# **The Standard**

## A HOPPING SUCCESS FOR OUTDOOR CAPTURE

University of Idaho / University of Western Australia / Royal Veterinary College, London



Dr. Craig McGowan, from the University of Idaho, and Dr. Alexis Wiktorowicz, from the Royal Veterinary College in London are researching kangaroo movement. They're working to understand how kangaroos change their body posture and hopping mechanics, with relation to their body size.

Many species adopt more upright postures as they mature, reducing the mechanical demands on the musculature, which in turn increases their mechanical advantage.

As McGowan explained, "We're looking to understand how the mechanical forces – the loads that are acting on the body – shape the bones and the muscular skeletal structure. We've got some good data for a smaller group of animals up to 13 lbs, and now we're extending that dataset to include animals that weigh as much as 66 lbs."

In past research, Dr. McGowan and Dr. Wiktorowicz used regular high-speed video to capture and analyze data for animal research. But their team was forced to hand digitize the markers on the animals

··· Continued

#### Vicon HOM + Stan Lee

Franchise debut

#### AIS / Berlei

Do more with less bounce

#### 

### New Frontiers In injury prevention

#### **Vicon Life Science**

"Using a Vicon outdoor system is really beneficial and speedy. It lets me capture the force plate data and Vicon camera data as the animal is passing through the corridor, and automatically writes it to the hard drive for me."





Discover more. www.sci.uidaho. edu/mcgowanlab/ index.htm



in order to quantify various motions, which lengthened the research process significantly. Additionally, it was clear that to continue the study, they needed a more sophisticated system that could capture and analyze data more efficiently and productively.

The research team partnered with Vicon, and set up a new system at the Alma Park Zoo in Brisbane, Australia. Their motion capture system was customized to include 12 Vicon T160 cameras with outdoor capability, Vicon Nexus software, and force plates to capture and analyze ground pressure at impact. The kangaroos then "hopped" through a corridor, and data was captured and analyzed.

Dr. Wiktorowicz explained some of the benefits. "Using a Vicon outdoor system is really beneficial and speedy. It lets me capture the force plate data and Vicon camera data as the animal is passing through the corridor, and automatically writes it to the hard drive for me. When I stop the trial, it auto advances to the next trial. The Vicon system is much easier. It can generate a lot of data. a lot faster." The Vicon system used by Dr. McGowan, Dr. Wiktorowicz and their team has created new avenues of research opportunity. Some of those benefits include a reduced workload, and the ability to analyze real-time feedback of the forces acting on the body and the forces the animal generates, which gives them the ability to tell if they have great data almost immediately after capturing. Dr. McGowan added, "We've got a lot of really great data and with the help of Vicon we're going to be able to analyze it a lot easier."

The teams also had reservations about capturing quality data outdoors, but were extremely happy with their end results using Vicon T160 cameras with outdoor capability.

Dr. McGowan concluded, "We were expecting the sun to be too bright to use an optical infrared system outdoors, but were really pleased the T160s handled it so well. We monitored the aperture and brightness throughout the day, but the cameras had a nice range to work with and flooding was never a problem. Data collection was excellent - the Vicon system exceeded our expectations!" The Standard www.vicon.com/standard

### The Standard

Welcome to Vicon's latest edition of The Standard. This edition features a great mix of Life Science, Entertainment and Engineering customer stories that have caught our attention and peaked our interest in recent months.

We hope you enjoy reading about the amazing work your peers are developing!

Editorial Team: Tara Valgoi, Hayley Roberts, Lindsay Gerber, Nathan Aswege

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2011 Edition 1

**Vicon Engineering** 

# FAST CARS FAST TRACKING

Credit Courtesy of MIRA MIRA is a leading independent product engineering, testing consultancy and certification organization. It focuses on all forms of automotive engineering from internal and external design of bikes, cars and large trucks, to the layout of roads and junctions.

Currently, MIRA is using a T40 system to track 3mm bubbles in one of the world's largest indoor wind tunnels (The Standard, Spring 2010). The MIRA test facility also has a large outdoor test area, which includes various road layouts and junctions.

Data capture methods for outdoor tracks have previously been limited to video capture, which can be very time consuming as the data needs to be hand-digitized. As an existing Vicon customer, MIRA came to Vicon to see if the same technology used in its wind tunnel could work outdoors.

Tim Edwards, Lead Engineer at MIRA said, "We contacted Vicon to see if they could help us set up an outdoor test. If we could make it work, it would open the doors for us to experiment with a wide variety of vehicle and road layout testing, which has never previously been possible."

Vicon spent one full day at MIRA's facility to demonstrate an outdoor T-Series system.

Edwards said, "The Vicon team arrived bright and early and set the T160 cameras up in the required position on the track. We managed to start capturing straight away; it was a very easy shoot!"

The team set up 10 outdoor T160 cameras and used 14mm markers down one side of the car. This meant that the car could be captured within a distance of about 10 – 15m. The car drove through the volume at varying speeds from 30 mph to 70 mph, with the system successfully capturing data every time.

Edwards summarized, "The day was a huge success. We're working with Vicon in our outdoor tests because we know the system is fast enough to process the data at the speed we want to capture. Not only did it work straight away, it gave us the same high-quality data we're used to seeing from our indoor system.

"As with our bubble-tracking system, when we present Vicon with a problem, they present us with a solution. They always exceed our expectations."

### **COO NOTE**

Imogen Moorhouse Vicon Motion Systems



This issue of The Standard celebrates a wide variety of customers who use their systems in very different ways. The Running Injury Clinic (page 24) at the University of Calgary has introduced a three-camera Bonita system into private physiotherapy clinics across Canada, giving clinicians the same quality data previously only available on campus.

In entertainment, I'd like to congratulate Quantic Dream. The Heavy Rain developer has won three





MIRA has been using an indoor Vicon motion capture system for two years in one of its wind tunnels.

BAFTAs and sold over two million copies of Heavy Rain worldwide. You can read about Quantic Dream's latest system upgrade on page 26.

Headley Court, the UK Armed Forces' dedicated rehabilitation center, joined the Vicon family this year after receiving funding from Help for Heroes. The charity helps so many of the UK's service men and women get their lives back, and I'm proud to say Vicon is part of their journey.

Looking forward, this year we'll be making a series of announcements during the summer conference season, so please look out for us at the next event near you (see back cover).

Vicon Entertainment

### THE NHL, STAN LEE AND VICON BRING NEW FANS TO NHL TEAMS EVERYWHERE

'The Guardian Project' short film premiered during NHL All-Star Game; Project built and rendered in the Unreal Engine as part of proprietary House of Moves workflow.



Watch 'The Guardian Project' film online. www.vicon.com/ guardians.htm



Vicon House of Moves (HOM), our full-service animation company, was contracted by Guardian Media Entertainment (GME), a joint venture between the National Hockey League<sup>®</sup> (NHL) and SLG Entertainment led by Stan Lee of POW! Entertainment, to develop a short film as part of their launch efforts for the new Guardian Project superhero franchise.

The Guardian Project Launch The Guardians, 30 animated superheroes created to reflect NHL team attributes, were individually introduced throughout the month of January via an elaborate social media campaign promoted with broadcast and in-arena marketing support. The culmination of this campaign came during the NHL All-Star Game presented by Discover on January 30th in Raleigh, North Carolina in the form of an animated short created by Vicon House of Moves. The short played in the stadium (on both the Versus and CBC Networks) and has also been posted online. The film introduces the new superheroes as they come together to battle villain, Deven Dark, while he attempts to take over the RBC Center stadium. A battle

of good vs. evil ensues as the 30 superheroes leap into action, with the Carolina Hurricane saving the stadium fans, the Guardians and ultimately the RBC Center from utter ruin.

