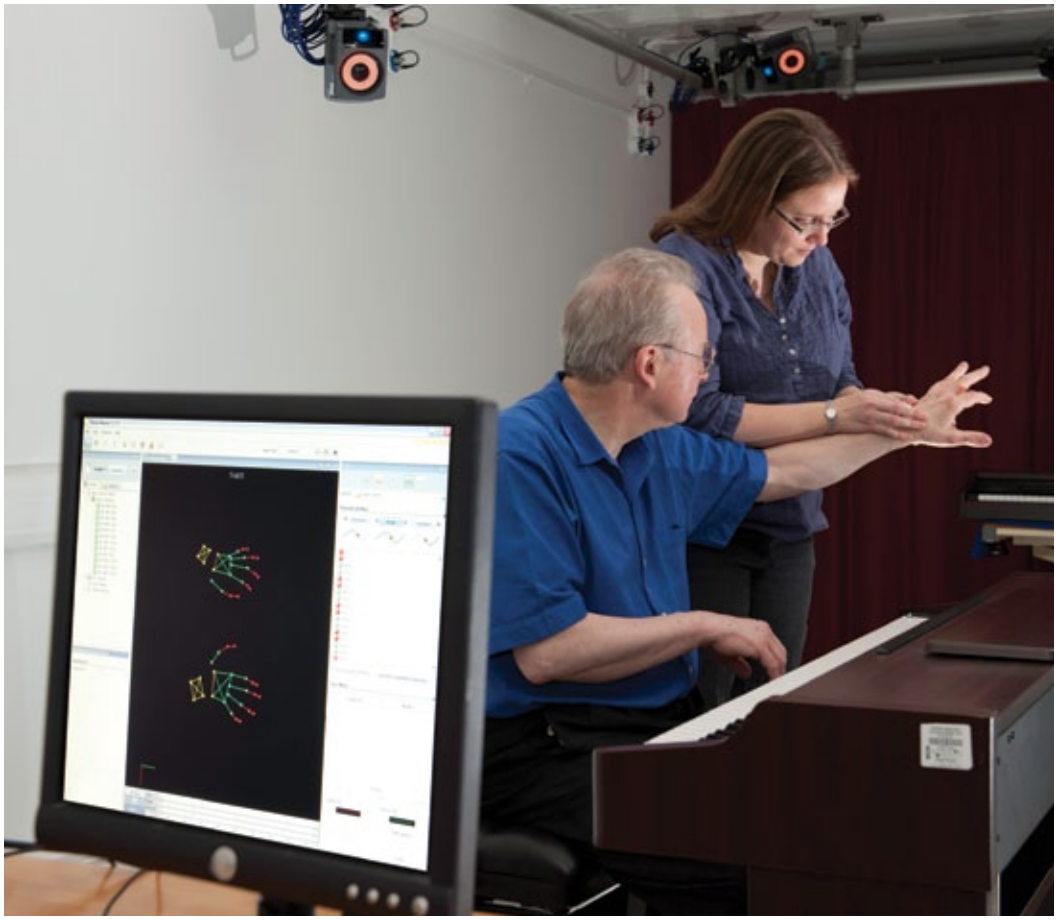
2012

VICON

The Standard

USING HOLLYWOOD TECHNOLOGY TO UNLOCK THE SECRET OF PIANIST'S SOUNDS



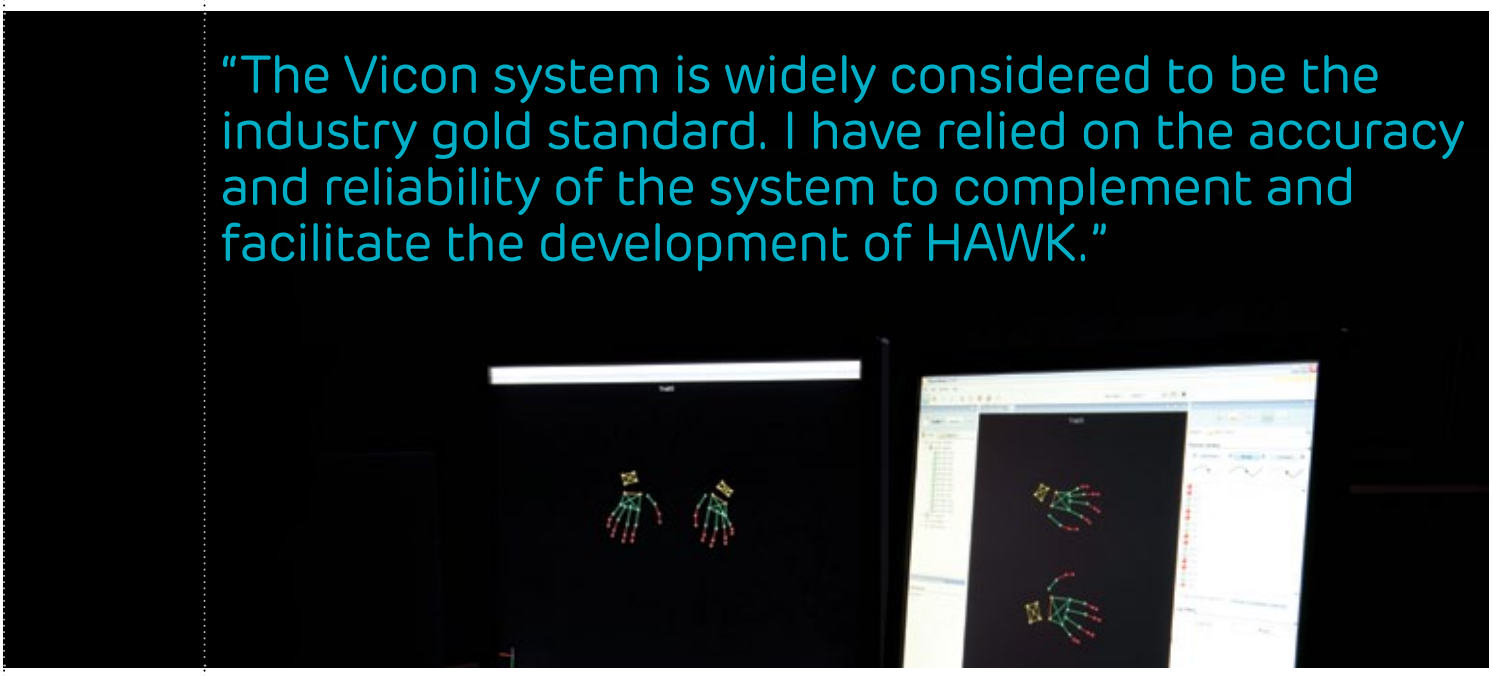
University of Southampton academics are pioneering a new way of using motion capture technology to examine the way pianists play the piano.

By using a unique kinematic measurement technique, known as HAWK (Hand and Wrist Kinematics), researchers will be able to look at individual pianists' playing technique - giving an insight into the posture of their hands on the keys and the movements they use - hopefully showing how this translates into the unique sound they create.

The research will also provide new information on musicians' hand health, to combat wrist injury (for example, repetitive strain injury - a common problem for pianists).

The project is being led by world-renowned pianist and University of Southampton Music Professor David Owen Norris and Health Sciences academic Dr. Cheryl Metcalf. Professor Norris can track the hand movements of pianists by using a 12 camera T-Series system and Nexus software from Vicon.

