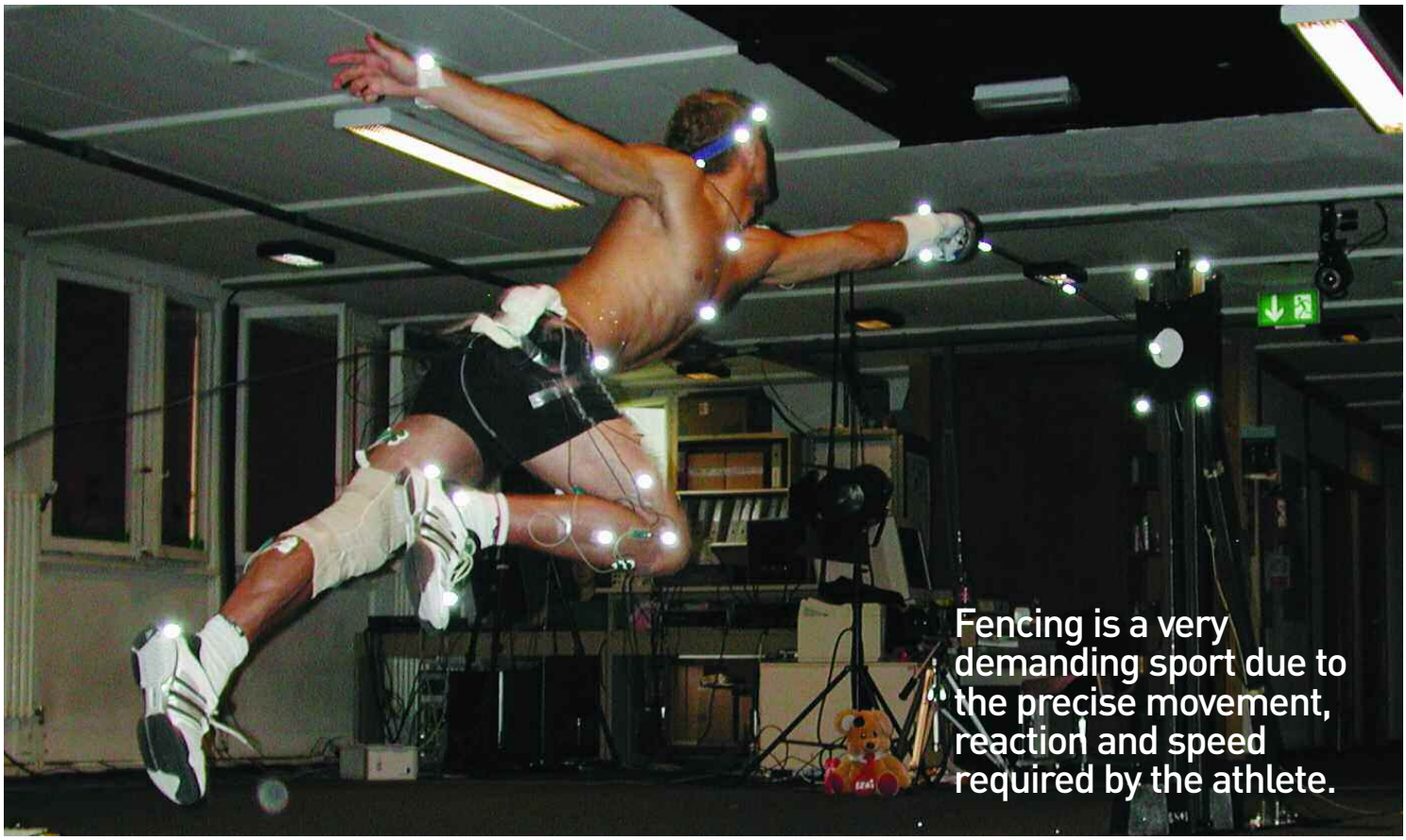
NO.1 2009

VICON

TheStandard

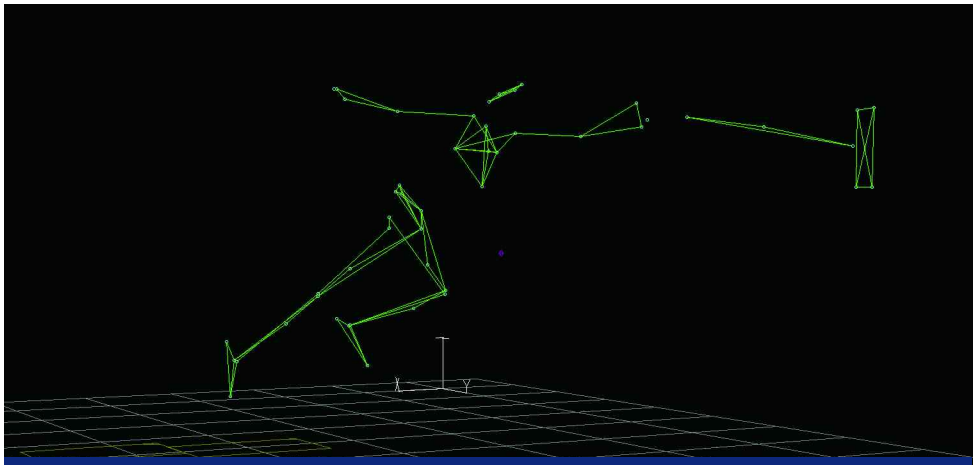


En Garde - Attaque - Touche: The Biomechanics of Fencing

Beat Göpfert : Laboratory of Orthopaedic Biomechanics, CM & BE, University of Basel, Switzerland
Jacqueline Romkes : Laboratory for Movement Analysis, CM & BE, University Children's Hospital Basel, Switzerland

Two Vicon systems (a 6 camera MX13 system and a 460 with 6 MCAM1's plus an MX Control) have been used to capture the movements of the Swiss National Fencing Team enabling the team to better understand and improve their performances as well as reduce the risk of injury.

Precise movement, reaction and speed required by the athlete make fencing a very challenging area to study. The focus of this project is on the coordination between the movement and muscular activation of the leg and shoulder muscles. We used a whole body marker set up (Romkes 2007) with two additional markers on the pelvis, three markers on the weapon and the target. The fencers aim to hit the target as precisely as possible while the activation of 14 muscles is recorded by surface electromyography (EMG) and the signals analyzed using the wavelet transformation method according to von Tscharner (von Tscharner 2000). Reaction time is a key element in fencing. Athletes start when a light at the target goes on. The target is equipped with an additional load cell to record the impact force of the weapon.



↑ View in Workstation of an athlete performing a flèche attack

We use a test setup that closely simulates training and competition conditions. An athlete reacts to the movements of his/her opponent and performs the correct movement to hit the opponent first, in order to score a point and win the bout. In this project, the athletes make small vertical bounces while standing with each foot on one of the force plates. As soon as the light on the target goes on they have to perform a flèche attack and try to hit the target in the centre. Athletes are required to perform ten successful trials where they aim to hit the target perfectly.

We have analyzed the kinematics, kinetics and the wavelet transformed EMG of eight male fencers from the Swiss National Team. The wavelet transformed from EMG enables us to determine each stage of the movement, in which frequency band and at what intensity a muscular activation occurs. Overall we observed different movement strategies among the 8 fencers while performing a flèche attack. The more experienced fencers execute the forward movement of the trunk and arm more parallel than the less experienced fencers, where the movement is sequential.

