



# International Society of Biomechanics Newsletter

ISSUE Number 96  
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### AFFILIATE SOCIETIES OF ISB:

American Society of Biomechanics; Australian and New Zealand Society of Biomechanics;  
British Association of Sport and Exercise Sciences; Bulgarian Society of Biomechanics;  
Canadian Society of Biomechanics/Société canadienne de biomécanique; Chinese Society  
of Sports Biomechanics; Comisia de Biomecanica Inginerie si Informatica (Romania);  
Czech Society of Biomechanics; Taiwanese Society of Biomechanics, Japanese Society of  
Biomechanics; Korean Society of Sport Biomechanics; Polish Society of Biomechanics;  
Russian Society of Biomechanics; Société de biomécanique (France).

## Note from the President

I can't believe that two years have passed by so quickly. It seems like just yesterday I began to serve as President of the International Society of Biomechanics. As I prepare to turn over the Presidential responsibilities to incoming President Brian Davis at the XXth ISB Congress in Cleveland, I am astounded at the many transitions that have occurred during my watch.

I have had the good fortune to be working with an excellent group of council members from all over the world who have shared a vision for global facilitation of biomechanics. During this time, we have seen the newsletter go from a paper to electronic format. We have had the first electronic election in ISB's history. And two more societies have become affiliated with ISB. In the last newsletter, we featured the Brazilian society and have a feature on the International Society of Biomechanics in Sport in this newsletter. Our work with affiliated and developing countries has been expanded through the efforts of Jill McNitt-Gray.

In addition, we now have our first elected student representative on the ISB council. Moto-shi Kaya was appointed in 2003 and has helped to facilitate this election. We look forward to working with Cheryl Metcalf to expand ISB student involvement. See an interview with Cheryl in this newsletter

Many thanks go to the outgoing council members for their hard work on behalf of ISB. Sandra Olney is finishing her term as Past-President. She did an excellent job of selecting the Muybridge Award winner and providing an impressive slate of candidates for this year's election. I enjoyed serving on the Muybridge

Award Committee with her. Senshi Fukushima was an appointed member of the Council who liaised with Asian sponsors, assisting Mark Grabner with ISB sponsorship. Bob Gregor did a top-notch job of updating the codes and constitution. Several constitutional changes were presented to the membership and voted in.

As we say goodbye to some, it's time to greet others as well. We welcome new members Toshio Moritani (Japan); Peter Milburn (New Zealand); John Challis (USA); Frans van der Helm (the Netherlands); and Cheryl Metcalf (United Kingdom).

When I look back over the past year, I am proud of what we as a Society have accomplished. As for my activities as President, I called and presided over the meeting of the Executive Council held in conjunction with the 2004 ESB conference in the Netherlands last July 3 and 4. I also will call the Council meetings just prior to the opening of the 2005 biennial Congress (at which my term of office expires) as well as a meeting of the General Assembly of members.

Also as President, I have provided guidance to President-Elect Brian Davis in overseeing the planning and conduct of the 2005 International Congress. I worked with him to insure a smooth transition to the next administration and proper continuity of Society business.

With the President-Elect and Past-President, I served as a member of the Committee of Presidents of the Executive Council to make decisions on urgent business that may arise between scheduled Council meetings; I communicated with Executive Council members regarding their duties and discussed specific issues

with them, and I corresponded regularly with the elected Executive Council members in order to keep them informed of new developments of concern to the Society and encouraged them in their individual and collective efforts regarding Society responsibilities.

In matters of Society policy, I spoke for the Executive Council, and I served as Chief Public Relations Officer of the Society. We had continuing communication regarding the transition to electronic elections and newsletters along with the Web site transitions. Based on the feedback from the Council, the following financial commitment was made related to the ISB student representative: The incoming and outgoing student representatives will receive up to \$500 to attend the Council meeting at the ISB conference. The student representative will also receive up to \$500 to attend the Council meeting in the non-conference year.

This year, I also represented the Society in all communications with other scientific and professional organizations, specifically Elsevier, ESB, WCB, and others.

Finally, I worked closely with Karen Sogaard in gathering material for the Society newsletter and provided guidance as well. It has been a pleasure to work with her.

Regarding this newsletter, there are a lot of important topics covered, and I hope you take the time to read them. Just some of these are Notes from the Archives, the Announcement of the Y-robot award, the program from World biomechanics and the results from the Council

election. Reports from the student biomechanists awarded Travel Grants, Congress grants, and dissertation grants are also in this newsletter.

Something not to be missed is the update on the ISB Cleveland 2005 conference. Our biennial international conference on biomechanics is so important because it provides us with the opportunity to gain an understanding of the current status of the field while making valuable professional and personal contacts. The conference will be held this August in Cleveland, Ohio, USA. Please read about the conference and plan on attending.

Now it's time for me to bid you farewell—as President at least. These past two years have been remarkable for me. I have learned so much and shared so much. I've had the opportunity to work with some of the finest people in our field, and together we have been able to make important changes that will help strengthen our organization. We've worked hard to ensure that the future of biomechanics will be a bright and promising one. Thank you for giving me these opportunities.

It has been an honor and privilege to serve as your President. I look forward to seeing you in Cleveland!

Until next time

*Mary Rodgers*

## Results of the Council Election 2005

### President-Elect:

Walter Herzog, Ph.D. (Canada)

### Student Member:

Cheryl Metcalf

### Council Members:

Maarten F. Bobbert, Ph.D. (The Netherlands)

Joseph Hamill, Ph.D. (U.S.A.)

Jill McNitt-Gray, Ph.D. (USA)

Karen Sjøgaard, Ph.D (Denmark)

Alex Stacoff, Ph.D. (Switzerland)

Toshio Moritani, Ph.D. (Japan)

Peter Milburn, Ph.D. (New Zealand)

Ewald Hennig, Ph.D. (Germany)

John H. Challis, Ph.D. (U.S.A.)

Frans C.T. van der Helm, Ph.D. (The Netherlands)



## Presentation of ISBS

The International Society of Biomechanics in Sports (ISBS) is composed of approximately 300 members from over 51 different countries with a common desire to study and understand human movement, especially as it relates to applied sport biomechanics. The first full scale conference of the ISBS was held June 20-25, 1982, in San Diego, California, with 123 participants. ISBS initiated a constitution on May 7, 1983, with subsequent constitutional revisions over time to suit the changing needs of the society. The society's main objectives are to expand the knowledge of sport biomechanics and to provide a forum for researchers, teachers, coaches, and practitioners. The annual symposia of the ISBS are conducted in a friendly atmosphere, which favors and encourages wide participation. Past conferences have been held in a variety of interesting locations including several European countries (Czech Republic, Germany, Greece, Hungary, Italy, Portugal), a number of US states (California, Colorado, Iowa, Oregon, Massachusetts, Texas), the Canadian provinces of Nova Scotia and Ontario, as well as Australia and Hong Kong. The ISBS sponsors the *Sports Biomechanics* journal, which is edited by Roger Bartlett and several other important resources such as the *Coaches Information Services* <http://www.coachesinfo.com/> and the *Teachers Information Services* <http://www.usfca.edu/ess/tis/>. For more information about the ISBS please visit our web site <http://www.uni-stuttgart.de/External/isbs/>

*Eadric Bressel, PhD*

## Interview with the student representative

Congratulations to Cheryl Metcalf on her election as student representative in the ISB-council!!

Cheryl has made history, since she is the first officially elected student. Cheryl will take over from Motoshi Kaya, who was appointed to promote students involvement in ISB council work. In the following interview, we would like to focus on our new student representative. Hopefully, this will inspire other student ISB members to contact their representative if they want certain issues to be brought forward to the council or have other suggestions that can promote students involvement in ISB. Read below Cheryl's presentation of herself and her answers to the editors questions.

"I would like to say how pleased and honoured I am to have been elected as the student representative on the council for the ISB. I'm looking forward to creating a more accessible interface between the Society and student members.

### *What is your own research?*

My research focus is upper limb biomechanics, with particular emphasis on hand and wrist kinematics during functional tasks. I am based at the University of Southampton in the United Kingdom under the supervision of Dr Jane Burridge, Dr Paul Chappell and Dr Vikkie Yule.

### *What was your first contact with the ISB and who introduced you to the ISB?*

I was introduced to the ISB by my supervisor Dr Vikkie Yule, who found it to be a helpful resource in her own research in Gait Analysis. I joined the society after looking at the ISB website and signing up for the BIOMECH-L email list, which has proved particularly useful.

### *What or who encouraged you to accept or be nominated for election?*

I thought a lot about standing for the election. I talked to a couple people about my interest, and it was my family who helped me make my final decision. The encouragement from my friends and colleagues since the election results were released has been great, and I would like to take this opportunity to thank everyone for their support, particularly my family.