Continued



Credit
Courtesy of Southampton University

Discover more.
youtube.com/watch?v=pVASKTF0YQw

Dr. Cheryl Metcalf, who designed, developed and validated the HAWK technique, says, "Human hand function is fascinating when you think of the variety of tasks we perform every day. However, measuring human hand function is complex given the many different ways we can complete a task. Creativity is fundamental to hand function and to self-expression. HAWK analysis will enable us to understand the biomechanics of how musicians achieve their unique expressions."

Professor Norris says, "It's fascinating to watch pianists' hands. Audiences always want to see exactly what's going on with those flashing fingers, and pianists look at hands too; we argue about the best ways to make certain sounds and we compare what different players do with their fingers and their wrists.

"When I saw how the system can analyze exactly what we're doing with our hands, I realized that we could find the answers to some fundamental questions by making an archive of piano-playing. Pianists could appear in a dual archive of recordings and HAWK films - we could hear the sounds they make, and we could see exactly how they make them. Our hope is that in just a few years this unique archive would acquire an international standing."

Professor Norris and Dr. Metcalf trialed this technique at the University's Multidisciplinary Research week earlier this year. The resulting film is available on the University's YouTube page.

"The Vicon system is widely considered to be the industry gold standard. The development and validation of HAWK has been a complex process; HAWK is the first kinematic technique to measure all the composite movements of the wrist, hand, fingers, and thumb, and the Vicon system has been an integral part of that process. We have two Vicon systems at the University of Southampton, and I have relied on the accuracy and reliability of the system to complement and facilitate the development of HAWK."

It is hoped that the research can be further developed to build an archive of pianists playing techniques, from music students to visiting concert pianists, with the hope of establishing how technique affects sound and advice on how to avoid injury.

The Standard
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 piqued our interest in recent months.

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

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Vicon Engineering

QUEEN MARY STUDENT WINS MAJOR ENGINEERING AWARD

Melissa Gabriel, a graduate of Queen Mary, University of London (QMUL) has been announced as the winner of the Vicon-sponsored category 'Best Project Involving the Design or Development of a Medical Device' at the iMechE awards. This prestigious international competition attracts entries from all over the world and focuses on the use of engineering principles within healthcare research.

Gabriel presented to the judging panel her report, which described her MEng group design project in collaboration with P&N Medical Ltd. The project, titled "The Effect of Shockwave Lithotripsy on Encrusted Urological Stents", investigated whether shock wave lithotripsy can safely and effectively be used to unblock urethral stents. The results of the project have been taken up by urologists who worked with the students on this project.

Dr. Tom Shannon, a judge at the iMechE awards, and Founder and Director at Vicon said, "Each year the judges' task in choosing a winner becomes ever more difficult due to the increasing quality and standard of the science and engineering presented. This year was certainly no exception and we congratulate all of the competitors for their work and in particular Melissa Gabriel for her study."

The presentation was followed by questions on the research from the judging panel made up of healthcare professionals from both academic and industrial organizations throughout the UK.

Credit
Mel Gabriel (center) with Tom Shannon from Vicon (left) and Iain Charlton, Software Engineer at Vicon and Competition Chairman (right)

COO NOTE

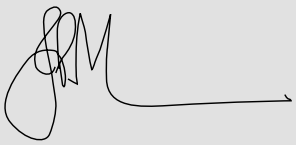
Imogen Moorhouse
Vicon Motion Systems

The Standard has always been a great way for us to share and highlight the diverse range of applications that use Vicon systems.

From training the next generation of visual effects artists and technicians to injury prevention in pianists, our customers never fail to push boundaries and surprise and delight all of us here at Vicon with their ingenuity and ambition.

From a product standpoint, the recently launched Bonita Video camera range is our first synchronized video platform specifically designed for motion capture. Another product we're really excited about is the Active Wand. Simultaneous optical and video calibration makes another industry first for Vicon.

We look forward to seeing you at our booth at the many international and national conferences we are attending this season where further product announcements will be made.



Vicon Entertainment

PREPARING FOR INDUSTRY: MOCAP IN EDUCATION AT THE UNIVERSITY OF BRADFORD

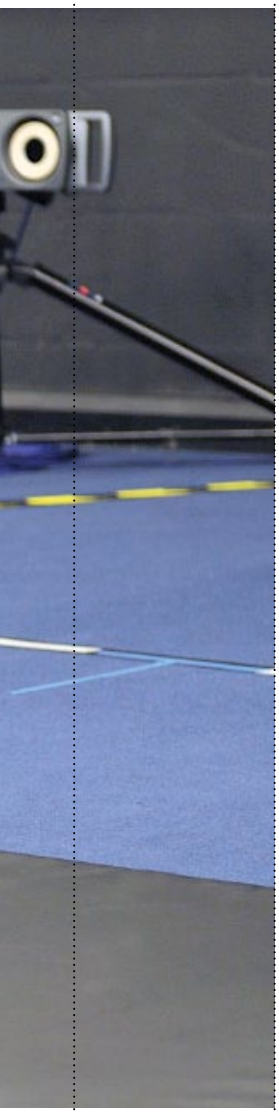
Credit
Courtesy of Bradford University

The University of Bradford was one of the first Universities in the country to venture into the area of informatics and computing. It's courses in animation and visual effects are especially pioneering, having been created 10 years ago and always attracting a high number of applicants. The combined research-and industry-informed approach to teaching has been very successful and beneficial to Bradford's students with world leading researchers and industry professionals teaching on its courses.

Karl Abson, lecturer in Creative Technology at the University of Bradford, says that practical experience is an important part of the program. He teaches a wide range of VFX subjects including computer animation and effects work, games, and interactive media.

Info

Bradford University is proud to be the number one university for graduate employment in the north of England and number two in the UK.



"Our ethos is to help students immerse themselves in these areas, and to encourage them to contribute towards their own advancement," said Abson. "Our courses are heavily influenced by industry, meaning that graduates are fundamentally prepared for the creative industries they wish to be involved in."

Exposing students to the same technology used in industry means they can hit the ground running. Modules include motion capture, facial modeling, animation, lighting, and rendering.

"We actively update our technology based on industry development," explained Abson. "Our software ranges from standard packages such as Autodesk Maya, Motion Builder, and Mudbox to more specialist packages such as Nuke, Zbrush, Unity, and CryEngine. We also invested in industry standard hardware, of which the most notable is our Vicon motion capture system."

The department's motion capture studio consists of 16 Vicon T20 cameras. The T20 is capable of capturing a staggering 500 frames per second at full frame resolution. It can accurately capture high speed movements such as an action sequence or a golf swing. The system is also capable of capturing both full body and detailed facial movement.

The motion capture modules are designed around industry practice and run like a real studio. Students get to take on roles from setting up the capture stage through to cleaning up data and end use.

"Students walk away with a mixture of industry specific skills based on the path they take throughout their degree, academic skills, as well as a good level of knowledge in regards to the industry itself," explained Abson. "This gives students the tools needed to successfully make informed decisions which lead to a successful career."

The final year of all degrees at Bradford is fundamentally concerned with applying the skills learned throughout the course to a real-world setting.

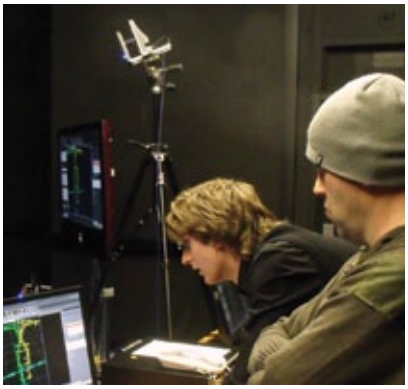
Abson said, "In our Design for Industry module, students work directly for clients. Our Digital Media Working Academy also reinforces this message through its search for commercial work, which our students can apply for, giving them valuable professional experience."