Overview of University of Basel

The Laboratory of Orthopaedic Biomechanics and the Laboratory for Movement Analysis are part of the Clinical Morphology & Biomedical Engineering Department (CM & BE) of the Medical Faculty at the University of Basel. The Laboratory of Orthopaedic Biomechanics was founded in 1990 by Professor Erwin W. Morscher, a pioneer in orthopaedic surgery. Its main focus is biomechanical research from macro (e.g. implant testing and development) to nano scale (e.g. material stability and surface reaction) and is equipped with different material testing machines (MTS, Calorimeters) to help answer questions on biomedical engineering.

The Laboratory for Movement Analysis was established in the late 1960s, as the first clinical gait lab in Europe specializing in clinical gait analysis of individuals with complex movement disorders for both clinical and research purposes. The laboratory is equipped with two Vicon systems.

- A Vicon 460 system with 6 MCAMs
- A Vicon MX system with 6 MX13s plus a MX Control
- Two Kistler force plates
- Three EMG systems
- Vicon Workstation, Nexus, Polygon, BodyBuilder, as well as Matlab software

The close collaboration between the laboratories also allows Master and PhD students from various backgrounds to gain experience in human movement sciences and related fields. The biomechanics of fencing is just one of the many projects being carried out at the University of Basel. ■

→ Preparing Marcel Fischer for the pilot test by Beat Göpfert (left) and Corina Nüesch (middle) under the critical observation of the national coach

Outlook

The combined analysis of kinematics, kinetics, and wavelet transformed EMG is a standard procedure in the majority of our projects related to human movement sciences. It helps us to understand the interaction between movement and muscular activation and the tuning of complex movements. For our sports biomechanics projects, our goal is not only to understand the performance but also to improve the athletes' performance and reduce the risk of injuries.

Acknowledgment

The fencing project was supported by the ProMotio Foundation in Basel and the Robert Mathys-Foundation (RMS) in Bettlach, Switzerland.

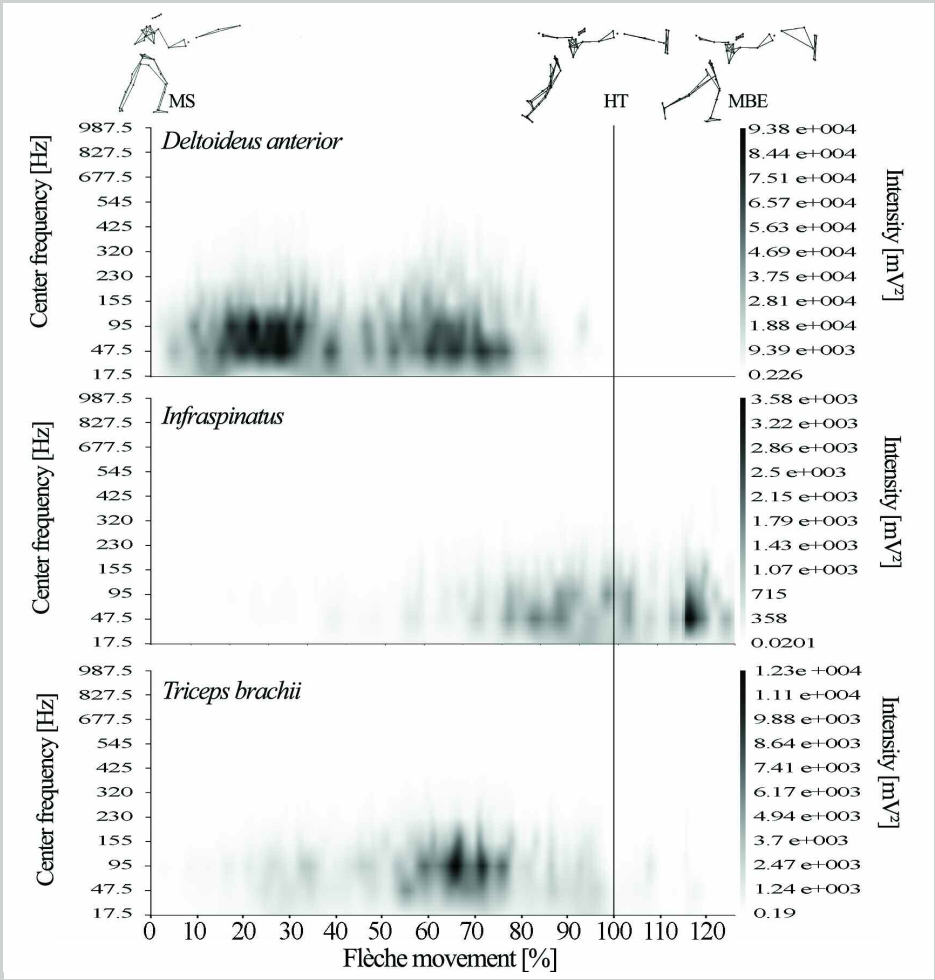
Literature

Romkes et al, J Pediatr Orthop B., 16:175-180, 2007.

von Tscharner, J Electromyogr Kinesiol, 10:433-445, 2000.

Working on the Fencing Project

Marcel Fischer (MD),
Julien Frere (M.Sc.),
Niklaus F. Friederich (MD),
Beat Göpfert (MEng, EMBA),
Corina Nüesch (M.Sc.),
Jacqueline Romkes (Ph.D),
Dieter Wirz (MD),



Mean Multi-Muscle Intensity pattern of three muscles for 10 flèche trials from one subject.
The grey scale indicates the intensity of the muscular activation (low: white, high: black)
MS: Start of the movement; HT: Hit of the target; MBE: Maximum bending of the épée

Editors Note

Welcome to the latest issue of The Standard. This expansive issue is our largest to date and is a testament to the interest in the field of biomechanics and all of the Vicon users conducting research throught the world.

We mail over 2,000 copies to people around the world and distribute The Standard at 15 conferences we attend.

Every issue is also available online at **www.vicon.com/standard**

Our goal is to introduce you to the many interesting and innovative ways members of the Vicon family are using their systems.

If you would like to see your lab or research featured in a future issue, please contact us at **editorial@viconstandard.org**

If you've been using your Vicon system for an unusual application be sure to get in touch so we can feature your work in the next issue.

Tara Valgoi
Vice President Global Marketing

Emma Wixey
Marketing Manager

Lindsey Gerber and Patricia Faust
Editorial Team

Vicon Sponsors Major Engineering Award

Vicon has supported the 2008 IMechE MED Student Project Competition award 'Best Project involving the Design or Development of a Medical Device' with a prize value of £500.

The award was open to recent graduates (2007), third/fourth year Undergraduates and taught Masters Degree students, who completed or were working on a project involving the design or development of a medical device.

Robin Read, a student from Middlesex University, scooped the top prize for his project - 'The Design and Development of an End-Effector for a Wheelchair-Mounted Robotic Arm'.

Iain Charlton, biomechanical engineer and developer at Vicon, has been a board member of the IMechE Medical Engineering Division (MED), independently of Vicon, for five years. This year he was in charge of organizing the student competition.

Charlton said, "The day was a great success, thanks in part to the extra sponsorship from Vicon, helping to attract more entries.