Each of the Guardian superheroes was designed by GME and brought to life as a computer generated (CG) character by HOM. Their traits were derived from the city and team brand; the Oiler has a weapon that he plunges into the ground, the Bruin fights evil with his sonic roar, the Los Angeles King has his earthquake-inducing sword and more.

"Vicon House of Moves was a true partner from the get-go, working with us on the 3D build-out of the characters, designing what their signature moves would look like, developing story concepts, creating storyboards, doing the live action



Credit Courtesy of House of Moves

shoot, completing motion capture along with managing all of the animation, voiceovers and final edit and delivery," said Adam Baratta, Chief Creative Officer, GME. "Bringing 30 different characters to life, each of which is tied to a highly revered NHL team, is no small task. House of Moves was a great partner to work with on every step of this production."

### Breaking Away with the Unreal Engine

Any project with 30 different characters interacting in a mix of CG and live action environments would pose a challenge to even the largest animation house. In an effort to maximize production efficiencies, HOM used Epic Games' Unreal Engine to render this animated short for broadcast. This revolutionary application of traditional gaming technology to build high-quality content for television was facilitated via HOM's proprietary workflow and a series of custom toolsets.

"Game engines give you the ability to light and render scenes interactively in real time, even when you're dealing with multiple characters. With the game engine, you reduce the time that it takes to make critical creative decisions because you have the ability to previsualize fully rendered scenes," said Peter Krygowski, Director. HOM.

"We wrote several pieces of code to help generate custom shaders and to be able to bring virtual cameras into and out of the Unreal Engine for the purposes of this project," explained Alberto Menache, HOM Visual Effects Supervisor and Pipeline Developer. "As a result we had incredible creative flexibility and could render out 8,000 frames in a matter of seconds, not to mention the savings in gear costs without the need for a multi-CPU render farm!"

In the future, HOM aims to tie the Unreal Engine to the Vicon motion



capture system so that clients will be able to see their recorded mocap performances integrated into game levels rendered in the game engine in real time.

"On a project like this, you have to think down the road of potentially extrapolating characters and environments into game assets, a television series, and flowing the CG creative elements between mediums. By building scenes in a game engine out of the gates, our options are much broader the need to create low res files from broadcast to game, for example, will be mitigated," explained Brian Rausch, Vice President of Production, HOM.

CG assets for the short were built using Autodesk Maya and Pixologic ZBrush. Autodesk MotionBuilder was used to retarget animation and navigate environments during motion capture sessions. HOM captured stunts and poses for each of the 30 Guardian superheroes at their 26,000 square feet of motion capture stages equipped with more than 200 Vicon T160 cameras over nine days of mocap shooting. The project was completed over six months with a team of creatives that started at 10 and grew to 200 at the project's peak.

The Guardian Project animated short at the NHL All-Star Game capped off a big hockey weekend in Raleigh, North Carolina that kicked off with NHL Fan Fair™ at the Raleigh Convention Center. In addition to the film, Vicon House of Moves designed a virtual interactive experience for The Guardian Project booth at NHL Fan Fair™. The experience allowed fans to don virtual reality goggles and immerse themselves into a computer-generated environment where they got up close and personal with some of the newly introduced Guardian superheroes as they performed their signature moves. 📕

Credit Quadrotor demonstrated by Brett (left) and Mario (the original builders of the facility) Photo courtesy of ACL, MIT

#### Vicon Engineering

### TRACKING THE FUTURE

Autonomous Unmanned Aerial Vehicles (UAVs) play a vital role in military operations and are often used to capture video footage of an area that is not deemed safe for a manned aircraft.



Four-bladed autonomous helicopter UAVs, also known as quadrotors, require sophisticated autonomous planning and control systems to ensure they can navigate safely and perform their mission effectively. One of these systems is designed and tested by Jonathan P. How, Professor of Aeronautics and Astronautics at Massachusetts Institute of Technology (MIT). Professor How has been working on indoor robotic systems for 15 years. "When I first started working on indoor robotics, we used 2D systems to track the quadrotors. It was fairly time consuming and didn't give us the results we needed," explained Professor How. "In 2000, the students decided they wanted

#### Credit 10 UAVs flown simultaneously Photo courtesy of ACL, MIT

Credit Autonomous prop-hang flight demonstrated by Adrian Photo courtesy of ACL, MIT to try something in 3D. We trialled GPS and magnetic systems and looked at laser-tracking. The laser-tracking worked for ground trials, but not flying because the computing that was required on-board made the quadrotor too heavy."

MIT needed a 3D system that was functional, easy to use and could provide robust, fast tracking.

In 2006, working with Boeing Research and Technology in Seattle, the Department of Aeronautics and Astronautics at MIT purchased their first Vicon system – 6 MCam2's. It was the first UAV research project of its kind to use motion capture technology to track quadrotors in a 3D space.

"The software works by replicating GPS technology for an indoor environment. The results from that first year were impressive.

"We decided to upgrade in 2007, adding 12 more MCam2 cameras





"Working with Vicon means we have more time to focus our energies on working towards a higher level of autonomy and rapid prototyping of UAV flight control."

to our set up. By this time we were capturing 10 quadrotors at one time.

"After moving to a bigger lab in 2009, we added another 12 MXF40 cameras to the system. The space we have available is roughly five meters squared, but we can track multiple quadrotors and airplanes (wing span of three ft.) flying at the same time," said Professor How.

"Making UAVs fly outdoors is a time -consuming task with many legal and logistical issues that must be overcome. When you have so many other factors to consider, being able to fly indoors while having a tracking system that works straight out of the box is a real time saver." "Working with Vicon means we have more time to focus our energies on working towards a higher level of autonomy and rapid prototyping of UAV flight control. Also, it's super critical that the Vicon system is capable of running at 100Hz with a latency of less than 20 milliseconds and that it can track robustly without occlusion being a problem," said Professor How.

The technology developed at MIT is just the beginning. Once MIT has completed its research, the UAV technologies will be picked up by industry and other government bodies such as the Department of Defense and developed for real-world applications.

### Top Tips. 📋

#### Keyboard shortcuts

- F5 toggles full screen mode in Nexus and Tracker
- F7 opens the options menu in

Nexus and Tracker

- F8 opens System Preparation Tools pane in Nexus (live mode only)
- F9 opens Subject Preparation Tools pane in Nexus
- F10 opens Capture Tools pane

(live mode only)

- F11 opens Label/Edit Tools pane (offline mode only)
- F12 opens Pipeline Tools pane
- CTRL-R resets the real time labeler in Blade, Nexus, and Tracker

**Vicon Entertainment** 

### **REEBOK PARTNERS WITH HOUSE OF MOVES** ON PRODUCT CAMPAIGN

Vicon House of Moves (HOM), our LA based animation studio, recently completed motion capture for a standout Reebok campaign directed by Alexei Tylevich of production company Logan via agency DDB Entertainment Berlin. The seven-spot campaign centers around animated versions of pro athletes.

"Working with House of Moves was a great experience. The shoot days were very smooth and the entire process from start to finish was seamless," said Alexei Tylevich, director and owner, Logan. "It was easy to work with HOM; they were great helping our team of animators receive and handle the data. Overall, the level of know-how, professionalism and support HOM provided is unsurpassed."

Logan came to HOM to capture the performances of various athletes for spots focused on a range of sports, from football and ice hockey to basketball. The performances were captured on HOM's main stage using Vicon's most advanced T160 motion capture cameras. Additionally, HOM used real-time cartoon shaders on set to mimic the final look of the project. This allowed Logan to preview captures in real time to quickly validate the direction of a given take rather than waiting for post render effects to be completed.