Rebecca Leybourne, a student at the University of Bradford said, "Learning motion capture has been a great way to really bring my animations to life. To think I'm using the same technology behind some of the biggest films and games of the last 10 years is very inspiring!"

Employment after graduation is very high on the agenda at Bradford. Many of its skilled graduates find work across the creative industries including the visual effects, games, and animation sectors. In recent years motion capture studios such as Centroid 3D, located at Pinewood Studios, and Ninja Theory have been on the list of graduate destinations.

Ben Guthrie, Motion Capture Supervisor at Framestore says, "Practical motion capture experience is a huge benefit to a potential hire. When browsing CVs as an employer, someone with hands-on studio or post processing experience definitely goes to the top of the list. It allows the employee a chance to confirm that the industry is indeed for them, and ensures that that they come to the job knowing enough to be productive right away." ■

"Practical motion capture experience is a huge benefit to a potential hire. When browsing CVs, someone with hands-on experience definitely goes to the top of the list."



Vicon Entertainment

OPTIMIZING THE CAPTURE VOLUME USING ROBOTIC RADIO FREQUENCY TECHNOLOGY

Louis-Nicolas Robert, Ms. Cinema.

Last year, the Digital Imagery Research and Development Center was launched in Matane, Québec, Canada. Key players of digital imagery in entertainment and research were present at this grand opening: Autodesk Media and Entertainment; the University of Québec in Rimouski; and the Natural Sciences and Engineering Research Council of Canada.

Known as CDRIN, this R&D center was developed over the last 10 years by the Cégep of Matane and marks a new way of doing business in R&D and Services.

CDRIN was specifically designed for R&D projects and big motion capture productions. The 8000 square foot studio includes a 20 foot truss structure with four arches that allow multiple capture volumes in the same space. In addition to that, another truss in the top of the studio was built to support two stuntmen for acrobatic motion.

The studio boasts 48 T160 motion capture cameras, two Bonita systems and Vicon's entertainment software package, Blade. It is also equipped with other technologies such as the SPS 1000 from Quattriuum Inc. (Montreal) who are currently working with CDRIN in R&D.

CDRIN has two main objectives: technology transfer and developing local, national, and international projects relating to R&D and digital imagery. The Cégep of Matane will help develop the R&D Center in six key educational programs: computer animation, multimedia, photography, electronics,

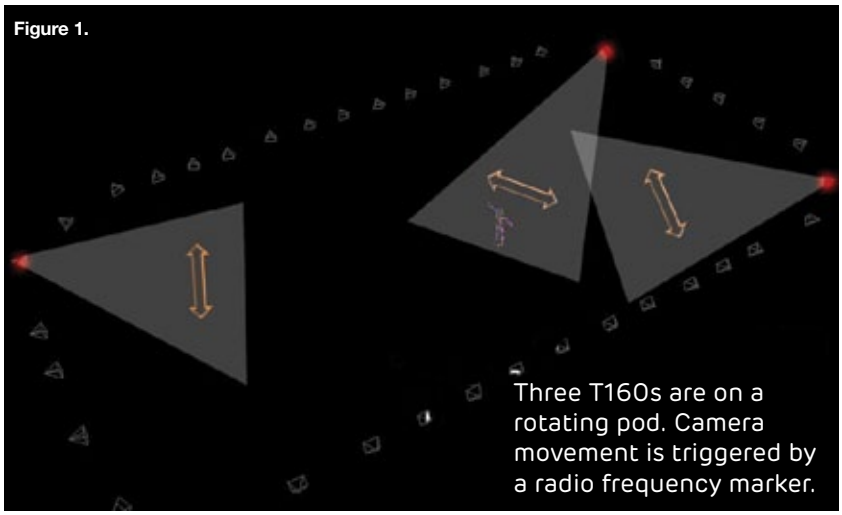


Figure 1.

Three T160s are on a rotating pod. Camera movement is triggered by a radio frequency marker.

interactive media programming, urbanism, and computing.

One of the important paradigms of CDRIN is the focus on developing new tools in digital imagery and because of that, optimizing the motion capture pipeline is a large field of research. CDRIN is currently working with Quattriuum Inc. to optimize the motion capture pipeline with the help of the robotic Radio Frequency (RF) system called SPS 1000.

The first step was setting up the capture volume, and like any studio, it was an adventure to prepare a solid, specific volume. To change that volume, a ladder or rig man was needed to change the camera angle.

The project began with basic questions about the capture volume – can a new capture

volume be changed or configured quickly without touching any cameras? Can the quality of the data captured on the edge of the volume be enhanced? Each time the response to these questions always pointed to robotic tools.

The hypothesis was the following: the use of robotics for changing camera rotation can enhance the quality of capture data and can also capture the data of a new volume more rapidly. This system is based on three pods that can rotate on three axes and track a radio frequency marker at any place in the volume.

Any type of camera can be placed on the pods. CDRIN tried three of the Vicon cameras and conducted a couple of tests with the RF system.

The next step will be the utilization of RF markers to rotate three pods simultaneously at the same time (see fig 1). With around 40 cameras, three of them (the red ones) are on pods that can rotate on three axes. Now, the range of the volume is not static. The new volume can be set up very quickly. After a new calibration, the new volume is ready to use with faster, high quality data capture.

Olivier Munger, Co-Researcher and President of Quattriuum Inc. said, "We're just in the beginning of our research using SPS 1000 and Vicon's T160 cameras. We already have a bunch of ideas to test multiple ways to work with these two innovative technologies. The volume capture issue is just our first branch of research, but surely not the last."

On a larger scale, CDRIN hope to capture with all the T160's on pods. The automatic rotation capabilities will not only enhance the quality of data capture, but will also optimize the motion capture pipeline. ■

Info

Louis-Nicolas Robert is the Project and Business Development Manager at CDRIN

Vicon Engineering

VIRTUAL ENVIRONMENTS WITH CLARITY

Discover more.
youtube.com/watch?v=qHv3zxvM0Uk

Based in Laval, France, CLARTE specializes in high performance equipment in the field of virtual reality (VR), augmented reality (AR), and haptics. It offers a service for companies wishing to incorporate VR into their development process. CLARTE acts as a test facility for VR and AR equipment and continually develop innovative experimental applications based on virtual and AR technologies.

Alexandre Bouchet, Responsible Technique & Scientifique at CLARTE said, "Our first experiments in VR started with the installation of a Reality Center in 1999. As the company has developed, our technology requirements have grown, so last year we purchased our first Vicon Bonita system to use in our VR environments."

