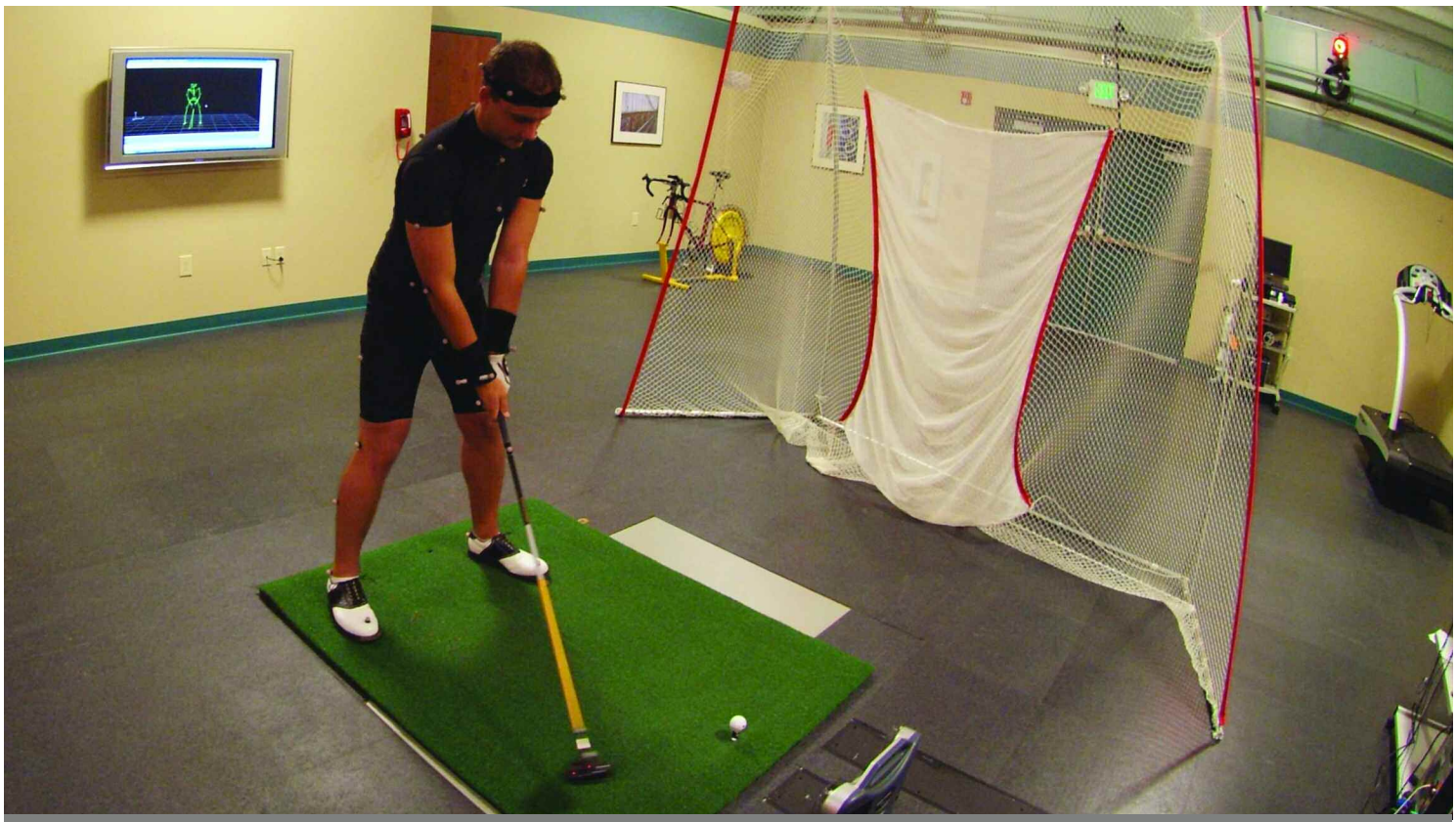
VICON

NO.1 2007

TheStandard



VICON MOTION CAPTURE TECHNOLOGY IS PLAYING A LARGE PART IN BALL STATE UNIVERSITY'S PROMISING FUTURE

Collaborations form a brighter future

CONTRIBUTIONS BY
DR. ERIC DUGAN

Muncie, Indiana may not seem like a hot bed of research but it is home to Ball State University, one of the United State's premier science and technology research centers. Ranked by the Princeton Review as one of the best universities in the Midwest, Ball State is maintaining that position by diligently enhancing both the students' and community's relationship and experience with the school. Almost unexpectedly, Vicon motion capture technology is playing a large part in Ball State's promising future.

Since 2003 Dr. Eric Dugan has headed the Biomechanics Lab at the School of Physical Education, Sport, and Exercise Science and is masterfully guiding undergrad and graduate students through the understanding of the mechanical and

neuromuscular characteristics of human movement. A broad research agenda encompassing injury mechanisms, the effectiveness of clinical intervention strategies, structural limitations, and the influence of both short-term (acute) and long-term (chronic) exercise protocols on various biomechanical aspects of human health and performance. This has led to several interdisciplinary collaborations within the university and the local medical community creating a wealth of opportunities for both student and school. The lab's uniqueness lies within its ability to apply movement analysis to a variety of situations beyond the standard gait or rehabilitation applications.