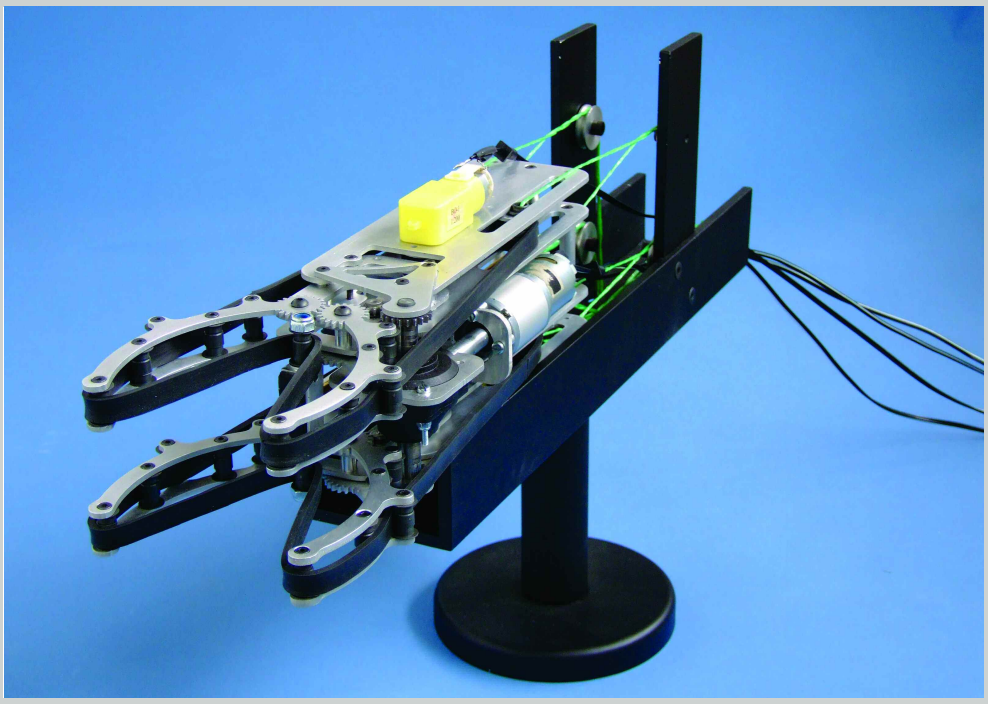
This is definitely an event that's growing and something we can be proud of being involved with.

The supervisors I spoke to now make it a regular event to encourage their students to apply to and we reach more Universities every year."

Winner, Robin Read said: "I am honored to have won the Vicon sponsored category in the 2008 IMechE MED Student Project Competition. Receiving such recognition from such a prestigious institution has very much validated what I have been doing for the past year."

Charlton continued, "One of the benefits of being the sponsor is to judge. Although Robin wowed us with his presentation, all of the finalists were very impressive and came across exceptionally well. It's been exciting to see such a high quality of entries this year."

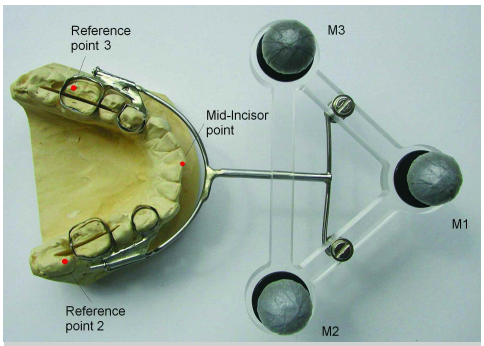
Next year, Vicon hopes to be even more involved and take an active part in the Industry and Academic Exhibition, which is aimed at schools and colleges. ■



↑ **Robin Read,** 2008 Winner

Dento-munch Trials at the University of Bristol

Revolutionary research taking place at the University of Bristol aims to provide a more realistic way to test materials for use in dentistry.



↑ **Images courtesy of Kazem Alemzadeh,** University of Bristol.

Some £2.5 billion is spent every year in the UK alone on dental materials, which are used to replace or strengthen teeth. But Kazem Alemzadeh, an engineer at Bristol University and the Bristol Robotics Laboratory, says the way these materials respond to everyday wear and tear can be hard to predict.

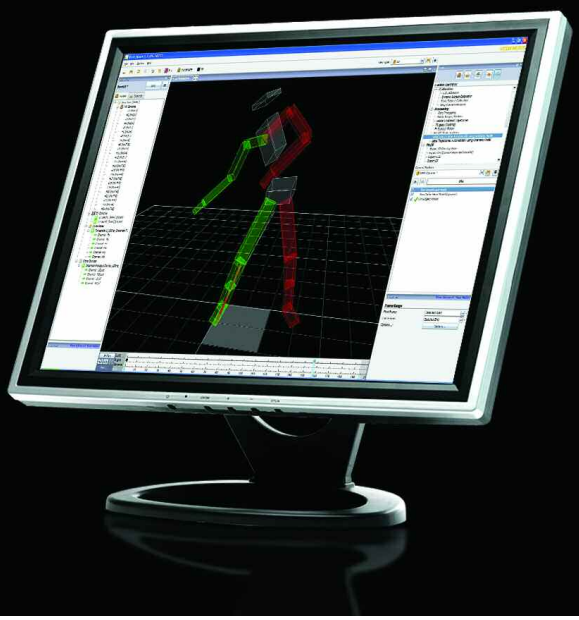
Dr. Kazem Alemzadeh in the bio-engineering research group of the Department of Mechanical Engineering captures the chewing motion with a Vicon motion capture system to test how materials would wear in the mouths of individual people. The temporomandibular joint (TMJ), connecting the lower jaw to the temporal bone at the side of the head, is one of the most complex joints in the human body. It has previously proved impossible to track with six degrees of freedom – the ability of the jaw to move smoothly up and down and side to side, allowing us to chew food, talk and yawn – but thanks to the accuracy of the Vicon system, Alemzadeh and his team have been able achieve the level of precision required.

For more information on the Dento-Munch project visit **http://www.bris.ac.uk/engineering/news/2008/5.html** ■

Vicon Online University Now Open

The Vicon Online University is pleased to offer a series of new training courses.

The classes are presented via Webex to conveniently give you an in-depth understanding of the Vicon software packages including Nexus, the Plug-In Gait model, BodyBuilder and Polygon. Please note courses are provided free of charge to customers under warranty, with Support credits or a Premier support contract. Courses are available at both Mountain Standard Time and Greenwich Mean Time. To register for a course visit **http://www.vicon.com/spots/onlineuniversity.html**



Conferences

North America

FEBRUARY

VETERINARY ORTHOPEDIC SOCIETY
***VICON EXHIBITING**
28 February-07 March 2009
Steamboat Springs, Colorado
www.amrms.com/ssl/gcmas/

AMERICAN PHYSICAL THERAPY ASSOCIATION
***VICON EXHIBITING**
09-12 February 2009
Las Vegas, Nevada
www.apta.org/csm09

AMERICAN ACADEMY OF ORTHOPAEDIC SURGEONS
***VICON EXHIBITING - BOOTH # 4750**
25-28 February 2009
Las Vegas, Nevada 2009
www.aaos.org

AMERICAN COLLEGE OF SPORTS MEDICINE REGIONAL MEETING
20-21 February 2009
Seattle, Washington
Http://www.acsm.org/am/template.cfm?section=regional_chapter_meetings&template=/cm/htmldisplay.cfm&contentid=3535

AMERICAN COLLEGE OF SPORTS MEDICINE REGIONAL MEETING
27-28 February 2009
Colorado Springs, Colorado
Http://www.acsm.org/am/template.cfm?section=regional_chapter_meetings&template=/cm/htmldisplay.cfm&contentid=3535