### *How do you think that students can benefit from membership to the ISB?*

I think the greatest asset of the ISB is its existing members and the knowledge and experience they can provide for the students. You only have to look at the speakers and tutorials at the upcoming congress to see that the ISB can provide first-hand access to quality research. For those students who are unable, for whatever reason to attend the many conferences and meetings affiliated with the Society, I'm hoping to develop a framework to allow easier access to the exist-

ing knowledgebase and experience of the members.

*Do you have suggestions for ISB initiatives that could improve student involvement in the ISB?*

I have a few ideas to encourage student participation in the ISB and to provide a forum for communication of ideas and current research. I mentioned in my nomination statement the idea of developing an online database for members to contribute some basic contact information and details about their research interests. This would hopefully assist in allowing members to access centres of related research, and for established researchers to identify students for potential recruitment.

My next idea is rather a grand plan, and one that will definitely need the support of the ISB if it is to exceed. Over the next two years I would like to set up a student symposium to encourage first-time speakers to present their work in a supportive environment. I think initially it would be more appropriate to organise these events on a national basis and this would obviously require volunteers from the student body of the ISB. I hope that this would encourage participation from student members in the society and to promote the society to non-members, or other national-based societies.

In addition, two ideas that could be implemented immediately would be firstly to allocate a student section in the Newsletter and invite student members to contribute a biography of their research, their interests and their department. This would promote the student's work and develop publicity for the specialism

of their department/centre or school. Secondly, with the backing of the ISB we could send out one poster to every ISB member. This would promote the ISB and encourage new members to join.

I'm very excited about attending the ISB-Cleveland congress and I'm particularly looking forward to attending the baseball game... (and the lectures of course!). I hope to see a lot of you there and please come and find me if you have anything you want to bring to the attention of the ISB council, have an idea to promote the society to encourage student participation, or would like to discuss any of the ideas that have been put forward. See you there!"

This is the first time ISB has an officially elected student representative in the council. Such a commitment involves participation in council meetings in connection to conferences. The ISB council has therefore made the following decision to financially support the student representative.

1) Financial assistance will be provided to both the outgoing and incoming representative up to the amount of \$500 (USD) each.

2) Financial assistance will be provided to representative up to the amount of \$500 (USD) for the council meeting in the non-congress year.

*Karen Søgaard*

## Notes from the archives

Eadweard Muybridge is considered one of the forefathers of both the movie industry and biomechanics. Our society's most prestigious award is named after Eadweard Muybridge, the Muybridge Award. This award is made at our congresses, but who is Eadweard Muybridge? Muybridge had a colorful life with many highlights; some of which are listed in the following timeline.

**1830** - Edward James Mugeridge was born in Kingston-on-Thames in England. He subsequently changed his name twice, first to Eadweard Muygridge and then to Eadweard Muybridge.

**1852** – left England for the USA, settled in San Francisco working as a book seller.

**1860** – took out a patent for a photographic plate printing.

**1867** – took landscape photos of Yosemite Valley, which led to some fame as a photographer.

**1872** – took photo-sequence of Leland Stanford's horse, Occident, trotting with all four hoofs simultaneously off of the ground. This apparently led to Stanford winning a \$25,000 bet. Multiple cameras placed in a row were used to capture the horse's motion.

**1874** – shot and killed George Larkyns.

**1875** – found innocent of murder, probably on grounds of temporary insanity.

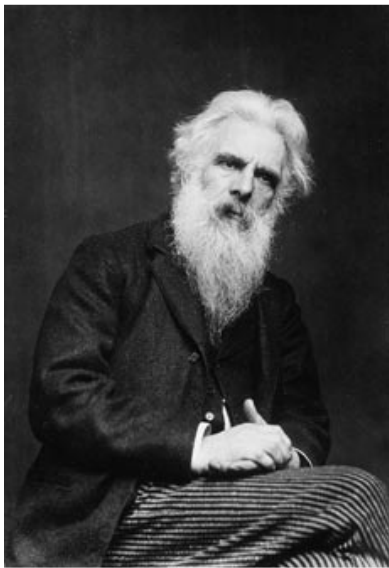
**1878** – drawings of his photographs of a horse walking and trotting appeared on the cover of *The Scientific American*.

**1881** – Muybridge's book *The Attitudes of Animals in Motion* was published.

**1884** – began work at the University of Pennsylvania. Using an electronically triggered 24 camera system he endeavored to catalog animal movement.

**1890** – Muybridge's books *Animal Locomotion: The Muybridge Work*, and *The Science of Animal Locomotion* were published.

**1904** – died in Kingston-on-Thames.



Eadweard Muybridge (1830-1904)



Muybridge images of a horse trotting.

Muybridge contribution from a biomechanical perspective was in the area of motion analysis. He did not take measurements, but was one of the first to capture motion and did so for many

species and movements. Although re-examination of his work has shown that he edited sets of photo-sequences together to produce a final sequence; this should not diminish our appreciation of the impact of his work as it promoted considerable thought about the nature of movement.

The recipients of the Muybridge Award to date are listed below.

Year	Recipient
2003	Tetsuo Fukunaga (Japan)
2001	David Winter (Canada)
1999	Paavo Komi (Finland)
1997	John P. Paul (United Kingdom)
1995	Savio L-Y. Woo (USA)
1993	Malcolm H. Pope (USA)
1991	Robert McNeill Alexander (United Kingdom)
1989	Gunnar Andersson (USA/Sweden)
1987	Peter R. Cavanagh (USA)

(The ISB has an archive of its important materials, kept at Penn. State University. If you have any materials you think should be in the archive, and you would consider donating them to the archive please contact John Challis (jhc10@psu.edu).)

## Editors notes

In addition to reading this Newsletter you may want to keep an eye on the homepage to know what your ISB council is working with:

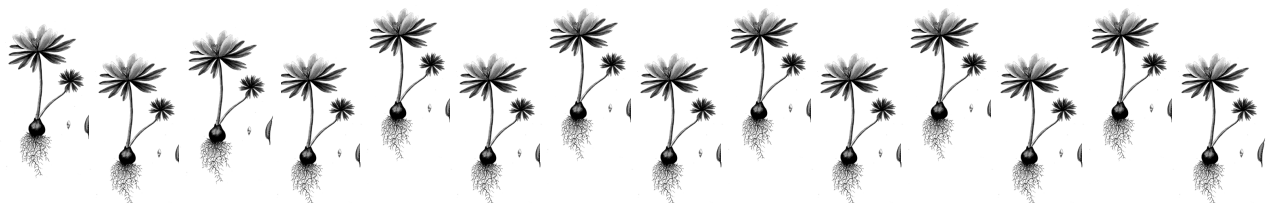
The full agenda for the Council meeting that will take place in Cleveland the 30 and 31 of July will be published on the homepage in due time before the meeting.

Next Newsletter will bring you the summary from the Council meeting. Further, we will present a short description of the new officers in the council. If you attend the ISB Conference we would welcome contributions with your opinion of the Conference and Cleveland in general.

Please, send your contribution in electronic form in any form of English to [ks@ami.ks](mailto:ks@ami.ks)

General deadline for the next Newsletter is the first of September !!

Summer greetings from the editor  
Karen Sjøgaard





## Latest News ISB/ASB Conference Cleveland 2005

- See updated program on the web page: <http://www.isb2005.org/program/>
- 1005 presentations have been scheduled
- 825 people have pre-registered for the congress. We expect over 1000 participants.
- University housing is nearly sold out. All 100 single rooms have been booked. You may still be lucky enough to find spaces in double rooms.
- All the following countries are represented with abstracts:

USA	479	India	3
Canada	98	Singapore	3
Taiwan	74	Ireland	2
Japan	69	Spain	2
United Kingdom	59	Turkey	2
Netherlands	31	Bulgaria	1
Germany	26	Czech Republic	1
Brazil	23	Finland	1
Australia	21	Greece	1
Denmark	14	Iran	1
Korea	14	Norway	1
Belgium	13	Portugal	1
France	12	Russia	1
Hong Kong	9	Serbia	1
New Zealand	7	Slovenia	1
Switzerland	6	South Africa	1
China	5	Thailand	1
Italy	5	Venezuela	1
Sweden	5		

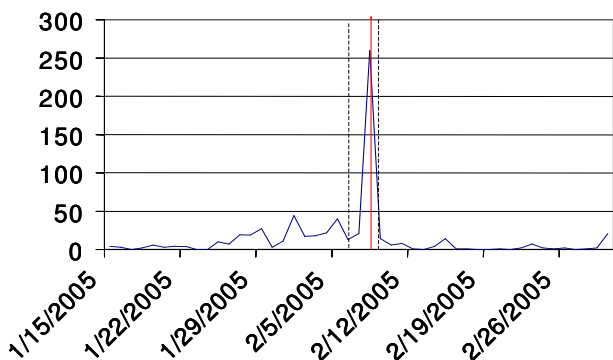
*Ton van der Bogert*



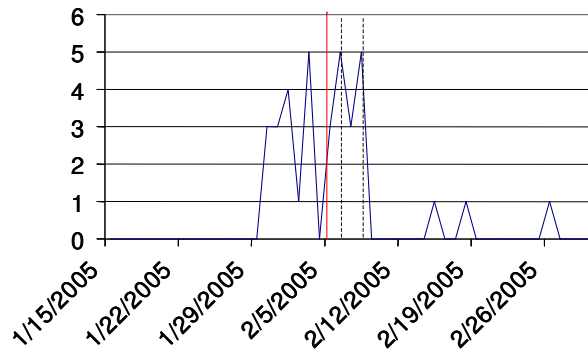
## Leaving abstracts submissions until the last minute!