Capturing F. Rabbath with Vicon MX cameras

"Innovative pedagogical tool that fuses art and science"

Art of the Bow

In 2005, Dr. Dugan and Hans Sturm from the School of Music collaborated to create Art of the Bow with bassist François Rabbath, a groundbreaking DVD that records what is known as one of the world's "sweetest swings" through motion-capture technology and 3-D animated graphics. An innovative pedagogical tool that fuses art and science, the instructional DVD has earned accolades from musicians around the world.

Sturm, a bassist himself, has studied the legendary François Rabbath's intricate bowing techniques for more than 5 years. Following a coaching session in Paris, Sturm approached Dr. Dugan about a project to capture the subtleties of Rabbath's renowned technique. Using a Vicon MX system, the team captured the nuances of the bassist's fingers, wrist and bow arm to create a graphically, realistic, interactive teaching tool.

While traditional music publications or videos are limited to illustrations or

photographs from a single viewpoint, the DVD's four camera angles enable a student to select viewing options that focus on an angle of particular interest. As a result of the pioneering in-depth study and its accompanying performances and interviews, the DVD has received international acclaim.

Digital Media

Dr. Dugan is also working with Ball State University's Center for Media Design (CMD) on several projects outside the normal boundaries of a traditional exercise science program. The projects, still in the developmental phase, fall into two broad categories. First, the two groups are exploring ways to integrate the center's eye-tracking and the biomechanics laboratory's motion capture capabilities. This will provide the ability to better understand how visual stimuli affect an individual's movement and postural control. Secondly, they are investigating the potential uses of motion capture in conjunction with the CMDs expertise in digital media to develop interactive learning environments for students in a variety of academic programs.

Community Involvement

Midwest Health strategies Motion Analysis and Therapy Complex

Unique collaborations are not in short supply for Ball State University's Biomechanics Lab. In May 2006, the Midwest Health Strategies Motion Analysis and Therapy Complex opened in partnership with Dr. Dugan's lab, featuring a 1,500 square foot motion analysis facility. Midwest Health Strategies, an affiliate of regional healthcare provider Cardinal Health System, is the area's most comprehensive provider of physical rehabilitation therapy services. As a result of the unique collaboration, the outpatient treatment and research facility is one of the first of its kind to open outside of a research hospital in a large, metropolitan community. "Two of our community's very substantial resources have come together once again to not only provide an outstanding and innovative service, but hopefully a model for others to follow in the delivery of healthcare.", commented Midwest Health Strategies' COO Gregg J. Altobella.

Created to provide unprecedented community access to innovative medical technology, the complex will also serve as an immersive learning experience for students. A 10 camera Vicon MX40 motion capture system provides critical rehabilitative data analysis as well as a hands-on learning. "It prepares students to work in healthcare related motion analysis facilities around the country," said Dugan. "A few of our recent graduates who have worked in the campus lab have said that experience with 3-D technologies allowed them to move right in to a similar job after graduation."

Future

The collaborative and entrepreneurial nature of the biomechanics lab has built a strong foundation to provide both undergraduate and graduate students a unique, 'hands on' learning experience. It has also expanded the lab's capacity to engage in both clinical and sport/ exercise research.

Some examples of the research taking place in the lab include studies to:

- compare functional outcomes in patients following total hip replacements via different surgical techniques
- determine the metabolic and muscular adaptations of cycling with independent cranks
- determine the effects of simulated golf on swing mechanics and performance
- determine the effects of visual feedback on skill acquisition in beginning dance students
- the effect of repeated drop jumps on landing strategies

For more information about the Ball State University's Biomechanics Program please visit **www.bsu.edu/biomechanics** or contact Dr. Eric L. Dugan at **eldugan@bsu.edu.**

Editors Note

Welcome to the new Vicon Standard. This first issue represents a design and content turning point in the Vicon Standard's 15 year history. Our goal is to provide you with interesting and relevant information concerning motion capture technology in the Life Science market. Take this opportunity to learn how Vicon customers are using their systems and the ground-breaking discoveries they are making. This issue contains articles on the pioneering work of Dr. Richard Baker, Dr. Eric Dugan and Dr. Iwan Griffiths.

The new Standard will carry on providing you with up-to-date conference listings and Dr. Ed Biden's literature review.

We welcome your feedback and encourage you to contact us if you would like to contribute or be featured in our upcoming edition. Contact **editorial@viconstandard.org**

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Vicon Profiles

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Clinical gait analysts have recently been focusing their attention on marker placement error – a problem which can arise when the reflective markers are not placed in exactly the same position on every occasion. This has been a key focus for Dr. Baker.