AMERICAN COLLEGE OF SPORTS MEDICINE REGIONAL MEETING
12-14 February 2009
Birmingham, Alabama
Http://www.acsm.org/am/template.cfm?section=regional_chapter_meetings&template=/cm/htmldisplay.cfm&contentid=3535

INTERNATIONAL SOCIETY OF BIOMECHANICS - 17TH ANNUAL SYMPOSIUM ON COMPUTATIONAL METHODS IN ORTHOPAEDIC BIOMECHANICS
21 February 2009
Las Vegas, Nevada
www.pre-ors.org/?cade4400

AMERICAN COLLEGE OF SPORTS MEDICINE - ADVANCED TEAM PHYSICIAN COURSE
4-8 February 2009
Orlando, Florida
www.acsm.org/Content/NavigationMenu/Education/Conferences/TeamPhysicianCourse/TPC_2009.htm

MARCH

GAIT AND CLINICAL MOVEMENT ANALYSIS SOCIETY - 14TH ANNUAL MEETING
***VICON EXHIBITING & HOSTING USER GROUP MEETING**
10-13 March 2009
Denver, Colorado
www.gcmas.org/conference

AMERICAN ALLIANCE FOR HEALTH, PHYSICAL EDUCATION, RECREATION & DANCE
31 March-04 April 2009
Tampa, Florida
www.ahperd.org

INTERNATIONAL SOCIETY OF BIOMECHANICS - AMERICAN ACADEMY OF ORTHOTISTS AND PROSTHETISTS—ANNUAL MEETING AND SCIENTIFIC SYMPOSIUM
4-7 March 2009
Atlanta, Georgia
www.academyannualmeeting.org/2009/

APRIL

SOUTHERN CALIFORNIA CONFERENCE ON BIOMECHANICS
11-12 April 2009
Thousand Oaks, California
www.callutheran.edu/biomechanics

INTERNATIONAL SOCIETY OF BIOMECHANICS - INTERNATIONAL PATELLOFEMORAL JOINT RESEARCH RETREAT
30 April-2 May 2009
Baltimore, Maryland
www.regonline.com/builder/site/Default.aspx?eventid=651959

MAY

AMERICAN COLLEGE OF SPORTS MEDICINE - 56TH ANNUAL MEETING
***VICON EXHIBITING**
27-30 May 2009
Seattle, Washington
www.acsm.org/annualmeeting

INJURY BIOMECHANICS SYMPOSIUM
17-19 May 2009
Columbus, Ohio
http://medicine.osu.edu/ibrl/3714.cfm

INTERNATIONAL SOCIETY OF BIOMECHANICS - 25TH SOUTHERN BIOMEDICAL ENGINEERING CONFERENCE
15-17 May 2009
Miami, Florida
www.bme.fiu.edu/SBEC2009/

JUNE

SOCIETY FOR EXPERIMENTAL MECHANICS – SEM XII ANNUAL CONFERENCE & EXPOSITION ON EXPERIMENTAL AND APPLIED MECHANICS
1-2 June 2009
Albuquerque, New Mexico
www.sem.org/Conferences.asp

SUMMER BIOENGINEERING CONFERENCE
17-21 June 2009
Lake Tahoe, California
www.asmeconferences.org/sbc2009/

NORTHWEST BIOMECHANICS SYMPOSIUM
5-6 June 2009
Pullman, Washington
http://coen.boisestate.edu/NBSymposium/index.asp

JULY

AMERICAN COLLEGE OF SPORTS MEDICINE REGIONAL MEETING
7-11 July 2009
Sitka, Alaska
http://www.acsm.org/AM/Template.cfm?Section=Regional_Chapter_Meetings&Template=/CM/HTMLDisplay.cfm&ContentID=3535

AUGUST

AMERICAN SOCIETY OF BIOMECHANICS - 2009 ANNUAL MEETING
26-29 August 2009
State College, Pennsylvania
www.conferences.psu.edu/ASB2009

SEPTEMBER

AMERICAN COLLEGE OF SPORTS MEDICINE - 125TH BIENNIAL SYMPOSIUM OF THE INTERNATIONAL COUNCIL FOR PHYSICAL ACTIVITY AND FITNESS RESEARCH
2-4 September 2009
Loma Linda, California
www.acsm.org/Content/NavigationMenu/Education/CalendarofEvents/EventCalendar1.pdf

OCTOBER

SOCIETY FOR EXPERIMENTAL MECHANICS–SEM SYMPOSIUM AND WORKSHOP
5-7 October 2009
Columbia, South Carolin
www.sem.org/CONF-FALL-TOP.asp

Rest of the World

JANUARY

9TH MOTOR CONTROL & HUMAN SKILLS CONFERENCE
28-31 January 2009
Hobart, Australia
www.utas.edu.au/psychol/external_conference/mcsc/index.htm

MARCH

INTERNATIONAL TECHNOLOGY, EDUCATION AND DEVELOPMENT CONFERENCE - INTED2009
9-11 March 2009
Valencia, Spain
www.iated.org/inted2009/

THE BRITISH ASSOCIATION OF SPORT & EXERCISE SCIENCES - 2009 BASES STUDENT CONFERENCE
31 March- 1 April 2009
University of Hull, UK
www.bases.org.uk/studentconf.asp

CLINICAL MOVEMENT ANALYSIS SOCIETY UK AND IRELAND - CMAS 2009
***VICON EXHIBITING**
30-31 March 2009
Royal College of Physicians of Edinburgh, UK
http://www.cmasuki.org/home.htm

APRIL

AMERICAN COLLEGE OF SPORTS MEDICINE - 4TH INTERNATIONAL STATE-OF-THE-ART CONGRESS, REHABILITATION: MOBILITY, EXERCISE & SPORTS
7-9 April 2009
Amsterdam, The Netherlands
www.move.vu.nl/links/rehabmove2009

INTERNATIONAL CONFERENCE ON COMPUTATIONAL & EXPERIMENTAL ENGINEERING AND SCIENCES
8-12 April 2009
Puket, Thailand
www.icces.org/cgi-bin/ices09/pages/index

STAFFORDSHIRE CONFERENCE ON CLINICAL BIOMECHANICS
April 2009
Staffordshire, UK
http://www.staffs.ac.uk/sccb/

MAY

2ND BRAZILIAN BIOMECHANICAL ENGINEERING MEETING
6-8 May 2009
Florianopolos, Santa Catarina, Brazil
www.enebi2009.ufsc.br/

THEMATIC WORKSHOP OF THE SOCIETE DE BIOMECHANIQUE - THE HUMAN MACHINE THROUGHOUT SPORTS PERFORMANCES
14-15 May 2009
Poitiers, France
http://jtsb2009.conference.univ-poitiers.fr/?lang=en

JUNE

4TH INTERNATIONAL CONFERENCE ON WHOLE-BODY VIBRATION INJURIES
2-4 June 2009
Montreal, Canada
www.irsst.qc.ca/en/home-vibrations-2009.html

EUROPEAN SOCIETY OF BIOMECHANICS 2009 WORKSHOP - MOVEMENT BIOMECHANICS AND SPORT
7-9 June 2009
Zurich, Switzerland
www.esb2009.ethz.ch/