We looked at the first 1,150 abstracts that were submitted to ISB2005 to determine when scientists submit abstracts to an international meeting. After separating abstracts according to time of submission and continent, it can be concluded that Australia is the continent that has the earliest average submission date. North America has the latest average submission date, but these researchers submitted the highest number of abstracts (i.e., 654). Note that (i) the vertical scales in the graphs below are different, and (ii) the vertical line indicates the average submission date whereas the dashed lines represent days close to the deadline.

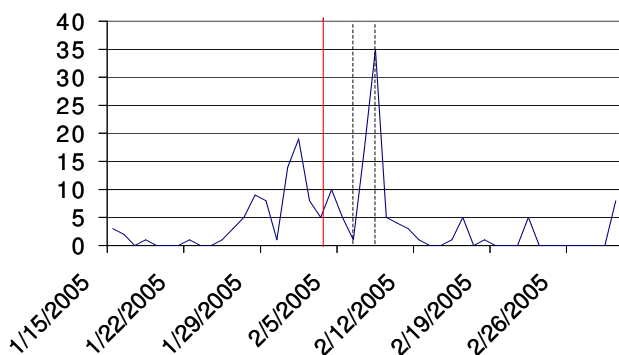
### North America



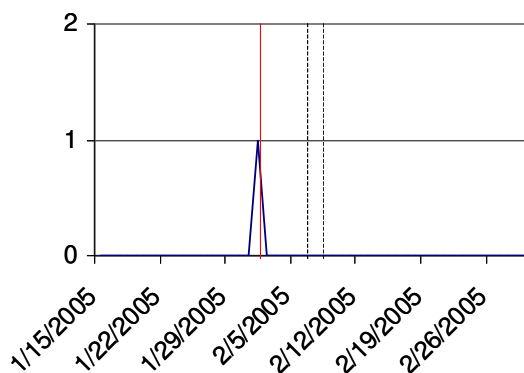
### South America



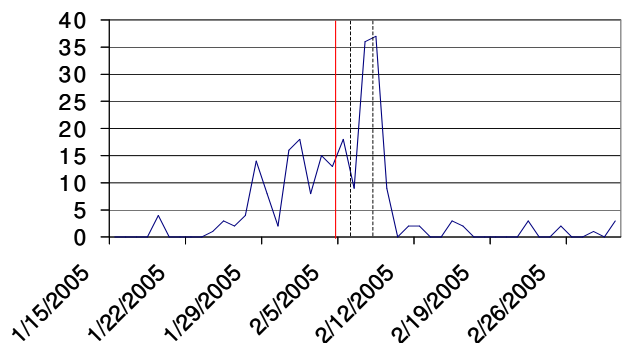
### Europe



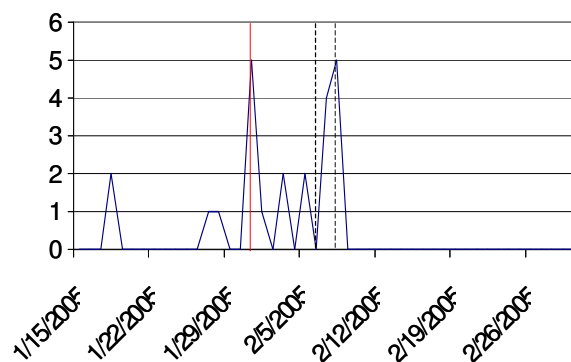
### Africa



### Asia



### Australia



Anthony Brown and Brian L. Davis



## ANNOUNCEMENT

### THE INTERNATIONAL CENTRE OF ORTHOPAEDIC RESEARCH, EDUCATION, AND TREATMENT (I.C.O.R.E.T.)

The I.C.O.R.E.T. is pleased to announce a special award for young researchers of orthopaedics, biomechanics/biology, operative techniques, and sports – the **Y-ROBOTS Award**. Manuscripts in the areas of orthopaedic biomechanics, orthopaedic biology, operative techniques in orthopaedics or sports medicine are being accepted for consideration of this outstanding research award. The first author must be less than 40 years or within no more than 8 years after his/her last academic degree (Ph.D. or M.D.) at the time of submission.

All applications will be reviewed and up to 10 finalists will be selected and invited for presentation at the 9<sup>th</sup> International Conference on Orthopaedics, Biomechanics, Sports Rehabilitation in Assisi/Perugia, Italy, between 11-13 November 2005. The winner of the **Y-ROBOTS Award** will be selected following the presentations by the finalists. The Members of the Award Committee are:

Chair:	Savio L-Y. Woo, Ph.D.	
Members:	Giuliano Cerulli, M.D.	Mario LaMontagne, Ph.D.
	Ejnar Eriksson, M.D., Ph.D.	Ronny Lorentzon, M.D.

#### The award consists of:

- 5.000,00 Euro
- Award Certificate
- Consideration for Publication in *Knee Surgery, Sports Traumatology, Arthroscopy* after the peer review process

The deadline for receipt of manuscripts will be **October 1, 2005**. Six (6) copies of the completed application and manuscript should be submitted to:

Savio L-Y. Woo, Ph.D.  
c/o Let People Move  
Via G.G. Pontani, 9  
06128 Perugia – Italy  
Phone: 011-39-075-500-3956  
Fax: 011-39-075-501-0921  
Email: letpeoplemove@tin.it  
Website: www.letpeoplemove.com

#### Note:

- *Submissions, including papers, photographs, illustrations, etc. submitted will not be returned unless a self-address stamped envelope is included.. Members of the research groups of the Award Committee are not eligible.*

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you there.

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Colorado: (303) 799 8686  
Web: [www.viconpeak.com](http://www.viconpeak.com)



## ISB Travel Grant

I would like to thank the International Society of Biomechanics Council for awarding me with an ISB Travel Grant. This 2000\$ grant enabled me to realize one of my doctoral researches focussed on locomotion efficiency and precisely on the mechanical factors affecting the efficiency of human running. In fact, Prof. Rodger Kram has invited me to be a full time graduate research student in the Locomotion Laboratory of the Integrative Physiology Department at the University of Colorado. This laboratory has developed original methods and concepts that make it an ideal location for me to further explore the mechanical factors influencing the energy cost of running. Then, I was in Boulder during a first period of three months (September 8 – December 8, 2004).

The purpose of my visit at the Locomotion Laboratory was to plan and perform a new experiment that combine methods used in the University of Saint Etienne and the University of Colorado: simulated downhill and uphill running was applied in simulated reduced gravity. In fact, I conducted research that involved normal running and running with aiding or impeding horizontal forces in normal and simulated reduced gravity. We used treadmill dynamometer to measure ground reaction forces and expired gas analysis to measure metabolic energy consumption. The aim of this study was to estimate the elastic energy stored during negative work phase and released during positive work phase of running in different conditions of gravity and speed running.

Moreover, I finished to write my first manuscript concerning the data of the experiment previously performed in Saint Etienne (entitled “New method of calculating the storage and release of elastic energy in running”) with the help of my two co-supervisors, Prof. Alain Belli from the University of Saint Etienne and Prof. Rodger Kram of the University of Colorado (CU).

During all my stay, I attended weekly department colloquium and journal clubs, observed and audited biomechanics classes. I also improved my knowledge in Matlab and Endnote programs. This American experience was very instructive and enriching because I was in total immersion and my abilities to both speak and write English improved.

At last, I would like to tell you that besides my wonderful professional experience, my life was very exciting because I lived in an international student center with around thirty other students who helped make a new place like Boulder feel like home. Moreover, I practiced a lot of physical activities such as biking, hiking, rock climbing, basketball, swimming, weight lifting and I played rugby in the CU rugby-women team: it was awesome and fascinating!