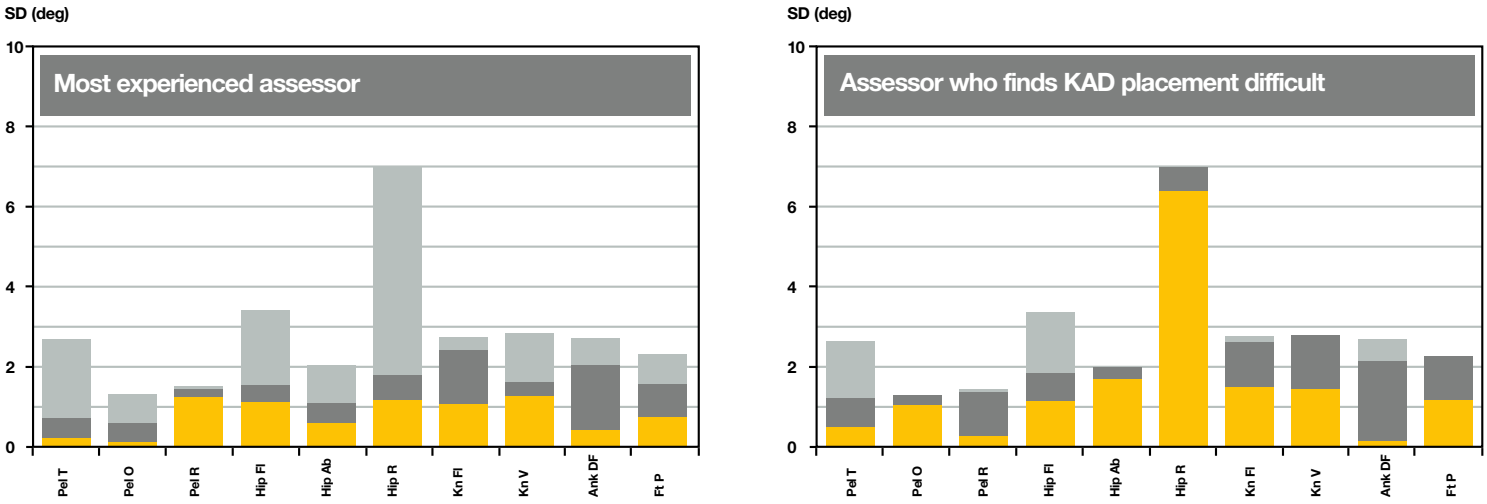
"Over the past 20 years many of us have been concerned that this might be a potential source of inconsistencies both within and between different centres. So for example, three clinics performing the same test on the same person may have varying results because the placement of the markers doesn't match at each clinic. Over the last five years however several studies have been published suggesting that the problem, in those centres studied, is far bigger than any of us would ever have imagined."

One of the problems is that almost all clinical laboratories are using software developed 20 years ago and designed for the camera technology that was available then. Dr. Baker's work has highlighted ways to overcome this by using more markers and placing them in different positions He is also using a new generation of software incorporating optimisation techniques to determine where the bones are in relation to the markers. These rely much less on the precise placement of the markers. The most recent results suggest that the repeatability of measurements from the new techniques is at least as repeatable as that of the most experienced staff using the old techniques.

Welcome to the Gaitabase

One of the reason the problem has remained undetected for so long is that clinical labs very rarely share data and make comparisons. To try and solve this issue, Dr Baker and colleague Dr Oren Tirsoh have devised the Gaitabase **http://gaitabase.rch.org.au.** The Gaitabase is a pool of gait analysis related information contributed by clinics and research centres around the world. The information is accessible to anyone for analysis and comparison with other research on the site. Information is searchable under categories such as symptoms, research contributor, patient age, left/right foot results, anatomical criteria and many other categories. Early analysis of the data on the Gaitabase has confirmed visually that variability of measurements can vary considerably between laboratories and between different staff in those laboratories.

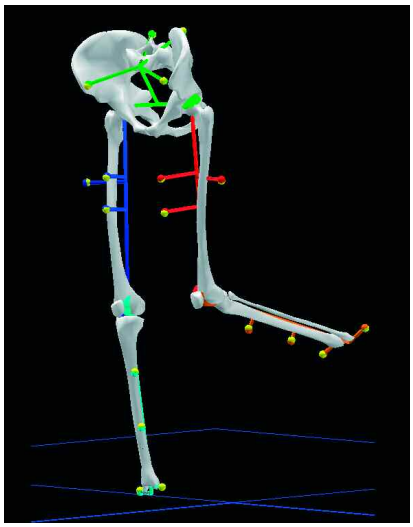
Another colleague Dr Jenny McGinley has been working on methods to quantify just how much variability there is in data and has developed the concept of Gait Reliability Profiles to tell staff and laboratories just how well they are performing. This uses state of the art statistical techniques to produce measures which are simple and easy to interpret.



↑ **Figure 4**__Gait reliability profiles showing differences in performance between a very experienced (left) and less experienced (right) assessor.

IN PRACTICE, THIS WILL PROVE INVALUABLE TO PATIENTS WHO SUFFER WITH PHYSICAL IMPAIRMENTS

↑ **2**__New marker set being used by Dr Baker.



↑ **3**__New software as visualized in Polygon.

The most recent step in this work has been to incorporate the Gait Reliability Profile software into Gaitabase so that anyone with access to the internet can upload their own data and receive a full analysis of how well they are performing at a simple mouse click. It is possible that this might lead to a scheme for certifying gait analysts. It certainly has the potential to allow doctors to assess which clinics they can trust and which they would like to disregard. In practice, this will prove invaluable to patients who suffer with physical impairments.

There are a wide range of medical conditions that might cause someone to require gait analysis, but physiotherapists working with this technology most often find themselves working with children with Cerebral Palsy. This is a neurological disorder that greatly affects the movement of an increasing number of children each year. There are currently over 17,000,000* people worldwide affected by CP. Dr. Baker explains: "As with most physical impairments each case is different, making the treatment potentially costly and time consuming. It is essential that we can rely on the data we capture from whichever laboratory it is being captured in. The main symptom of cerebral palsy is a difficulty with movement. Simple things that most people take for granted, like climbing stairs, can be a daily struggle for some sufferers. There is no known cure, and patients are relying on gait analysis-based treatment diagnoses to help alleviate some of their impaired movement."