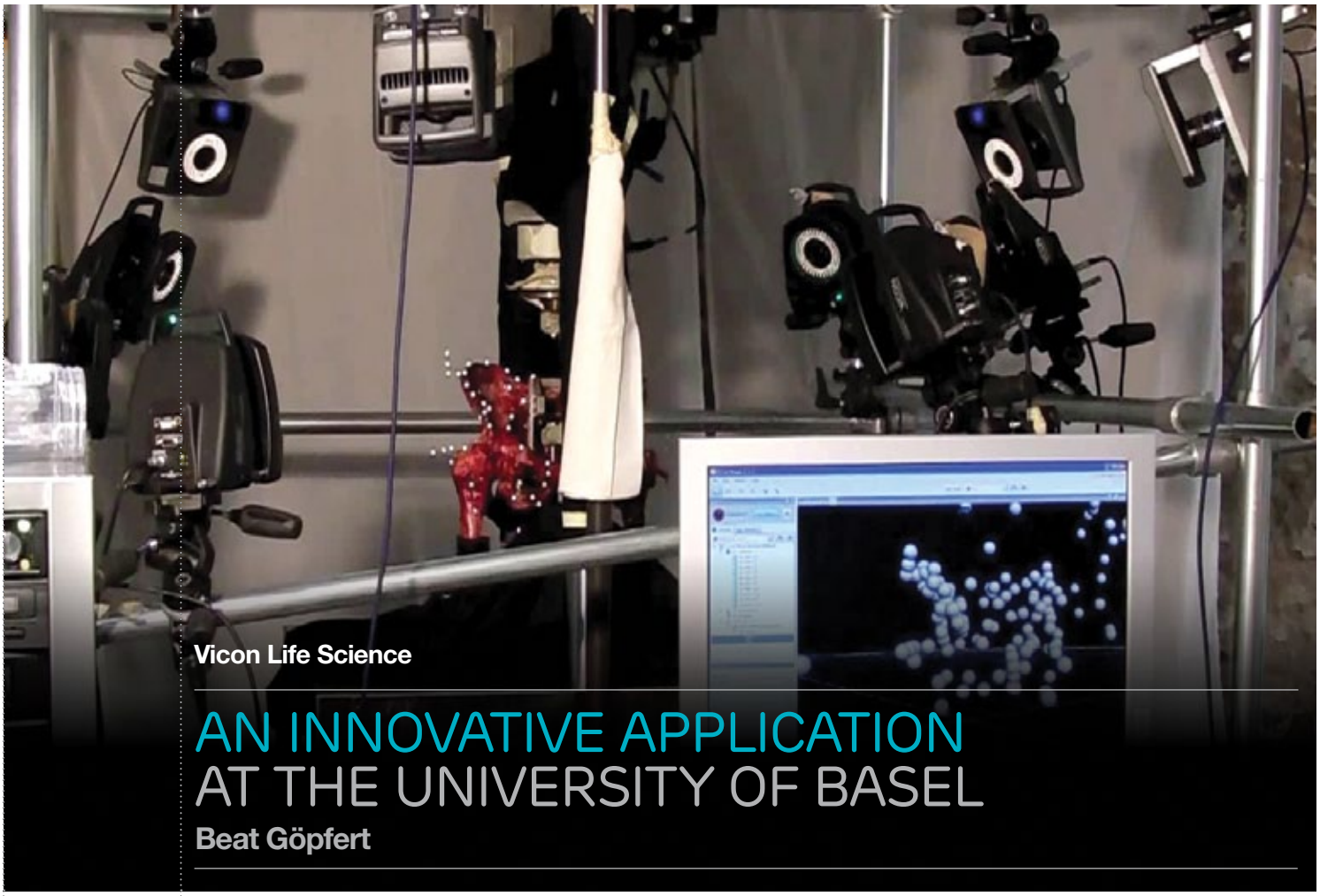
> "For me, the Bonita cameras really stand out for three reasons – low latency, a high refresh rate up to 200 Hz, and the wide field of view."

The largest VR environment at CLARTE is the powerwall. A powerwall is a large stereoscopic screen, with a projector that creates a high quality picture. It is mostly used for design reviews, viewing models on a 1:1 scale, where picture quality and sense of immersion is crucial. The user, wearing a pair of stereoscopic glasses, is tracked with the Bonita cameras as they interact with the display.

"We've been really impressed with the quality of the system so far, especially with the powerwall, where a wide field of view and low latency is very important to the quality of the experience for the user," said Bouchet.

A workbench is a simpler and generally smaller VR application, and includes two small angled screens to display CAD data for the user to interact with. The view on the screens change with the user's perspective by tracking the person's head. This system is most frequently used to validate the mechanical assembly of components in a manufacturing setting.

Bouchet praised, "For me, the Bonita cameras really stand out for three reasons – low latency, a high refresh rate up to 200 Hz, and the wide field of view. Two cameras will create quite a large tracking volume, which is pretty impressive." ■



Vicon Life Science

AN INNOVATIVE APPLICATION AT THE UNIVERSITY OF BASEL

Beat Göpfert

Measuring 3D deformation under dynamic loading conditions

Credit
Courtesy of the University of Basel

Understanding dynamic 3D deformation of the pelvic bones is a crucial factor in the successful design and longevity of complex orthopedic oncological implants.

The current measurement techniques do not offer an optimal level of accuracy; thus it would be interesting to utilize new technology to measure the pelvic bone to see if we can improve the knowledge base, for a better implant design. We hypothesized it would be possible to achieve sub-millimeter accuracy by combining a material testing machine with a 3D motion capture system, to measure deformation of a whole human cadaverous pelvis specimen.

The measurement setup is the result of a collaboration of the Laboratory of Biomechanics and Biocalorimetry, the Laboratory for Movement Analysis Basel at the University Children's Hospital Basel (UKBB) and the Paediatric Orthopaedic Department of the UKBB. The tests were performed at the interdisciplinary medical research center, Clinical Morphology & Biomedical Engineering, at the University of Basel.

Over the last few years, advancement in motion capture technology has opened the doors for new fields of study where high resolution is needed. The combination of a servo-hydraulic material testing machine (MTS Bionix 858, MTS Systems Corporation, Eden Prairie, MN, USA) with a Vicon motion capture system allows the measurement of 3D deformation under dynamic loading conditions. These results, combined with a computer tomography, allow the linkage between the 3D-movement of the reflecting surface markers and its underlining bone structure. This opens new possibilities in validating biomechanical simulations based on the finite element method and may increase the longevity of complex implant systems.

A 3D linear stage (M-461-XYZ-M, Newport Spectra-Physics GmbH, Darmstadt, Germany) with three manually-driven differential micrometers (DM-13, Newport Spectra-Physics GmbH, Resolution 0.0001 mm) was mounted on the table of the material testing machine in order to determine the initial accuracy of the set-up.

Several markers on the stage could be seen by a different number of cameras. This allowed the simulation of a real test condition, where not all markers are simultaneously seen by all cameras. The accuracy of the setup (six MX13+ and four T40 cameras) was dependant on the number of cameras tracking a marker: with six or more cameras, the accuracy was ±0.022mm; with two cameras, it was ±0.036mm.

The limiting factor of the system was the noise level of the cameras. During static data collection, it was possible to detect movements as small as 0.01mm; however, due to the noise level of the cameras this wasn't expected for dynamic measurements. Even taking into account the noise level, the accuracy of the Vicon system was still approximately 20 times better than the resolution of a medical CT-scanner.

The measurement of 3D-deformation of a human pelvic bone was done in a two-leg standing position. First the soft tissue was removed from the fresh frozen and thawed specimen, while leaving the joint capsule and the ligaments intact. Then an adjustable fixture was fixed at the sacrum, allowing unconstrained rotational and transversal motion [Widmer 1997]. After adjusting the pelvis on the testing machine, about 80 reflective markers were fixed at anatomically defined positions on the bone with cyanoacrylate. Finally, the dynamic loading of the specimen could be performed. It consisted of 100 sinusoidal cycles at 1 Hz with amplitudes between 100 N and either 0.5; 1; or 1.5× body weight respectively. The movement was tracked at a frame rate of 60 Hz.