INTERNATIONAL SOCIETY FOR POSTURE AND GAIT RESEARCH
***VICON EXHIBITING**
21-25 June 2009
Bologna, Italy
http://ispgr.org/conferences/italy-2009/conference-overview/index.html

EUROPEAN COLLEGE OF SPORTS SCIENCE
24-27 June 2009
Oslo, Norway
http://www.ecss-congress.eu/OSLO2009/

JULY

INTERNATIONAL SOCIETY OF BIOMECHANICS CONFERENCE - 22ND CONGRESS
***VICON EXHIBITING**
5-9 July 2009
Cape Town, South Africa
www.isb2009.org/

FOURTH INTERNATIONAL ANKLE SYMPOSIUM
16-18 July 2009
Sydney, Australia
www.fhs.usyd.edu.au/clinicalrehabilitation/IAS4/speakers.shtml

INTERNATIONAL SOCIETY OF MOTOR CONTROL - 7TH EDITION OF PROGRESS IN MOTOR CONROL
23-25 July 2009
Marseilles, France
www.pmc2009.fr/

XIII BRAZILIAN CONGRESS OF BIOMECHANICS
28 July- August 1 2009
Sao Paolo, Brazil
http://isbweb.org/o/content/view/40/57/

AUGUST

INTERNATIONAL SOCIETY OF BIOMECHANICS IN SPORTS - ANNUAL MEETING
***VICON EXHIBITING**
17-21 August 2009
Limerick, Ireland
http://www.isbs.org/

SEPTEMBER

EUROPEAN SOCIETY OF MOVEMENT ANALYSIS IN ADULTS AND CHILDREN - XVIII ANNUAL ESMAC
***VICON EXHIBITING**
14-19 September 2009
London, UK
http://www.esmac.org/

4TH INTERNATIONAL CONFERENCE ON COMPUTATIONAL BIOENGINEERING
16-18 September 2009
Bertinoro, Italy
www.iccb2009.org/

THE BRITISH ASSOCIATION OF SPORT & EXERCISE SCIENCES - 2009 BASES ANNUAL CONFERENCE
1-3 September 2009
Leeds Metropolitan University, UK
www.bases.org.uk/annualconf.asp

4TH ASIA-PACIFIC CONGRESS SPORTS TECHNOLOGY - APCST 2009 - THE IMPACT OF TECHNOLOGY ON SPORTS
21 – 23 September 2009
Honolulu, Hawaii
http://www.rmit.edu.au/apcst2009

IEEE 31ST ANNUAL INTERNATIONAL CONFERENCE OF ENGINEERING IN MEDICINE & BIOLOGY SOCIETY
2–6 September 2009
Minneapolis, Minnesota
http://www.embs.org/conferences/index.html

INTERNATIONAL RESEARCH COUNCIL ON BIOMECHANICS OF INJURY
2–6 September 2009
Minneapolis, Minnesota
http://www.embs.org/conferences/index.html

OCTOBER

SOCIETY FOR EXPERIMENTAL MECHANICS - SEM SYMPOSIUM AND WORKSHOP
5-7 October 2009
Columbia, South Carolin
www.sem.org/CONF-FALL-TOP.asp

Vicon Profiles

Dr. David Raichlen and Dr. Herman Pontzer

University Anthropologists Shed Light on the Holy Grail of Anthropology

Vicon motion capture equipment may someday play a role in fully understanding the origins of human bipedalism. According to Dr. David Raichlen, the Holy Grail in the field of anthropology is why did bipedalism evolve in the first place?

↑ **Azy,** 32 year old male Orangutan.

Dr. David Raichlen, Ph.D., Assistant Professor of Anthropology at University of Arizona in Tucson, and Dr. Herman Pontzer, Ph.D., Assistant Professor of Anthropology at the University of Washington in St. Louis each have their own Vicon motion analysis labs at their respective universities. During the summer of 2008, they took a Vicon system on the road to the Great Ape Trust in Des Moines, Iowa, to study the difference in energy output between orangutans and humans.

Dr. Pontzer stated the hypothesis of this research project was that "Humans are a high energy throughput species. We contend that orangutans do not have the same large energy budgets as humans. Evolution is all about how you turn energy into offspring." Scientists know, for example, that human walking is 75% less costly than both quadrupedal and bipedal walking in chimpanzees. The data collected from this recent study on orangutans will hopefully provide information on energy use in a closely related species and will help scientists better understand how human bipedalism evolved.

Challenges Presented Working with Primates

Both scientists reported there were particular challenges working with the orangutans. "You cannot train the orangutans to not pull off the markers; they are too inquisitive," said Pontzer. "So we got one take and were able to do a video analysis. Also, the difference (between humans and orangutans) is so great that the errors that occur from not being able to use the actual markers do not pose a problem. Respiration data was collected (volts vs time) through the Vicon MX Control".

When asked how Vicon contributed to this research project, Raichlen replied "The speed in which we can analyze the data is much faster with Vicon. The whole process is much faster and smoother; it takes five minutes versus

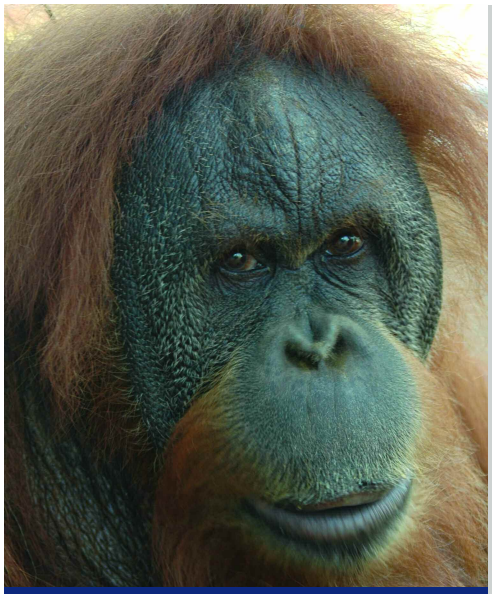
a week to perform the analysis." Pontzer added that he chose Vicon equipment "because it was a greater value for the money. We got more cameras, better equipment and more capability. With Vicon, we have the ability to simultaneously collect multiple data sources—respirometry, EMG, multiple cameras, force plate and more."

The Holy Grail of Anthropology

Raichlen also stated that "the preliminary findings of our study of the great apes give the first view of the empirical evidence of ape energetics. We have the first glimpse at what kind of energy shifts happened 6-8 million years ago." What would constitute a breakthrough in Pontzer and Raichlen's research—to fully understand the origins of bipedalism? Raichlen said "We need to find a pelvis designed like humans. The earliest pelvic structure that has been found existed 3-4 million years after the origin of bipedalism. A breakthrough would be to apply this model of kinematics to fossils that are old enough. The Holy Grail (in this field) is why did bipedalism evolve in the first place? This may never be answered." Analyzing the orangutans will provide one more piece of the anthropological puzzle that spans millions of years of evolution.

The speed in which we can analyze the data is much faster with Vicon. The whole process is much faster and smoother; it takes five minutes versus a week to perform the analysis.

What does the future hold for Pontzer and Raichlen? Visit **http://www.dmanisi.org.ge/** to learn about Pontzer's field work in the Republic of Georgia, where evidence was found of the first hominids to venture out of Africa. Raichlen is currently examining the neurobiology of running in mammals to better understand the motivation for endurance running; ultimately, this study will help determine whether endurance running played a role in the evolution of humans.



↑ **Knobi,** 30 year old female orangutan.

