



International Society of Biomechanics Newsletter

ISSUE Number 57, FEBRUARY / MARCH, 1995

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AFFILIATE SOCIETIES OF ISB:

American Society of Biomechanics; British Association of Sports Science; Bulgarian Society of Biomechanics; Canadian Society of Biomechanics; China Sports Biomechanics Association; Czechoslovak Committee on Biomechanics; French Société de Biomécanique; Japanese Society of Biomechanics; Korean Society of Biomechanics; Polish Society of Biomechanics; Romanian Comisia de Biomecanica, Inginerie Si Informatica.

ISB News

FROM THE PRESIDENT - Ron Zernicke

As I write this message 1995 is off to a flying start for the ISB. Paavo Komi and Kari Keskinen have informed me that more than 500 abstracts have been submitted to the Scientific Committee of the XVth Congress, which will be held in Jyväskylä in July. That is excellent news, and portends a well-attended and successful Congress. Presumably, by the time you actually read this note in the ISB Newsletter, you will have registered for the meeting and will be in the process of making travel plans.

ISB Technical and Working groups, currently, are occupied with their plans for meetings to be coordinated with the timing of the ISB Congress. The Technical Group on Computer Simulation plans to hold its 5th symposium in Jyväskylä just before the Congress. The Working Group on Functional Footwear has also organized a symposium in Germany. Please see the "Coming Events" section of this Newsletter for specifics about each of these symposia.

On other fronts, Micheline Gagnon (ISB Affiliated Societies Officer) has been communicating with Prof. Skobeleva Inna, Secretary of The Russian Society of Biomechanics. The RSB plans to submit their official application to be an Affiliated Society with the ISB at the Executive Council meeting in Jyväskylä.

Our ISB Past-President, Aurelio Cappozzo has accepted the invitation of the special ISB committee, co-chaired by Micheline Gagnon and Sandra Olney (ISB Education Officer), to be an ISB Distinguished Lecturer in selected countries with ISB-Affiliated Societies. We are pleased that Aurelio has agreed to deliver these lectures, and we hope that this will only be the "first of many" such lectures and interchanges.

Prof. Yuli Toshev, the President of the Bulgarian Society of Biomechanics, recently sent a letter in which he officially thanked the members of ISB and ESB who sent books and journals to The Bulgarian Society of Biomechanics for biomechanics students in the South-West University, Blagoevgrad, Bulgaria. Although other thanks may be given to these people and organization, I, too, wish to give my personal thanks to:

- * Dr. Savio Woo for journals, such as Ann Biomed Eng, Orthop Rev, and J Neuromusculoskeletal Syst.
- * Dr. Gerry Loeb for "Electromyography for Experimentalists".
- * Dr. F. A. Schuind for "Advances in the Biomechanics of the Hand and Wrist".
- * Dr. Aurelio Cappozzo for "Biocomotion: A Century of Research using Moving Pictures."

- * Bertec Corporation for "Biomechanics of Human Movement: Applications in Rehabilitation, Sports, and Ergonomics".

Prof. Toshev assures you that such donations of biomechanics-related literature are greatly appreciated. If any other members wish to contact Prof. Toshev, you may do so via Internet, as he says that email (for the moment) is inexpensive for him, whereas fax and letters are expensive. His e-mail address is:

YTOSHEV@BGEARN.BITNET

In these days of the "Global Village" and the "Information Superhighway" our task of communicating with biomechanists around the world is becoming easier. We need to continue to develop and nurture these links among ISB members and affiliated members. I see this as one of the exciting opportunities for the next several years.

FROM THE TREASURER - Graeme A. Wood

Very soon an important package will be mailed from this office to those members who are currently financial. This package will contain (i) voting papers for the 1995/96 ISB Executive Council elections, (ii) a booklet prepared by the ISB committee on Standards and Terminology, and (iii) proposed constitutional changes to enable Incorporation of the Society. Please give this package your serious attention as it has the potential to shape the future of your Society in many important ways.

Forgotten Something ?

Are you one of the members who has not yet paid 1995 dues?



Unfortunately your Society can't operate on good intentions alone!

Mail or Fax your Renewal Form back to the Treasurer Today (If it's hopelessly buried on your desk then ask for a new copy)

If you are one of the 'forgetful' who have yet to renew their ISB Membership the address label on the envelope that brought you this Newsletter will have an 'X' at the top right-hand corner. I look forward to hearing from you very soon.

XVth CONGRESS UPDATE

XVTH CONGRESS OF THE INTERNATIONAL SOCIETY OF BIOMECHANICS

Hosted by the University of Jyväskylä
Finland, July 2-6, 1995.



The review process of the abstracts submitted for the XVth Congress of the International Society of Biomechanics (ISB XVth) have been completed. A notification to authors was sent on March the 8th and we hope that by now everybody has received the respective letter. The message informs you whether the paper has been accepted in its present form or accepted with revision or rejected. Enclosed please find also the Registration Form for the ISB Tutorials to be held at the Congress site on July the 2nd just prior to the opening of the ISB XVth. In case you haven't got the message yet, please contact the Congress secretary, Ms Multasuo, for more information (see address below).

REGISTRATION

Please note also that the final inclusion of any paper in the program will depend upon receipt of the full registration fee from the presenting author by April 15, 1995. The early registration fee for the participants is FIM 2200 and FIM 1700 for the students. From April 16 to June 1 the registration fee is FIM 2500 for all participants including students.

TECHNICAL EXHIBITION

A technical exhibition will be arranged on the Congress site. It will be open to manufacturers of sports, medical and scientific equipment, to pharmaceutical and software companies and scientific publishers. Please contact Ms Multasuo for the exhibitor's kit. Congress information have been delivered to manufacturers who participated the ISB XIV in Paris 1993 and 2nd World Congress of Biomechanics in Amsterdam 1994. There will be more information for you after a short while.

SCIENTIFIC PROGRAM

The scientific program will include oral and poster presentations and the authors have indicated their preference. More papers have been submitted for podium presentations. In order to balance the two forms of presentations the final decision will be made by the organizer. In general no more than one oral paper can be presented by a single participant. In addition the Scientific Committee has decided to readjust the scientific program to allow more visibility for poster sessions. All abstracts accepted for presentation will be published in the Book of Abstracts in equal forms provided that the registration fees as indicated above will be received at the latest by April 15. The final form of the presentation will be informed as early as possible in May.

HIGHLIGHTS

1. Invited highlights:

Wartenweiler Memorial Lecture: David A. Winter (Waterloo, Canada) "Total Body Kinetics: Our Window into the Synergies of Human Movement"

Muybridge Lecture: Savio L-Y. Woo (Pittsburgh, USA) "Ligament Biomechanics - Historical Prospectives and New Frontiers"

Presidential Address: Ronald F. Zernicke (President of ISB) "Functional Adaptation of Bone"

2. Invited keynote speakers

Roger Bartlett (Manchester, England)

"Current Issues in Mechanics of Athletic Activities"

Roger Enoka (Cleveland, USA) "Neural Adaptations with Chronic Physical Activity"

Tetsuo Fukunaga (Tokyo, Japan) "Muscle Architecture and Muscle Function in Humans"

Stuart McGill (Waterloo, Canada) "Biomechanics of Low Back Injury"

Guenter Rau (Aachen, Germany)

"Noninvasive Approach to Motor Unit Characterization: Membrane Dynamics, Muscle Structure and Neural Control"

With Best Regards,

Paavo V. Komi, Congress Chairman
Keijo Hakkinen, Congress Vice-Chair
Kari L. Keskinen, Secretary General

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For further Congress information contact:

XVth ISB Congress Secretariat
Ms Tiina Multasuo
University of Jyväskylä
Jyväskylä Congresses
P.O.Box 35
FIN-40351 Jyväskylä
FINLAND
Tel: + 358 41 603621
Fax: + 358 41 603621
E-mail: multasuo@jyu.fi



ATTENTION ALL BIOMECHANISTS GOING TO THE ISB CONGRESS IN JYVASKYLA!!

As it is getting near to Registration Day for the ISB Congress, you should be considering attending the fine tutorials arranged for the day prior to Congress, SUNDAY, JULY 2, 1995.

The tutorials are as follows:

TUTORIAL 1: 9:00 am to 12:00 noon
3-D RECONSTRUCTION OF HUMAN MOTION: THEORETICAL ASPECTS
Aurelio Cappozzo and John P. Paul and Others

The topics include:

- One hundred years of measurement of human motion
- Close range photogrammetry: experimental errors and artefacts - Estimation of bone position and orientation during movement using clusters of markers
- Anatomical landmark and frame standardization

TUTORIAL 2: 9:00 am to 12:00 noon
SPORT SHOES: BIOMECHANICS, MEASUREMENT AND DESIGN
Martyn Shorten and Joe Hammill

The topics include:

- Fundamentals of shoe biomechanics: traction, cushioning and stability - The influence of footwear on kinetics, kinematics, athletic performance - In vitro and in vivo laboratory methods for measuring shoe characteristics and influence on performance
- Implementation of biomechanical principles in shoe designs

TUTORIAL 3: 2:00 to 5:00 pm
3-D RECONSTRUCTION OF HUMAN MOTION - PRACTICAL ASPECTS
Aurelio Cappozzo and John Paul and Others

The topics include:

- Motion analysis laboratory architecture
- Experimental set-up spot checks
- Problems in terminology
- Marker placement
- Data pre-processing
- Data sharing: the CAMARC experience

TUTORIAL 4: 2:00 to 5:00 pm
RECORDING, SIGNAL PROCESSING AND ANALYSIS OF ELECTROMYOGRAPHY
Moshe Solomonow and Richard Baratta

The topics include:

- Essential factors involved in recording EMG signals
- Signal processing of EMG
- Data analysis using EMG
- Reporting EMG

How much does it cost?