Although 17,000,000 sounds a huge number across the world, any one centre only sees a small proportion of this and some centres see very few. Gaitabase makes it possible for different centres to share data and thus to allow results from a much greater number of patients to be compared. It is hoped that this will greatly increase our capacity to learn more about this disease and how to treat it.

Dr. Baker and Vicon are thus making it possible for surgeons and other medical professionals to make more informed decisions when it comes to their patients, thanks to the data available in the Gaitabase. That can only be good news for all those people with cerebral palsy.

* www.cerebralpalsymagazine.com ■

Tracking the motion of footballs in three dimensions

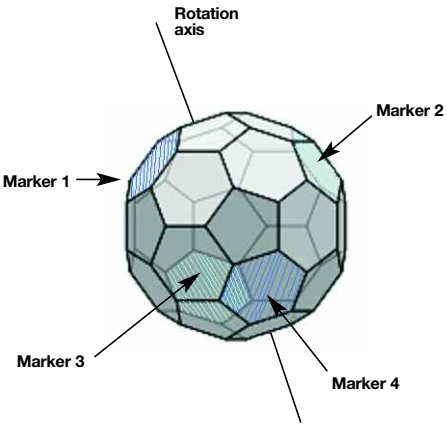
DR IWAN GRIFFITHS, MOTION ANALYSIS LABORATORY, SCHOOL OF HUMAN SCIENCES, SWANSEA UNIVERSITY. CONTACT I.W.GRIFFITHS@SWAN.AC.UK

The Motion Analysis laboratory at Swansea carries out sport and clinical studies using a Vicon system. The Vicon system has been used on a number of innovative projects such as interlacing Vicon data with EMG data in new seating investigations and physiotherapy and weight bearing investigations.

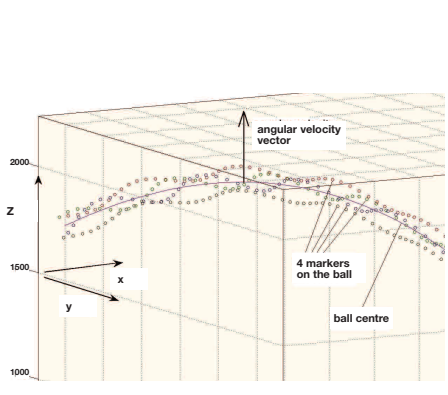
The lab has also recently been awarded a grant for 390K GBP over 21 months from the Knowledge Exploitation fund (Collaborative Industrial Award) to pursue a Comfort Index Research project in collaboration with the Chiropractic Clinic at the University of Glamorgan. The Vicon system will be used to monitor human movement in a range of seats for automotive, aircraft, domestic and wheelchair use. A major goal of the study will be to produce the first objectively-based measurement of seat comfort and performance. The project is being endorsed by Magstim, Invacare, Giroflex Ltd, Medical Supply System Ltd, Rockwood Hospital and Huntleigh Healthcare. This is for the future, but recently the most significant work carried out is tracking the motion of footballs in three dimensions. We've used Vicon technology to track the trajectory of a rapidly-moving spinning football. [1] Patches of reflective tape are attached to the ball at four specific locations and the ball is kicked with sidespin towards a goal. The patches occur at tetrahedrally selected positions on the ball surface and are usually hexagonal shaped coinciding with four of the hexagons making up the football, as shown in **Figure 1**.

The Vicon system tracks the four markers which allows three dimensional position, velocity and spin characteristics to be inferred. The markers follow helical paths **(Figure 2)** and measuring their positions accurately using Vicon technology, allows us to calculate everything we need to know about the motion of the ball. Typical ball speeds in our investigations have ranged from 22-32 m/s and ball rotation speeds up to 60 rad/s. A procedure has been developed to extract the velocity of the ball and the spin rate, its angle with respect to the z axis and its angle in the x-y plane. The results so far have enabled the deflection of the ball due to the sidespin to be accurately measured. This is what's called the Magnus effect, named after Heinrich Magnus who first described it in 1853. The Magnus effect occurs when spinning balls tend to deflect sideways when they are projected through the air

"Skilled exponents of this banana kick such as Roberto Carlos and David Beckham have used the Magnus Effect for direct free kicks and have demonstrated that very large ball deflections are possible."



↑ **Figure 1**_Soccer ball marked at four tetrahedral locations. Markers 1, 3 and 4 are "behind the ball"; marker 2 is "this side" of the ball.



↑ **Figure 2**_ The four markers on the soccer ball can be tracked inside the Vicon capture volume.

and is critically dependent on the detailed nature of the airflow over the ball.

Figure 3 shows that the air stream is deflected sideways as it flows around the ball.

> "The beauty of using Vicon technology for motion tracking is that the ball is entirely unaltered apart from the surface patches of reflective tape used to reflect the light back to the Vicon cameras."