The Great Ape Trust is located in Des Moines, Iowa, and it is a world class research facility that focuses on non-invasive, cognitive research. Its mission is to provide sanctuary and an honorable life for the great apes living there, study their intelligence, advance the conservation of great apes, and provide unique educational experiences to a limited public in a way that cannot be compared in any way to a zoo. The orangutan subjects, Azy, Knobi, Allie and Katy were likeable, willing subjects, and they were never forced to do anything they did not wish to do. More information can be found on them at **www.greatapetrust.org** ■

Related Research

Chimpanzee Energetics
Insights into Ape Locomotor Evolution and the Origins of Bipedalism
Pontzer, Raichlen & Sockol

The Human Evolutionary Biomechanics Laboratory is located at the Department of Anthropology at Washington University, St. Louis, Missouri.

Here, Dr. Pontzer, his team and colleagues study the form, function, and evolution of the primate musculoskeletal system, focusing on locomotor energetics, biomechanics, and ranging ecology in humans and other apes.
http://artsci.wustl.edu/~hpontzer/EvoBiomechLab.htm

Biomechanics of Dmanisi Hominids
Locomotor Adaptations in the First Hominids in Europe
Pontzer, Jashashvilli, Rightmire, & Lordkipanidze

Pelvic Dimorphism and Locomotor Efficiency
Linking Limb Design and Locomotor Energetics
Pontzer

Evolution of Bipedal Walking and Running
the role of endurance running in the evolution of humans
Raichlen, Lieberman & Bramble

Locomotor Ontogeny in Baboons
the effects of limb mass distribution on the locomotor mechanics and energetics of primates
Raichlen & Shapiro

The University of Arizona (Tucson) Evolutionary Biomechanics Lab examines the evolution of mammalian locomotion using a combination of experimental and model-based techniques.

Dr. Raichlen utilizes a wide array of equipment to measure kinematics, kinetics, and muscle activation in both humans and non-human organisms.
http://www.ic.arizona.edu/~raichlen/RaichlenLab.html

Ergonomic Motion Capture in the Field

Drs. Ryan Mizner and Dan Anton at Eastern Washington University and Drs. Jennifer Hess and Laurel Kincl at the University of Oregon are collaborating on a series of investigations to evaluate the effectiveness of ergonomic controls to reduce MSDs among masonry workers.

Work-related musculoskeletal disorders (MSDs) are quite common among construction trade workers. The cost of work-related MSDs to the economy is estimated in the billions of dollars in lost wages, medical expenses, and insurance administration costs. Bricklayers have particularly high rates of injury with about 75% reporting low back symptoms and over half with shoulder symptoms. Exposure to physical risk factors in the workplace has been associated with MSDs. Examples of physical risk factors include repetitive heavy lifting of concrete blocks that can weigh over 20kg, awkward trunk and arm postures, and forceful exertions while building walls.

Drs. Ryan Mizner and Dan Anton at Eastern Washington University and Drs. Jennifer Hess and Laurel Kincl at the University of Oregon are collaborating on a series of investigations to evaluate the effectiveness of ergonomic controls to reduce MSDs among masonry workers. The projects are funded by a grant awarded to Eastern Washington University from the Center for Construction Research and Training (CPWR) and National Institute of Occupational Safety & Health (NIOSH). At some masonry worksites, concrete blocks are handled by two-person lift teams, instead of by a single mason. The extent to which this promising ergonomic control reduces physical risk factors was the first intervention to be investigated with the project.

Video motion capture tracked body segment and concrete block position as part of determination of physical exposure of masons as they built test walls using each lift technique.

Most studies of ergonomics and physical exposure in the construction trade industry use rudimentary estimates of motion like a camcorder or visual observation coupled with a tape measure. More sophisticated tools like electrogoniometers are also used, but they can be bulky and restrict postures of the trunk and shoulder that are part of a masons normal work day. Video motion capture systems also have been used in ergonomic studies, but are typically restricted to laboratory simulations of work environments, often with volunteers instead of the craftsman that actually ply their trade. While laboratory experiments add the benefit of better precision of measurement of body posture and movement, there is a trade off of lack of real work conditions. The current project represents what is believed to be the first application of video motion capture for in the field assessments of physical exposure in bricklaying mason's.

The investigators collaborated with an apprenticeship training center (International Masonry Institute, IMI) in Seattle, WA as an appropriate site with sufficient flexibility and expertise for fieldwork using motion capture. Special recognition is due to Terry Hays and Lee West who are the apprentice instructors at the IMI. Their generous sharing of time

and knowledge helped make the data collection as close as possible to real working conditions.

The research team fabricated custom containers and packed the lab's 8 camera Vicon system into a van to drive the 4.5 hour trip to the West side of the state. Masons wore elastic shirts and baseball pants during data collection to prevent loose clothing from blocking markers, but still allow for some protection from material handling while building the wall. Since it was possible that the markers could be covered in mortar during collections, a tracking array with redundant markers was used to quantify body segment's position in space.

The data collection was aimed at minimizing the interference with the normal operations of the IMI facility. Most of the cameras were custom mounted on the rafters with clamps and cable ties, to avoid the large footprint of using tripods and the risk of being bumped or damaged from passersby. The goal was to capture motion during one block placement in each row in a way that would be accurate and would not hinder the worker's movements or distract them from the job of building the wall. Surface electromyography (EMG) of the upper trapezius muscle, the finger flexors, and the lumbar paraspinal muscles was recorded simultaneously with the motion capture using a Delsys data logger. The EMG data was used as a means to quantify muscular exertions and compliment the kinematic data obtained from the Vicon system.

The study is still ongoing, but early findings suggest that the two-mason lift teams were most effective when concrete blocks were handled at waist height. Muscle activity of the low back and shoulder was lower when using the lift team. Somewhat surprising, higher shoulder muscle activity was noted when using lift teams to lay block at the higher rows. Preliminary results will be presented this spring at the Combined Sections Meeting of the American Physical Therapy Association, the Construction Safety Conference, and the Applied Ergonomics Meeting.

Future Ergonomic Motion Capture Investigations

The use of rebar is required for structural support in many buildings made of concrete block. Engineers have expressed increased concern about the potential for building damage and personal injury resulting from block buildings crumbling following hurricanes, seismic activity, and terrorist bombs. This has led to increased use of rebar around the country and the trend is likely to continue. In buildings that require vertical rebar for structural reinforcement, masons lift blocks above their shoulder over rebar to set it in place. The result is considerable low back and upper extremity exertion. As use of rebar increases, the incidence of upper extremity and low back injuries to masons will likely increase.

The research team is currently investigating alternatives to lifting block over rebar. One method is to insert rebar after building the wall, but before pouring the grout filler using rebar. Another alternative is using open-ended H shaped block. These open-ended blocks allow masons to place block around rebar (see title photo).

The aim of this study is to examine and compare several alternatives to placing block over rebar to evaluate their effect on worker physical exposure as it impacts injury risk.