.100 FIM per tutorial until April 15, and thereafter 120 FIM
ISB Affiliate members from Bulgaria, China, Czeck Republic Poland and Romania half price

How can I register and pay?

Fill in the sheet included with your paper acceptance and pay with your Registration

or

fill in the following and FAX it to Tiina Multasuo

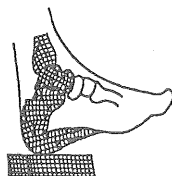
I want to attend tutorial	1	2	3	4
Please charge FIM _____ to my				
VISA ___ MASTERCARD ___ EUROCARD ___				
Card number: _____				
Expiry Date _____ / _____				
Signature: _____				
Name: _____				
Mailing Address: _____				
TEL: _____ FAX _____				
E-mail _____				
FAX to: +358 41 603 621				
Ms. Tiina Multasuo				
JYVASKYLA CONGRESSES				
If either method of payment presents problems for you then send a message to register, and we can arrange for your payment on site.				

WORKING GROUP ON
FUNCTIONAL FOOTWEAR

SYMPOSIUM on FOOTWEAR
BIOMECHANICS

June 28-30, 1995

Deutsche Sporthochschule, Cologne, Germany



The second Symposium of the International Society of Biomechanics Working Group on Functional Footwear will be held at the Deutsche Sporthochschule, Cologne, Germany, from June 28-30, 1995.

The primary aim of the ISB Working Group is to provide a forum for those interested in biomechanical aspects of clinical, athletic and other kinds of functional footwear. The Symposium will build on the successful format of the first Symposium, with extended seminar presentations by invited speakers and opportunities for extended discussion of important issues in footwear biomechanics. Approximately half of the Symposium will be devoted to original papers.

The Symposium is intended to fit conveniently into the schedules of those attending the ISB Congress in Jyväskylä, Finland (July 2nd - 6th). Flights are available from Cologne, Duesseldorf or Hamburg to Helsinki.

PROGRAMME

Welcome Reception	June 28th
Evening Scientific meetings	June 29th-June 30th
Bierkeller Social Event	June 30th, evening

AREAS OF INTEREST

- the influence of footwear on the kinematics and kinetics of human movement.
- the influence of footwear and footwear design on human performance - application of biomechanics research to the design of clinical and athletic footwear
- the role of footwear in the prevention and treatment of diseases of the lower extremity
- the role of footwear in the prevention and treatment of athletic injuries
- influence of footwear on the etiology, occurrence and frequency of athletic injuries
- the relationship between shoe biomechanical properties and human subjects' perceptions
- methods for laboratory and field measurement of a shoe's biomechanical properties

The official language will be English.

ACCOMMODATION

Accommodation in one of the given hotels should be made directly with the local organisers in Cologne, as we negotiated discounted rates for the Symposium participants. On-campus accommodation will be allocated on a first come first served basis, with student applications preferred.

Accommodation costs:

	single	double	
hotel A	150,-	100,-	per person per night
hotel B	200,-	140,-	per person per night on campus
		120,-	per person for all 3 nights

(prices are given in German Marks)

The hotel rates include a breakfast buffet. The rate for on campus accommodation does not include breakfast. Note that the on campus rate is the total for all three nights. Even if you will stay only one night we have to charge you the total amount of 120,- DM.

Registration fees:

	earlybird before May 5	normal after May 5	on-site
participants	150,-	175,-	200,-
students	120,-	150,-	200,-
companions	50,-	60,-	70,-

Registration for accompanying persons consists of tickets to social Events only.

The most inexpensive and convenient way for both you the participant and the organisers to pay your bill is your credit card. Give us:

1. the credit card company (VISA, Diner's Club, American Express, Mastercard and Eurocard are welcome)
2. the card number
3. the expiration date
4. the billing address
5. the amount of money you have calculated to be paid.
6. your arrival and departure dates
7. the hotel category you want to stay in.

Send this information to:

Dr. Axel Knicker
German Sports University Cologne
Institute for Athletics and Gymnastics
Carl Diem Weg 6
50927 Cologne
Germany
or by fax +49 221 4973 454
or email: turn_knick@rz.dshs.uni-koeln.de

Martyn R. Shorten, Ph.D.
Coordinator, ISB Working Group on Functional Footwear
EMAIL 73700.263@compuserve.com
TEL # (USA) 503 774 7855
FAX # (USA) 503 774 7868

Affiliate society news

An Open Letter from the President of
THE BULGARIAN SOCIETY OF BIOMECHANICS
Professor Yuli Toshev.

The Bulgarian Society of Biomechanics, taking into account the discussions during the Executive Council Meeting of ISB and the General Assembly of ESB in Amsterdam in 1994, makes a request to all members of ISB and ESB as well as their associated Societies of Biomechanics, Institutes and Departments working on Biomechanics, for material and technical support. This assistance will be very helpful, both for education and research in the field of Biomechanics in Bulgaria and may consist of:

1. Used or new literature for the undergraduate and the postgraduate students at the Department of Biomechanics, South-Western University, Blagoevgrad, in the field of:
 - Biomechanics of motion
 - Biomechanics of bone-joint-muscular systems
 - Prosthetic and orthotic devices
 - Biomechanics of sport
 - Dynamics and rheology of cardio-vascular system
 - Methodology (Experimental methods and devices; simulation)
2. Used or new basic courses on: Mathematics, Physics, Mechanics, Anatomy, Physiology, Biology, Computer Sciences (hardware and software)
3. Used or new Journals (after 1990)
 - Journal of Biomechanics
 - Annals of Biomedical Engineering
 - Journal of Electromyography and Kinesiology
 - Mathematical Biosciences
 - Journal of Sport Biomechanics
 - Biomedical Engineering
 - Bioreology
4. Used or new Proceedings of the:
 - Congresses of ISB, ASB and ESB
 - World Congresses of Biomechanics
 - North American Conferences on Biomechanics
 - French Society of Biomechanics
 - Biomechanics Seminars
 - NATO ISI Series

5. Used devices: computers, peripheral devices, software products, measuring devices in the field of biomechanics of motion, cardio-vascular measuring systems, devices for neuromuscular and bioreology investigation.

The printed matter (books, journals, proceedings etc.) can be sent to:

Prof. Yuli Toshev
Bulgaria, Sofia 113, P.O. Box 89

The Bulgarian Society of Biomechanics takes on the responsibility for all Customs clearances for the packages including used or new apparatus and devices. An accompanying letter is necessary to be enclosed however, stating the following:

"The donation is granted to the Bulgarian Agency for International Assistance and is destined to the Department of Biomechanics, South-Western University, Blagoevgrad."

The address of the Agency is:
Agency for International Assistance
1, Vrabcha Str. 1000 Sofia, Bulgaria
Tel: +359.2.88 19 51/297, 80 33 28
Fax: +359.2.88 50 39

All those wishing to help us can make a previous contact with us using the following addresses:

Prof. Yuli Toshev
Sofia 113, P.O. Box 89, Bulgaria
E-mail: ytoshev@bgearn.bitnet
Fax: (359.2) 70.20.56; Tel: (359.2) 72.52.80

Thank you in advance for the help to about 150 students on biomechanics in the South-West University, Blagoevgrad, Bulgaria.

Yours sincerely,

Professor Yuli Toshev
President of the Bulgarian Society of Biomechanics

ISB PUBLICATIONS

The following Society publications can be obtained at the special member rates shown by writing to the person indicated with each item.

BOOK OF ABSTRACTS, XIVth Congress of the International Society of Biomechanics.

Price: 550 FF plus postage

Supplier: Professor S. Metral
Explorations Fonction. du Systeme Nervuux
C.H. Bicetre, 78 Avenue du General Leclerc
94275 Kremlin Bicetre, FRANCE
Fax: (33.1) 45.21.27.14

BOOKS OF ABSTRACTS, XIIth and XIIIth Congresses of the International Society of Biomechanics.

Price: \$AUS 40 plus postage (\$AUS40 airmail) ea.

Supplier: Graeme A. Wood
Department of Human Movement
The University of Western Australia
Nedlands, WA 6009, AUSTRALIA
Fax: +61 9 380-1039

BIOMECHANICS XI-A and XI-B, Proceedings of the XIth Congress of the Intn'l. Society of Biomechanics.

Price: 200 Dfl (includes both volumes and postage)

Supplier: Peter Hollander
Faculty of Human Movement Sciences
Vrije Universiteit
van de Boechorststraat 9
1081 BT Amsterdam
THE NETHERLANDS
Fax: +31-20-6442043

BIOLOCOMOTION: A CENTURY OF RESEARCH USING MOVING PICTURES, edited by A.Cappozzo, M.Marchetti and V.Tosi (ISB Book Series-Volume 1; Hard-bound, 356 pages, 180 b&w and 7 colour figures).