I am impatient to go back to Boulder next summer for 3 other months in order to analyze, discuss and I hope to publish the data of the experiment performed at the Locomotion Laboratory. I hope I will be able to participate to the 20<sup>th</sup> or 21<sup>st</sup> ISB congress in order to present you the results of my experiment.

*Christelle Chauv*



## ISB Travel Grant

I would like to thank the International Society of Biomechanics for awarding the travel grant. With this funding, I was able to visit the computational biomechanics group in Istituti Ortopedici Rizzoli (IOR), Bologna, Italy, and join the Multimod Project developing team. This grant helped cover the costs of traveling, accommodation, subsistence and computer facilities for software development. I feel that I benefited significantly by working with both the engineers and programmers in this group during this one month visit. This enabled me to use their well equipped research facilities, experience the application of computer graphics and image processing techniques in computer simulation of biomechanics, and obtain valuable expertise for my further research at APU.

The aim of my study is to design and analyze an algorithm for the registration of CT and MR images, which will contribute to Finite Element (FE) modeling. FE method is widely used to simulate the mechanics of human joints. Human joints are a kind of complex organization, where both hard and soft tissues coexist adjacently. In the CT and MRI images of human joints, both hard tissue and soft tissue contain useful information that can contribute to the subsequent Finite Element Analysis (FEA). I attempt to develop a systematic theory-framework and a practical method to analyze musculo-skeletal structure of human joints through effective multi-modal medical image registration.

The primary goal of my visit was to join Multimod Project developing team and study the principles and skills of Multimod Application Framework (MAF), a software toolkit for the rapid development of computer-aided medicine applications. This study enabled me to integrate medical image registration algorithm in the MAF in future projects within APU as well as joint research ventures computational biomechanics research group in IOR.

Through the working with the MAF toolkit developers, I have increased understanding of the hierarchical data structure to integrate heterogeneous medical data and the multimod visualisation capabilities in MAF. I added an operation for registering two volume datasets, this program will can be used for the further algorithm development in the research. I also worked with biomechanics engineers in the group at IOR, to investigate the application requirement of medical image visualization and registration of heterogeneous biomedical data for biomechanics research. They are the first users of the DataManager, a software developed with MAF, which will be used to combine the data from different imaging modalities for musculo-skeletal simulation, as well as opening up new areas for bioengineering research.

Again I would like to thank the ISB for their financial support for this transnational access to the famous biomechanics lab in the world.

*Yan Yang*

## ISB Dissertation Grant Report

To begin, I would like to offer my sincere gratitude to the International Society of Biomechanics and particularly the Awards Committee for awarding me with an ISB Student Dissertation Grant for 2004. This grant afforded the time and the tools necessary to develop the methods central to my dissertation. I intend to present my results at the XX<sup>th</sup> Congress of the International Society of Biomechanics in August 2005.

The focus of my doctoral dissertation, entitled “The Determination of Individual Muscle Action in Human Locomotion”, is the development of a time efficient and robust method of computing muscle forces in a musculoskeletal model of human gait. The goal is to use these muscle forces to understand how individual muscles contribute to the aspects of support, stabilization and forward progression during the different phases of human walking. This research was motivated by the work of Anderson and Pandy (2001) where a large-scale optimization method was used to predict muscle function in a complex musculoskeletal model. The major drawback of their method was the difficulty in getting the optimization to converge and the months of supercomputing time necessary to calculate an accurate solution. In most clinical settings, prediction is less critical than knowing what is actually occurring. In fact, gait analysis already provides a significant amount of information that describes the patient’s movement. What is missing, however, is the knowledge of how the nervous system and muscles work to produce that motion.

A new computational method for computing individual muscle forces was developed that takes advantage of the available observations of body motion from position markers affixed to a subject’s body as well as ground reaction forces measured via force-plates. The problem was one of how to solve for the muscle forces in order to actuate a musculoskeletal model so that it follows these observations, which is essentially a tracking problem.

The tracking problem was partitioned into two parts: first a skeletal-motion control problem and then a neuromuscular control problem. Since the motion of a multi-body system, like the skeleton, is uniquely governed by applied joint torques (rotational forces), the observations of the motion and external reaction forces were used to formulate a tracking-control solution to determine the required joint torques. The well-known “method of computed torques” from robotics was extended to include the tracking of ground-reaction forces in order to provide more accurate and

stable torques. In the second part, an optimal control system describing the neuromuscular “excitation-to-torque” dynamics was controlled to track the computed torques. The neuromuscular system was manipulated using nonlinear control theory to cast it into an optimal linear-quadratic tracking problem, which has an efficient method of solution. This novel approach provides the ability to track torques while simultaneously minimizing a performance criterion to resolve the muscle redundancy problem.

Muscle redundancy is a natural consequence of the human musculature, which has many muscles spanning a joint and therefore has a continuous set of muscle force combinations that can produce the same joint torque.

Thus, a form of optimal decision-making is necessary to uniquely and efficiently distribute muscle activity. An advantage of our approach is that it can minimize a criterion such as total muscle effort, which is evaluated over the entire performance period, opposed to simpler methods that minimize instantaneous muscle stress. This is an important feature that enables realistic performance criteria to be applied. These algorithms for skeletal-motion and neuromuscular tracking provide a new methodology for computing muscle force estimates in a few minutes rather than days or weeks without neglecting neuromuscular dynamics, sacrificing the accuracy of forward simulations, or being adversely affected by model complexity. This methodology was applied to a model of maximal-height jumping as a challenging benchmark problem, which revealed that tracking could generate accurate results comparable to large-scale parameter optimization but in a minute fraction of the time. I am currently preparing to submit the tracking methodology and these results for review and publication.

The necessity for vast amounts of computing time and resources has been a large obstacle facing the acceptance of musculoskeletal modeling as a clinical tool. Now that muscle forces from complex musculoskeletal models can be accurately computed in a matter of minutes, the door is opening for models to be included in the clinical diagnosis and treatment planning processes. As a result of this methodology, one can begin to understand the role of individual muscles during gait on a subject-by-subject basis and not have to resort to an “average subject” representation. Hopefully, this work will give rise to new clinical tools for identifying and quantifying patient specific deficiencies within a broader and more detailed understanding of “normal” gait. *Ajay Seth*

## ISB Dissertation Grant Report

First of all, I would like to thank the International Society of Biomechanics (ISB) for having supported my research work with the Dissertation Matching award. It was a substantial and very helpful financial support for my work and I hope this will be the case for many future students as well.

My research work was focussed on total ankle implants of unconstrained type, namely the Buechel-Pappas prosthesis. This particular prosthesis was chosen as a representative for several mechanically almost identical designs that are available on the orthopaedic market these days (e.g. STAR, Hintegra, Salto etc.). Ankle prostheses of unconstrained type are designed as not to transmit shear stresses at the implant-to-bone interface at the level of the tibia. Thus they are less prone to loosening tendencies, which early prosthesis designs of constrained type did show. This design rationale of minimizing the shear stresses is attained in several modern designs by means of a meniscal PE bearing which is free to glide and rotate on a flat tibial metal component. This tibial component therefore transmits only compressive forces from the foot to the shank segment.

The main research objective of my work was to determine, whether subjects with a prostheses of unconstrained type alter the transmitted net moment at the level of the ankle joint as compared to normal healthy subjects, particularly in the transverse plane. In order to answer this question two groups of 10 individuals each were analyzed in our gait laboratory. The first group consisted of 10 normal adults, whereas the second group was formed by persons with a total ankle implant of unconstrained type (Buechel-Pappas). All persons with a total ankle implant showed a good clinical outcome. The used measurement equipment for these biomechanical measurements consisted of a 7 camera Vicon™ 3.5 System and a Ki-

stler™ force measuring platform (Type 9281B). Time resolved kinematic segment information was gained with a least squares cluster fit routine of a redundant marker set according to Gander and Hrebicek in the 3-dimensional laboratory space (translation plus rotation, in total 6 DoF per segment). A static calibration of the statically over-determined force measuring platform was performed to improve accuracy (Dettwyler 2003).

After correction for individual height and mass, the net forces and net moments as well as inverted time of ground contact as a measure of speed were compared. It was found that the subjects with ankle prosthesis showed a lowered walking speed by approximately 10% ( $p > 0.99$ ). As a consequence, the net forces in vertical direction showed less dynamics ( $p > 0.99$ ). The forces and moments in the transverse plane were, however, not altered significantly. This finding was not expected intuitively at the beginning of the project. However, it has to be stressed out that the group with an ankle arthroplasty included only subject of good or excellent clinical outcome.

