into artists' visions.





Ranked the UK's most research-intensive modern university, Roehampton has seen its biomechanics and life science research accelerate by leaps and bounds after upgrading to the Vicon Vantage V5 system with Nexus 2 software.

Named 'Best Modern University' in the Complete University Guide 2015, Sunday Times Good University Guide 2015 and Guardian University Guide 2016, The University of Roehampton purchased its first Vicon system for biomechanics in 1996.

Vicon motion capture technology has been at the heart of the multifunctional laboratory at Roehampton ever since. Widely used for teaching and research purposes, the system is used predominantly by the Sports and Exercise Science faculty and within the Biomechanics courses. Many PhD students go on to use the Vicon system in their dissertations; current studies include the injury risks from cricket bowling, golf swings and cutting manoeuvres in football.

Roehampton's staff are also able to make great use of the Vicon facility for research. Much research has focused on people with lower limb amputations, concentrating on factors such as back pain, movement, exercise intervention to improve daily tasks and gait retraining. Based on results from the Research Excellence Framework (REF)

2014, the institute won acclaim as the Most Research Intensive University in the UK, based on results from the Research Excellence Framework 2014.

It was this award that enabled Roehampton to upgrade from a dozen well-used Vicon motion capture cameras to a new 12-unit Vicon Vantage V5 system this year. The V5 is the fastest camera in Vicon's Vantage range and significantly outperforms similar motion capture cameras in both resolution and speed. Able to capture 420fps at 5MP, it's ideal for capturing high-speed movements in a golf swing or the nuances of gait analysis.

Although the system was only installed over the 2016 Easter break, considerable benefits for both staff and students are already evident. "The new improved workflow is making a massive difference to staff with their research, and students for their dissertations and their projects," says Alison Carlisle, Specialist Technician, Sport and Exercise Sciences, Department of Life Sciences at Roehampton. "The really big

improvements I've seen are in the field of view, the quality of data, the resolution and the software."

Step up in quality

The Vicon system at Roehampton uses models such as Plug-in-Gait for gait analysis, which is based upon the Helen Hayes marker set.

"We usually use lower body markers to look at kinematics and kinetics - joint angles, joint moments, joint powers, as well as things like hopping," explains Carlisle.

"They're 14mm retroreflective balls, with 16 markers in all for the lower body. It's very powerful. You can get intra-spatial parameters like hop distance, step length, or stride length, out of it really quickly."

Based on the research that was entered into the REF, two students are conducting a study on prosthetic 'blades' designed for forward propulsion and jogging. "The research is about how the prosthetic responds to lateral movement, for example to see if the side movement could allow amputees to



play tennis. The stiffness can be changed on the blade, so they're looking at the effects of that. This will all feed into the design of the blades."

The marker system has to be very precise. "We're always striving to minimise errors," says Carlisle. "The new Vantage system offers increased resolution, and Nexus 2 introduces new marker detection algorithms, which together enable greater accuracy. We place markers all over the prosthetic limb and some of them are quite closely placed. The older system sometimes couldn't tell them apart, but this new system finds it really easy."

Another task for the department has been processing the motion data for students below Masters level. While third-year students are taught about processing, they don't do it themselves.

"It would be fraught with problems because they're new users," says Carlisle. "It's quite complicated and the students wouldn't even know that they had gaps because they're just not experienced enough. They have very high expectations - they haven't gone through the onerous frame-by-frame workflow of older biomechanists. It's amazing how it has come forward in leaps and bounds. Nexus 2.3 offers a really wonderfully improved workflow, from my point of view, in that there's automatic gap filling."

The new Nexus system also features Range of Motion (ROM) calibration, an enhancement on the method available in the first version of Nexus. "We used to just have a static subject calibration process, but now there's also one for a range of movements all around the joints," enthuses Carlisle. "That's a huge improvement to the automation of a process, which can be very time consuming."

"I used to have to spend a lot of time with students processing the results," she says. "Processing and data collection is much smoother. It gives more accurate data because there are fewer gaps. Vicon has also developed software capabilities to improve labelling. I'm delighted that students are getting much better results



with Vicon Vantage, which frees me up to do more work on research."

Taking a wider view

The Vantage system is mounted 3.5m high on a rig, providing significantly more coverage in the lab.

"With the larger area, we get more walking or running strides, which is really important for both students and research," adds the specialist technician. "We do a lot of research on running, looking at gait retraining, and other injury reduction ideas, such as retraining people to run with a shorter stride length."