Price: \$AUS 65 plus postage (\$AUD 20 airmail)

Supplier: Graeme A. Wood (address as above)

SECOND WORLD CONGRESS OF BIOMECHANICS ABSTRACT BOOKS (Vols I & II)

Price: NLG 100 (both vols including postage)

Supplier: SWCB Office, Biomechanics Section,
Institute of Orthopaedics
University of Nijmegen
P.O. Box 9101
NL-6500 HB Nijmegen
THE NETHERLANDS
Fax: +31-80-540555

EDITOR'S NOTE

This Newsletter is published quarterly: February-March (Spring); May-June (Summer); August-September (Autumn), and November-December (Winter). Deadlines for material and articles are the first day of each first named month, and the Newsletter is mailed to members early in the second named month.

Members can submit *Letters, Special Articles, Affiliate Society News, Laboratory Features, Reports, or Announcements of Meetings, Conferences, and Jobs Available*. Also, *Short Abstracts* from biomechanics society meetings and *Thesis Abstracts* can be published. In special circumstances a complete edition of the Newsletter can be devoted to the publishing of a Society's "Proceedings".

Submitted material must be in letter-quality print and computer scannable, or on a computer disk as a text-only file, and in English. Graphics or complex equations must be in camera-ready art form, and photographs must be black and white.

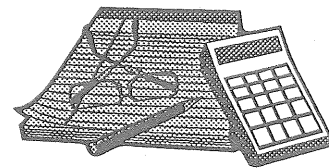
Society abstracts should not be more than 250 words in length. They should be submitted with full details of the conference, and accompanied by any conference or society logos which could be printed as well.

Thesis abstracts should be submitted with full details of:
Title, Student's Name, Department, Name of Degree and Conferring Institution, together with Supervisor's Name.

Thesis abstracts should not be more than one Newsletter page in length.

UPDATE FROM THE ISB SUB-COMMITTEE ON STANDARDIZATION OF JOINT COORDINATE SYSTEMS

This subcommittee has now published in booklet form its *Recommendations for Standardization in the Reporting of Kinematic Data* together with a reprint of earlier material prepared by the ISB Committee for *Standards & Terminology on Quantities and Units of Measurement in Biomechanics*. A copy of this booklet will shortly be mailed to all financial members of the Society.



Special feature articles

BIOMECHANICAL DATA - HOW SHOULD THEY BE DISPLAYED?

by

Brian L. Davis, Ph.D. and Amy C. Courtney, Ph.D.

Department of Biomedical Engineering
Cleveland Clinic Foundation

A seminar in our department recently focused on methods of data presentation. The speaker (from our Department of Biostatistics) urged us to strive for certain goals when displaying data and recommended a book entitled "The Visual Display of Quantitative Information", written by Edward Tufte. In this book the author suggests that graphical displays should:

- a) show all the data (i.e., not just bar graphs showing means for different conditions)
- b) induce readers to think about the data (rather than flashy patterns)
- c) avoid data distortion
- d) present many numbers in a small space
- e) make large data sets coherent
- f) encourage the eye to make comparisons

- g) reveal both a broad overview and fine detail
- h) serve a clear purpose
- i) be closely integrated with statistical and verbal descriptions of the data.

One of the early workers in biomechanics--Etienne Jules Marey--was high on Tufte's list of outstanding contributors to the development of graphical methods. Marey's data detailing the movement patterns of horses, lizards and starfish as well as his displays of the history of royalty and a Paris-Lyon train schedule are examples highly regarded by Tufte. Marey, in turn, was impressed by the work of Charles Minard (1781-1870) who depicted the fate of Napoleon's army in Russia (Figure 1). Beginning at the left, the thick band shows the size of the army at each step of the journey. Note how thin the band

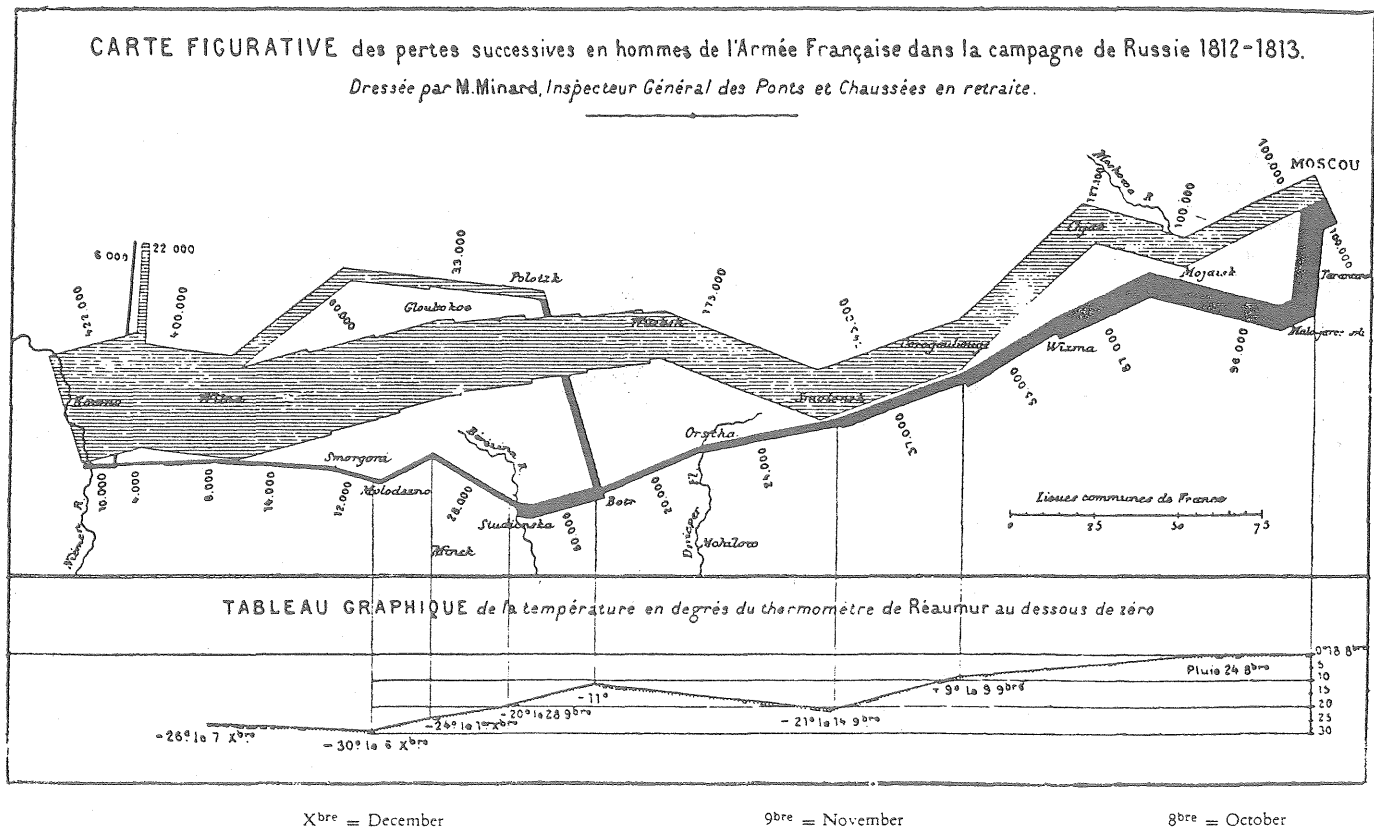


Figure 1

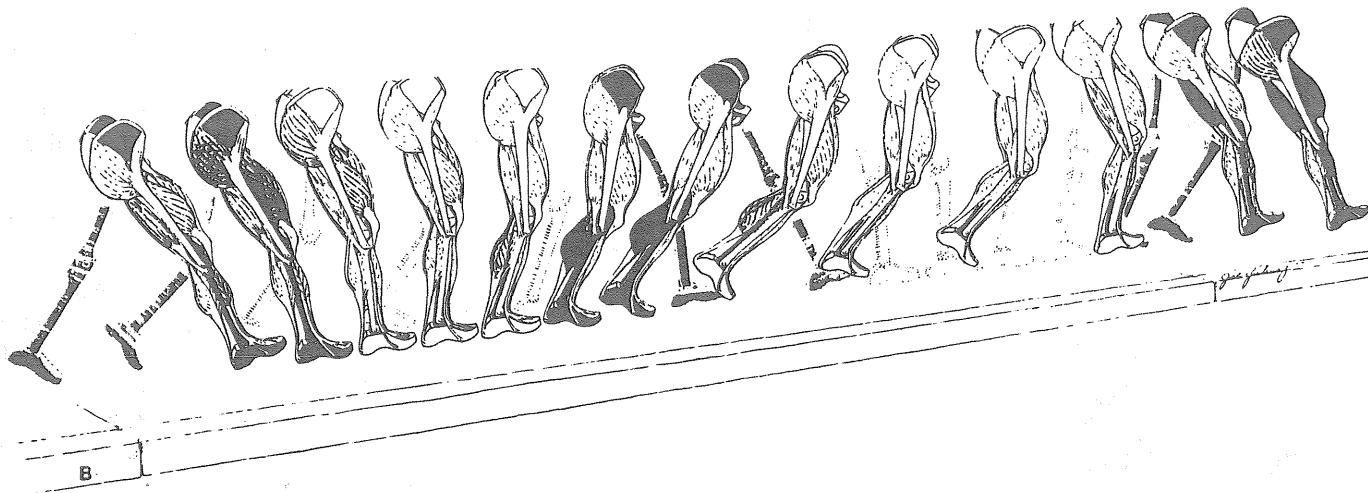


Figure 2 (from Inman, Ralston & Todd, 1981)

is when the army returned—only 10,000 of the original 422,000 soldiers survived! Six variables are plotted: the size of the army, its location (two dimensions), direction of movement, the temperature, and dates corresponding to certain locations. It has been described as perhaps the best statistical graphic ever drawn.