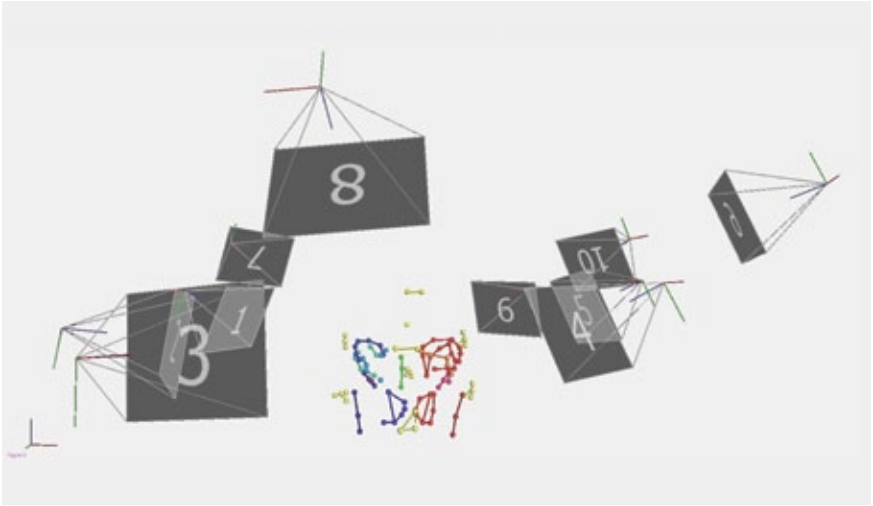
Following this, the whole specimen with all the markers was carefully moved to the CT-scanner. The CT-scan was done in the same position as the mechanical test. Finally the 3D-data of the tracked markers and the dataset from the CT-scan were combined in one single dataset holding the 3D-position of the markers with its underlying structure.

It can be concluded that the combination of a Vicon system with a material testing machine leads towards a comfortable and precise measurement methodology for determining 3D movements and deformation in the range from micrometers to several centimeters. Adding a CT-scan allows a linkage of surface 3D-deformation measurements with the underlying bony structure, which assists the development of Finite Element Modeling and Rapid Prototyping.

This new approach opens possibilities in dynamic testing of a wide range of materials, like anatomical specimens, biomaterials, and its combinations. The resulting 3D deformation dataset can be used for a better estimation of material characteristics of the underlying structures. This is an important factor in reliable biomechanical modeling and simulation as well as the successful design of complex implants. ■

Persons involved in the project:
Marie Freslier; MSc biomed eng
Beat Göpfert; MEng EMBA
Andreas H. Krieg, M.D.
Zdzislaw Krol; PhD.
Dieter Wirz, M.D.

"Even taking into account the noise level, the accuracy of the Vicon system was still approximately 20 times better than the medical CT scanner."



Credit
Courtesy of the University of Basel

Vicon Entertainment

ANDY SERKIS PICKS VICON FOR MOTION CAPTURE

Vicon has signed an agreement to become the main motion capture technology supplier to The Imaginarium.

Credit
AP/Press Association

The Imaginarium is a London-based studio, co-founded by actor/director Andy Serkis and film producer Jonathan Cavendish. The Studio offers performance capture consultancy and production services to film studios, television, and video game companies as well as developing its own work.

Vicon is supplying 80 of its cutting edge T160 motion capture cameras and new Blade software.

Nick Bolton, Vicon's CEO says,

"We couldn't be happier than to be collaborating with such talented people. This is much more than just a contract to supply equipment; we're working closely with The Imaginarium team on this exciting venture, which aims to become a global center of excellence taking motion capture to a new level - technologically and creatively."

The Imaginarium is also taking part in Vicon's alpha project for its next major entertainment software release, due to be announced soon.

Andy Ray, Vicon's Sales and Support Manager added, "The Vicon T160 cameras are the most advanced motion capture cameras available today. They will enable The Imaginarium to film on location in outdoor settings, adding another level of realism to the actors' performance."

The 16 megapixel cameras and latest software will enable The Imaginarium to deliver high quality data which, combined with the studio's unique creative direction, will make it one of the world's leading performance capture studios.

Nicholas Taylor, The Imaginarium's Managing Director, says, "The Imaginarium is a world-class performance capture studio, whose ambition is to become internationally recognized for harnessing science, art and cutting edge technology to create emotionally engaging characters that delight and astound audiences all over the globe. Vicon were the obvious choice of partner for us as we pursue this goal." ■

Info Andy Serkis and Jonathan Cavendish joined forces in 2009 to pursue their vision of combining an integrated performance capture facility with a cutting edge development and production studio.

News in Brief

WHAT'S NEW AT VICON

Earlier this year, Vicon announced the launch of a new range within the Bonita product family - Bonita Video.

Bonita Video is the world's first reference video camera designed specifically for motion capture. Combined with the world's first dynamic calibration technique using the Vicon Active Wand, video and optical cameras can now be calibrated together providing unrivalled accuracy.

The Bonita Video range launches with three new cameras. The 720, available in color or monochrome, has a fully synchronized frame rate of 120 Hz that captures every detail in HD resolution. The monochrome 480m will capture high speed movement with an impressive frame rate of 350 fps.

Vicon's Life Science software package, Nexus, has also been updated to support the new hardware.

Info vicon.com/products/bonita.html
vicon.com/products/nexus.html

Info

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.

For this review we consider four papers, all of which examine measurement technology with Vicon as the data collection system.

Wolf, A., Senesh M., "Estimating joint kinematics from skin motion observation: modeling and validation", Computer Methods in Biomechanics and Biomedical Engineering, 2011, Vol 14:11, pp 939-946.

The authors are looking at ways to reduce the effect of skin motion artifact. Their model for comparison uses markers on a rigid body simulating the human arm with experiments on the arms of 18 volunteers (10 M and 8 F).

An eight camera Vicon MX system was used for data collection.

Markers were applied in a pattern to either the rigid model of the forearm or to the forearms of the participants. The participants' motions were done in a jig which allowed independent measurement of the movements. The motions were relatively slow so that high velocity or acceleration were not really confounding factors. The study hypothesis was that by using a Kalman Filter there would be an improvement in the accuracy over more conventional low pass filtering combined with a Point Cluster Technique. For anyone who hasn't run across Kalman Filtering, the concept is that for a noisy measurement situation, you develop a model of the system you are going to measure and then as the noisy data is collected and is mapped against the model predictions as a means of reducing the noise. These are used widely in engineering measurements.

Both Kalman Filtering and low pass filtering combined with the Point Cluster Technique improved the results but there was no particular improvement for Kalman filtering. The authors think this is due to the model not being accurate enough, which is probably true. This raises the question of just how complex a model one would need to be able to model skin characteristics.

In many ways the take home message of this paper is to always evaluate new procedures carefully before assuming they will improve on what has gone before.

Reid, M., Campbell, A., Elliott, B., "Technical Note: Comparison of Endpoint Data Treatment Methods-

for Estimation of Kinematics and Kinetics Near Impact During the Tennis Serve" Journal of Applied Biomechanics 2011 E Publication ahead of Print.

These authors also look at filtering but in a very dynamic activity, the tennis serve, particularly the point where the racquet and ball meet. They use a 12 Camera Vicon 612 at 500 Hz. They applied markers to the racquet, hand, wrist, forearm, upper arm, and thorax; but focused on the racquet tip for this experiment. By using the racquet tip there is no skin artifact, only the intrinsic error of the system plus the impact dynamics.

They looked at a variety of approaches which have been used for this problem. They report that smoothing through the impact or stopping just prior to impact and extrapolating are the most common approaches. They tried extrapolation using equations of 2nd order and 5th order combined with smoothing using either a Woltring quintic spline (QSF) or a Butterworth digital filter. It is gratifying to see that the work of Hermann Woltring, who was a key collaborator for the early development of Vicon before his untimely death, is still very much in use.