The campaign features animated versions of pro athletes such as Chad Ochocinco, Alexander Ovechkin, Lewis Hamilton and others training in a stylized, illustrated world. Each spot starts out as a single red line on a solid black background that forms line-drawn environments, athletes and training routines in a fantastic animated universe culminating in the zigzag shape of the Zigtech shoe sole.

"Because the look of the campaign was so simple, the main focus was on the movement of the athletes. Keyframe animation was out of the question in this case. With motion capture we were able to re-enact the signature moves of specific athletes at the HOM studio, and work with the data to construct compelling action-filled sequences from various bits of captured data stitched together. This type of seamless athletic performance would've been impossible to achieve in any other way," concluded Tylevich.

Vicon House of Moves has been the go-to studio for film, television, game and commercial creatives for over 15 years and has recently worked on advertising projects for Zoic Studios, Motion Theory, MPC, Psyop, Method, Radium and The Mill. In addition to the HOM main stage, the 26,000 square-foot facility is also home to a full performance capture volume capable of recording simultaneous high-quality audio with a capture session without any interfering background noise.



ZigTech: A special lightweight foam that is engineered into an innovative, geometric, zig-zag shape.

#### EVERY ISSUE IS AVAILABLE ONLINE AT WWW.VICON.COM/STANDARD

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Watch the entire commercial. www.vicon.com/ reebok.html





#### Credit Courtesy of Northumbria University



### THE DANCE OF LOVE WHAT WOMEN REALLY WANT

In 1859, Charles Darwin proposed that certain male traits evolved owing to sexual selection via female mate choice. Some authors have suggested that females may evaluate males largely on the quality of their movements, especially those movements that contain elements of vigour or skill, because these are most likely to indicate health and genetic quality.

To put Darwin's theory to the test, researchers at Northumbria University set up a trial using 12 Vicon T20 motion capture cameras and Nexus software to analyze the dance moves of 19 male volunteers.

"Identifying the characteristics of attractive dance is difficult because of the confounding effects of facial attractiveness, height, clothing and socioeconomic status, dominance, body morphology and shape. Previous studies assessing women's perceptions of male dancing ability have attempted to control for these factors using blurred video clips or simple motion capture avatars," explained Dr. Nick Neave, Senior Lecturer in Psychology at Northumbria University.

Dr. Neave and colleague Dr. Nick Caplan improved on this methodology by using their Vicon mocap system to create more realistic 3D avatars from which precise biomechanical measurements can be extracted.

"To our knowledge, no previous studies have actually identified specific movement components within a dance that may influence perceived dance quality, a gap we aimed to fill in our study," said Dr. Neave. The advanced 3D mocap technology from Vicon identified possible biomechanical differences between women's perceptions of 'good' and 'bad' male dancers. Nineteen males were recorded using the 12 camera system and avatars were then created. Videos of the dancing avatars were shown to 37 women to be rated for dance quality.

Matlab was used to calculate the amplitude, speed, duration and variability of body movements. The analysis concentrated on three body regions: legs (ankle, hip and knee), arms (shoulder, elbow and wrist) and the central body (neck and trunk).

Dr. Caplan continues, "We attached 38 reflective markers to each participant, using the Vicon Plugin-Gait marker set to capture all the major structures of the body.

#### Credit Courtesy of Northumbria University



After calibration, our participants were asked to perform one 30 second dance to a constant core drum beat."

The avatar used to rate 'good' or 'bad' dancing was created from each individual's mocap data and built using Autodesk MotionBuilder.

The avatar chosen was a featureless, gender-neutral humanoid character that was included in the software package in order to put maximum



emphasis on the biological movement (figure 1).

"Using these avatars, the female participants rated dance quality on a seven-point Likert scale one being an extremely bad dancer and seven being an extremely good dancer," explained Dr. Caplan.

Dr. Neave added, "By using cuttingedge Vicon T-Series technology, we have been able to precisely break down and analyze specific motion

"To our knowledge, no previous studies have actually identified specific movement components within a dance that may influence perceived dance quality, a gap we aimed to fill in our study."

patterns in male dancing that seem to influence women's perceptions of dance quality."

Variability and amplitude of movements in the central body regions and speed of the right knee movements are especially important in signalling dance quality.

A 'good' dancer displays larger and more variable movements in relation to bending and twisting movements of their head/neck and torso, and faster bending and twisting movements of their right knee. As 80 percent of individuals are right-footed, this is perhaps to be expected.

Dr. Neave concluded, "We suggest that human male movements could form honest signals of traits such as health, fitness, genetic quality and developmental history. By uncovering some specific movement parameters used in the assessments of dance quality, we are now in a much stronger position to further research the possible signaling mechanisms of dance in humans.

"The accuracy of the Vicon system has helped us identify the specific movements within men's dance that influence women's perceptions of dancing ability."

This research has been published in the journal **Biology Letters** and a PDF of the paper can be obtained from the principal author nick.neave@northumbria.ac.uk

Credit Figure 1 Gender-neutral humanoid character

### UNIVERSITY OF NEW BRUNSWICK'S NEW HUMAN PERFORMANCE LAB



We caught up with long-time Vicon user Dr. Vicky Chester and her team at the University of New Brunswick, to discuss their new Vicon T160 system and the opening of the Andrew and Marjorie McCain Human Performance Laboratory in April 2011.

#### What was the primary focus of your research using your MX40 Vicon System?

Our primary focus has been clinical Gait analysis, including orthopedic and prosthetic biomechanics, strength-training studies, and EMG. With the new Vicon system, we will focus more on multi-segment foot models, and additional new research opportunities.

Our new lab is built with an integrated 190m jogging track, which is a first for a lab in Canada. This added feature will allow runners and walkers to enter the lab for measurement, and exit back onto the track.

We also conduct upper-extremity research with Ed Biden, and recently started looking at adult feet using multi-segment models. Previously we had always treated the foot as a single block, but with our new T160 system we are going to be able to look at it with more markers on the foot and model it with more segments.

#### How has your Vicon system aided the development of new research methods, practices or opportunities?

In terms of research, the multisegment foot is a big one. There are not a lot of devices that can model the foot as a multi-segment unit, but with Vicon high-resolution cameras it is relatively easy to put tiny markers on the foot and gain a better understanding of how the foot moves.

This information is extremely desirable to clinicians doing surgery. In one instance, we measured the foot kinematics on a stroke patient, took the data directly into the operating room (after sterilizing the computer) and showed Vicon graphs in Polygon so surgeons would not have to go by memory, and they are very interested in this.

We struggled with our other system at a million pixels; we could only do adult feet and could not always capture a full gait cycle. But with the new T160 Vicon system, we are going to be able to take this avenue of research so much further than before.

#### What are you most surprised about, in terms of new advancements and opportunity?

I think the intelligence of the Vicon system is amazing. From calibration, to real-time capability, to resolution, it is going to be unreal. The difference between what a 4MP camera sees and a 16MP is huge, and we feel the possibilities are endless!

### What impresses you the most about your Vicon system?

It has been fantastic overall. If we have trouble with CPUs, a new one arrives. Vicon is also very personable and we love talking to them at shows, and I am personally looking forward to Amy August coming and setting up our new system soon! With regard to Vicon Support, there are service agreements, but I know no matter what, I can always call or go online and someone will help me. Vicon is very dependable.

You've had the opportunity to change / upgrade your motion capture system, why have you continued to choose Vicon? Some people are attracted to other systems, but I have seen most of them at work and they lack accuracy compared to Vicon.

With Vicon you have total control. You can change how you model the human body, from the markers to the end product. The performance and software is amazing.