How do we shape up in biomechanics? Well, we have taken a "first step" in choosing graphical displays that meet many of the requirements listed above. Other readers are welcome to select their "top five" selections and send them in to the newsletter. In compiling our selection, two additional factors we considered were:

- (i) How unusual is the idea being presented, and
- (ii) What significance does the graphical display have in biomechanics?

Figure 2 is remarkable in that it gives an immediate visual display of muscle activity during gait (Inman, Ralston and Todd, 1981). It shows anatomical locations of muscles, how vigorously they act during each part of the walking cycle, as well as kinematic information. With this information one could "look deeper" and get some idea of concentric and eccentric muscle activity.

Figure 3 (McMahon, 1984) showing the length-tension relationship for muscle was selected for the following reasons: (i) It has stood the test of time and remains a fundamental concept in biomechanics, (ii) It combines both experimental and anatomical information, and (iii) The anatomical details showing actin and myosin serve to give an understanding of why the curve is shaped the way it is. Still on the topic of muscle, Figure 4 (Zajac and Gordon, 1989) shows that gastrocnemius cannot be simply described as a knee flexor and foot plantarflexor. This graphic condenses considerable information into a small area. The reader

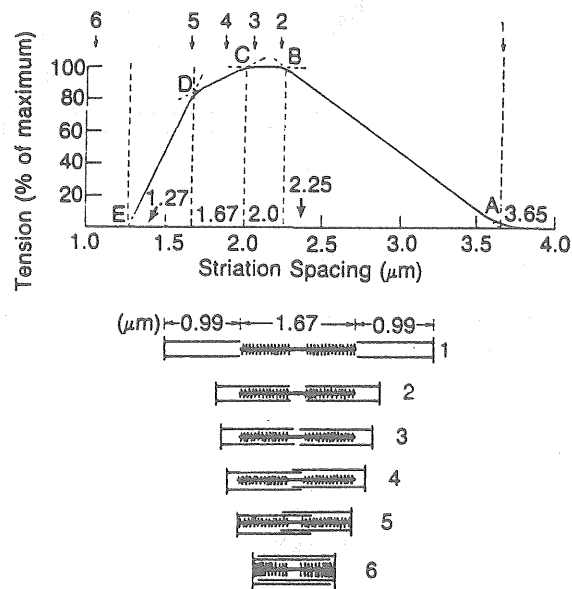


Figure 3 (from McMahon, 1984)

can determine the effects caused by changing the relative lever arms at the knee and ankle, the effects caused by different postures and what combinations of ankle and knee motion are possible. This graph scores high in being "innovative" in biomechanics.

One of Tufte's suggestions was that a display should reveal both a broad overview and fine detail. Figure 5 (Hayes, 1991) does just this. While the data being displayed are more descriptive than quantitative, no one can dispute the insight that a presentation such as this gives. This, and similar diagrams showing the breakdown of muscle from gross organs to muscle filaments, serve

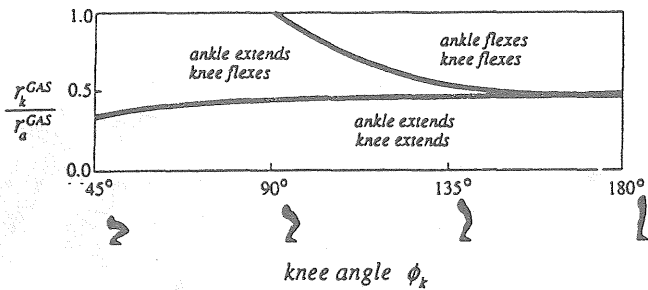


Figure 4 (from Zajac & Gordon, 1989)

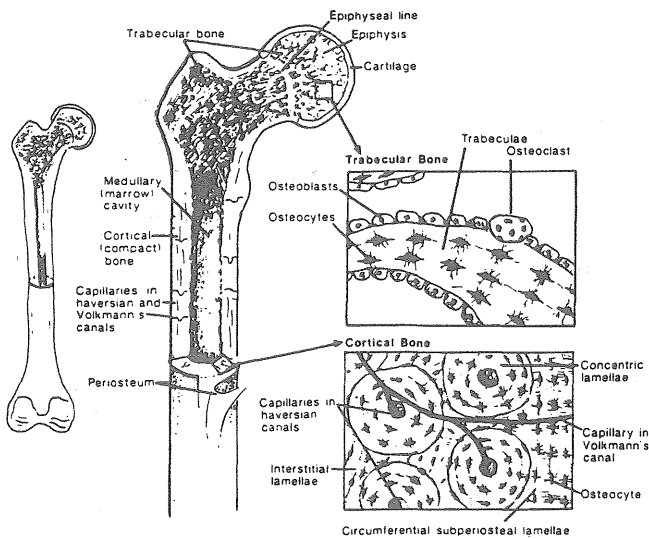
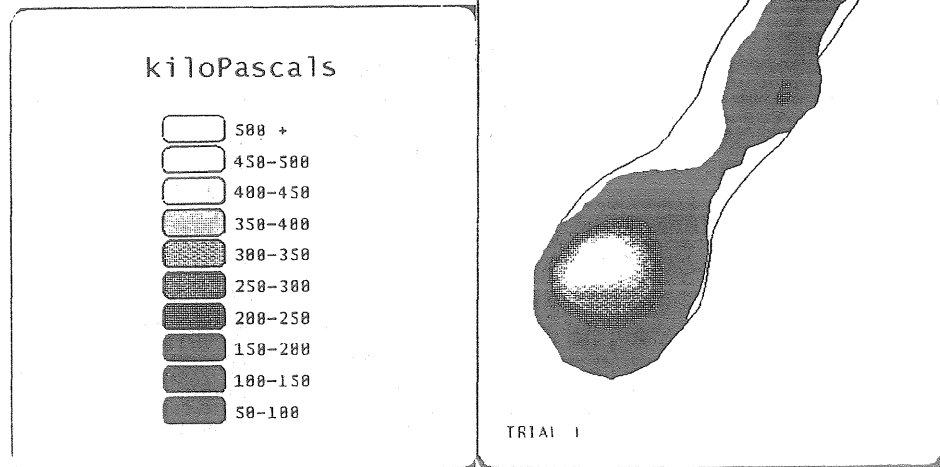


Figure 5 (from Hayes, 1991)

to link biomechanists interested in functional anatomy to those dealing with basic physiology.

Our last Figure is one that is graphical in nature. It is taken from the work of Cavanagh, Simoneau and Ulbrecht (1993), and shows a pressure distribution beneath the foot of a diabetic patient. The number of data points that are used in these pressure maps is considerable—in the same way that contour plots showing elevation above sea level are based on many measure-

Figure 6
(from Cavanagh,
Simoneau &
Ulbrecht, 1993)



ments. In this particular case a reader is able to relate the picture to footprints commonly seen when walking barefoot across a bathroom floor. Note that the absence of toe information, together with a "hump" in the midfoot region, leads one to suspect that some diabetic feet may be very different to "normal" feet.

In summary, it is possible for a graphical display to be accurate and visually appealing. While it might not be possible for these displays to be generated at the click of a mouse button, it may be well worth the extra effort. Let's see what we can produce at ISB '95!

- Cavanagh, P.R., Simoneau, G.G., Ulbrecht, J.S. (1993) Ulceration, unsteadiness, and uncertainty: the biomechanical consequences of diabetes mellitus. *J Biomechanics* 26, Suppl 1, 23-40
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- Inman, V.T., Ralston, H.J., and Todd, F. (1981) *Human Walking*, Williams and Wilkins, Baltimore/London.
- McMahon, T.A. (1984) *Muscles, Reflexes, and Locomotion*, Princeton University Press, Princeton, NJ.
- Tufte E.R. (1983) *The Visual Display of Quantitative Information*, Graphics Press, Box 430, Cheshire, Connecticut, 06410.
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Birdy's Corner

LS- "Let's be careful out there"

LS (least-squares) fitting of measured data to a function is a common problem in many areas of science. It is also one of the most used and abused methods in research today. Many powerful and easy to use statistical packages are now available for the desktop computer and these can be very useful for the analysis of our data; however, it has also clearly increased the the possibility of misuse of statistics. I extracted the following quote by an eminent statistician writing in the journal *Biometrics* recently.

Perhaps one of the most worrying features of present-day scientific research is the extent to which complex statistical procedures have been made available to research workers by statistical program packages in the absence of adequate guidance for their use.

There are many computer packages which offer least-squares curve fitting of different types of functions. Also, some packages even allow the user to define their own functions which they wish to fit. My intent here is not to compare the performance of these different packages; but, rather to point out they often do not "fit" your problem and thus should be used with extreme caution. In this note I will deal with only one of the methods - LS fitting of straight lines.

QB's Problem

QB (Quick Bob) finds a note from his boss (number 1 or just N1 for short) on his desk with the following information.

I have collected the following data: (1,1), (2,5), (5,3), (7,5) with weights at each data point of (1,10), (2,5), (3,2) and (4,1). Give me a least-squares straight line fit to these data. I would like to see the results when I return from lunch.