For more information regarding this project, contact Dr. Ryan L. Mizner, PT, PhD, Clinical Orthopaedics Laboratory, Eastern Washington University at **rmizner@ewu.edu** or visit our website at **http://www.ewu.edu/x27135.xml/.** ■

Contributions by Drs. Ryan Mizner and Dan Anton

← **Markers that accumulated mortar during the data collection**

Animated Recovery

An innovative medical research team in The Netherlands has developed an easier route for recovery for PTSD sufferers

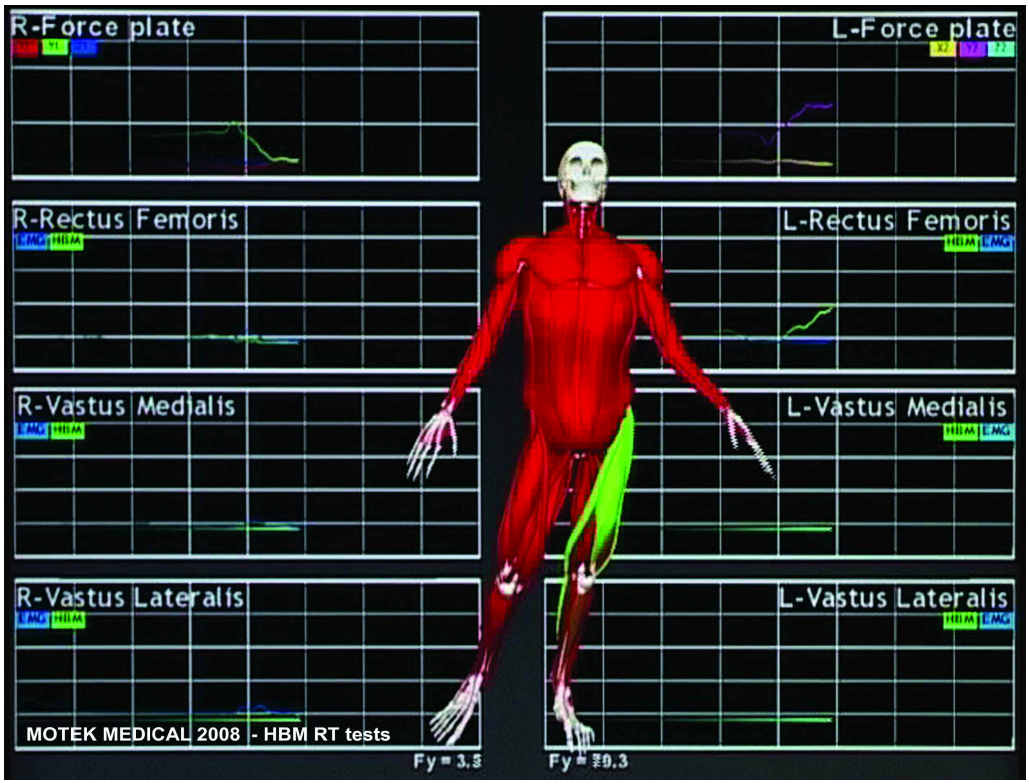
Post Traumatic Stress Disorder
Recovery for soldiers wounded in Afghanistan and Iraq isn't always as simple as treating a physical injury. For a lot of the service men and women, dealing with Post Traumatic Stress Disorder (PTSD) can be the real battle.

PTSD is a term for severe consequences of exposure to stressful experiences. Such as threatened death, serious physical injury, or a threat to physical and/or psychological integrity, to the extent that the usual defences are incapable of coping.

Typical symptoms include restlessness, insomnia, aggression, depression, dissociation, emotional detachment and nightmares. Sufferers can also experience memory loss regarding the traumatic event, which sometimes causes other underlying psychological conditions to appear.

The presence of a PTSD response is influenced by the intensity of the experience, its duration, and the individual person involved. PTSD may also have a delayed onset of months, years or even decades.

In the UK, the armed forces are not always warmly received when they return home. It's frequently in the news - getting turned away from hotels, receiving inadequate medical treatment and being unable to wear their uniform with pride. However, treatment for injured soldiers is improving. Dealing with PTSD issues quickly allows the solider to get on with life and back to where they want to be – whether that's back to their family and friends, or re-joining their squadron.



Within CAREN, soldiers can face their fears directly and overcome them at a much faster pace, without the fear of actually being in that situation. With this system they are in complete control.

← **Human Body Modeling data** being compared in real time with EMG data from the same muscle group

CAREN

A medical team in The Netherlands has found a creative way to utilize cutting edge technology to create a training environment that dramatically reduces the recovery time for PTSD sufferers and allows the patient greater control over their treatment.

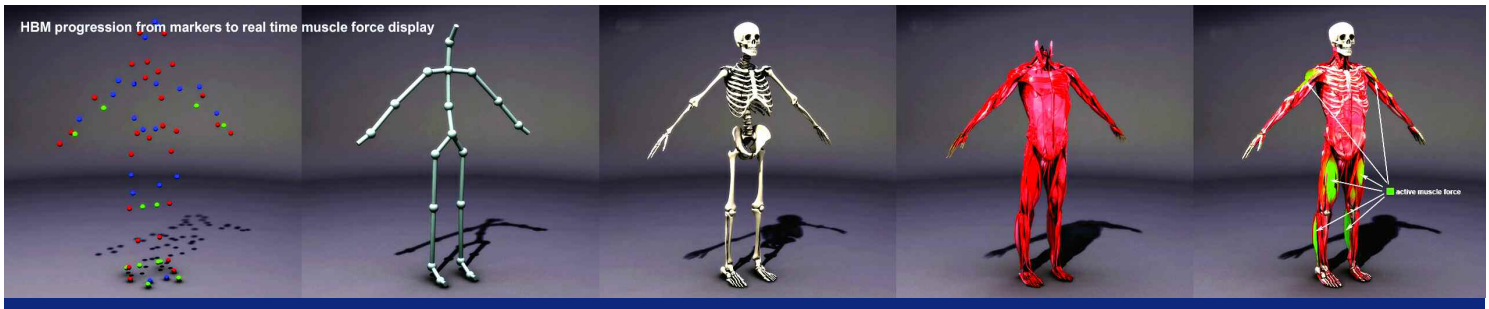
MOTEK Medical, the research team behind the virtual training environment, creates, develops, integrates and implements revolutionary technologies for the medical industry. It is widely recognized for its innovative rehabilitation technology and achievements in shortening rehabilitation processes for orthopaedic and neurological patients.

The virtual environment – the CAREN System – creates a real-time virtual world, where the patient can interact and move seamlessly thanks to Vicon motion capture technology. The patient's movements are captured by the 13 Vicon MX40+ cameras situated around the studio. This data is then transferred in real-time to the virtual environment, where the patient can see themselves moving in the animated world.

Oshri Even-Zohar, head researcher at MOTEK Medical said: "The CAREN System can create any environment that is necessary. The most popular of these, a crowded street scene, allows the patient to interact with a situation in a completely controlled environment.

"Previously, the best a soldier could hope for would be one-to-one counseling, which can take months, even years, to be effective. Within CAREN, soldiers can face their fears directly and overcome them at a much faster pace, without the fear of actually being in that situation – they are completely in control."

The rehabilitation time is shortened thanks to the software behind the system - D-Flow™. It works by enabling the real-time integration of multisensory input and output devices; a pioneering set of tools that can take over some balance functions from the human brain.



The future for MOTEK

MOTEK is leading the way for virtual reality research and development. At the moment, the majority of its VR patients are injured soldiers, but as the treatment develops and becomes more widely available, the CAREN system will revolutionize the way we think about treating all psychological disorders; from a fear of flying to claustrophobia.

The Technology

MOTEK started off in 1994 with an aim of creating realistic real-time animation using motion capture technology, mainly for the entertainment industry. Then, 10 years ago, MOTEK received funding from the European Commission to develop the CAREN System, which was the first ever multi sensory real-time feedback system using immersive integrated reality technology.