The tests suggest that the optimal low pass cut off is only 17 Hz, which seems quite low for such a dynamic situation, although it is substantially higher than typical gait measures.

The authors found that a combination of extrapolation and digital filtering didn't give as good a prediction as the QSF combined with the 2nd order extrapolation. Their results do suggest that earlier work probably underestimates velocity. They also find that there are very large differences in acceleration estimates.

This one might expect since a 2nd order fit will probably not give a good estimate of acceleration as the 2nd derivative.

Gholizadeh H, Osman NA, Kamyab M, Eshraghi A, Abas WA, Azam MN. Transtibial prosthetic socket pistoning: Static evaluation of Seal-In(®) X5 and Dermo(®) Liner using motion analysis system. Clin Biomech 2012 vol (1) pp 34-99. Epub 2011 Jul 26.

This paper looks at the relative movement between a person's limb and the socket of their prosthetic leg. A typical suspension system has a sock-like liner put on over the amputated limb and the leg is then slid into the prosthetic socket. The authors were interested in a new system to reduce "pistoning" of the limb inside the prosthetic socket. To do this they tested various loading conditions in a primarily static way using a seven camera Vicon 612 system.

What makes this an interesting paper from a motion capture technology point of view is that they needed to measure movement inside the prosthetic socket. They start with a clear experimental socket. What is really unique about this is that they then put thin flat markers on the liner inside the socket and image the markers through the clear socket. The Vicon system was able to image flat markers on the inside of the socket and on the outside and measure their relative motion. The advantage of doing it this way rather then measuring relative to points on the skin surface above the socket is that the socket extends up to knee level and this method means there is minimal effect of knee flexion.

The authors were able to measure sub-millimeter changes in position of the markers relative to one another. The results show the capability to measure in-socket motion and they did confirm their hypothesis that the system being tested reduced pistoning.

What I find amazing about this is imaging through the socket material, which I would not have thought possible.

Hong WH, Chen HC, Yang FP, Wu CY, Chen CL, Wong AM. "Speech-associated labiomandibular movement in Mandarin-speaking children with quadriplegic cerebral palsy: a kinematic study." Res Dev Disabil. 2011 Vol 32(6): pp 2595-601. Epub 2011 Jul 19.

Every once in a while one runs across an application of movement analysis which seems completely new. The authors use an older six camera Vicon 370 plus video. They track facial motions while speaking, for a group of 12 children with the Spastic Quadriplegia form of Cerebral Palsy and 12 controls (7 boys, 5 girls in each group). Both groups were from 7 to 11 years old.

Six millimeter markers were placed on the faces of children and/or on a mask which covered the forehead and provided the reference frame (the mask had four markers to define the coordinate system). Kinematic measurements were then made of the movement of the face but focused on the plane of the mouth.

Children pronounced various sounds which were judged to be "correct" or "incorrect" by a speech pathologist. These could then be matched with the facial kinematics as represented by measured displacements and velocities.

The authors were able to detect difficulty in the coupling movements as the children with cerebral palsy were speaking compared to controls. Using a Vicon system allowed measurement of both temporal and spatial coupling. They found that the problems which the children experienced were primarily temporal and that their facial velocity components were higher than the control group.

In choosing papers for this review I was intrigued at the diversity of measurement which can be done with movement analysis. The field grows by the day as people find new things they can measure.

Info

Dr. Caroline Stewart is a Bioengineer in ORLAU, a clinical department of the Robert Jones and Agnes Hunt Orthopaedic Hospital in the UK.

Vicon Life Science

LITERATURE REVIEW
THE STANDARD

Caroline Stewart, Ph.D.

In clinical gait analysis each patient poses a particular kind of challenge. Sometimes the challenges are technical, where careful thought is needed when positioning markers in the presence of pathological morphology, orthoses, prostheses, or adipose tissue.

On other occasions the focus of the team is on the patient, who may be self-conscious, determined to remove the markers, or desperate to be elsewhere. Working with human subjects I am always full of admiration for those who attempt to perform movement analysis on animals. Perhaps the greatest challenge of all, however, is to understand the movement of subjects who no longer exist. This is the concern of researchers with an interest in archaeology.

Archaeology is a particular interest of mine, so writing this review has given me the opportunity to bring two of my worlds together. Saying that, I am very much an amateur digger, so I apologize for any inadvertent archaeological heresies.

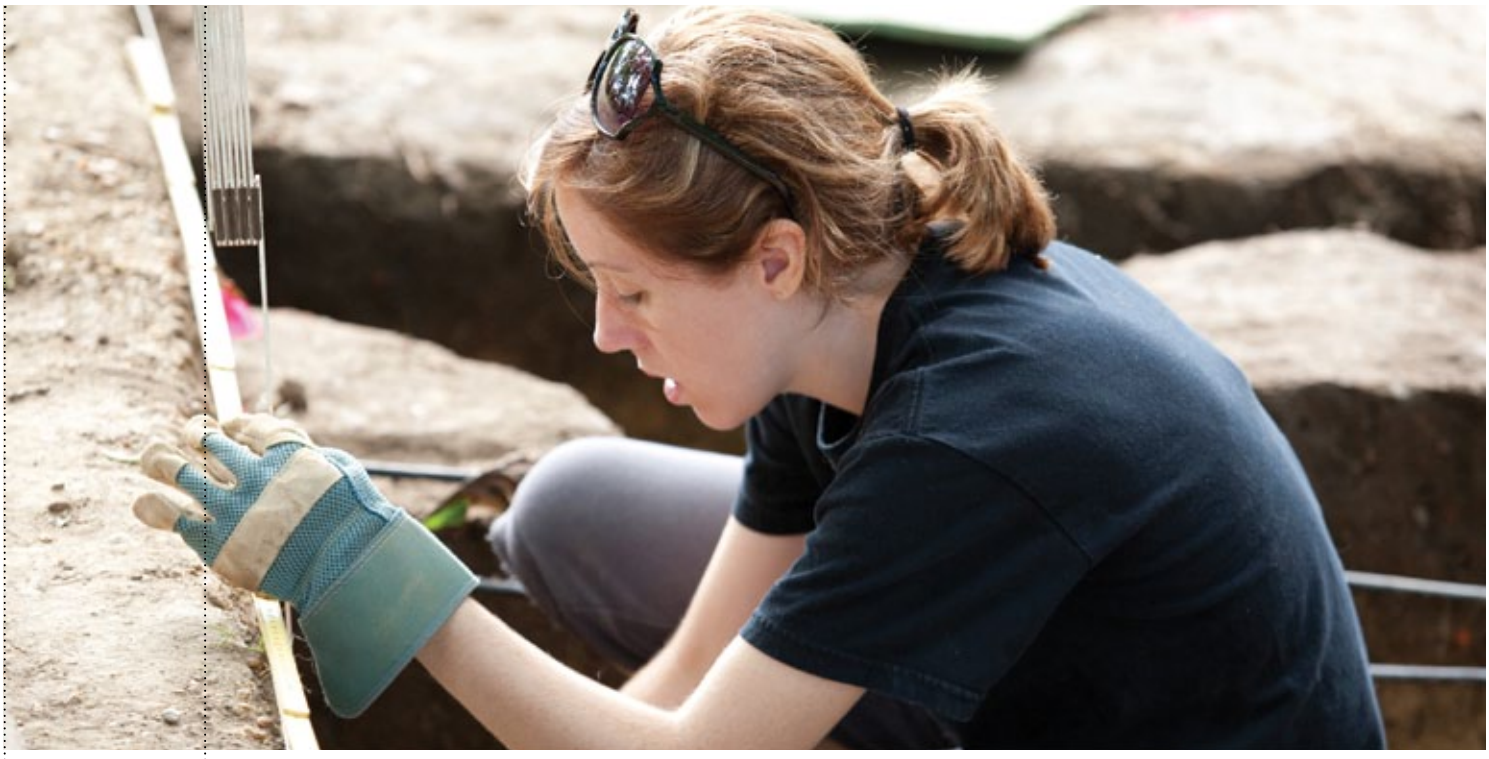
Williams EM, Gordon AD & Richmond BG. Upper limb kinematics and the role of the wrist during stone tool production. American Journal of Physical Anthropology 143: 134-145 (2010).