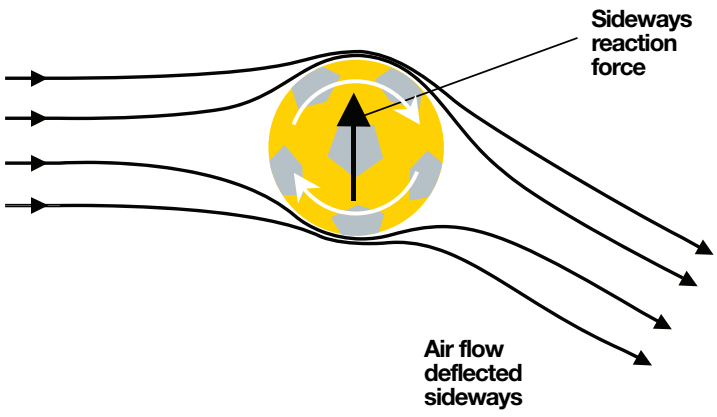
Conservation of momentum means that there is a Magnus force on the ball pushing it sideways as the ball moves along. This allows footballers to exploit the curved trajectory of the ball as a means of deceiving opposing players that the ball is going to miss the goal when in fact it is not. Skilled exponents of this banana kick such as Roberto Carlos and David Beckham have used the Magnus Effect for direct free kicks and have demonstrated that very large ball deflections are possible.
In our work we have succeeded in measuring the lift coefficient for the football as a function of the parameter

***where d = diameter of the ball, _ = angular velocity and v = velocity of ball.**

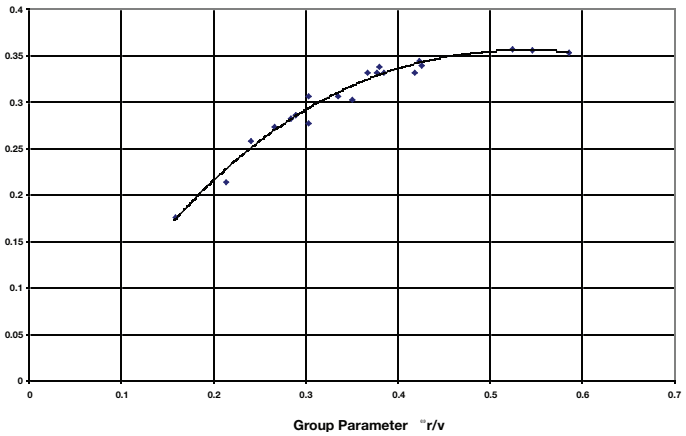
The results for the drag coefficient are summarized in **Figure 4** and are in broad agreement with our previously published preliminary results. [1]

The beauty of using Vicon technology for motion tracking is that the ball is entirely unaltered apart from the surface patches of reflective tape used to reflect the light back to the Vicon cameras. In our work it was found that good results were obtained using the four hexagonal patches provided that the reconstruction parameters were adjusted and optimized for a rapidly-moving and spinning object. Also, it was found that the radius of the ball, when calculated from the four coordinates of the patches, gave a value about 20% smaller than the true radius of the ball, since the Vicon software was identifying the location of the patch at a point slightly inside the ball as opposed to on its surface.

Knowledge of the lift coefficient for the soccer ball together with drag coefficients inferred from the work of Dr. Wesson [2] has enabled us to model the motion of the ball over distances comparable with those used in real free kicks. In our work, we have assumed that the ball is to be kicked over a defensive wall of players 2m high and is aimed for goal at a target 2m above the floor. **Figure 5** shows three possible combinations of projection angle and ball velocity that result in the ball striking the target. In the modeling of the ball motion we have incorporated realistic variations of the drag coefficient with ball velocity and lift coefficient with embed equation DSMT4. In the absence of spin, the stipulation of wall height and target height constrains the initial ball velocity and the angle of projection to a fairly narrow range of possible values. Modeling of the banana kick using the drag and lift coefficients results in a prediction of the amount of deflection obtainable for a given amount of spin on the ball. For example, Figure 6 shows the deflection obtainable for ball angular velocities of 15, 30 and 60 rad/s for a free kick taken at a distance of 28m. The figure shows the final position of the ball in the plane of the goal posts, ground level is at z = 0 and the size of the goal is indicated in the y-z plane. In this case the initial velocity of the ball was 32.2m/s and in the simulation the angular velocity vector was rotated through a complete circle in the y-z plane. This results in a slightly elliptical locus of final destinations representing various combinations of



↑ **Figure 3**_ A spinning football deflects the air flow sideways as it moves along.



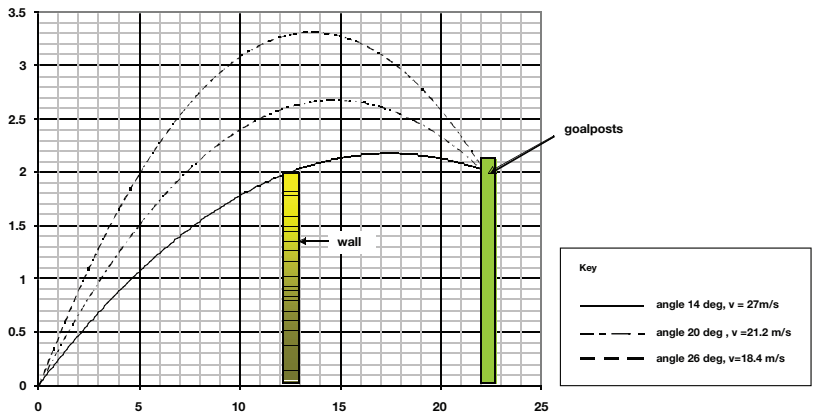
↑ **Figure 4**_Summary of typical data for the soccer ball lift coefficient.