I tell my students all the time that Vicon is worth every dollar. It outperforms at every level. I also love the idea that I get to buy the same systems that entertainment pros and directors ask for. So it is a good thing to buy into, because it is constantly changing and is so accurate. I also work in legal cases outside of my job, and when the lawyers ask me about data, I say, 'It is a Vicon - take me to court, and ask me about this system'... that is the confidence, accuracy and reliability you get with Vicon Systems.



Dr. Ed Biden is Professor, Mechanical Engineering Dean, School of Graduate Studies at University of New Brunswick, Canada.

Vicon Life Science

# LITERATURE REVIEW THE STANDARD

Ed Biden, Ph.D.

### In recent years, library systems have evolved dramatically in their ability to search and utilize online indices and full copy material.

One of the things which this has opened up is the ability to find conference papers and other sources which would have been relegated to the "unknown" or at best the grey literature.

Vicon, very generously, gives very few guidelines as to how these updates should be written. So this one rambles among a number of different technologies and applications of motion which I found to be very interesting and I hope you do as well.

The first two papers in this review are both applications of Vicon motion capture in the area of dance.

Castañer, M., Torrents, C., Morey, G., Anguera, M.T., Jofre T. (2010) Appraising the Aesthetics of Human Movement: An Application to Contemporary Dance Using a Motion Capture System. MB '10 Proceedings of the 7th International Conference on Methods and Techniques in Behavioral Research, ACM New York, NY, USA.

Neave, N., McCarty, K., Freynik, J., Caplan, N., Honekopp, J., Fink, b. (2010) Male dance moves that catch a woman's eye. Royal Society Biology Letters. 7, 221-224. The first of these papers used a Vicon motion capture system to measure the motions (using video and Plug-in-Gait) for four experienced dancers performing a variety of moves. The data collected were then presented for evaluation as stick figures and as regular video. The objective was to see whether the perceptions of the motions were influenced by factors like facial expression which could be observed in the video but is lost in the stick figure animation.

The review group was composed of 101 students in Sport Science. The ratings for kinematic parameters were well correlated. Curiously, the stick figures were awarded higher scores on some aesthetic measures. The authors speculate that the stick figures hide some of the subtle positioning of the hands, tension in the limbs and other elements which can be seen in the actual videos.

The second paper took a group of 30 men (ages 18-35), none of whom were professional dancers, and had them dance while their movements were recorded by a Vicon system using Plug-in-Gait. The joint angles were calculated and used to animate avatars, which were then shown to a group of women in the same age group who rated them for their dance ability. The interesting thing here is that the correlation of rating of ability and the motions captured were strongly related to the central body region. These reflected amplitude and variability of motion. The leg motions correlated mostly for speed of motion with the right knee internal/ external rotation being most highly correlated. It is interesting that the results allowed prediction of the ratings by the women with a good degree of accuracy.

It would be very interesting to apply the methods of the second study to the first one to see if it could tease out whether it is really trunk or limb motion which defined the differences observed between the video and the motion tracking.

The next two papers are examples of motion capture systems used, either to validate other systems, or to provide remote measurements.

Only a few years back the idea of Vicon being accurate enough to measure deflection as a proxy for force, or that GPS would be sensitive enough to track motions



"The plots of force allow visualization of the loads applied from the point where the gymnast is doing a handstand on the bar, through the complete motion."

in a tennis court would have seemed near impossible.

Cagran, C., Huber, P., Muller, W. (2010) Dynamic force measurements for a high bar using 3D motion capturing. Journal of Biomechanics. (43) 4, 767-770.

The work in this paper is amazing. The authors wanted a way to measure the forces in a high bar. The authors came up with the idea that they could measure the displacements of the bar using Vicon and then use pre-measured force deflection curves to calculate the forces the gymnast was applying as they undertook the activity.

The initial experiment was to place markers along the top and bottom of the bar in a uniformly spaced pattern and then to apply loads to the bar through a load cell and strap system. They then model the bar, accounting for moment of inertia and other effects. They provide one proof of concept example. To test an athlete, the array of markers was replaced by a pair of markers at known locations on the bar. The authors, test show an example of measurements made for a gymnast doing a giant swing. The plots of force allow visualization of the loads applied from the point where the gymnast is doing a handstand on the bar, through the complete motion.

Duffield, R., Reid, M., Baker, J., Spratford, W. (2010) Accuracy and reliability of GPS devices for measurement of movement patterns in confined spaces for court-based sports. Journal of Science and Medicine in Sport. 13, 523–525 The authors of this paper had tennis players use a GPS device to track their motions during play to analyze their movements. To check the accuracy of the GPS device, a Vicon motion capture system tracked a marker on the GPS unit itself.

Two GPS units were used: one which recorded at 1Hz and one at 5Hz. Not surprisingly, the 100Hz Vicon system gave results that were substantially different from either of the GPS units, in that the path of motion measured was much longer. This would seem to be related to two things: (1) the intrinsic ability of the systems in terms of spatial resolution, and (2) perhaps more important, the fact that even at 5Hz the sample rate of the GPS is likely below the frequency for the motions involved, which produces erroneous results. Vicon, in this case with very good spatial resolution and a frequency of 100Hz, readily out-performed the GPS. It is nice to see motion capture as the "gold standard" for such tests.



Dr. Brook Galna Ph.D, is a Research Associate (Movement Science) at the Institute for Ageing and Health, Newcastle University

**Vicon Life Science** 

# LITERATURE REVIEW THE STANDARD

Brook Galna, Ph.D.

This literature review takes us into the field of human gait analysis. Recent advances in motion capture technology and ever-increasing computer speeds have resulted in some fascinating new methods to help us understand and treat gait pathologies.





Hunt, M.A., Simic, M., Hinman, R.S., Bennel, L., Wrigley, T.V. (2011) Feasibility of a gait retraining strategy for reducing knee joint loading: Increased trunk lean guided by real time biofeedback. Journal of Biomechanics. 44 (5), 943-947.

In this article, the collaboration between Australian and Canadian researchers has resulted in a novel way of potentially reducing load on osteoarthritic knees during gait. The authors explain that reducing the loading on the knee is one of the few ways that can help delay the progression of knee osteoarthritis. They propose that one potential mechanism for reducing load on the medial aspect of the knee when walking, is to train people to lean over their foot as it is about to hit the ground. As proof of concept, the authors test whether they can train healthy adults to reduce the load on their knees as they walk by increasing their lateral trunk lean.

An eight camera Vicon system and AMTI force plates were used to measure moments of force across the knee and hip joints in 12 healthy adults. Markers were placed on the participants using the standard Vicon lower limb and trunk Plug-in-Gait model. Participants were trained to walk in such a way that their trunk was leaning at 4 degrees, 8 degrees or 12 degrees over their foot as it contacted the ground.

The particularly interesting aspect of this article is how the authors used real-time biofeedback to help train participants to walk with the desired trunk lean. Vicon Nexus streamed real-time information about the trunk markers to Matlab software, where trunk lean was calculated, graphed and then projected onto a screen in front of the participant as they practiced their walking with increased trunk lean.

The results showed that increasing levels of trunk lean at foot contact was associated with reduced loading on the knee, where a trunk lean of 12 degrees was associated with a 25 percent reduction of the knee adduction moment. Although the results are promising, they only measured healthy young adults. The true test of this gait retraining technique will be when it is tried on people who have knee osteoarthritis. Regardless, this is a good example of a potential use of Vicon to present real-time biofeedback for gait retraining.

The next article showcases the use of the Vicon Plug-in-Gait model in a turning study, as well showcasing the usefulness of the skeleton visualization in Vicon Polygon software.