When studying the lower limb, the analysis of walking has been the predominant focus of researchers. The upper limb does not appear to have an equivalent fundamental activity which dictates development, function, and engagement in society. Stone tool production, however, had a major influence on human development and this study seeks to link the morphology of the upper limb with the ability to knap flint, fundamental to the production of early tools. Flint knapping is the process by which a hammer stone is gripped in one hand and brought down hard on a flint nodule, breaking off a flake.

Kinematic analysis of the flint knapping process highlighted the importance of wrist mobility, especially wrist extension, in generating sufficient force to break off a flint flake. Modern flint knappers, with markers secured through a tight glove, showed a pattern of movement progressing down the upper limb joints from proximal to distal, a sequence also required for throwing. If you wish to walk on the knuckles of the upper limb then a stable wrist is needed. When weight bearing is no longer required, new possibilities open up. This paper shows the first step, which led in time to the screw driver, the hedge trimmer, and the laptop.

Raichlen DA, Armstrong H & Lieberman DE. Calcaneus length determines running economy: Implications for endurance running performance in modern humans and Neanderthals. Journal of Human Evolution. 60:299-308 (2011). Also featured in New Scientist 'You'd beat a Neanderthal in a race' Issue 2798 (Feb 2011).

In order to hunt prey in a hot climate, endurance running is important. Human beings sweat and so are able to keep cool



during sustained running. The same is not true of potential quadripedal prey which depend on panting to maintain their body temperature. Being unable to gallop and pant concurrently, animals which are pursued for a long period collapse with heat exhaustion. In this fascinating study the endurance running capacity of Neaderthals is compared with that of contemporaneous modern humans.

During running, energy is stored in the Achilles tendon. Having a short moment arm about the ankle increases the potential for elastic energy storage, so having a short calcaneal tuber should correlate with greater running efficiency. The authors of this paper were able to demonstrate this relationship in an analysis of eight distance runners. The Achilles tendon moment arm explained 64% of the variation in mass-specific energy cost.

Fortunately Neanderthal remains include calcanei, which could be measured. It turns out that these were relative long. The authors therefore predict that the energy cost of Neanderthals would be significantly higher than that of modern man. It should be a relief to know that if you ever meet a Neanderthal on a dark night at a biomechanics conference, you should be able to run away.

Magnenat-Thalmann N, Papagiannakis G. Recreating Daily life in Pompeii. Virtual Archaeology Review 1:16-20 (2010).

This paper comes from what may be referred to as 'the other side of Vicon's world'. For those of us working in biomechanics, the applications of animation and virtual reality rarely cross our path.

Understanding historic cultures and civilizations involves a leap of the imagination. This will be apparent to anyone who has visited an archaeological site and has walked around a town, a castle, or a temple in ruins. Trying to recreate the vibrant world which existed centuries before can be a challenge, helped only in part by display boards and museum exhibits.

This paper describes a project to recreate a scene in the Termopolium (tavern) in Pompei using a Mixed Reality method. In order to be effective, skin, clothing, faces, and movements had to be credible and authentic. Characters needed to be able to move and interact. The authors drew on architectural information, social customs, dress, and hairstyles and used a Vicon system to capture motion sequences using actors. A number of technical challenges had to be overcome.

As well as informing visitors to historic sites, simulations can contribute to the understanding of how buildings and structures were used, bringing the past back to life.

I hope the papers above have been of interest. The desire to understand the links between structure, function, and environment are common to many researchers using Vicon systems. I have certainly enjoyed the excuse to read articles in a completely different area of research from my own.

Vicon Engineering

GETTING CREATIVE WITH FLEXIBLE VIRTUAL REALITY

University of California, San Diego (UCSD) started their partnership with Vicon in 2006 with the purchase of a 25-camera high-end motion capture system. The system is currently installed in the university's 20,000 sq. ft. research facility, but is often used on location for university projects.

UCSD houses an organized research unit, The Center for Research in Computing and the Arts (CRCA). As UCSD's oldest arts research center, CRCA has a long history of facilitating immersive and interactive artworks, and pursues speculative cultural activities that draw upon humanistic analysis, engineering innovation, and the insights of artistic expression.

Todd Margolis, Technical Director for CRCA at UCSD said, "Historically, we used various forms of custom and professional tracking systems, but six years ago we decided to upgrade our motion capture technology for something that is easy to deploy and flexible enough to use anywhere on campus or on location."

Experience from more than six years of campus-wide collaborations and many publications reporting on those projects both in the virtual reality (VR) community and also the domain sciences is flowing into the design and development of the new CalVR software framework.

CalVR is a virtual reality framework that develops numerous VR projects, most of which are classified as scientific visualization, cultural heritage or pre-visualization. It supports nonstandard VR systems like autostereoscopic displays, as well as multi-user support for viewing and interaction. CalVR has built-in navigation algorithms, a 3D menu system, support for collaborative work at different sites, and a variety of 3D displays and works with their Vicon motion capture system. Vicon contributes real-time head and hand tracking for multiple virtual reality installations using the framework.

Margolis said, "For example, a CalVR plug-in called ArtifactVis merges archaeology with interactive 3D VR. The head position is used so we can properly render a left eye and right eye image from the user's perspective. The hand tracking provides us with the capability to interact with the virtual world on many levels. We can simply navigate through spaces as well as significantly alter the form and content of virtual objects.

"So far, the research is going great! Vicon Tracker provides us with low latency and accurate data to enable rich interactive environments. Using an extremely high quality and reliable system that is easy to deploy in research labs as well as public venues like museums and galleries, gives us the flexibility we need to be creative."