Now, what to do? First, QB plots these data points (a good beginning). QB concludes from this plot that it does not seem unreasonable to fit a straight line through these points; but, of course one must have some reason for using a straight line fit—here QB was told to fit the data to a straight line so fortunately he does not need to justify a straight line approximation. Also, he was told to use a LS fit and fortunately again, QB took a course in statistics earlier and remembers that ordinary linear regression can be used to obtain a LS fit to a straight line. Things are looking promising now. But, what about the data weights at each point. QB assumes that these are the inverse of the variances in x and y at each point. Actually N1 and QB had been looking at some image data the day before and N1 had mentioned to him the idea of weighting the

measured coordinates according to the inverse of their variances; i.e. the smaller the variances the less our uncertainty. Now to the computer...input the data and...Upphs! There is a weighted LS fit option available but it allows for errors in only one of the variables. QB quickly checks his other statistical program packages...nothing and then finally digs out his old statistics textbook...nothing again. Yes, QB, the good news is that you have defined the problem; but, the bad news is that none of your statistical packages can estimate the parameters for the errors in both variables problem $Y_e:X_e$ LS model (and time is passing...N1 will be back soon). QB begins to panic!

QB's Compromise

QB calms himself and assesses his situation quickly—It does not seem possible that I can solve this problem myself and also seems very unlikely that I will be able to find an existing computer solution before N1 returns. Of course QB wishes to keep his job so he quickly decides on his course of action. Why don't I perform a $Y_e:X$ LS (errors in Y -variable only), a $X_e:Y$ LS (errors in X -variable only) then take the average of the two results — this should be close, right? QB now feels a little better, enters the data into his favorite statistical program and out comes the following plots (fig. 1) which he will show to N1 when he returns. However, QB is still rather uneasy about his "quick-and-dirty" solution.

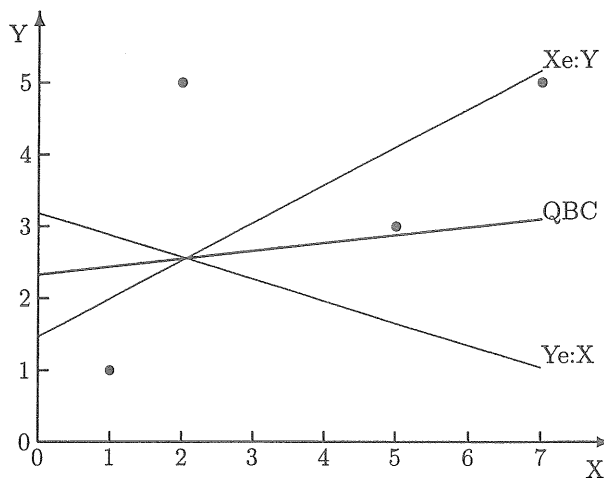


Figure 1. $Y_e:X$ —LS fit to errors in Y -variable only, $X_e:Y$ —LS fit to errors in X -variable only, QBC—QB's compromise (average).

It can be shown, that under quite ordinary conditions the estimated parameters obtained for $Y_e:X$ LS and $X_e:Y$ LS do not even bound the parameters obtained from $Y_e:X_e$ LS (look at fig. 2)! This certainly makes QB's compromise suspect to say the least.

Weighted LS Fitting of Straight Lines

Simply stated I want to find parameters a, b in the straight line equation: $y = a + bx$. I will only consider the case $Y_e:X_e$ LS; i.e, measurement errors in both variables; since the other cases are covered in most statistical textbooks. Assume a set of data pairs $(x_i, y_i), i = 1, \dots, N$ with weight-

ing factors wx_i, wy_i for each data point. The weighting factors should reflect the uncertainty in x_i, y_i ; thus, one usually defines $wx_i = 1/sx_i^2, wy_i = 1/sy_i^2$, where sx_i, sy_i is the standard deviation of x_i, y_i . Clearly, large (small) weights reflect high (low) confidence in the accuracy of a measurement. It can be shown that the weighted LS solution for straight line fits to errors in both variables can be obtained by minimizing the following function:

$$S = \sum_{i=1}^N [wt_i(v_i - bu_i)^2]$$

where,

$$wt_i = \frac{wx_i wy_i}{wx_i + b^2 wy_i}, \quad u_i = x_i - \bar{x}, \quad v_i = y_i - \bar{y}$$

and

$$\bar{x} = \frac{\sum_{i=1}^N wt_i x_i}{\sum_{i=1}^N wt_i} \quad \bar{y} = \frac{\sum_{i=1}^N wt_i y_i}{\sum_{i=1}^N wt_i}$$

Once the b is found which minimizes S then $a = \bar{y} - b\bar{x}$. It is important to note that the slope, b , appears both in the numerator of S and in the denominator as part of the "effective" weight, wt_i . This makes the problem nonlinear in b and in general requires some iterative procedure to solve for the slope, b . Indeed this is where things have often gone astray in the past—approximations, nonexact methods, slow convergence, etc.

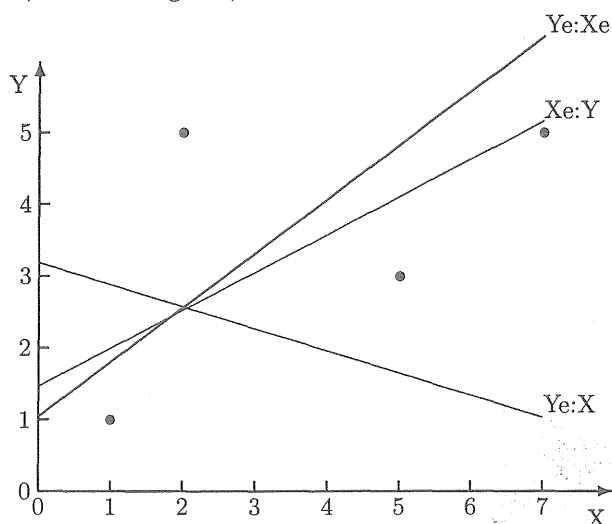


Figure 2. Ye:X—LS fit to errors in Y-variable only, Xe:Y—LS fit to errors in X-variable only, Ye:Xe—LS fit to errors in both variables (the correct solution).

Let's take a closer look at S before venturing into the nonlinear morass. First, an important observation is that a does not appear in S thus we may be able to do some sort of search for the minimum of S in one-dimension (e.g. Brent's method). In general one-dimensional searches are much easier to perform than multi-dimensional searches (the curse of dimension). However, before applying a one-dimensional search one must know something about the characteristics of the function S . I have spent considerable time investigating these rational quadratic polynomials in b and it seems quite clear that one-dimensional

search methods are appropriate for this problem (apparently this simple and fast approach has been overlooked in the past). Again, a complete PASCAL program with test data and references is available via FTP (FTP address: ftp.ki.se//pub/outgoing/ISB02.ZIP) for you to use as you see fit.

It should now be clear that QB's compromise was inappropriate for this problem since the Ye:Xe LS solution is quite different. In general, ordinary LS straight line fitting, Ye:X (Xe:Y), is appropriate only if $1/sx_i^2 \ll 1/sy_i^2$ ($1/sy_i^2 \ll 1/sx_i^2$).

Epilogue

QB's salary raise was not as much as he had hoped for the following year. You see, the data really wasn't image data but was some coded values which N1 was using for estimating salary raises. Had QB used the correct model (errors in both variables) he would have gotten a more favorable salary raise.

I have made a short list of what I call *Five easy ways to fail at statistical analysis*

1. Avoid graphical displays of your data—"What a waste of time, I know what my data looks like".
2. Force your data to fit into the options available in your favorite statistical packages—"If the analysis I wanted to do isn't there then I will just choose something close".
3. Assign all statistical analysis to graduate assistants or your co-authors—"I have more important things to do".
4. Never consider taking a course in statistics—"I repeat, I have more important things to do".
5. Avoid statisticians and places where they are known to frequent—"They might want to see my data".

Erratum (for M&M's)

Unfortunately, there were errors in the pseudo-code for the estimation of the mean and median frequencies; although the computer code in ISB01.ZIP was correct. Please make the following corrections to PROCEDURE MMF on page 8.

```
replace
  RTR(i1, i2, S, Integral1)
by
  RTR(i1, i2, F, S, Integral1)
replace
  RM1 (i1, i2, S, Integral2)
by
  RM1 (i1, i2, F, S, Integral2)
replace
  fMedian = (HalfArea - Area)/Slope + f(k - 1)
by
  fMedian = (HalfArea - PrevArea)/Slope + f(k - 1)
```

Th-th-tha-that's all folks!

Announcements

THIRD INTERNATIONAL WORKSHOP ON ANIMAL LOCOMOTION 1st ANNOUNCEMENT AND CALL FOR ABSTRACTS

DATE: May 20-23, 1996

CONGRESS TOPICS:

The meeting will be open to all animal species.