The calculation of the individual muscle forces at the ankle is, in terms of mathematics, an over-determined system, the solution of which would have been only feasible with further assumptions. Selected EMG recordings showed no consistently different activation pattern between the two investigated groups. Mainly the peroneal and the posterior tibial muscles can potentially generate an external/internal rotation torque in the transverse plane at the level of the ankle.

A simple model of the cylindrical joint contact between the trochlea of the talus and the inferior joint surface of the tibia showed, that this joint is able to transmit a rotational torque in the transverse plane when loaded.



During normal ambulation, compressive forces in the order of 4-5 times bodyweight are generated in the ankle.

The cylindrical joint surfaces are therefore highly loaded in the healthy ankle which leads to a considerable contribution to the rotational resistance in the transverse plane. This effect is not present in persons with an ankle arthroplasty of unconstrained type.

Passive structures such as ligaments have to compensate for this lack of rotational stiffness. It would therefore be interesting to investigate whether persons with an ankle arthroplasty of unconstrained type show an increased ligament strength and/or build-up

after rehabilitation or in the course of time following the surgery.

Recent clinical results with total ankle implants of unconstrained type are encouraging and a growing interest in this particular field is present in professional circles.

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#### References:

**Buechel F. F., Pappas M. J. and Iorio L. J.** *New Jersey low contact stress total ankle replacement: Biomechanical rationale and review of 23 cementless cases.* Foot & Ankle 8(6):279-290, 1988.

**Dettwyler M., Stacoff A. and Stüssi E.** *Static in situ calibration of statically over-determined ground reaction force measuring platforms.* In: XIX<sup>th</sup> International Congress of Biomechanics, p. 88, Dunedin 2003.

**Gander W. and Hrebicek J.** *Solving Problems in Scientific Computing using Maple and MATLAB.* 3<sup>rd</sup> edition. Springer, 1997.



## ISB Travel Grant Report

Wednesday, 17<sup>th</sup> March 2004, 6.00pm: I was playing football in the sports hall with the staff of Exercise and Sport Science Dept when my colleague Luca Ardigò entered the room wearing an unrecognisably large smile. Wondering the reason for the unusual expression, I asked him about it and he replied, almost moved to tears: “We’ve just been awarded the ISB Travel Grant!” Having at that time fairly ropey financial situation, the news was absolutely great: with the ISB grant I would be able to carry on with my project on the development of cross-country skiing (from 3000BC to date) and the biomechanical and physiological implications of locomotion on snow.

The ISB Travel Grant alone supported half the expenses related to my project: from flight tickets to car and ski tunnel rental. My initial impression was of a pleasant trip to Finland, which in May, as in the rest of Northern Scandinavia, is still covered in snow. Little did we know that our fate was about to reveal itself as something quite different! The flight was spent praying for the safe arrival of the skis: perfect replicas of ancient models found in Scandinavian bogs, painstakingly made by Mr Tony Whitehead and his collaborators at the Design and Technology Dept at MMU, and now being carried on a plane (hopefully the right one) after the potentially perilous loading. Fortunately, however our arrival at the Vuokatti ski tunnel was smooth: Mr Pekka Vahasoyrinki and his collaborators welcomed us as warmly as they could (temperature was  $-12^{\circ}\text{C}$ ) and the gas cylinder, needed to calibrate the oxygen consumption system, had arrived at the tunnel. Everything seemed fine, but we quickly became aware of what working in the ski tunnel actually meant. We spent 10 days working an average of 11 hours in the absolutely ‘standard environmental conditions’ we had looked for:  $-5.2^{\circ}\text{C}$  ( $\pm 1.1^{\circ}\text{C}$ ,  $n=115$ ) and 84% humidity! Despite being a somewhat chilly experience, the instruments worked well, the data collection was

good and gave us interesting results to be published in the very near future (we shall see it in one of the next ‘Literature updates’ by Young-Hui Chang). This opportunity was immensely helpful for me, as it provided the chance to practise proper biomechanical fieldwork as well as learning how to perform experiments outside the laboratory, with technology only ever used at the University. We collected data about oxygen consumption, heart rate and motion (by means of inertial sensors) of participants skiing the length of the tunnel (1250m) back and forth at two different speeds, with a total of 7 pairs of skis belonging to different historical periods, from 3000BC to the modern times. The cost of skiing was calculated as well as the work against friction and the internal work. The external work was estimated by subtracting from the measured cost of skiing the metabolic equivalent of internal work and work against friction. Kinematic variables such as speed at different gradients and stride length were measured and calculated.

On the last day of our stay we finally had a really lovely evening and our sufferings were rewarded: our frozen limbs (upper and lower) were warmed in a typical Finnish sauna and our souls reanimated by beer and meat, all in front of a fire, looking at a still-frozen lake just outside the window.

Thank you to ISB, my Professor Alberto Minetti and Mr Luca Ardigò for their much appreciated help.

*Federico Formenti*  
*Manchester Metropolitan University, UK*

## ISB Travel Grant Report

I would like to thank the ISB council for awarding me a 2003 ISB Congress Travel Grant. The award made it possible for me to travel half way around the world from Ann Arbor, Michigan USA to my first ever scientific meeting in Dunedin, New Zealand. I couldn't have dreamed up a better first experience.

One of the most exciting aspects of doing research is collaboration. Science cannot move forward unless minds merge, feedback swirls, and innovation is unleashed; I experienced some of all of these elements when we convened in Dunedin. I found the interactions I had with other students, professors, and researchers at the XIXth Congress extremely exciting and stimulating. The scope, variety and quality of the research presented was astounding.

I thoroughly enjoyed attending many of the talks and posters in the program. I particularly enjoyed the keynote lecture given by Alberto Minetti because of its relevance to my own area of research. It was great to finally put faces with many of the names I have only seen in journal publications: Maarten Bobbert, Steven Vogel, Thomas Brown, Chris Kirtley, and Roger Enoka to name a few.

The meeting solidified my view that it is extremely important to do work in areas where standard disciplines overlap (i.e. Neuromechanics). It is equally important to learn to speak to other scientists coming from different backgrounds. Clear communication can lead to great progress. I had the unique opportunity at the XIXth Congress to present my work supported by the Christopher Reeve Paralysis Foundation on powered lower limb orthoses to an attentive and enthusiastic audience. Our work on powered orthoses is new and largely untested. My presentation was well attended and generated considerable interest from the ISB

community. This positive experience gave me continued motivation and confidence that my work is important. In addition my colleague and good friend, Keith Gordon, was presented with the Young Investigator Award for best poster presentation on his work using our powered orthoses to study adaptation in human locomotion. I was extremely excited for Keith and his award also signaled the importance of our work.

Finally, I would like to thank the organizing committee and the University of Otago for the accommodations, hospitality, and a well designed program that included many fun events (Sea Kayaking, Bicycling, the Pub Crawl, Lunches and Teas) in addition to lots of good science. I look forward to attending future meetings of the ISB. See you next time!!!!

*Greg Sawicki  
Human Neuromechanics Lab  
University of Michigan, USA*



# ISB Travel Grant Report

## ***Biomechanics and energetics of pentapedal locomotion in Red Kangaroos***

Kangaroos (Macropoidea) move in a biomechanically interesting way at slow speeds; they walk pentapedally using their tail to "crutch" along. Early work by Dawson and Taylor (1973) on two Red Kangaroos (*Macropus rufus*) suggested that this mode of locomotion is metabolically expensive. Despite the apparent expense, kangaroos largely rely on their pentapedal gait to forage and graze. I proposed to study the biomechanics and energetics of pentapedal walking in kangaroos for two main reasons. First, understanding the biomechanical determinants of the metabolic cost of pentapedal walking provides insight into the behavior, ecology and evolution of a relatively large group of animals (there are 45 recognized species of kangaroos). Second, applying theory developed during our previous work on bipedal walking to a unique form of locomotion is a strict test of the generality of its principles.

To study pentapedal walking, I traveled to the University of New South Wales to work with Prof. Terry Dawson in the Department of Biological Sciences. With the help of my colleagues, I studied the metabolic energetics of pentapedal walking in seven Red Kangaroos. We trained the animals to wear a mask and walk on a treadmill at a range of speeds. This allowed us to measure metabolic power using open-flow indirect calorimetry. To study biomechanics of pentapedal walking, we trained the same animals to walk along a walkway and across a force reaction platform. A video camera recorded sagittal plane motion. By combining video and ground reaction force data, the mechanical work required to walk pentapedally could be calculated. In addition, this methodology allows us to determine the relative contributions of the fore limbs, hind limbs and, in particular, the tail to the dynamics of pentapedal walking.