MOTEK bought its first Vicon motion capture system 16 years ago, and today has a total of 13 cameras.

The system works in real-time and enables the creation of a variety of experiments in a controlled and repeatable environment by using different virtual reality principles. It enables the researchers to analyse balance behaviour, latency, response times and the relations between different sensory inputs that affect human decision protocols, human balance, posture and locomotion behaviours.

Even-Zohar continued: "For the soldiers we're treating, the virtual environments utilise the multi sensory inputs available inside the system to apply a type of exposure therapy; a cognitive behavioural therapy technique for reducing fear and anxiety responses. It is similar to systematic desensitisation, though it works more quickly and produces more robust results. It is also very closely related to exposure and response prevention, a method widely used for the treatment of obsessive-compulsive disorder – it's based on the principles of habituation and cognitive dissonance."

However, PTSD isn't the only beneficiary of this technology.

Even-Zohar explains: "As well as our work with soldiers suffering from PTSD, we're also developing a Human Body Model (HBM), which is a software tool enabling, for the first time, researchers to be able to view muscle forces and joint torques in the body in real-time. Hopefully in the future, this will have applications for sports performance enhancement – perhaps even developing our next Olympic winners!"

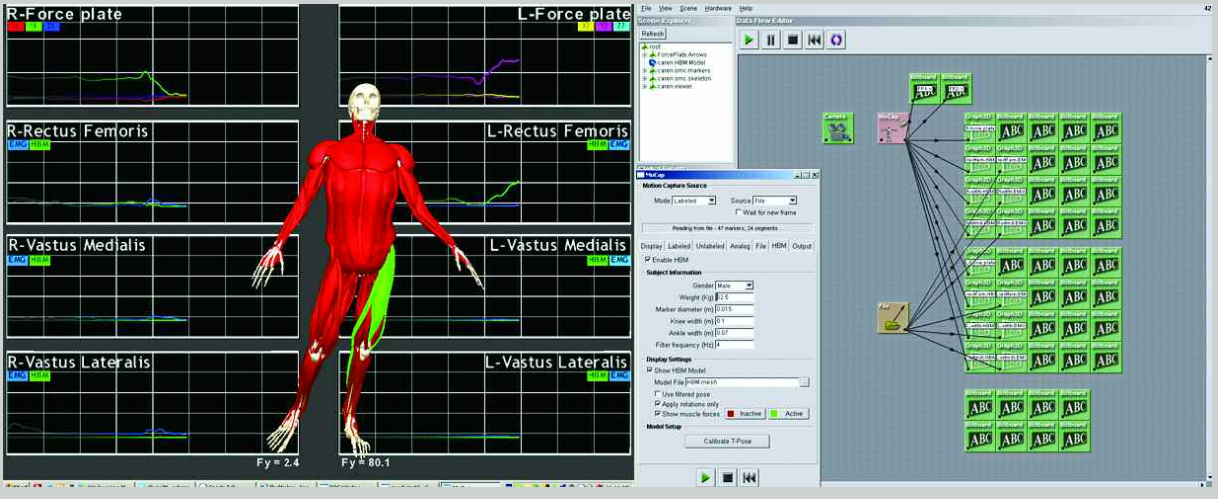
Muscle Modeling

An understanding of how the muscles in the body work hasn't been possible – until recently. MOTEK has developed a system which allows researchers to analyse the force of the muscle that you can't see in operation in the human body.

Even-Zohar comments: "The patient wears the Vicon motion capture suit and their muscular skeleton is represented in real-time on a digital display. The D-Flow™ software analyses which muscles are in use and highlights them in green – the harder the muscle is working the greener it will be. The inactive muscles are highlighted in red.

"This data can then be compared to a healthy patient, to see where the discrepancies lie. We then advise the patient on how to use their muscles correctly to achieve optimum performance."

With more work into this area, Even-Zohar is hoping to isolate the cause behind the 'Parkinson's tremors', which some Parkinson's sufferers report. At the moment, it is not known where this problem originates. ■



CAREN software → editor interface

New Gait Laboratory at The University of Missouri-Kansas City

The School of Computing and Engineering at the University of Missouri-Kansas City (UMKC) opened the university's first gait and balance laboratory in December 2008.

The laboratory is equipped with 6 Vicon MX-T40 cameras; Vicon Nexus, Polygon, and Motus Video software; four AMTI OR6-6 force platforms; and a Delsys 16-channel EMG system.

The lab will mutually support four research programs within UMKC's School of Computing and Engineering, with contributions from its Computer Science and Electrical Engineering and Civil and Mechanical Engineering departments. Funding for the laboratory's equipment was obtained through a National Science Foundation Major Research Instrumentation (NSF-MRI) grant.

Faculty members directly involved in this endeavor are Dr. Trent M. Guess, Dr. Gregory W. King, Dr. Reza Derakhshani and Dr. Walter D. Leon-Salas. Research activities within this group include computational and experimental biomechanics, biomedical signal processing, biometrics and body area sensor networks. Planned projects within the laboratory include capturing real-world human activities for multi-scale computational knee model simulations, predicting and eliminating fall risk among balance-impaired older adults, finding gait characteristics for biometric identification and validating sensor networks used in mobile motion capture applications.

The University of Missouri-Kansas City (UMKC), one of four University of Missouri campuses, is a public university serving more than 14,000 undergraduate, graduate and professional students.

Celebrating 75 years, UMKC engages with the community and economy based on a four-part mission: life and health sciences; visual and performing arts; urban issues and education; and a vibrant learning and campus life experience.

Congratulations to the entire team at UMKC, we wish you success in your research and will follow-up your work in a future issue of The Standard. ■

↑ **Left to right:** Dr. Walter D. Leon-Salas, Dr. Gregory W. King, Dr. Reza Derakhshani, Assistant Professor and Dr. Trent M. Guess.

Digital Camera Winner

Azael Herrero from the Universidad Europea Miguel de Cervantes was the lucky name to be pulled out of the hat to win the digital camera.

Azael completed the Vicon Online Survey along with 100 other entrants. As you can see from his photo he was over the moon to win.

VICON

Vicon Annual User Group

JOIN US FOR OUR ANNUAL USER GROUP MEETING AND SUPPORT+SERVICE SESSIONS DURING GCMAS 2009

DENVER, CO
MARCH 10-13

Support+Service Sessions

HYATT REGENCY DENVER AT THE
COLORADO CONVENTION CENTER

Vicon Support+Services will be offering 45 minute One on One sessions that will allow users to focus on specific topics with a dedicated Support Engineer. Take this opportunity to ask all of the technical support questions you've been meaning to call about and you can find out more about our Service and Support plans. While you're there, be sure to check out the many classes now offered at our newly developed Online University. Time slots will be available on the hour between 8:00 AM and 5:00 PM Tuesday through Friday excluding lunch breaks. Reserve your time by contacting **Kroepke@vicon.com**

User Group Event

BUBBA GUMP SHRIMP COMPANY
WEDNESDAY, MARCH 11TH 6:30PM
DINNER & DRINKS

This year's event is all about you – the user. Take a moment to tell us what you'd like to see at the User Group Event and be entered to win one of 3 iPod's to be given away.

Please RSVP to **gcmasusergroup@vicon.com** to secure a spot for each member of your group attending this event.

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