- Measurement techniques in animal locomotion
- Biomechanics of bones, joints and tendons
- Computer simulations in locomotion research
- Neuro-muscular activity
- Normal, athletic and comparative locomotion
- Abnormal locomotion
- Free communications
- Workshops and experimental demonstrations

SCIENTIFIC COMMITTEE:

Helen Davies (University Melbourne, Australia)
Nancy Deuel (University of Maryland, USA)
Stig Drevemo (University of Uppsala, Sweden)
Henk Schamhardt (University of Utrecht, The Netherlands)
Eric Barrey (National Institute of Agricultural Research, France)

ORGANIZING COMMITTEE:

The National Institute of Agricultural Research (INRA) and the Equestrian National School (ENE) will be the official organizers of the meeting. An organizing committee has been created:

Eric Barrey (INRA)
Christian Cambo (ENE Director)
Patrick Galloux (ENE Research Manager)
Antoine Sinniger (ENE Communication Manager)
Jean-Marie Denoix (Veterinary School of Alfort)
Bertrand Langlois (INRA)
Elisabeth Laville (INRA)
Valarie Cinqualbre (French National Stud)
Emmanuel Rossier and Nicolas Baudoin (Horse Institute)

CONGRESS FORMAT AND OFFICIAL LANGUAGES:

- Keynote lectures (invited)
- Oral presentations
- Poster sessions
- Laboratory demonstrations

The official scientific languages of the congress are English and French. All authors are greatly encouraged to present their work in English. Simultaneous translation into English will be provided during official communications.

ABSTRACT SUBMISSION:

In order to present an oral communication, a poster or a laboratory demonstration, an abstract should be submitted to the IWAL 3 Scientific committee. The material to be presented must cover original and completed research that has not been published or presented elsewhere.

A person may present no more than one oral communication and two posters. If you wish to submit several abstracts (maximum 3) the most acceptable one will be chosen for oral presentation. Co-authorship is allowed on any number of abstracts.

The abstracts will be selected by the scientific committee. Abstracts should be prepared in English on a special form according to the instructions which will be sent with the second announcement in May 1995.

In order to obtain abstract forms, please mail or fax a request to the secretariat of the congress.

MANUSCRIPT SUBMISSION:

If the abstract is accepted for an oral or a poster presentation, a full paper can be submitted for publication in the refereed proceedings which will be published after the congress. The instructions to authors will be available in January 1996. The manuscripts will be reviewed by the scientific committee and all participants of the congress may be asked to contribute to the reviewing process.

Two special issues have been published in conjunction with IWAL 1 and IWAL 2, namely:

Animal Locomotion, D. Leach and H.C. Schamhardt (Eds), 1993. *Acta Anatomica*, vol. 146, N 2-3, pp 81-204.

Animal Locomotion, H.C. Schamhardt, Hilary Clayton and Janette F. Wade (Eds), 1994, *Equine Veterinary Journal* Suppl. 17, June 1994.

TIME SCHEDULE:

- * Mailing of the Second announcement and abstract forms in May 1995.
- * Deadline for abstract submission the 30th October 1995.
- * Notification to authors in January 1996.
- * Deadline for manuscript submission the 30th April 1996.
- * Third IWAL 20-23 May 1996.
- * Notification for the publication in the scientific issue: July 1996.

VENUE:

The Third International Workshop on Animal Locomotion (IWAL 3) will be held in a pleasant

historical town, Saumur, which is located in the Loire Valley in the west of France between Tours and Angers. All scientific events will take place in the National Equestrian School of Saumur.

SOCIAL PROGRAM:

The school and the Loire Valley open a broad scope of social activities. We propose a visit of the School and Castles of the Loire valley. A gastronomic dinner will be organized. The Cadre Noir will present a Dressage show.

REQUEST FOR SECOND ANNOUNCEMENT AND ABSTRACT FORMS :

To obtain abstract and registration forms, please reply to:

Surface mail:

INRA, SGQA
Secretariat of IWAL 3 - E. Barrey
78352 JOUY-EN-JOSAS CEDEX
France

Fax:

Secretariat of IWAL 3 - E. Barrey
Fax : Int + 33 1 34 65 22 10

E-mail:

ugeneba@dga1.jouy.inra.fr

NEW RESEARCH LIST AVAILABLE ON INTERNET/BITNET

NeuroMus - Forum on Neuromuscular Aspects of Motor Performance

The Neurology Section of the American Physical Therapy Association announces *NeuroMus*, a research-oriented forum to discuss issues/questions related to the neuromuscular control of motor performance. *NeuroMus* is also initiating an extensive electronic library of files related to funding sources, topical bibliographies, instrumentation/software, and other Internet/BITNET resources related to research. Since the list is very new, we're asking your patience while the library is compiled the next few months.

To subscribe, send the following:

To: listserv@sjvum.stjohns.edu

Message:

subscribe neuromus yourfirstname yourlastname

Do not include anything else in the message (ie. "hi, thanks," etc).

Those having ideas for useful information to place in the *NeuroMus* library, including self-written computer programs, bibliographies, or short papers on some aspect of research should contact Andy Messaros (andrew-messaros@uiowa.edu).

- Andy Messaros, MA, PT(University of Iowa)
- Roger Enoka, PhD (Cleveland Clinic Foundation)
NeuroMus List Coordinators

9TH INTERNATIONAL CONFERENCE ON MECHANICS IN MEDICINE AND BIOLOGY

July 1-5, 1996

The Slovenian Society of Medical and Biological Engineering invites you to participate at the Ninth International Conference on Mechanics in Medicine and Biology in Ljubljana. The Conference follows its very successful predecessors in Aachen (1978), Osaka (1980), Compigne (1982), Buffalo (1984), Bologna (1986), San Antonio (1988), Portschach (1991), Amsterdam (1994).

The Conference is planned to promote the full scope of theoretical and experimental mechanics in the field of medical and biological engineering. The conference is intended to attract not only scientists and specialists but also clinical engineers, physicists, metallurgists, medical doctors, physical therapists, biologists, allied health personnel and representatives of medical equipment industry. Invited are leading experts in research, technology and clinical applications as also various users.

Topics:

Animal biomechanics	Clinical biomechanics
Biomaterials	Dental mechanics and orthodontics
Biomechanics of trauma	Biorobotics
Ergonomics	Blood flow
Experimental techniques	Functional Electrical Stimulation
Bone remodeling	Gait analysis
Artificial organs	Internal organs
Cardiac mechanics	Micro-circulation
Cell biomechanics	Muscle mechanics
Orthopaedics	Sensory organs
Pharmacokinetics	Simulation / modelling
Prosthetics	Skin and soft tissue biomechanics
Rehabilitation	Sport biomechanics
Respiratory biomechanics	

IMPORTANT DEADLINES:

Submission of final camera-ready papers:

February 1, 1996

Acceptance notification: May 1, 1996

Conference: July 1-5, 1996

Exhibition:

An exhibition of industrial products and scientific achievements will take place in the pleasant and functional environment of the foyer of Cankarjev dom.

SOCIAL PROGRAMME

Social programme for participants and accompanying persons will be organized, with excursions to places of general and cultural interest. Ljubljana is the capital of the Republic of Slovenia and its cultural, scientific and commercial centre with the University of 24.000 students, 40 scientific institutes and a renowned Clinical Centre. Its numerous Art Galleries, Museums and Theatres reflect the rather demanding cultural

requirements of its citizens. With its International Graphic Centre in Tivoli Mansion and the International Graphics Biennial, Ljubljana is also one of the important centres of graphic art in Europe. Cultural and Congress centre Cankarjev dom hosts numerous cultural and artistic productions, professional meetings and congresses. One of Ljubljana's great advantages is also the fact that it is surrounded by outstandingly beautiful countryside of quite amazing variety. On one side there is the Alpine region with its high mountains, torrents and lakes, another direction takes you to the soft wine-growing lowlands of Dolenjska and Tajerska, yet another to the Carst region with its underground stone-lace world and vanishing rivers, while the seaside offers a lowly Mediterranean climate with lots of fresh sea-food, rosemary, lavender and wines.

In order to receive further information on ICMMB 96 including the preliminary programme and registration form, please write to:

ICMMB 96, A. Kregar, Cankarjev dom,
Cultural and Congress Centre, Presernova 10,
61000 Ljubljana, Slovenia
Tel.: +386 61 223 988, Fax: +386 61 217 431

For other questions:

Dr. Uros Stanic, J. Stefan Institute, Jamova 39,
61000 Ljubljana, Slovenia
Tel: +386-61-125-91-99, Fax: +386-61-219-385

Dr. Marko Munih, Dr. Tadej Bajd, Faculty of
Electrical and Computer Engineering, Trzaska 25,
61000 Ljubljana, Slovenia
Tel: +386-61-1768-238, Fax: +386-61-264-990,
E-mail: icmmb@robo.fer.uni-lj.si

Dr. Robert Jaeger, Pritzker Institute of Medical
Engineering, 10 W 32nd Street, E1-125 IIT
Center, Chicago, IL 60521 USA
Tel.: 312-567-5324, Fax.: 312-567-5707

Final Announcement of the
**2ND INTERDISCIPLINARY WORLD CONGRESS
ON LOW BACK PAIN; THE INTEGRATED
FUNCTION OF THE LUMBAR SPINE AND
SACROILIAC JOINTS**

La Jolla, California, U.S.A., November 9 - 11, 1995

You are invited to participate in the 2nd Interdisciplinary World Congress on Low Back Pain. As in the previous congress the integrated function of the lumbar spine and sacroiliac joints will be emphasized and the consequences for diagnosis and treatment of low back pain will be discussed. Low Back pain, both acute and chronic, remains a world wide problem. Treatment through the services of various professions has not yet solved the puzzle of low back pain. A fresh look at the

scientific basis of low back pain based on renewed studies in anatomy, applied biomechanics and physiology is the aim of basic researchers and clinicians worldwide. Through the initiative of the Scientific Committee, clinicians and researchers will be brought together to exchange ideas and advance our understanding of low back pain. The first congress addressed several important issues emphasizing the importance of developing interdisciplinary standards for treating low back pain. New research, both clinical and academic, is now available. All written contributions will be available at the time of the meeting.