sidespin and topspin. The results will be of special significance to players and coaches anxious to know how to kick the ball for best results. Based on the results of other research groups, it is now possible to specify how and where the ball should be kicked in order to specify the amount of topspin and sidespin required to produce a given ball trajectory which is on target and which has the maximum deception potential. ■

References

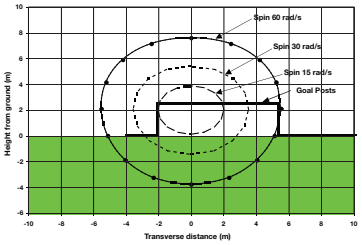
1_Griffiths, I.W., Evans, C.J. & Griffiths, N. Tracking the flight of a spinning football in three dimensions. Measurement Science and Technology 16: 10; 2056-2065, 2005

2_Wesson, J. (2002) Football physics. Physics World, 5, 41-44



↑ **Figure 5_** Three possible ball trajectories of a soccer ball from a free kick. (No spin)

↱ **Figure 6_** The locus of final end points in the plane of the goal posts for a soccer ball kicked from a distance of 28m from goal for various amounts of spin on the ball. With no spin, the ball would have traveled to the point y = 0, z = 2.



A study in motion
Principles of Biomechanics and Motion

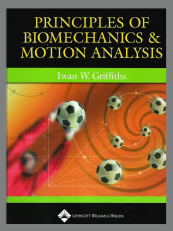
DR. GRIFFITHS' NEW BOOK FEATURING VICON MOTION CAPTURE TECHNOLOGY.

Dr. Iwan Griffiths has been busy writing a new book offering a fresh perspective on the basic concepts and fundamentals of modern motion capture. "Principles of Biomechanics and Motion Analysis" was published in November 2005 and offers a new practical approach to the subject by illustrating mechanical and mathematical principles with real-life examples. The book, published by Lippincott, Williams & Wilkins, seeks to explain the principles of mechanics and how they are applied to human movement. It does not assume that readers have a prior understanding of kinetics. This innovative text will be of particular value to students of sports science, human movement, physical therapy and sports technology and also allows access to electronic data so that readers can practice analysis and processing in a realistic, modern way.

The new text introduces contemporary motion capture technology in Chapter 1 and includes Vicon camera technology as part of the toolkit for motion analysis laboratories. Three-dimensional data, often obtained using Vicon, is featured heavily throughout the book in examples and case studies. A CD-ROM and a Web-based Resources section are available to access more data for problem-solving.

"Our studies in the Motion Analysis Laboratory have demonstrated that research into biomechanics has the potential to impact several study areas. The availability of state-of-the-art equipment has been invaluable in furthering our understanding of the subject and several case studies of the ground-breaking research carried out at the University are highlighted in the book," said Dr. Griffiths.

Some of the information presented in the book has already been hailed as being 'fine original work' and 'unobtainable elsewhere' by biomechanics experts. Principles of Biomechanics and Motion Analysis will be translated into Japanese for publication in 2007. ■



Principles of Biomechanics and Motion Analysis is published by Lippincott Williams & Wilkins. Further information at www.lww.com.

Conferences

North America

February

AMERICAN PHYSICAL THERAPY ASSOCIATION
February 14-18, 2007
Boston, MA
*Vicon Booth #516
www.apta.org

AMERICAN ASSOCIATION OF ORTHOPEDIC SURGEONS
February 14-16, 2007
San Diego, CA
*Vicon Booth #5345
www.aaos.org/education/anmeet/anmeet.asp

March

VETERINARY ORTHOPEDIC SOCIETY
March 3-10, 2007
Sun Valley, ID
www.vosdvm.org

AMERICA ASSOCIATION OF HEALTH, PHYSICAL EDUCATION, RECREATION AND DANCE
March 13-17, 2007
Baltimore, MD
www.aahperd.org/convention

AMERICAN ACADEMY OF ORTHOTISTS AND PROSTHETISTS
March 21-24, 2007
San Francisco, CA
www.academyannualmeeting.org/2007

April

GAIT AND CLINICAL MOVEMENT ANALYSIS ASSOCIATION
April 11-14, 2007
Springfield, MA
*Vicon exhibiting and hosting the Annual User Group Meeting
www.amrinc.net/gcmas

SOUTHEAST BIOMECHANICS CONFERENCE
April 19-21, 2007
Durham, NC
www.ap.gatech.edu/sebc

May

AMERICAN COLLEGE OF SPORTS MEDICINE
May 30 – June 2, 2007
New Orleans, LA
*Vicon exhibiting and hosting cocktail reception
www.acsm.org

June

SOCIETY FOR EXPERIMENTAL MECHANICS CONFERENCE AND EXPO
June 3-6, 2007
Springfield, MA
www.sem.org

July

INTERNATIONAL SOCIETY OF POSTURE AND GAIT RESEARCH
July 14-18, 2007
Burlington, VT
*Vicon exhibiting
www.ispgr.org

August

PROGRESS IN MOTOR CONTROL VI
August 9-12, 2007
Santos, Brazil
www.demotu.org/pmcvi