We found that pentapedal walking is mechanically expensive. When compared to human bipedal walking at the same speed, pentapedal walking requires, on average, 5.5 times the mechanical power when normalized for body mass. Correspondingly, and in support of the earlier work of Dawson and Taylor, we found that pentapedal walking is metabolically expensive. When compared to human bipedal walking at the same speeds, pentapedal walking requires, on average, 2.6 times the gross metabolic power when normalized for body mass. The efficiency of performing mechanical work was 0.20, close to that predicted from isolated muscle experiments (0.21), suggesting that the metabolic expense of pentapedal locomotion is a result of a large mechanical work requirement. We also found that the front legs, hind legs and tail have different functions. The hind legs support the majority of the body weight and perform the majority of the work. The front legs act mainly as a brake and the tail acts mainly as a motor. Surprisingly, the tail generates the same amount of mechanical power as both human legs in bipedal walking. Using mathematical models, we are currently studying whether the asymmetry in the length of the legs may be responsible for the elevated mechanical work requirements of pentapedal walking.

I performed this research in collaboration with Terry Dawson, Rodger Kram, Suzette Rodereda, and Alena Grabowski. We would like to thank Andrew McIntosh, Adam Munn and Koa Webster for their help and the International Society of Biomechanics for helping fund this research.

*J. Maxwell Donelan*

# ISB Dissertation Grant Report 2004

I would like to thank the International Society of Biomechanics for awarding me the ISB Matching Dissertation Grant for 2004. The grant contributed to my data collection and to my ability to attend International Society of Biomechanics' XXth Congress in Cleveland in August 2005.

## Purpose and Background

Precision work is associated with musculoskeletal disorders of the upper extremities, particularly the shoulders (4, 7) that develop as a response to long duration fatigue from light repetitive work (11). Musculoskeletal stress increased with increased precision in tasks (5, 7, 9) that were so short that fatigue was not likely to develop. However, fatigue would be progressive in (2) and accompanied by changes in performance, discomfort, and physiological indices. My dissertation work expands on my earlier repetitive precision work (8, 9, 10) to determine how movement patterns, muscle activation patterns, and performance changes throughout precision tasks that last seven minutes, and how performance on a standardized task is altered after those seven minutes.

Repetitive tapping, with a hand-held probe, between a Home and a precision target was studied earlier. Precision was at three levels and movements in the sagittal or scapular plane were elicited while joint trajectories and electromyographic data were recorded. Changes in both precision and layout elicited changes in joint kinematics (8,9,10) and the EMGs of shoulder muscles (9). Dividing the Home to target movement into two components: a rapid distance covering component (Phase I) and a slower homing in component (Phase II) showed that joint dynamics and the EMG of two shoulder muscles were very different during these two phases. Joint velocities were statistically different ( $P < 0.05$ ) for different levels of precision during Phase II (9). There were monotonic increases in the EMG of the descending trapezius with increased precision, in both phases with such differences reaching statistical significance ( $P < 0.05$ ) during Phase II (9). Movements in the two different planes produced statistically different joint postures and velocities ( $P < 0.05$ ) and movements in the sagittal plane produced higher EMGs in the descending trapezius (16).

## Experimental

In the experiments performed in 2004, layout was set at 2 levels described above. Targets of 19 mm, 10 mm, and 3.2 mm diameter created low, medium, and high precision conditions. A 48 mm diameter target (no precision) was added since work in this condition elicited only a ballistic movement (Phase I). Any fatigue or performance changes in this condition could be attributed to rapid repetitive work, and not precision. Nine participants worked in the sagittal plane only, eleven worked in the scapular planes, and nine worked in both the scapular and sagittal planes.

During Main Tasks participants repetitively tapped between the Home and a single precision target for seven minutes while joint trajectories, and the electromyograms of six muscles were monitored. Each Main Task was part of a Task Unit, which included an Early Discomfort Survey (3) and Early Composite Task, the Main Task, and a Late Composite Task, a Late Discomfort Survey, and a fatigue survey. A measure of motivation was incorporated on the fatigue survey (1). Breaks were provided after each of the Task Units.

Composite Tasks lasted 45 seconds and elicited movements of multiple amplitudes at three levels of precision and in the same movement plane as the Main Task. Participants moved between the Home and a ray of targets that were tapped in a pre-defined order.

## Results and Discussion

People reported significantly greater discomfort after repetitive work than before ( $P < 0.001$ ) and significantly more errors ( $P = 0.043$ ) were made during Composite Tasks after that work. There were small and monotonic, although statistically insignificant<sup>1</sup> increases in Early and Late Discomfort Ratings with increasing Task Unit Number.

Discomfort increased monotonically with increased precision for the high, medium, and low precision conditions and it was significantly greater after high precision than after low precision work. There was also a statistically significant interaction between precision and Task Unit Number ( $P = 0.029$ ). For the high precision condition, Late Discomfort ratings increased greatly with Task Unit Number, whereas ratings for other levels of precision did not increase or increased much less with Task Unit Number. Pre-

<sup>1</sup> Discomfort data is reported for the sagittal plane movements.

cision also statistically impacted motivation ( $P < 0.001$ ) and there was a statistically significant interaction between precision and Task Unit Number on motivation ( $P < 0.001$ ). People were less motivated after performing high than medium or low precision work. The decline in motivation was exacerbated with Task Unit Number for the high precision tasks, whereas it did not decline much, or may have even increased with time for tasks at other levels of precision. Performance during the Late Composite Tasks was not impacted by precision ( $P = 0.712$ ).

In summary, results show that discomfort develops during seven minutes of repetitive tapping and performance does decline after work. High precision tasks had a greater impact than low precision tasks on discomfort and motivation. The strong effect of precision on discomfort and on motivation, and the significant interaction between precision and Task Unit

Number on both discomfort and motivation shows that tasks of different levels of precision are somehow different. The effects of residual discomfort are exacerbated when high precision work is performed, whereas it may not be when medium or low precision work is performed.

Conclusions about the kinematics and muscle activation patterns from the 2004 study are not yet available. However, characterizing joint movement patterns and muscle activation patterns throughout Main Tasks and of joint movements from the Composite Tasks will shed more light on how work during both Phase I and Phase II elicits changes in movements and other metrics of fatigue.

*Kathleen Shyhalla*  
*School of Engineering and Applied Sciences*  
*University of Buffalo*  
*The State University of New York, USA*

## References

1. Ahsberg E. (2000). Dimensions of fatigue in different working populations. Scandinavian Journal of Psychology, 41, 231-241.
2. Bystrom, S., and Fransson-Hall, C. (1994). Acceptability of intermittent handgrip contractions based on physiological response. Human Factors, 36, 158-171.
3. Corlett, E., and Bishop, R.P. (1976). A techniques for assessing postural discomfort. Ergonomics, 19, 175-182.
4. Ekberg, K., Karlsson, M., and Axelsson, O. (1995). Cross-sectional study of risk factors for symptoms in the neck and shoulder area. Ergonomics, 38, 971-980.
5. Laursen, B., Jensen, B.R., and Sjogaard, G. (1998). Effect of speed and precision demands on human shoulder muscle electromyography during a repetitive task. European Journal of Applied Physiology & Occupational Physiology, 78, 544-548
6. Milerad, E., and Ekenvall, L. (1990). Symptoms of the neck and upper extremities in dentists. Scandinavian Journal of Work Environment Health, 16, 129-134.
7. Milerad, E., Ericson, M.O., Nisell, R., and Kilbom, A. (1991). An electromyographic study of dental work. Ergonomics, 34, 953-962.
8. Shyhalla, K. (2003). Wrist and forearm movements while homing in on precision Targets. Proceedings of the 47th Annual Meeting of the Human Factors and Ergonomics Society, Denver, Colorado, September 13-September 17, 2003. Human Factors and Ergonomics Society, Santa Monica, California.
9. Shyhalla, K. (2002). Effects of layout and precision on shoulder musculoskeletal stress during repetitive tapping tasks. Unpublished Master's thesis. University at Buffalo: Buffalo, NY.
10. Shyhalla, K., Paquet, V. and, Drury, C. (2002). Wrist and forearm postures during movements to targets during repetitive precision tasks. Bridging Fundamentals and New Opportunities. Proceedings of the 46th Annual Meeting of the Human Factors and Ergonomics Society. Baltimore, Maryland. Human Factors and Ergonomics Society, Santa Monica, California.
11. Westerblad, H., Bruton, J. D., Allen, D. G., and Lannergren, J. (2000). Functional significance of Ca<sup>2+</sup> in long-lasting fatigue of skeletal muscle. European Journal of Applied Physiology, 83, 166-174.