Spildooren, J., Vercruysse, S., Desloovere, K., Vandenberghe, W., Kerckhofs, E., Nieuwboer, A. (2010) Freezing of gait in Parkinson's disease: The impact of dual-tasking and turning. Movement Disorders. 25 (15), 2563-2570.

Here, authors test how well people with Parkinson's disease walk around a cone under singletask and multi-tasking conditions. Although seemingly natural for most of us, turning while walking can result in a freezing of gait episode (an involuntary cessation of movement) in people with Parkinson's Disease.

Freezing of gait can be debilitating and is associated with a high risk of falling. An eight camera Vicon system along with Workstation software was used to examine 180 degrees and 360 degrees turns in three groups: people with Parkinson's disease who experience freezing episodes, people with Parkinson's disease who don't experience freezing and healthy older controls. A full-body Vicon Plug-in-Gait marker set was used to provide spatiotemporal characteristics of turning as well as produce 3D skeletons using Vicon's Polygon Viewer software. Using 3D skeleton models in Polygon allowed the researchers to determine visually whether a freezing of gait episode had occurred while still keeping the assessor blinded to which group the participant was in, thus reducing potential bias.

The results showed that doing a complete 360 degrees turn while performing an additional cognitive task was the most likely condition to elicit a freezing episode in the people with Parkinson's disease. Interestingly, people with Parkinson's disease who demonstrated freezing episodes had difficulty regulating their cadence when turning. In addition, these subjects adopted a 'posture-second' strategy, whereby they maintained their performance on the cognitive task at the expense of their deteriorating walking performance.

This article shows a useful application of the full-body visualizations in Polygon to provide an effective way to anonymize participants while still allowing valid judgements to be made about the quality of movement.

The next article showcases another use of real-time processing of gait, where a research group in the Netherlands were interested in whether alcohol affects our ability to avoid tripping on obstacles.

Hegeman, J., Weerdesteyn, V., van den Bemt B.J.F., Nienhuis, B., van Limbeek, J., Duysens, J. (2010) Even low alcohol concentrations affect obstacle avoidance reactions in healthy senior individuals. BMC Research Notes. 3, 243.

In this study, 13 healthy older adults were asked to walk on a treadmill at 3km per hour and avoid an obstacle that was released in the early, mid or late stance phase of gait. To measure foot trajectories and response to the obstacle, the researchers used an eight camera Vicon system sampling at 100Hz. Response times to the obstacle being released were measured using an electromyography system (Zerowire, Aurion) synchronized to Vicon, with electrodes on the back of the leg (biceps femoris). The ensuing success or failure in avoiding the obstacle was also recorded.

The position of markers on the feet were measured in real time to determine when to release the obstacle and also to ensure the participants had at least five consistent strides before releasing the obstacle again. The experimenter was also able to check whether the participant was the correct distance from the obstacle in real time so they could give verbal feedback to walk closer or further away from the obstacle.

Testing occurred half an hour after drinking a non-alcoholic drink and then twice more, each time after drinking a glass of orange and vodka. The results showed that as the concentration of alcohol in the participants' blood increased, their response time to the obstacle decreased, as well as being more likely to make contact with the obstacle.

From a technical point of view, this is a nice paper because the authors were able to synchronize the experimental stimulus (release of the obstacle) to precise phases of gait. The lab set up also allowed the authors to analyze the dynamic trajectory of the obstacle in relation to the participants' adaptations, as well as the timing of the muscle response.



### **VICON AT THE MOVIES**

# Everyone loves a great movie and Vicon has been fortunate to be a part of this year's biggest hits!

Check out the making of Tron. www.vicon.com/ tron.html



One of the most recent is the award-winning **Black Swan**. In the final dance sequence, Natalie Portman grows huge black wings, symbolizing that her character has truly become the 'Black Swan'.

VFX specialists, Look Effects, hired Curious Pictures to carry out the motion capture work. Curious used a 24 camera Vicon system on location to film a professional ballet dancer for this iconic scene.

UK studio Audiomotion was hired to tackle the 3rd installment of

The Chronicles of Narnia. MPC, the VFX studio behind The Voyage of the Dawn Treader, called on Audiomotion to create hundreds of digital double animations for the film, based on its successful creature work on Prince Caspian.

Another great special effects film of 2010 was **TRON: Legacy**. Our LA-based animation studio, House of Moves (HOM), was hired by Grid Productions to complete seven days of motion capture prior to the film's release. The crew shot high-impact stunt work along with more subtle body and finger poses, and movements of actors sitting on and riding the film's signature Light Cycles at HOM's 26,000 square foot studio.

2011 is an exciting year for special effects films. Be sure to look out for the highly anticipated **Green** Lantern due for release on June 17th!

#### We want your feedback.

To ensure we're as up to date as possible on the service you've received

from Vicon, please take five minutes to complete the customer satisfaction survey located in your Vicon Online Support Account. www.vicon.com/support



**News in Brief** 

### WHAT'S NEW AT VICON

### VICON OPTIMIZES OUTDOOR MOTION CAPTURE AND LAUNCHES NEW S EDITION CAMERAS

# All T-Series systems sold will now be outdoor ready

At the beginning of February, Vicon announced that all new T-Series cameras are now fully optimized for outdoor motion capture.

The new capabilities allow highly accurate motion capture to be achieved outdoors without interference from natural elements and lighting. Customers with an existing T-Series system can also

.....

have their cameras upgraded for outdoor capture.

In addition, Vicon is also launching the new T-Series S Edition motion capture cameras – the T40S, T20S and the T10S. The new S Edition builds on the speed and flexibility of the existing T-Series cameras, and boasts the fastest full-frame one-megapixel mocap camera in the world.

#### VICON SOCIAL MEDIA NEWSROOM

We launched our social media newsroom earlier this year. This page aims to make it much easier for you to find all our latest case studies, customer news, job opportunities and much more!

Visit vicon.com/company/ socialmedianewsroom.html

### Top Tips. 📋

Helpful shortcuts in Tracker and Nexus

Jog any of the numerical fields in Nexus and Tracker by 'winding' them up or down.

Right-drag from the field and the mouse cursor will change to a

pair of semicircular arrows. Hold down the right mouse button and draw semicircles around the field - clockwise will increase the value and anti-clockwise will decrease the value. **Vicon Life Sciences** 

### **DO MORE** WITH LESS BOUNCE

Credit Australian Institute of Sport



Every woman knows the difference a good bra can make to a plunging neckline, but few fully appreciate the difference a good sports bra can make while exercising. Research has shown that up to 56 percent of women suffer breast pain during physical activity such as dancing, jogging or boxing, which can ultimately lead to damage to the chest ligaments, sagging of the breasts or back pain.

Many sports bras are not designed with these biomechanical functions in mind. Now, the Australian Institute of Sport (AIS) is using motion capture technology to help Berlei test the level of bounce reduction their sports bras offer and apply this testing to design new sports bras that provide even more of a biomechanics advantage.

The AIS is Australia's premiere sports training institute. It has an international reputation as



the world's best practice model for high-performance athlete development. Its biomechanics department houses a 22 camera Vicon motion capture system, which is used to test the performance of athletes. Everything from running gait, volleyball and bowling techniques are analyzed using the state-of-the-art system.

Berlei is a major sponsor of the AIS, working with the biomechanics unit to measure breast bounce, testing its latest sports bra designs to understand the level of bounce reduction they offer. All Berlei sports bras are tested through the AIS biomechanics department and findings have been responsible for significant advances in the product design of Berlei's sports bras. As a result, all Berlei sports bras are tested and endorsed by the AIS. "Our research with Berlei relates to breast bounce and comfort. It's important for athletes because performance can be limited by breast discomfort," said Dr. Nick Brown Head of the AIS Biomechanics department.