Carlisle states that in combination with the increased volume, there's also a much better field of view. "That's a huge plus in my eyes," she says. "It enhances the sport work we do, because if you're capturing running you need to have a certain amount of space to get good, quality data. We've got a long enough lab to get enough velocity up." It's not just running. A current example of research is a golf intervention study for a movement therapist who works with coaches for PGA-level golfers. "The idea of the intervention is to increase stability to the lower body," explains Carlisle. "It's to reduce the chance of getting injured from the golf swing movement and allow the body to move in a freer fashion."

"We have a big net, so people don't bowl a cricket ball or hit a golf ball into the cameras," says Carlisle. "We can take the sampling rate right up, which is very important for this kind of work, and it's now easier to get really good data at higher sampling rates."

The Vicon system works in conjunction with three Kistler force plates mounted in the floor of the lab, which are used to measure ground reaction forces in three dimensions. Gap filling improvements in the Vicon system result in improved reconstruction algorithms which, according to Carlisle, benefit their jumping studies.

"Jumping has traditionally been quite challenging," she explains. "Now with the Vantage system we are really able to



capture and analyse these movements. Greater capabilities in the Nexus software, linked to the new cameras, are really benefitting the data for studies of jumping."

Rapid response

Over the past 20 years, Roehampton has enjoyed a long and successful working relationship with Vicon. "We've had excellent support, and Vicon actually took our old system away as a part exchange," reveals Carlisle. "I've been a technician for a long time and worked with different companies. Sometimes the slowness of the response is very frustrating. We've always found Vicon to be really amazing in their response to get problems fixed."

"This is very high tech," she concedes. "It's complex and there are a lot of things that can go wrong, but Vicon continue to work on ways to improve it. The new Vantage workflow is making a massive difference. There's much greater accuracy, greater usability, and we get cleaner data with Vantage. I didn't really know, until we got it, how great it would be."



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viconmocap Oregon Football and the #Marcus Mariota Sports Performance Center #Vicon #Vantage #MotionCapture #GaitAnalysis #Lab

Creating realistic experiences for virtual reality environments



There's a lot of buzz around virtual reality at the moment and consumers' expectations are high.

In a recent Vicon industry survey 28% of respondents stated that high quality content was important to ensuring a good VR experience. For VR to really take off, the industry needs to address challenges such as improving the development of accessible and high quality content.



Ensuring a good user experience

In line with Moore's Law, graphical processing capacity of off-the-shelf computers has continued to improve and this has helped push the industry forward in creating realistic VR environments. To ensure realism it's important that graphics are generated in good quality and as quickly as possible, however the VR hardware also needs to display these images properly and with the highest fidelity and lowest latency. Interestingly, the tools for generating content have been made more accessible to the mass market over the past 18 months, both in terms of cost and usability. Games engines such as Unreal and Unity are easier to use and are also much more affordable. The industry's starting to see an increase in content created by individuals and the public, rather than by games companies or large studios. Certainly the improvements in graphic processing and hardware will continue to drive forward the realism of VR content, as the ability to render an image quickly becomes easier and cheaper.

In fact we've already seen companies like Sharp develop 4K LCD screens for smartphones and tablets and will soon reach 8K. Once VR display devices are able to integrate with these higher resolution

screens, we will again see another step change in the quality and realism of virtual environments – and developers will be able to bring higher quality content to market.

Navigating gameplay

The current head-mounted displays on the market such as the Oculus Rift and HTC Vive are designed for living room sized tracking environments. For VR to become accessible to the mass market the industry must address the challenges it faces in the scalability and tracking of larger spaces. Looking from the ground up will help developers design content for VR devices, they will really need to focus on new approaches to game navigation, control and interaction. The adoption of VR in general will be limited by the quality of the user experience, if the developers cannot think of new ways to control gameplay then consumers will be reluctant to uptake the technology.

Cross platform development

Although over half of the respondents in our recent VR survey, thought that it would take three to five years to set sufficient standards for cross-platform development, it may well be sooner, since engines like Unreal and Unity allow developers to create content that encompasses the whole development process; narrative, assets and gameplay. They are then able to deploy the game very easily over multiple platforms, for example Windows, Android, Apple and of course, consoles.

The process of creating VR experiences cross-platform will come seamlessly because the game engines currently on the market already have this capability in place and are being used to distribute content for traditional games. It may well take one or two years for that to start following through, but the infrastructure is already in place for VR.