PROGRAM OUTLINE

Thursday, November 9, 1995

- 7 am Registration
- 8.30 Opening
- 9.05 Session on Basic Mechanisms of the Spine
- 9.50 Session on The Integrated Function of the Sacroiliac Joints
- 10.50 Break
- 12.45 Lunch break
- 14.00 Session on Pelvic Pain and Instability I
- 15.45 Break
- 16.15 Session on Surgical Approaches
- 17.45 Conclusions and Reception

Friday, November 10, 1995

- 8.30 Session on Clinical Approaches I
- 10.10 Break
- 10.45 Session on Clinical Approaches II
- 12.05 Lunch Break
- 13.30 Session on Clinical Approaches III
- 14.45 Break
- 15.15 Session on Pelvic Pain and Instability II
- 18.05 Conclusions

Saturday, November 11, 1995

- 8.30 Session on Low Back Pain and the Lumbar Spine
- 10.30 Break
- 11.00 Session on Low Back Pain and its Relation to the SI Joints
- 12.15 Lunch break
- 14.00 Start parallel workshops

For detailed information please contact in the U.S.:

University of California at San Diego
Office of Continuing Medical Education
9500 Gilman Drive 0617, La Jolla,
California 92093-0617
Tel: 619-534 3940; Fax: 619-534 7672.

In Europe:

European Conference Organizers
POB 4334
3006 AH Rotterdam
The Netherlands.
Tel: 31-10-4133287; Fax 31-10-4147988

Biomechanics positions available

UNIVERSITY OF BERN

Maurice E. Mueller Institute for Biomechanics
Orthopaedic Biomechanics Division

The Orthopaedic Biomechanics Division at the Maurice E. Mueller Institute for Biomechanics is searching for qualified applicants to lead a biomechanics research group. The position has a limited tenure of 2-3 years. Candidates should have an earned doctorate in bioengineering, engineering, or a related field. Requirements include expertise in clinical biomechanics, including mathematical, i.e. analytical and approximation methods (FEM) as well as in vitro and in vivo experimental protocols. Experience in spine biomechanics, in particular related to implant design/evaluation and surgical techniques is highly desired.

The successful applicant will be expected to develop a strong externally funded research program in the appropriate discipline and participate in various interdisciplinary research activities. The position does not involve any teaching responsibilities.

Please send curriculum vitae and references to:

Lutz-P. Nolte, Ph.D.
Maurice E. Mueller Institute for
Biomechanics
P.O. Box 30
3010 Bern
SWITZERLAND

Tel: +41-31-632-8722
Fax: +41-31-632-4951
Internet: nolte@mem.unibe.ch
WWW: <http://cranium.unibe.ch/>

POST-DOCTORAL POSITION IN GERIATRIC BIOMECHANICS

Biomechanics Research Laboratory
Department of Mechanical Engineering and Applied
Mechanics University of Michigan

A Post-Doctoral Scholar is sought to conduct research in geriatric biomechanics with emphasis on studies of falls and mobility impairments among healthy and frail old adults. The Laboratory has the space, equipment, support staff and experience to foster research in these areas. The Laboratory cooperates in geriatric biomechanics research with the University's Division of Geriatric Medicine, Institute of Gerontology, Neuropsychology Program, Bioengineering Program and other University units.

Applicants must hold a recent PhD in engineering or in a closely related field. Desirable additional qualifications include graduate-level training in and/or laboratory experience with dynamics, control systems and instrumentation. Familiarity with digital data acquisition and processing, computer simulation and optimization and writing of scientific journal articles and proposals would also be desirable.

The initial appointment will be for 12 months at full-time, at an annual salary of approximately \$30,000. This appointment may be renewable if mutually agreeable to the applicant and the Laboratory, and if Laboratory funding permits renewal.

Preference may be given to applicants who are US citizens or permanent residents, since the University's Institute of Gerontology may be able to partially fund those applicants through a Training Grant from the National Institute on Aging.

We hope to fill this position by May 15, 1995, but will consider all applications until the position is filled.

Please submit applications, biographic and other supporting materials to:

James A. Ashton-Miller, PhD or
Albert B. Schultz, PhD.
Department of Mechanical Engineering and
Applied Mechanics University of Michigan
Ann Arbor MI 48109-2125

Tel: 313-763-2320 (Ashton-Miller)
313-764-3728 (Schultz)
Fax: 313-763-9332

The University is a nondiscriminatory, affirmative action employer.

TENURE TRACK FACULTY POSITION IN BIOMECHANICS - ASSOCIATE PROFESSOR

Department of Physical Education
Western Illinois University
Macomb, IL 61455

Requirements: Doctorate in Physical Education. Previous collegiate teaching experience preferred. Must have proven record of excellence in teaching and completing research.

Teaching/Primary Duties to include:

1. Teaching undergraduate classes in Biomechanics.
2. Teaching graduate classes in Biomechanics.

3. Teaching undergraduate classes in Anatomy & Physiology to undergraduate Physical Education majors.
4. Additional teaching responsibilities may be one or more of the following areas: Physiology of Exercise, Graduate class in Research Methods, Professional Activity classes, strength training.

The College of Education and Human Services is committed to distance learning through the use of television and technology. Teaching assignments could reflect this type of instruction.

Additional responsibilities to include:

1. Serving on departmental, college, and university committees.
2. Chairing masters degree theses and serving on theses committees.
3. Supervision of graduate students independent research projects.
4. other responsibilities as assigned.

Rank: Associate Professor

Salary: Contingent upon qualifications

Date: Screening of applicants will begin April 20 and will continue until an acceptable candidate is chosen.

To apply, send the following:

Send most recent transcript, current resume, and three letters of recommendation to:

Dr. Donna Phillips, Chairperson
 Department of Physical Education
 Brophy Hall
 Western Illinois University
 Macomb, IL 61455
 Tel: (309) 298-1981; Fax: (309) 298-2981

DOCTORAL STUDENT POSITIONS IN POSTURE

Department of Exercise and Sport Science
 Center for Locomotion Studies
 The Pennsylvania State University

Graduate student fellowships are available, for fall 1995, for doctoral students to conduct research in biomechanics of posture and elderly falls. The graduate program in the Department of Exercise and Sport Science has a total of thirty faculty members, thirty-one doctoral students and twenty-two master students. Research projects will be conducted at Center for Locomotion studies that is well equipped for postural research.

The applicants should have finished M.S. degree at the time of admission. Background in biomechanics of locomotion, neuromuscular control, biomedical/mechanical engineering, or other related fields is preferred. The required documents include transcripts, GRE, TOFEL (for foreign students), CV, and statement of interest. Interested candidates should contact:

Ge Wu, Ph.D.
 Center for Locomotion Studies
 The Pennsylvania State University
 University Park, PA 16802, USA

Tel: (814)-865-1972
 e-mail: gwu@ecl.psu.edu

**DIRECTOR
 BIOENGINEERING ALLIANCE OF SOUTH
 CAROLINA
 Clemson University**

The Department of Bioengineering, Clemson University invites applications and nominations for the position of Director, Bioengineering Alliance of South Carolina.

The Bioengineering Alliance of South Carolina is a structured effort between Clemson University, the University of South Carolina and the Medical University of South Carolina. The mission of the Alliance is to foster and promote collaborative bioengineering research and teaching in South Carolina and to generate external funding for these efforts. The Director of the Alliance holds a tenure track appointment in the Bioengineering Department at Clemson University.

The ideal candidate will be an experienced researcher with a demonstrated record of extramural funding and collaborative research, and is expected to teach courses and supervise graduate research in Bioengineering. We anticipate filling the position at the Associate Professor level or higher. Review of applications will begin June 1, 1995, and will continue until the position is filled.

To apply, please send your curriculum vitae and the names, addresses and telephone numbers of at least three references to:

Vasanti M. Gharpuray, Chair, BASC
 Director Search Committee
 Department of Bioengineering
 Clemson University
 Clemson, SC 29634-0905, USA
 Tel: (803) 656-5555; Fax: (803) 656-4466
 E-mail: vasanti@eng.clemson.edu

Clemson University is an equal opportunity/affirmative action employer.

Thesis abstract

NEUROMUSCULAR PERFORMANCE OF POORLY AND NORMALLY COORDINATED CHILDREN

by

Annette J. Raynor

Doctor of Philosophy Thesis

Department of Human Movement
The University of Western Australia
Nedlands, WA 6907

Supervisors: Assoc. Prof. Graeme A. Wood and
Dr Dawne Larkin

Poorly coordinated children are known to display significantly different movement patterns to those of age-matched normally coordinated peers; however, the reasons for such differences have yet to be established. A multi-dimensional approach was used in this thesis to investigate the movement problems experienced by these children, with the neural, neuromuscular and biomechanical dimensions being specifically examined. Findings were subsequently related to the systems, computational and information processing paradigms which have recently been used to investigate this problem. The major hypothesis examined by this study was that the movement problems experienced by the poorly coordinated child are related to deficits in the underlying neuromuscular system. Also examined was the hypothesis that these problems may be compounded by increased movement complexity or degrees of freedom of a task, as defined by the number of joints involved in the action.