INTERNATIONAL SOCIETY OF BIOMECHANICS IN SPORTS
August 23-27, 2007
Ouero Peurto, Brazil
*Vicon exhibiting
www.isbs2007.com

Rest of World

February

AUSTRALASIAN BIOMECHANICS CONFERENCE
February 15-17, 2007
Auckland, New Zealand
www.anzsb.asn.au/abc6.htm

April

CLINICAL MOTION ANALYSIS SOCIETY – UK & IRELAND
April 2-3, 2007
Birmingham, UK
*Vicon exhibiting
www.cmasuki.org

May

5TH STAFFORDSHIRE CONFERENCE ON CLINICAL BIOMECHANICS
May 27-28, 2007
Staffordshire, UK
*Vicon exhibiting
www.staffs.ac.uk/sccb

June

INTERNATIONAL CONFERENCE ON REHABILITATIVE ROBOTICS
June 13-15, 2007
Noordwijk, The Netherlands
www.icorr2007.org

MATHEMATICAL MODELING IN SPORT
June 24-26, 2007
Manchester, UK
www.ima.org.uk/Conferences/Maths%20Modeling%20in%20Sport.htm

8TH BIENNIAL FOOTWEAR BIOMECHANICS SYMPOSIUM
June 27-29, 2007
Taipei, Taiwan
http://fbs2007.ym.edu.tw/index.htm

July

XXI CONGRESS OF THE INTERNATIONAL SOCIETY OF BIOMECHANICS
July 1-6, 2007
Taipei, Taiwan
*Vicon exhibiting
www.isb2007.org

12TH ANNUAL CONGRESS OF THE EUROPEAN COLLEGE OF SPORT SCIENCE
July 11-14, 2007
Jyväskylä, Finland
www.jyu.fi/en/congress/ecss07
*Vicon exhibiting

September

2007 ANNUAL BASES CONFERENCE (BRITISH ASSOCIATION OF SPORT AND EXERCISE SCIENCE)
September 12-14, 2007
Bath, UK
*Vicon exhibiting
www.bases.org.uk/newsite/annualconf2007.asp

SALFORD'S 4TH INTERNATIONAL BIOMECHANICS CONFERENCE
September 3-5, 2007-01-12
Salford, UK
*Vicon exhibiting
www.ihscr.salford.ac.uk/CRHPR/biomechanics2007

16TH ANNUAL MEETING OF ESMAC
September 24-29, 2007
Athens, Greece
*Vicon exhibiting
www.esmac.org

Literature Update for The Standard

DR. ED BIDEN

It has been well over 25 years since I first saw a computer-based motion capture system in fact; it was an original Vicon system. At that time gait assessment was challenging to say the least. The idea of being able to capture movement data of the foot, treated as a multi-segment structure, seemed next to impossible. As I began to collect literature for this Update it became clear that foot mechanics is now well within reach.

'Foot and ankle kinematics and ground reaction forces during ambulation', Foot Ankle Int. 2006 Oct;27(10):808-13. Kitaoka H, Crevoisier XM, Hansen D, Katajarvi B, Harbst K, Kaufman K.,

The authors acknowledge the challenges of measuring motion in the foot and make the point that most gait analysis has treated the foot as a single rigid segment. They present data for 20 normal subjects based on a three-segment model using eleven markers to track relative motions within the foot. Their objective is to establish a normal standard for such motions. They document motions in three planes between the calf and the hind foot and the mid-foot. To provide coherence with more conventional measures, they link their data to measures of ground reaction force, and time distance measures. The difficulty in this sort of approach is that the measured motions are likely to be highly correlated with the model chosen and with the marker set which is applied.

More interesting still, in that they provide norms and comparisons is Tome, J., Nawoczenski, D., Flemister, A., Houck, J., **'Comparison of Foot Kinematics Between Subjects With Posterior Tibialis Tendon Dysfunction and Healthy Controls', Journal of Orthopedic and Sports Physical Therapy, 2006 Vol.36 No.9, pp 635-644.**

They present a complex foot model with five segments including tibia, rear foot, midfoot forefoot and hallux to compare 14 people with posterior tibialis dysfunction to a group of 10 normal controls. Their controls were age, gender and body mass index matched to the test group. As a result, their information is somewhat less generic than that of the previous paper but more readily interpreted. In their measurements they use a triad of three markers per segment, which allows determination of independent coordinate systems for each. Their comparisons with normal, involve measures of the inter-segmental motions across the foot. They find that for the population tested there were systematic differences at each articulation. On the basis of this they make suggestions as to appropriate therapy to address this condition.

The authors present In a somewhat similar study, the authors, **Khazzam M, Long J., Marks R., Harris G.,' Kinematic changes of the foot and ankle in patients with systemic rheumatoid arthritis and forefoot deformity', Journal Orthopedic Research. 2006 Dec 1**; draw on a group of 22 adults with rheumatoid arthritis and a control group of 25 using a four segment model. Their results showed significant differences between the two groups for overall gait parameters as well as for the relative motion of their defined segments within the foot. They suggest that understanding of the details of the inter-segmental motions within the foot can lead to improved treatment planning by being able to be more specific as to which muscles, ligaments, etc. are likely to be involved directly.