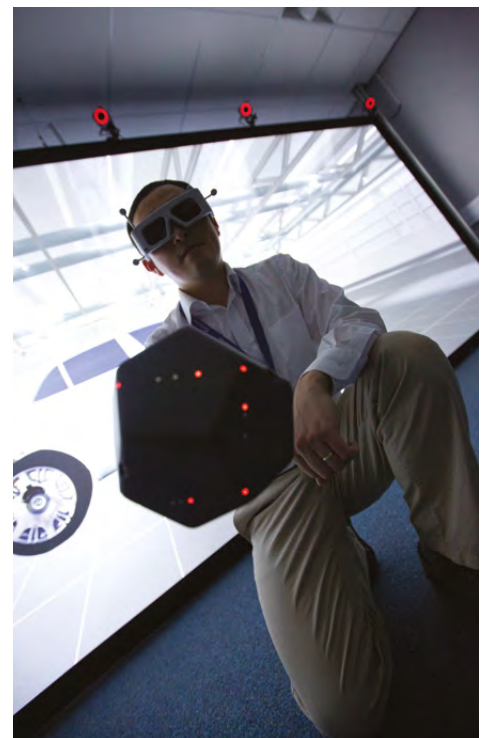
What does the future hold for VR?

As game engines become more accessible to the mass market, the VR industry will see more content being created by smaller developers and individuals. It's a

trend which we've already seen happen within mobile app development. If you look at major app stores, a large proportion of available content is created by smaller companies. Since its introduction this model has become an incredibly successful way of distributing content and if replicated for the VR industry, the ability to deliver VR content to consumers would be made easier. As well as providing smaller developers with the opportunity to gain maximum exposure for their content.

If the VR industry adopts this model, developers will also have the ability to monetise the cost of developing apps and drive the industry forward. As we've already seen that 'in app' upgrades and payments are very successful and ways of achieving this for VR will naturally follow.

By Warren Lester -
Engineering Product Manager





Q&A with Artanim



Caecilia Charbonnier, Co-Founder, President & Research Director of Artanim Foundation.

Tell us a bit about Artanim

Artanim is a Swiss research centre based in Geneva, which was founded in 2010. Artanim conducts research projects in two main areas. The original focus is in the medical research arena; where we combine motion capture with 3D medical imaging in order to better understand human joint structures, as well as using and improving the diagnosis and treatment of musculoskeletal disorders.

Our latest area of focus looks at developing virtual or augmented reality applications, with an emphasis on real-time interaction and using cutting-edge motion capture and 3D body scanning technologies.

We also provide motion capture services to game developers and 3D producers in order to help bring their projects to life. As one of the largest motion capture centres in Switzerland, we hope to make motion capture technology more accessible and encourage its use.

Why did Artanim choose Vicor as its motion capture system?

All of Artanim's co-founders have either worked or studied at the MIRALab, University of Geneva. The lab was installed with a Vicor system and has been a customer of Vicor since 2003. As a longstanding Vicor customer and having previously used the technology on a large number of different projects, the team were sure that continuing to work with Vicor was the right choice

both commercially and technically. Our use of Vicor solutions has always been reliable, precise and with super low latency which is really important for real-time applications. Vicor's ongoing continual development in all areas of motion capture, their support network via direct and through resellers, and working ethos with customers, makes it easy to choose to be a Vicor customer!

How has virtual reality changed over the last 5 years?

VR hardware and software platforms have vastly improved in terms of both choice and price point. What is really great is that they are of a quality suitable for consumers and prosumers alike – making perfect market conditions for growth, and importantly, acceptance. With VR hardware being accessible it becomes about content creation and making an amazing immersive experience. Game engines, such as Unreal © and Unity © have massive communities making accessibility to developers of VR environments considerably easier. With Vicor's continual development of their solutions, including Tracker & Pegasus, the ability of using these tools in a reliable, repeatable and robust way allows the concept of large scale multiple player VR worlds to come to reality. As VR technology become more mainstream, our ultimate goal will be to deceive the five human senses of hearing, sight, touch, smell, and taste - in a way that allows the user to believe they're in a real environment.

What do the next two years hold for Artanim?

At the moment we are preparing to launch and commercialise our spin-off company Artanim Interactive and the 'Real Virtuality' VR platform we've been developing over the last few years. The platform will allow users to become immersed in a VR scene by walking, running and interacting with physical objects and other people/characters. We're looking to deploy location-based VR experiences around the world – starting with those in the entertainment industry.

We are also trying more and more to mix our two research areas, so developing VR/AR applications for medicine. For example, we are working on a new project called Holomed that aims to develop two different tools: A VR rehabilitation platform which combines both VR and mocap in order to improve performance and motivation for patients undergoing rehabilitation. As well as an anatomical see-through tool with HoloLens for use in surgery and sport medicine. This would allow medical teams to visualise and analyse a patient's anatomy in real-time and whilst they move.