Credit
Courtesy of UCSD

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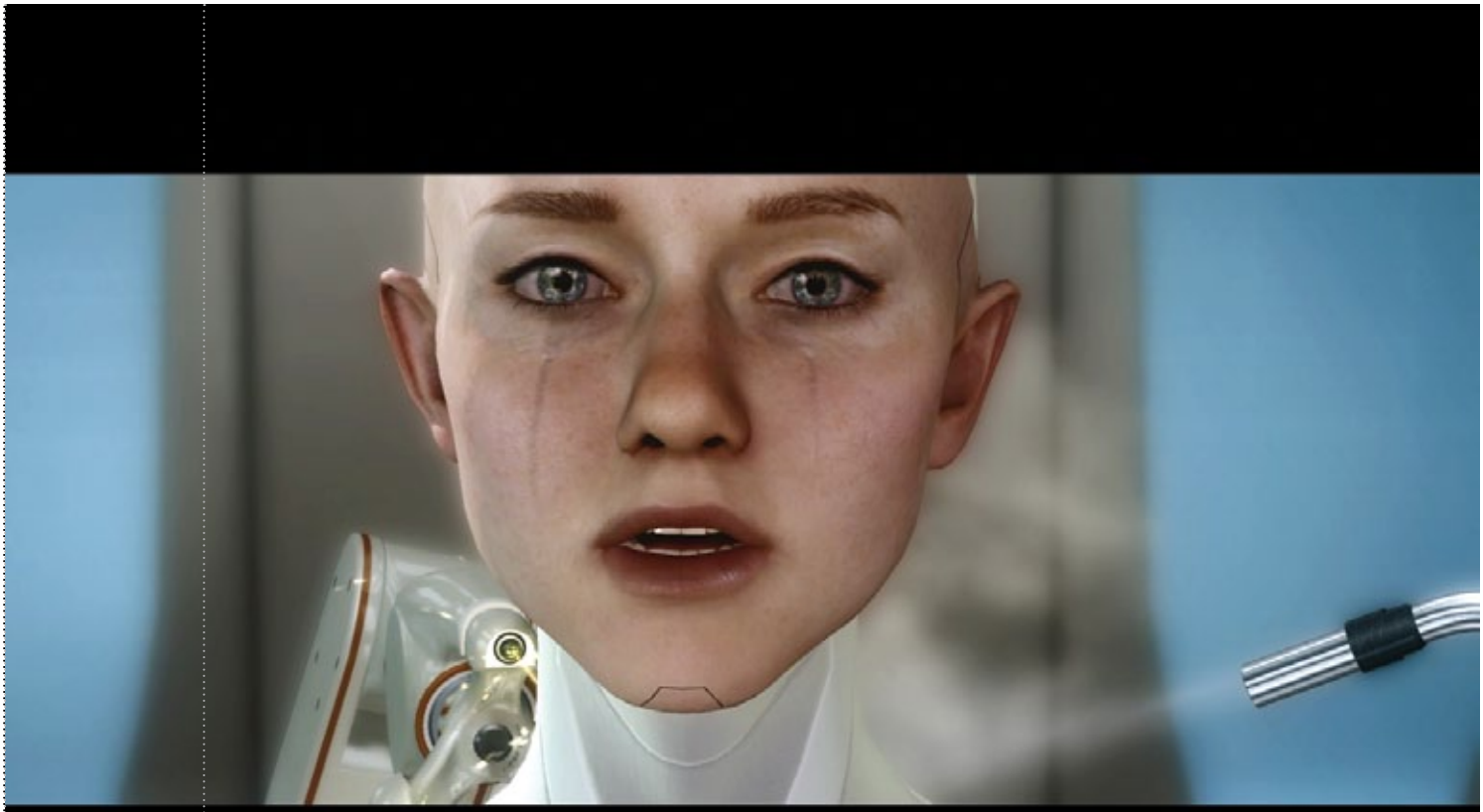

Vicon Entertainment

QUANTIC DREAM 'KARA' TECH DEMO POWERED BY VICON

Credit
Courtesy of Quantic Dream

Discover more.
youtube.com/watch?v=mSnFN8Ja58s

After the phenomenal success of Heavy Rain, developer Quantic Dream wanted to push the boundaries of motion capture even further. Investing in 36 new T-Series cameras was just the first step.

The motion capture for Heavy Rain was done using a Vicon F-Series system back in 2007. Guillaume de Fondaumière, Co-CEO and Executive Producer at Quantic Dream explains, "With our F-Series system, we had to split the performance in two: the body was shot on our large stage, but the facial capture had to be shot in our sound booth, forcing the actor to play seated, allowing only a very narrow field of movements. This brought numerous issues, in particular the need for the actor to perform the same thing twice and for the animators to render the facial and body movements coherently."

As an exclusive Sony PlayStation(TM) developer, Quantic Dream wanted to provide Sony with a demo that showcased what the new Vicon technology was capable of.

"When we were developing the Kara tech demo, the high precision of the T160 cameras made it possible for us to capture the entire performance of our actors at once, and on a large stage."

The Kara project took approximately seven months to complete from casting to final delivery. This included R&D on Quantic Dream's new PS3 game engine, setting up the new motion capture studio, and all the preparation work for the shoot day.

"Kara was our very first attempt at realizing a full performance capture session. It enabled us to better understand and streamline the possibilities of this technique and its processes," said Fondaumière. ■

Info Quantic Dream's next PS3 title, Beyond: Two Souls, is due to be released Q1, 2013.

Vicon Life Sciences

STANDING ON TWO FEET

Researchers at George Washington University are collecting data on fossilized human footprints to discover the evolutionary secret behind human bipedalism

Dr. Brian Richmond and Kevin Hatala at George Washington University are studying how particular anatomical and functional variables influence our locomotion. They hope to develop a hypothesis about how our ancestors, whose anatomies were slightly different than our own, may have moved in a similar or different manner.

Credit
Courtesy of George Washington University

Hatala said, "Our research focuses on understanding the evolution of human bipedal locomotion. In order to address questions about how human locomotion has evolved, we need to quantify the kinematics of human bipedalism."

Richmond and Hatala conduct many of their biomechanical experiments in the field, near Lake Turkana in northern Kenya, gathering data on people who grow up habitually unshod (not wearing shoes). As such, the development of their foot anatomy and function has not been influenced by modern footwear. This condition likely provides the best approximation of foot anatomy and function in our evolutionary ancestors, who most likely did not wear footwear until recently (the past 50,000 years or so).

Hatala continues, "Field conditions are not conducive to the setup that one would prefer for a typical biomechanics laboratory. However, we've been able to use a combination of video cameras and Vicon Motus to digitize joint markers in order to capture kinematic data from our experimental subjects.

"The Vicon system enables us to easily capture kinematic data in a field setting, which would otherwise be very difficult. We are able to travel to a very remote part of the world, and collect sophisticated data that can typically only be collected in a laboratory setting."

Fossilized footprints are being discovered with increasing frequency in the human fossil record. Researchers know of fossil footprints that sample at least three different species of human ancestors, across a time range from 3.7 million years ago to the very recent past.

"Our research is aimed at understanding how particular anatomical and functional variables are recorded in footprints. By quantifying the influence of specific variables, we hope that these new discoveries can be used as informative tools that will provide new insight on long-standing questions about the timing and nature of the evolution of human bipedalism," said Hatala.

The unshod volunteers provide data on their foot anatomies and foot function, which helps the researchers understand how it is represented in footprints. After collecting basic metric data on each subject's foot anatomy, the volunteer walks across a pad that measures the distribution of foot pressure, and then through a patch of wet sediment to produce a footprint.

"We analyze the data to look at how anatomical variables, such as arch height and toe length, and functional variables, such as joint postures and the distribution of peak pressures, are recorded in footprint topography," explained Hatala.

By developing a thorough understanding of how these variables are recorded in footprints, they hope to infer from human fossil footprints how these variables have changed through human evolution.

"We are finding that particular anatomical and functional variables do leave detectable signatures in footprint topography. We still have much more to learn, however, about the interactions between variables and how substrate properties influence footprint morphology.

We hope to use the Vicon system to analyze the effects of substrate properties on gait. With some more work, we can apply our results to the human fossil record to address some of the important hypotheses about the evolution of human anatomy and locomotion." concluded Hatala. ■

"The Vicon system allows us to easily capture kinematic data in a field setting, which would otherwise be very difficult. We are able to travel to a very remote part of the world, and collect sophisticated data that can typically only be collected in a laboratory setting."

Credit
Courtesy of George Washington University

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ECSS
Bruges, Belgium
July 4 - 7, 2012

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Bologna, Italy
July 18 - 20, 2012

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August 15 - 19, 2012

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September 12 - 15, 2012

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	5			4				9
	9	8	4				2	
	3		2		7		9	
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	2	5	7	8	1			

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