Motion capture technology is most commonly associated with the entertainment industry, with the likes of blockbuster films, **A Christmas Carol** and **Tron**, making the technique a household name. However, the technology originated in the life science market nearly 30 years ago, moving to the sports science and entertainment markets 10 years later. AIS research with Berlei is conducted using a treadmill and eight Vicon MX40 motion capture cameras with Nexus software.

The treadmill is surrounded by the Vicon cameras and six reflective markers are placed on the participant's chest in a set formation. The light emitted by the cameras is reflected back and the markers' 3D position is used to create a digital skeleton in the software.

Dr. Brown continued, "As well as the digital information collected with the Vicon system, we also ask each participant to give a selfassessment of breast pain and bra comfort after a walk, a jog and a run versus the unsupported test."

The AIS is working directly with the Berlei design and product development team, and can take the feedback straight away to help them develop something new, moving the range forward. Berlei is the only sports bra manufacturer to test their bras in this way. "The beauty of the Vicon system is that it enables us to precisely quantify vertical bounce using the Nexus software, relative to the trunk. Therefore showing us how much the bra reduces bounce," praised Dr. Brown. "This can mean up to a 60 percent bounce reduction versus an unsupported test.

"Berlei's designers love to see the results coming back in real time. At the end of a working day we have up to 60 ten-second trials that have been fully digitalized. The speed that the data is processed is impressive, making it convenient and easy to demonstrate the differences to Berlei in real time and get feedback straight away," concluded Dr. Brown.



The AIS houses a 22 camera Vicon motion capture system, which is used to test the performance of athletes. Everything from running gait, volleyball and bowling techniques are analyzed. Vicon Engineering

### VIRTUAL TEAM'S WORK PRODUCES REAL SAVINGS





Info

AWE has been central to the defense of the United Kingdom for more than 50 years.

.....**Credit** Courtesy of AWE The Atomic Weapons Establishment's (AWE) virtual reality (VR) lab is a new facility where users can experience design proposals before they become reality. It allows engineers to see for themselves if things are right and therefore avoid costly mistakes.

There are six people in the engineering VR team at the Aldermaston AWE facility. The engineering VR team leader spoke to The Standard about the benefits of VR and described how the Vicon motion capture system is vital in creating their virtual world.

A plan on a piece of paper can't convey the same understanding that a VR environment can. The VR team leader said, "Being able to see things in front of you and move about the space gives you a real sense of what it would be like once the design is put into production. We use CAD (computer aided design) models as a basis and design lifelike images which can be scrutinized in great detail. The Vicon system is then used to fully immerse the engineer in that VR world."

The VR lab houses a 21 camera Vicon MX03+ system running Tracker software. The team leader explains, "We want our VR engineers to use the best tools available, which is why we're working with Vicon.

"Our virtual prototypes are demonstrated to an audience wearing stereo-glasses in the purpose built theater, or experienced individually in the VR headset where someone can personally explore the virtual space.

"Using VR to visualize designs before they are built, provides the opportunity for mistakes to be identified early in the design process, promoting a right first time approach," the team leader said. "Often something very simple that you can catch early on can save many thousands of pounds. "We're involved in all the main programs at AWE – everything from assembly and disassembly, through to facilities and emergency response training."

When planning a new facility, workers are often asked to 'try it out' first in the VR lab. Once they're markered up, the Vicon system transports them into the VR environment.

"Can they reach things, are they comfortable, can they see everything? We also use real physical constraints, such as arm-holes for glove boxes, to make it as realistic as possible, which is where the accuracy of the Vicon system comes in.

"If we're trying to gauge the distance a worker can reach or control a component, the system needs to be giving us the correct data.

"It's not a question of whether to use VR, but how much it could cost not to use it," concluded the VR team leader. **Vicon Engineering** 

### **UPENN - GRASP LAB** PUSHING THE BOUNDARIES OF POSSIBILITY

By using Vicon motion capture systems to track position in space, the University of Pennsylvania is achieving highly precise flight maneuvers with quadrotor unmanned aerial vehicles (UAVs).

Watch UAVs in action. www.vicon.com/ upenn.html





The GRASP Lab at the University of Pennsylvania's Department of Mechanical Engineering is conducting research that aims to achieve computer-driven quadrotor UAV flight that is precise enough to someday be applied practically in scenarios including search and rescue operations in which human entry inside buildings, damaged by earthquakes or fires, is too dangerous.

Each quadrotor is equipped with an IMU (Inertial Measurement Unit) sensor to measure its angular velocity, and affixed with four passive optical markers that are tracked by 20 Vicon T40 cameras set up in a 5m<sup>2</sup> volume. The Vicon motion capture system feeds position in space of a quadrotor into the lab's computer-driven navigation system. The lab has achieved this successfully with up to eight quadrotors flying simultaneously. Highly precise navigation, including flying through windows with less than three inches of clearance, is driven using algorithms designed by The GRASP Lab's research team consisting of Dr. Vijay Kumar, Daniel Mellinger and Dr. Nathan Michael.

"Vicon mocap is in use on a dayto-day basis on the project. Those developing agile robotic systems need some way of measuring position and orientation in real time at very high rates, and the Vicon system gives us that reliable data. We push the system to the limit on a daily basis. The quadrotors fly very closely to each other and we can't afford to make errors or we get spectacular crashes," explained Dr. Vijay Kumar.

The quadrotors perform a variety of maneuvers, including single, double and triple flips, flying through space

with any reasonable velocity or pitch angle, flying through windows at various angles with less than three inches of clearance on all sides, flying between other quadrotors, and ascending or descending through a narrow horizontal slot. Additionally, with appropriate claws or perching aids, the UAV can perch directly onto a flat, vertical or inverted spot within a space.

"Figuring out position, or localization, is one of the most challenging problems for engineers working with UAVs," says Daniel Mellinger, Ph.D. student at the School of Mechanical Engineering at the University of Pennsylvania. "But by using a Vicon system, we can very accurately determine where the UAVs are in space at a very high rate."

The onboard IMU on each quadrotor measures angular velocity; however, determining where the quadrotor resides in space is the tricky part. According to the GRASP Lab team, that's where the Vicon system and Tracker software come in. "With any big engineering problem, it's helpful if you can parse out portions of the problem and solve those individually," shares Mellinger. "Vicon's motion capture system allows us to focus on one part of problem - the dynamics and control. That is a big advantage in projects of this scale."

For now, this remarkable achievement lives in the lab, but in the future, the University of Pennsylvania hopes to recreate these scenarios in real-world outdoor settings and is researching technologies to make this possible.



**Vicon Life Sciences** 

### OUTDOOR CAPTURE RAISING STANDARD FOR CRICKET TESTING



Watch UWA set-up and capture outdoors. www.vicon.com/ uwa.html



In March 2011, the University of Western Australia (UWA) became the first Vicon customer to purchase a new outdoor T-Series S Edition system.

UWA was selected as part of a group chosen to provide real-world testing for the new cameras prior to February's launch. UWA utilized the Vicon test system outdoors to look at cricketers bowling action. Prior to this technology, UWA used an indoor Vicon MX3+ system; however, they wished to move to a more realistic on-field testing environment.

Jacqueline Alderson, Assistant Professor at UWA explains, "With Vicon's outdoor capable motion capture cameras, we aren't constricted to lab conditions. The ability to capture outdoors is invaluable for our own cricket testing center and is another step toward improving ecological validity."

In cricket, a player is deemed to have an illegal bowling action if their elbow extension exceeds 15 degrees during the bowl. This may result in the player being banned by the International Cricket Council (ICC). The player would then need to undergo technique re-training and be re-tested with a motion capture system until their elbow extension is proved to be below the allowable 15 degree threshold. UWA is a world leader in cricket research and its Vicon outdoor system will be their new gold standard.