The Artanim team will be carefully following new motion capture and VR/AR developments in order to stay at the forefront of technology in those fields.

Usability: Prioritized



Derek Potter - Head of product management at Vicon.

As a product manager, my most vital role is to help set the development direction for our product lines: the product roadmap. Many factors affect what will make a successful roadmap. The immediate needs of our users, requests from the field, as well as brand new innovative features making the product(s) more powerful. The factor that increasingly rises to the top of the list can be captured with one word: "Usability".

The modern age of motion capture is three decades old and the technology has evolved. The technical adeptness of the average user has also increased substantially. The term 'Motion Capture' once only known to a small group of highly specialized users in entertainment, research and engineering is now familiar to almost everyone.

All technologies move through life cycles. Early technologies are taken up by enthusiastic early adopters who are excited by rapidly changing technologies and are accepting of more complex and often more challenging and changing interfaces. Over time the user base of successful systems shifts to a broader and more technically

diverse group whose success measure is the ability of the system to get them to their end goal quickly and effortlessly; whether this is a clinical gait report, an animated games character, or driving the movements of a robotic drone. These users still demand powerful new innovations; however, in the age of tablet and smart phone, usability is no longer an optional extra. It's not even a perk; it's simply expected.

Leading companies like Apple and Google, with their strong usability focus, have increased expectations that technology can (and needs to) be powerful while still being immediately intuitive. It's not enough to introduce a revolutionary new feature, it also needs to be effortless in its operation. I've always loved the Apple tag line "... you already know how to use it". It's a clever and concise concept that really defines what they do best (and it's catchy marketing). Technology that's powerful but complex and difficult to use struggles to succeed on today's playing field. Powerful must be paired with usable.

Modern technology needs to be intelligent and to know what you want to do or which way is the best way to do it. Usable technology can be said to 'sink into the background', allowing the user to focus on their end goal and let the system take care of itself. It's a tool that gets you to where you need to go and does it as automatically or as intuitively as possible.

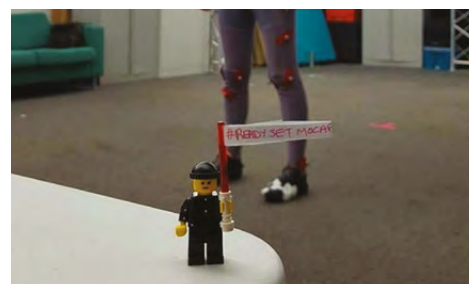
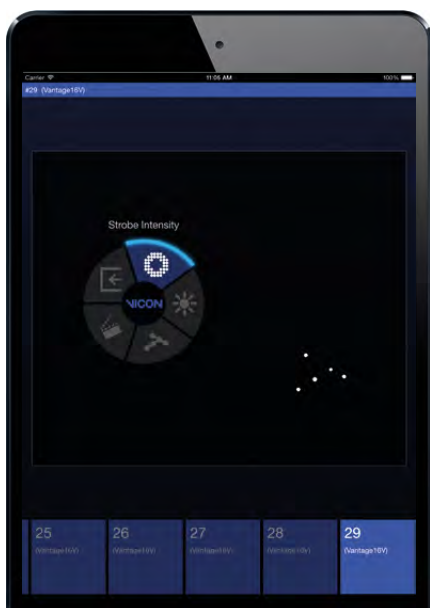
Usability is what has been driving the Vicon roadmap over the past two years. Our Vantage and Vero cameras have increased usability, introducing on-board displays and accelerometers that allow 'tap' control. The entire system can be directly controlled via our phone and tablet applications – Vicon Control.

We've focused on usability in each of our major markets. In Life Science the terms Automated, Accessible and Intelligence are what each new Nexus feature strives to achieve, and we've been building features

that automate the required processing steps in an intelligent way. For example, starting and stopping captures automatically when the subject is recognized in the volume, or filling any data gaps intelligently with the most appropriate method.

Our engineering software platform can run in a headless mode and truly sink into the background. Highly motivated users can build their own front end to meet a very specific function while Tracker supplies highly accurate, low latency data.

One of the most exciting projects this year is the introduction of a completely new entertainment platform; project Katana. The goal is "Final quality skeletal data by day's end". The focus is on delivering high quality data faster and more effortlessly. Live subject calibration that can be updated without a hiccup. A system that can monitor its own camera calibration health. Calibration repair tools that are seamless and have almost no impact on the actions of the performers, meaning the system just keeps working with little intervention.



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