## ISB Dissertation Grant Report 2003

In June 2003, I was awarded \$2000 by the ISB to assist my research in the stability of acetabular components in cemented hip replacements. I would like to thank the society for this Student Dissertation Award which was of valuable help in the running of my research program.

The money obtained was used to purchase a computer with high specifications which allowed me to carry out my finite element (FE) analysis involving contact elements faster. The computer was also used to capture confidential CT-Scan data from the collaborating hospitals as this process required a stand-alone computer. This enabled me to satisfy the internal regulations related to data protection act and patient confidentiality. This funding was matched by Anglia Polytechnic University for the purchase of 10 synthetic hemi pelvic bones. These will be used for the *in-vitro* testing of cemented reconstructed hemi pelves to validate my FE models.

It has been recognised that the rate of loosening of hip implants increases exponentially 10 years post operatively. With the ageing population who are most prone to hip disorders, the aim of my research is to improve the long-term stability of acetabular components in cemented hip re-

placements. Ct-Scan data of hospital patients with different sizes of acetabula is downloaded into Materialise software which acts as an interface between Ct-Scan data and any FE package. The contours generated are then exported into I-Deas 11.0, FE analysis package, where 3-D anatomically correct of reconstructed hemi pelves are created through a lofting process. Using the FEA package, we are then able to investigate the stress distribution in the cement mantle for hemi pelvic models with different sizes of acetabula and different bone quality.

*In-vitro* tests are carried out on composite synthetic bones obtained from Sawbones Company, to validate the finite element models. These synthetic bones possess material properties comparable to human bone. A biaxial hydraulic mechanical testing machine (Instron 8874) is used for the dynamic testing of the reconstructed hemi pelves. We will make use of a hip simulator that will be able to mimic the gait cycle of a patient having undergone a hip replacement.

*Jean-Marie Steeve Lamvohee  
Bioengineering Research Group  
Anglia Polytechnic University, UK*

# 5<sup>th</sup> World Congress of Biomechanics



Munich, Germany - July 29<sup>th</sup>-August 4<sup>th</sup> 2006



Incorporating  
The 31<sup>st</sup> Congress of the Société de Biomécanique  
The 15<sup>th</sup> European Society of Biomechanics

## First Call for Papers

The Scientific Organizing Committee of the 5th World Congress of Biomechanics is seeking original research and application papers in the following areas:

### Musculoskeletal mechanics

Cartilage  
Disc  
Muscle mechanics  
Tendons and ligaments  
Tissue adaptation and remodeling

### Cellular and molecular mechanics

Cell mechanics  
Cytoskeletal and membrane rheology  
Cell migration and molecular motor  
Mechanotransduction  
Molecular biomechanics  
DNA and protein mechanics  
Microstructural modeling of cells

### Bone mechanics

Bone healing  
Bone as an organ  
Bone remodeling  
Bone tissue  
Osteointegration  
Osteoporosis

### Respiratory mechanics

Airway liquid dynamics  
Parenchymal and whole lung mechanics  
Flow through compliant airways  
Pulmonary cell mechanics  
Whole lung function measurement and control

### Biomechanics in nature

Bionics  
Swimming and flying  
Micro organisms  
Plant biomechanics  
Terrestrial locomotion

### Artificial organs

Artificial kidney and dialysis  
Artificial heart devices  
Artificial circulatory assist devices  
Artificial liver  
Artificial lungs and pulmonary assistance

### Occupational and impact biomechanics

Impact injury biomechanics  
Vehicular biomechanics-safety, impact vehicular guidance  
Ergonomics  
Spine kinematics  
Low back pain  
Occupational disorders, repetitive strain injury  
Rehabilitation mechanics

### Implants for trauma and orthopedics

Hip endoprosthetics  
Knee endoprosthetics  
Wear  
Shoulder endoprosthetics  
Trauma implants  
Implantable telemetry

### Microcirculation and biorheology

Cell-vascular wall interactions and cell adhesion  
Blood rheology  
Angiogenesis  
Glycocalyx  
Microvascular fluid mechanics

### Brain and neural mechanics

Cerebral aneurysms  
Panta Rei  
Imaging  
Cerebro-spinal fluid



### **Musculoskeletal systems and performance**

Gait analysis  
Joints  
Hip  
Knee  
Upper extremity  
Locomotion and falls – mechanisms, injuries and interventions  
Neuromuscular control  
Spine mechanics

### **Cardiovascular mechanics**

Cardiac mechanics and biology  
Cardiovascular function and control  
Tissue adaptation and remodeling  
Coronary circulation  
Arterial or large vessel fluid mechanics  
Heart valves and prostheses  
Vascular wall elasticity  
Mechanobiology of vascular walls and cells  
Vascular implants and devices  
Computational modeling  
Flow measurement and imaging  
Cardiovascular disease

### **General biomechanics**

Bioheat transfer  
Biological mass transport  
Clean room technology  
Flow-structure interactions  
Geriatric mechanics  
Micro-fluidic devices  
Paediatric mechanics

### **Sport biomechanics**

### **Dental mechanics**

Bone implant interaction phenomena  
Bone and periodontal ligament  
Dental implant mechanics  
Dental materials reliability  
Image processing and computer-aided presurgical analysis  
Mechanics and mechanobiology in orthodontics  
Dental device manufacturing and biomechanical reliability  
Numerical modeling in dental biomechanics  
Experimental testing in dental biomechanics

### **Computer-assisted surgery**

Navigation in orthopaedic surgery  
Navigation in neurosurgery  
Robotic systems  
Vascular surgery  
Surgical technologies  
Large vessel tissue and cardiac valve engineering and vascular elasticity  
Platform technologies in tissue engineering

### **Biomaterials**

Characterization of biomaterials  
Endovascular materials

### **Biomechanics of miscellaneous organs**

Soft tissues  
Reproductive systems  
Eyes  
Ears  
Skin  
Urinary tract

### **Computational Biomechanics**

The conference language will be English. Submissions to the Congress will be electronic and should consist of an extended two page abstract.

At least one author of each accepted paper must register for and present the work at the Congress.

For more information please consult the Congress website at [www.wcb2006.org](http://www.wcb2006.org)

### **Important Dates**

Abstract Submission Deadline	January 30 <sup>th</sup> , 2006
Notification of Acceptance	March 15 <sup>th</sup> 2006
Early registration Deadline	May 1 <sup>st</sup> 2006
Congress Dates	July 29 <sup>th</sup> -August 4, 2006



## Upcoming meetings, workshops

### 2005

#### The 9th World Multi-Conference on Systemics, Cybernetics and Informatics

Dates: July 10-13, 2005  
Venue: Orlando, Florida, USA

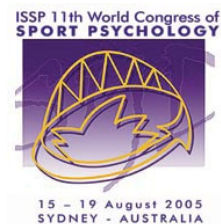
**Information:** See web-site:  
[www.iiisci.org/sci2005](http://www.iiisci.org/sci2005)



#### ISSP 11th World Congress of Sport Psychology

Dates: August 15 – 19, 2005  
Venue: Sydney, Australia

**Information:**  
See website:  
[www.issp2005.com](http://www.issp2005.com)



#### European Society for Biomaterials combined session with European Society of Biomechanics at the 19th European Conference on Biomaterials

Dates: 11-15 September, 2005  
Venue: Sorrento, Italy

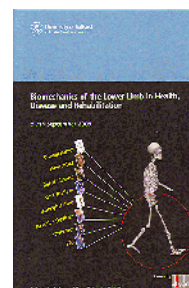
**Information:**  
Professor Elizabeth Tanner, Department of Materials  
Queen Mary University of London  
Mile End Road, London, E1 4NS, UK  
Dr Damien Lacroix, CREB  
University Polytechnica de Catalunya  
Ave Diagonal, Barcelona, Spain



#### 3rd International Conference on "Biomechanics of the lower limb in health, disease and rehabilitation"

Dates: September 5-7th 2005  
Venue: Centre for Rehabilitation and Human Performance Research, University of Salford, England.