Kane Middleton, a Ph.D. candidate at UWA provided additional insight into the quality of the data captured with the Vicon test system. "The cameras performed remarkably well even in high lighting conditions. A few cables into the cameras from the main box and we were ready to go!

"Data quality was great with very few broken trajectories. Vicon has given Sports Biomechanists the ability to perform high quality, ecologically valid research. Being able to collect 3D data in the field is priceless as it does away with the constraints of laboratory data collection."

The UWA team doesn't just concentrate on cricket. As one of the world's leading sports research facilities, Alderson and Middleton plan to use the 12 T40S outdoor cameras for a variety of sports research.

Alderson explains, "We will be able to utilize the system for all our other sports research as well, initially Australian Rules Football, soccer and athletics. It will enable soccer players to play on real grass with real goal posts and athletes can be tested surrounded by equipment and playing environments familiar to them."

Alex Muir, Asia Pacific Sales Manager at Vicon said, "We've had a long-standing partnership with UWA and to bring their research outside is something we've always dreamt about!

"The capabilities of the T-Series S Edition cameras mean that we don't need to add anything else to make them work outside. They're optimized for outdoor use so, most importantly, there's no loss in performance. UWA needs accurate data – this testing can cost some players their careers - there's no room for error.



**Vicon Entertainment** 

### SEGA STUDIOS AUSTRALIA ACES OUTDOOR CAPTURE



### Top Tips. 📋

#### Helpful Shortcuts in Blade

There are many ways to play back a file in Blade. In addition to the standard play controls, you can also:

#### SEGA Studios Australia, the biggest animation studio in Australia, has used a 10 camera Vicon system to capture performances in an outdoor setting for an upcoming video game release.

To maximize realism for the title, the development team wanted to conduct motion capture sessions in an outdoor setting. This enabled the capture of authentic movement over the course of an eight-hour motion capture session. Multiple performers were captured simultaneously in an 8x8 meter volume.

"Being able to capture data outside is brilliant. It will add a whole new level of realism to the game," said Kendra Fairbairn McCarthy, Head of Animation and Motion Capture at SEGA Studios Australia. "We couldn't have achieved this type of outdoor optical motion

- Spin the mouse wheel to scroll time forward and backward.
- Use the A and S keys as hot keys to step forward (S) and backwards (A) one frame at a time. This is a good way to review a motion. When you hold the key down, playback will be a consistent speed; when you

capture before the availability of the Vicon T-Series!"

Alex Muir, Asia Pacific Sales Manager at Vicon explained, "Today's game player expects every nuance to look perfect. SEGA knew they had to shoot their motion capture outside to make the game play realistic.

"With all of the sunlight, wind and natural elements, this would have been a daunting thought previously. However, with the Vicon T-Series, SEGA was able to capture and deliver the motion needed. Also, as we were in the Australian sun, we had the added bonus of getting a tan!"

SEGA Studios Australia (formerly known as The Creative Assembly Oz) has the largest motion capture facility in Australia. The developer is currently working on a AAA SEGA title, due to be announced in the coming months.

let go playback immediately stops. If you set your repeat delay in the Windows keyboard settings to 'short', this can be even more interactive.

 Use the + and – keys on your keyboard to change the size of the manipulator in the 3D view.

....... Credit SEGA Studios Australia **Vicon Life Sciences** 

### NEW FRONTIERS IN INJURY PREVENTION



Stay up-to-date on the latest news at RIC. www.running injuryclinic.com



Established in 2004, the Running Injury Clinic is the first of its kind in Canada investigating running injuries from both a research and clinical perspective. Located on campus at The University of Calgary and within the Center for Clinical Gait Research, the Clinic has a full complement of Post-doctoral, Doctoral, and Master's students and is headed up by Dr. Reed Ferber.

Funded by several provincial national and international research agencies, the Clinic conducts research studies investigating the biomechanical factors that give rise to several common running related injuries including patellofemoral pain syndrome, iliotibial band syndrome, plantar fasciitis, and shin splints. In addition to its research arm, the Clinic employs athletic therapists, physical therapists, and rehabilitation specialists who work clinically to assess and treat runners experiencing running related injuries.

#### Use of Vicon Motion Capture Systems within The Running Injury Clinic-Research Purposes

A cornerstone to the collection of objective, accurate, and reliable biomechanical data for research purposes within the Clinic has been the use of Vicon's MX optical motion capture system. Using a retro-reflective passive marker set, the Running Injury Clinic utilizes the following components when performing a running or walking biomechanical gait analysis:

- Eight Vicon MX3+ cameras
- Instrumented treadmill with two force plates
- Vicon Nexus motion capture software
- Vicon MX control unit

While biomechanical research drives most of the work being done in the Clinic, a separate aspect of the Clinic is the injury assessment and treatment of both recreational and elite runners who are experiencing a running-related injury.

Accessible to any member of the running community, the Clinic offers its clients a comprehensive and scientific analysis of their strength, flexibility, and anatomical alignment. In addition, and in a manner similar to the research studies, the joint kinematics and kinetics of the injured runner are determined during a 3D running analysis using the Vicon motion capture system. The Vicon system provides clinicians with objective and reliable joint range of motion (ROM) and force data that would otherwise not be observable through a visual gait analysis of the runner.

Following the entire data collection, the clinician then considers the client's strength, flexibility, and biomechanical data, and provides an assessment of the potential causes of injury. From this, a tailored rehabilitation program is developed to address the previously determined impairments identified in the injured runner. In large part due to the biomechanical conclusions drawn from the Vicon system, the runner is given a program to address the issues surrounding his or her running injury. When the biomechanics and strength of the runner are taken together, a reliable, valid determination of the injury can often be determined.

Many of the research initiatives undertaken within the Clinic depend on the collection of objective, accurate, and reliable biomechanical data. This is accomplished using the eight MX3 camera 3D motion analysis system. Retro-reflective markers are placed on specific anatomical landmarks on the injured runner's lower extremity

**Credit** Courtesy of University of Calgary



"If we can reduce running injuries by 5%, we could save the Canadian government a billion dollars a year." Dr. Reed Ferber

to aid in the determination of joint centers and joint positions. Using video data and force plates embedded in the treadmill, specific 3D limb positions and joint forces that occur during the gait cycle are measured. Reliable and scientifically valid data can then be calculated, allowing the effects of an intervention or the factors contributing to a particular injury to be determined.

Subsequently, using the Vicon system, the Clinic has recently published peer-reviewed research investigating the day-to-day reliability of anatomical marker placement (Pohl et al., 2010), the role of the tibialis posterior tendon in gait biomechanics (Pohl et al., 2010), and the gait characteristics of runners with iliotibial-band syndrome (Ferber et al., 2010). The effect of hip muscle strengthening on changes in gait mechanics has been elucidated for patients with low back pain (Kendall et al., 2010) and for runners with patellofemoral pain syndrome (Ferber et al., 2011). Recently, and most exciting, is research being done in the Clinic in the area of running injury prediction. Specifically, through the use of classification algorithms that help distinguish specific features of a particular injury, it may be possible to identify those most at risk for injury (Fukuchi et al., 2010).

The ability to predict injury may seem a bit far-fetched, but the development of the world's largest running injury database will be central to this initiative.