"They suggest that understanding of the details of the inter-segmental motions within the foot can lead to improved treatment planning by being able to be more specific as to which muscles, ligaments, etc. are likely to be involved directly."

The last paper reviewed regarding foot models is by **Galois L, Girard D, Martinet N, Delagoutte JP, Mainard D, "Optoelectronic gait analysis after metatarsophalangeal arthrodesis of the hallux: fifteen cases", Rev Chir Orthop Reparatrice Appar Mot. 2006 Feb;92(1):**

52-9. Their results are interesting in that they studied patients after arthrodesis and found that there was little change in the overall gait parameters because the people tested were able to compensate by movements within the foot itself. They found that the interphalangeal joint was providing the adaptation needed to compensate for the arthrodesis in order to leave the whole leg motion measures unchanged. This is a strong argument for multi segmental foot models because it illustrates that they have the potential to detect pathology and guide treatment even when whole limb models define the motions as normal. This seems to be an area where consistency in approach to modeling is going to be critical if there is any hope of comparing across studies to draw broad conclusions.

Upper Limb

Another area, which is increasingly being assessed using motion analysis, is that of the upper limb. Generally arm motions are less cyclic than gait, which poses specific challenges. This is particularly true for conditions such as Cerebral Palsy, which affect coordination. **Sanger, T, 'Arm trajectories in dyskinetic cerebral palsy have increased random variability.', Journal Child Neurology. 2006 Jul;21(7):551-7** approaches this problem in a unique way. He compares 7 children who are between the ages of 4 and 13 and have Cerebral Palsy (CP) with a control group of 21 unaffected children in approximately the same age range. The measured task was outward reaching, and the measurement to assess consistency was to fit the pattern of reaching and then use this fitted curve compared to the actual motion to define a "signal to noise" ratio where the fitted curve is taken as the "signal" and deviations from it represent the noise. Not surprisingly the children with CP had significantly reduced "signal to noise" ratios, which the author then speculates may be due to the children being unable to filter their controlling signals properly. This approach gives a straightforward way to model variability in non-cyclic motions. Upper limb measurements also extend to assessment of high performance sport.

Roca M, Elliott B, Alderson J, Foster D,'The relationship between shoulder alignment and elbow joint angle in cricket fast-medium bowlers', Journal Sports Science. 2006Nov. 24(11):1127-35 study high performance cricketers measuring shoulder alignment and elbow angles to assess whether the players are likely to exceed International standards for elbow tolerance. They conclude that variations in style are likely to put some athletes at risk and recommend particular trunk orientations during the pitching motion to minimize the effect. This is a good example of the use of motion analysis to enhance the qualitative information, which coaches or clinicians can obtain by visual observation.

IT ILLUSTRATES THAT VICON IS TRULY "THE STANDARD". THE AUTHORS EXAMINE A SIMPLE MAT BASED SYSTEM FOR MOTION ANALYSIS. IT CONSISTS OF AN ARRAY OF SWITCHES THAT COVER THE MAT SURFACE AND ALLOW DETECTION OF TIME DISTANCE PARAMETERS BY USING A COMPUTER TO MONITOR THE STATE OF THE SWITCHES CONTINUOUSLY. THEIR BENCHMARK FOR MEASUREMENT WAS A VICON SYSTEM THAT THEY DESCRIBE AS THE "GOLD STANDARD FOR MOTION ANALYSIS".

The last paper is by **Barker S, Craik R, Freedman W, Herrmann N, Hillstrom H' Accuracy, reliability, and validity of a spatiotemporal gait analysis system', Med Eng Phys. 2006 Jun;28(5):460-7.**

It illustrates that Vicon is truly "the standard". The authors examine a simple mat based system for motion analysis. It consists of an array of switches that cover the mat surface and allow detection of time distance parameters by using a computer to monitor the state of the switches continuously. Their benchmark for measurement was a Vicon system that they describe as the "Gold Standard for motion analysis". They found that the mat system was very comparable in terms of timing measures but that it had some difficulty in measures of distance due primarily to the fact that the switch locations were not completely consistent. They conclude that the differences were small enough that the errors would be unlikely to affect clinical decision-making. The advancement of motion analysis continues to fascinate me. The very broad range of motions that pique people's interests seems to be ever expanding.

Best wishes for the New Year,

Ed Biden
University of New Brunswick
Canada

VICON

Vicon Annual Users Group Meeting

VICON WILL BE HOSTING ITS ANNUAL USERS GROUP MEETING AND SUPPORT SESSIONS DURING THE 12TH ANNUAL GAIT AND CLINICAL MOVEMENT ANALYSIS SOCIETY MEETING
AT THE SHERATON SPRINGFIELD
MONARCH PLACE, SPRINGFIELD, MA
APRIL 11-14, 2007

Support+Service Sessions

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 find out more about our newly developed service and support plans. Time slots will be available on the hour between 8:00 AM and 5:00 PM Wednesday through Friday excluding lunch breaks. To reserve the time slot of your choice, please RSVP to **dudley.tabakin@vicon.com** with a summary of your question and your preferred time.

User Group Event

HIGHLAND BALLROOM
THURSDAY, APRIL 12TH - 7PM

Join us and your colleagues for an entertaining evening with dinner and drinks while you experience what's new at Vicon. Try out our latest software, Vicon Nexus or get your hands on a new MX40+ camera to see what makes Vicon technology truly revolutionary.

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

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