**Information:**  
<http://www.healthcare.salford.ac.uk/crhpr/> email:  
[c.j.nester@salford.ac.uk](mailto:c.j.nester@salford.ac.uk)



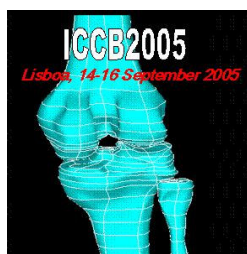
#### II International Conference on Computational Bioengineering

Dates: 14-16 September, 2005

Venue: Lisboa, Portugal

**Information:**

See website:  
[www.dem.ist.utl.pt/~iccb2005/](http://www.dem.ist.utl.pt/~iccb2005/)



#### APCST 2005

#### Asia-Pacific Congress on Sports Technology -

Dates: September 12-14, 2005

Venue: Tokyo Institute of Technology, Japan

**Information:**

E-mail

[Aleksandar.Subic@rmit.edu.au](mailto:Aleksandar.Subic@rmit.edu.au)

[ujihashi@mei.titech.ac.jp](mailto:ujihashi@mei.titech.ac.jp)

See website: [www.astaonline.com.au](http://www.astaonline.com.au)

#### ISB XX

#### International Society of Biomechanics Congress

Dates: August 1-5, 2005

Venue: Cleveland, Ohio, USA

**Information:**

E-mail: [info@isb2005.org](mailto:info@isb2005.org)

See website:

<http://www.ISB2005.org>



#### 11th International ACAPS Conference

Dates: 26-28 October, 2005

Venue: Paris, France

**Information:**

See website: [www.acaps-paris.org](http://www.acaps-paris.org)

**ISPO 2005**  
**Annual Scientific Meeting of the International Society for Prosthetics and Orthotics, Australian National Member Society**



Dates: 2-5 November, 2005  
Venue: Sydney, Australia

**Information:**

See website:

[www.dcconferences.com.au/ispo2005/index.php](http://www.dcconferences.com.au/ispo2005/index.php)

**APB2005**

**The Second Asian-Pacific Conference on Biomechanics**

Dates: 23-25 November, 2005  
Venue: Taipei, Taiwan

**Information:**

Email: Jaw-Lin Wang, [jlwang@ntu.edu.tw](mailto:jlwang@ntu.edu.tw)

**5th World Congress of First International Conference on Mechanics of Biomaterials & Tissues**

Dates: December 11-14, 2005  
Venue: Waikoloa, Hawai'i, USA

**Information:** See web-site:

[www.icmobt.elsevier.com](http://www.icmobt.elsevier.com)

**Canadian Society of Biomechanics Meeting**

Dates: August 16-19th, 2006  
Venue: University of Waterloo, Waterloo, Ontario, Canada.

**Information:**

Email: [callagha@healthy.uwaterloo.ca](mailto:callagha@healthy.uwaterloo.ca)

Email: [sprentic@healthy.uwaterloo.ca](mailto:sprentic@healthy.uwaterloo.ca)

<http://www.csb2006.uwaterloo.ca/>



**2006**



**NASPSPA 2006 Conference**

For this conference, we will join with the American College of Sports Medicine.

Dates: June 1-3, 2006

Venue: Denver, Colorado.

**24<sup>th</sup> Symposium of the International Society of Biomechanics in Sports (ISBS)**

Dates: 14-18 July, 2006

Venue Salzburg, Austria

**Information:**

Email: Prof. Dr. Hermann Schwameder, [harmann.schwameder@sbg.at](mailto:harmann.schwameder@sbg.at)

**3<sup>rd</sup> International Ankle Symposium**

Dates: 1-3 September, 2006

Venue: Dublin, Ireland

**Information:**

[Anklesymposium3@ucd.ie](mailto:Anklesymposium3@ucd.ie)

Munich, Germany – July 29- August 4, 2006  
**V. World Congress of Biomechanics**



**ISB Membership News**

Listed on the following pages are the Society's new members. Membership is growing rapidly, particularly in the student category.

Existing members who have not renewed their 2005 membership have all been sent a reminder notice by e-mail. If you are not sure of your status then login at [www.isbmem.org](http://www.isbmem.org) and check for yourself. Our primary means of communicating with our members now is via e-mail, so please make sure that your e-mail address is kept current.

The ISB Executive Council will meet in Cleveland on the two days prior to Congress2005. Matters planned for discussion during those meetings will shortly be posted on our website: [www.isbweb.org](http://www.isbweb.org). If you would like to see additional matters discussed then by all means let the President or General-Secretary know.

FIRST INTERNATIONAL CONFERENCE ON  
MECHANICS OF BIOMATERIALS & TISSUES

DECEMBER 11-14, 2005  
WAIKOLOA, HAWAII, USA

**Biomechanics**

Dates: 29 July - 4 August, 2006.

Venue: Munich, Germany

**Information:**

Email: Prof. Dr.-Ing. habil.

Dieter Liepsch, [info@WCB2006.org](mailto:info@WCB2006.org)

See website: <http://www.wcb2006.org>

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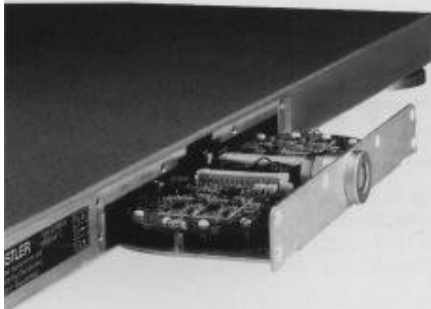
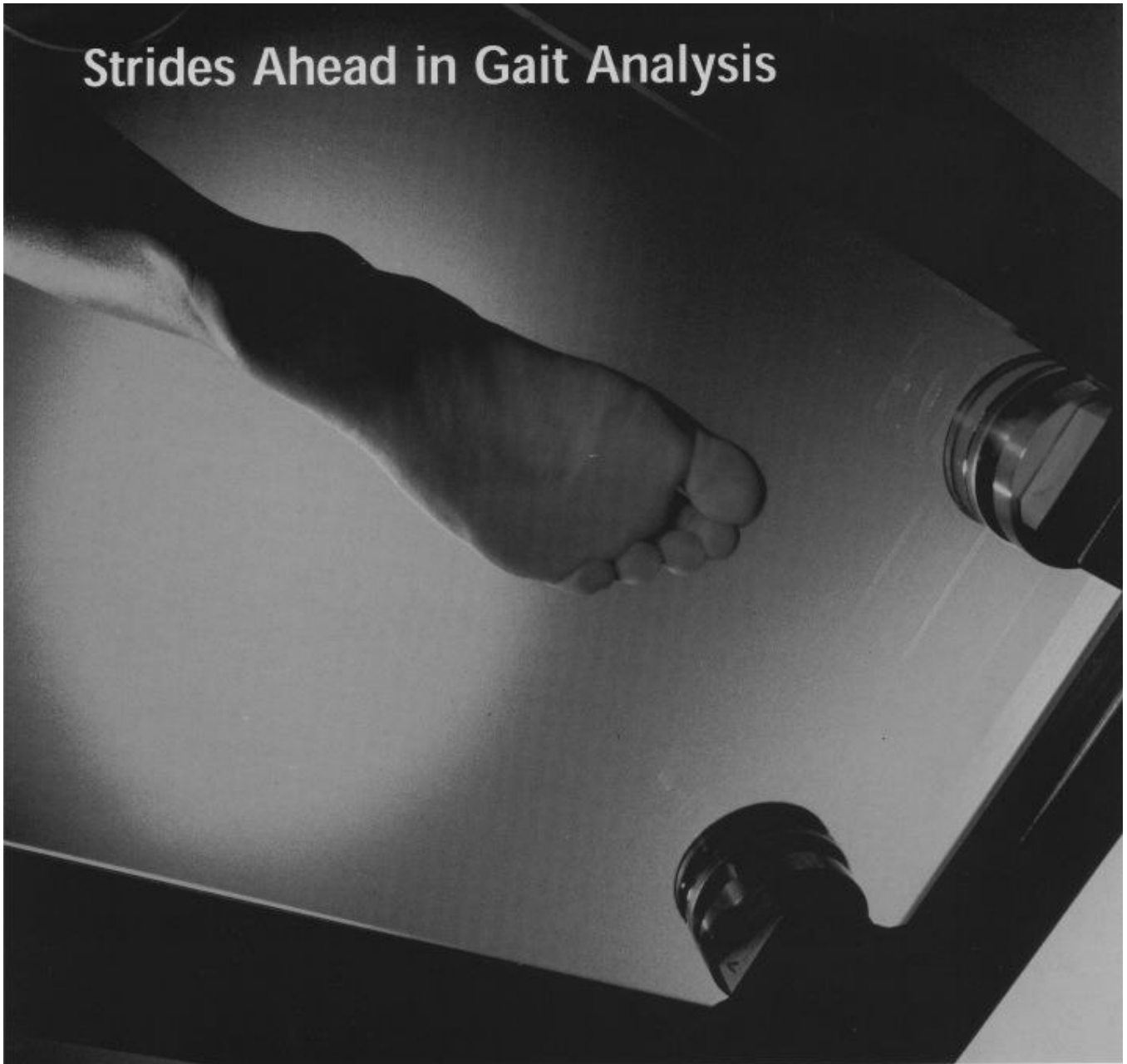
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