#### Current and Future Work in The Running Injury Clinic A primary objective of the Clinic

over the past several years and into the future is the continued development of its running injury database. The purpose of the database is to store all data collected on injured runners, stratify this information by injury type, and provide an output of the characteristics most common to a particular type of injury. The database will provide the researcher with more insight as to the possible causes of a particular injury. Further, it will benefit the average runner in that their individualized data can be compared to the average of thousands of runners with the same injury thereby allowing a comparison to normative data. Assisting in the development and validation of the database are other institutions such as the University of San Paulo, Brazil, AUT University in New Zealand, and McGill University in Montreal, Canada.

In addition to the growth of the database, the Clinic has, after several years of research and development, introduced the Vicon system into private physiotherapy clinics across Western Canada.

This private system includes three Vicon Bonita cameras, Tracker software, and our custom-written Matlab software. This set-up is valuable in that it can provide the clinician with the same researchquality data that was previously only available at the Running Injury Clinic on campus at The University of Calgary. The introduction of the Bonita system into clinics is promising since it provides clinicians the opportunity to objectify and better

guantify their lower extremity injury assessment findings. Moreover, the data collected within these clinics can be sent back to the Clinic where it can be added to the growing database of running injury information, promoting a further understanding of the aetiology of running injuries. Continued development of the Clinic database and research in the area of gait biomechanics will continue to facilitate a better understanding of running injuries with the ultimate goal of helping predict injury before it happens.

Dr. Reed Ferber is a board certified athletic therapist and holds a Ph.D. in Sports Medicine and Gait Biomechanics. He has completed post-doctoral research fellowships at the University of Delaware and the University of Calgary and specializes in the research and clinical treatment of lower extremity injuries. He is the Director of the Running Injury Clinic and an Assistant Professor in the Faculties of Kinesiology and Nursing at the University of Calgary. Dr. Ferber is also a Population Health Investigator through the Alberta Heritage Foundation for Medical Research.

Ryan Leigh is a licensed Physical Therapist who works in a private sport physiotherapy clinic in Calgary. He completed his MSc in exercise physiology before completing his physiotherapy MPT degree, both at The University of Western Ontario. He is presently working on his Ph.D. in biomechanics under the supervision of Dr. Ferber. **Vicon Entertainment** 

### QUANTIC DREAM INCREASES CAPTURE OPPORTUNITIES UPGRADES TO T160 CAMERAS

**Credit** Courtesy of Quantic Dream



# Heavy Rain developer upgrade to create highly precise performance capture stage

Heavy Rain developer, Quantic Dream, has recently updated their F-Series Vicon motion capture system by adding 36 T160 cameras. The new, highly precise performance capture stage will be able to record voice, body and facial movements simultaneously.

Guillaume de Fondaumiere, CEO Quantic Dream said, "Considering the focus of our work at Quantic Dream, we are continuously researching the best way to capture actors performances and refining our processes and pipelines.

"On Heavy Rain, we had to split the performance of actors in two, capturing facial/voice and body separately. This method proved quite heavy on the actors, who had to perform all dialogue sequences twice. Also, combining body and facial moves proved technically challenging. Last but not least, the performance suffered from it, as you lose spontaneity and synchronization on the way.

"When we saw that a more accurate system was available from Vicon, enabling us to realize true all-in-oneshoot performance capture, we decided to test and consequently adopt it."

The system will be used on all of Quantic Dream's upcoming projects, but will also be available to third parties looking for highly precise performance capture.

Fondaumiere concluded, "We started to use the T160 system and to test our new capture pipeline in December. We are extremely satisfied with the results. This is exactly what we were looking for.

"With such a high degree of precision, Vicon provides the best motion capture system I've ever seen." Vicon Sponsors

### **IMECHE AWARD**

#### Vicon sponsored IMechE MED Student Project award

The Vicon sponsored award, Best Project involving the Design or Development of a Medical Device, was awarded to Rebecca Eden from Newcastle University for her research into Biotribology of Ex Vivo 36mm Metal-on-Metal Total Hip Prostheses.

Dr. Tom Shannon, Founder and Director at Vicon said, "Vicon is very proud to continue to act as a prize sponsor for the Annual Medical Engineering Student Project Competition organized by the Institution of Mechanical Engineers.

"The standard of entries continues to rise significantly year on year. Choosing a final winner from the excellent entries submitted this year was hard work."

Metal on Metal prostheses are being more commonly used in total hip replacement procedures but concerns are being raised about wear rates, patient hypersensitivity, and in some cases post-operative blood poisoning. Eden's project looked at the wear rates and patterns in explanted devices that may have a crucial role to play in a better understanding of the causes of failure and acceptance of this approach.

Dr. Shannon said, "All present at the meeting heartily congratulated Rebecca on the outcome of this most important work and Vicon was honored to present her with this year's prize."

Eden is currently studying Mechanical Engineering with Honors in Materials Science at Newcastle University.

Eden comments, "I am honored to have won the Vicon Prize for Best Medical Engineering Project 2011, and have my work recognized by the IMechE. It was a privilege to present my findings to such a distinguished panel of judges including Dr. Tom Shannon of Vicon, Professor Brian Davies and Professor Anthony Bull of Imperial College, London. I would also like to thank Dr. Tom Joyce for supervising me through my project."



#### Vicon Q&A

### RESELLER FOCUS

Five minutes with Henry Chow: VR & Simulation System Specialist at Antycip Simulation.



html

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#### Tell us a bit about Antycip

Antycip provides independent modeling and simulation tools, projection systems and other engineering services.

We've got 50 offices all across Europe and over 10 years experience as a preferred supplier to government agencies, top universities, research laboratories and private sector companies.

Our core areas of expertise range from Independent Simulation and Training, to Engineering Services and Consultancy for System Integrators.

### How long have you been working with Vicon?

We've been working with Vicon for nearly two years, mainly selling



Bonita systems. Our partnership came about after a customer came to us looking for a tracking system. After looking at other contractors, Vicon came out on top for price and quality. They have a great track record.

### What do your customers use their Bonita systems for?

So far, our customers have been using their Bonita systems for VR training, simulation and content management. We recently sold a six-camera Bonita system and Tracker software to the University of Strasbourg.

### What do the next two years hold for Antycip?

Looking forward, tracking systems will become a much bigger part

of our business, and the quality of what we sell is key. As a company, we're focusing more and more on gesture recognition technology, so as a partner Vicon will play a big role in that.

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Antycip Simulation has accumulated experience in diverse industries including Defense, Aerospace, Security, Transportation, Automotive, Telecommunications and Education.



We're always excited to hear about the interesting and diverse projects our customers are working on. If you have work you'd like featured in the next edition of The Standard, please contact us at editorial@viconstandard.org

### The Standard

### Always Online.

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#### Vicon Events

### 2011 **CONFERENCES**

Events throughout the world allow you to visit with colleagues and meet up with your friends at Vicon. They are great opportunities to discover what's new, get answers to support questions and to let us know what you are working on.

Please check the website for complete up-to-date listings www.vicon.com/company events.html

### Life Science

#### **ISBS**

Porto, Portugal June 27-July 1, 2011

#### ISB

Brussels, Belgium July 3-7, 2011

#### **ASB**

Long Beach, CA USA August 10-13, 2011

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standard

Wondering what these are?



Vienna, Austria September 15-17, 2011

#### SfN

Washington, DC USA November 12-16, 2011

### Entertainment

#### DEVELOP

Brighton, UK July 19-21, 2011

#### SIGGRAPH

Vancouver, CAN August 9-11, 2011

QR Codes are a quick and

easy way to share video,

pictures and websites on

To use QR Codes, download

a QR Code Reader from your

your smart phone.



smart phone. Once installed, take a picture of the code and the Reader will take you directly to the video.

For more information on QR codes and how to

download a Reader, type 'QR Code' into your search engine.



#### Words to find

SEGA

#### Standard

- UAU
- Veterinary
- Vicon

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