Two experiments were conducted which investigated the neuromuscular performance of poorly and normally coordinated children on tasks with differing degrees of freedom. Three broad categories of tasks were investigated in Experiment One; namely, reflexive and visual reaction time tasks, single joint static and dynamic tasks and a multi-joint cycling task. As a result of findings from Experiment One, the single joint static and dynamic tasks were further investigated in a second experiment, together with the muscular compliance of a similar group of children. In addition to the reciprocal knee extension-flexion action performed in Experiment One (dynamic task), unidirectional knee extension and knee flexion actions were also investigated in Experiment Two. Muscular activity was recorded from relevant muscles of the right lower limb during all tasks using surface electromyographic techniques, with the single joint static and dynamic tasks being performed on a

Biodex dynamometer. The notion of motor dysfunction or developmental delay was investigated using two age groups in Experiment One; namely, 6-7 and 9-10 years. Experiment Two used only a single age group ranging from six to ten years.

Temporal analysis indicated that the poorly coordinated group had an extended motor time during the visual reaction time task and the dynamic single joint knee extension-flexion actions. Although the six year old poorly coordinated group also had a longer reflex motor time compared to the six year old normally coordinated group this result must be viewed cautiously as neither six year old group differed significantly from the nine year old groups. The premotor time was also longer in the poorly coordinated group during the visual reaction time task, suggesting both a central and peripheral timing deficit in these children. To investigate the possible causes of the increased peripheral delay in the poorly coordinated group, the muscular compliance of both coordination levels was investigated in Experiment Two; however, no conclusive differences were seen.

Significant neuromuscular findings included an increased level of coactivation in the poorly coordinated group during the visual reaction time task and during the static knee flexor action; while EMG power spectral analysis suggested differences in the development of motor unit firing patterns in the two levels of coordination during the static knee flexor task.

The poorly coordinated group was consistently weaker and less powerful than the normally coordinated group during both the static and dynamic knee extension and flexion tasks. These strength deficits during the dynamic action were found to occur irrespective of whether the knee extension-flexion action was performed as a reciprocal movement (Experiment One) or as unidirectional movements (Experiment Two). Unlike the knee extensor action, the peak knee flexor torque

produced by the poorly coordinated group was affected by the ordering of the reciprocal action, with lower levels of peak torque produced when flexion was performed as the second phase of the reciprocal action. Based on these results it appears that flexion may be a more difficult action for the poorly coordinated group to perform compared to the extensor action. The only biomechanical parameter affected by the level of coordination was the time taken to attain the required isokinetic velocity which is believed to be a reflection of the decreased power in the poorly coordinated group.

The multi-joint cycling task was performed at three speeds with the temporal organisation of muscle activity being analysed by initially clustering subjects according to the muscle onset and cessation using the statistical Fastclus procedure. A "classical" pattern of muscular activation was evident at each of the three speeds, with divergent patterns of the tibialis anterior muscle contributing to the formation of additional clusters. The clusters formed were not, however, dominated by any particular coordination or age group which is thought to be due to the constraints placed on the task such as the specified speeds, no additional resistance being applied and the use of toe-clips.

In conclusion, neuromuscular differences between the two levels of coordination were observed in the single joint tasks investigated in this thesis. It was suggested that the multi-joint task be further investigated with less constraints placed on the movement. With respect to the systems perspective of motor control, the findings from the present study suggest both a motor and musculo-skeletal dysfunction in these children, while the observed timing and force problems may be associated with timing and force computational deficits. This work therefore contributes to the earlier associations of specific system (Sveistrup, Burtner & Woollacott, 1992) and computational (Lundy-Ekman, Ivry, Keele & Woollacott, 1991) deficits with the poorly coordinated child.

The effect of increasing age on the two levels of coordination differed across the variables investigated in this thesis and thus it cannot be unequivocally stated whether the movement problems displayed by poorly coordinated children are due to a developmental delay or a motor dysfunction. Some of the differences imply a delay while others are suggestive of a neuromuscular dysfunction. As a result, it appears that both a delay and a dysfunction may be interacting to cause the observed movement problem in these children.

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Calendar of scientific events

May 19-20, 1995

Injuries in Football and Basketball Course. The Wynfrey Hotel, Birmingham, Alabama. Contact: Judith Gold, Course Coordinator, American Sports Medicine Institute, P.O. Box 550039, Birmingham, AL 35255-0039. Tel: +1-205-918-2135; Fax: +1-205-918-0800.

June 1-3, 1995

Second Annual North American Clinical Gait Laboratory Conference, Waterloo, Ontario, Canada. Contact: Betty Bax, Department of Kinesiology, University of Waterloo, Waterloo, ON Canada N2L 3G1; Tel: (519) 888-4567 ext.2610; Fax (519) 742-9312; E-mail: bax@healthy.uwaterloo.ca

June 18-22, 1995

22nd Annual Meeting of the International Society for the Lumbar Spine, Helsinki, Finland. Contact: Dr Bjorn Rydevik, ISSLS, Sunnybrook Medical Center, Rm A-309, 2075 Bayview Avenue, Toronto, ON Canada M4N 3M5. Tel: 1-416-480 4833; Fax: 1-416-480 6055.

June 21-23, 1995

BIOMED '95: Third International Conference on Simulations in Medicine, Palazzo delle Stelline, Milan, Italy. Contact: Jan Evans, Wessex Institute of Technology, Ashurst Lodge, Ashurst, Southampton, SO40 7AA UK. Tel: 44(0)703 293223; Fax: 44(0)703 292853; E-mail CMI@ib.ri.ac.uk.

June 28-30, 1995

5th International Symposium on Computer Simulation in Biomechanics. University of Jyväskylä, Finland. Further information from: Dr. Erkki Laitinen, Laboratory for Scientific Computing, University of Jyväskylä, PO Box 35, FIN-40351, Jyväskylä, Finland. Tel: +358 41 602745; Fax: +358 41 602731; E-mail: biomech@math.jyu.fi.

July 2-6, 1995

XVth Congress of the International Society of Biomechanics. Jyväskylä, Finland. Contact: XVth ISB Congress, Jyväskylä Congresses, P.O. Box 35, FIN-40351 Jyväskylä, FINLAND. Tel: +358 41 603621; Fax: +358 41 603 664.

July 12-14, 1995

Third International Conference on Sport, Leisure and Ergonomics, Cheshire, England. Contact: Dr Greg Atkinson, Centre for Sport and Exercise Sciences, Liverpool John Moores University, Byrom Street, Liverpool, L3 3AF, England. Tel: 051 231 2157; Fax: 051 298 1261.

July 18-22, 1995

XIII International Symposium on Biomechanics in Sports, Lakehead University, Thunder Bay, ON Canada. Contact: Tony Bauer, Chairperson, Department of Kinesiology, Lakehead University, 955 Oliver Rd., Thunderbay, ON Canada. Tel: (807) 343-8654; Fax: (807) 343-8944; E-mail: Tony.Bauer@Lakeheadu.ca.

August 24-26, 1995

19th Annual Meeting of the American Society of Biomechanics, Stanford University, CA, USA. Contact: Keith Williams, PhD, Department of Physical Education, University of California, Davis, CA 95616, USA. Tel: (916) 752-3337; Fax: (916) 752-6681; E-mail: krwilliams@ucdavis.edu

September 10-11, 1995

Second Triennial International Hand and Wrist Biomechanics Symposium, San Francisco, California. Contact: David L. Nelson, M.D. Co-Chairman, Hand and Wrist Biomechanics Symposium, 56 Delmar Street San Francisco, CA 94117, USA.

September 20-25, 1995

17th Annual International Conference of the IEEE Engineering in Medicine and Biology Society & 21st Canadian Medical and Biological Engineering Conference, Montreal, QC, Canada. Conference secretariat: Coplanor Congres inc., 511 Place d'Armes, Suite 600, Montreal, QC, Canada H2Y 2W7. Tel: 514-848-1133; Fax: 514-288-6469; E-mail: embc95@coplanor.qc.ca. Up-to-date information on World Wide Web at <http://ralph.biomed.mcgill.ca/EMBC95>.

November 9-12, 1995

2nd Interdisciplinary World Congress on Low Back Pain: The Integrated Function of the Lumbar Spine and Sacroiliac Joints, La Jolla, USA. Contact: UCSD, Office of Continuing Medical Education, UC San Diego School of Medicine, La Jolla, CA 92093-0617, USA.

August 28-31, 1996

10th Conference of the European Society of Biomechanics, Leuven, Belgium. Contact: Dr J. Vander Sloten, Katholieke Universiteit Leuven, Division of Biomechanics and Engineering Design, Celestijnenlaan 200-A, B-3001 Heverlee, Belgium. Tel: xx.32.16.20.70.96; Fax: xx.32.16.29.27.16; E-mail: jos.vandersloten@mech.kuleuven.ac.be.

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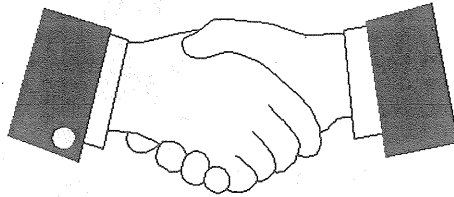
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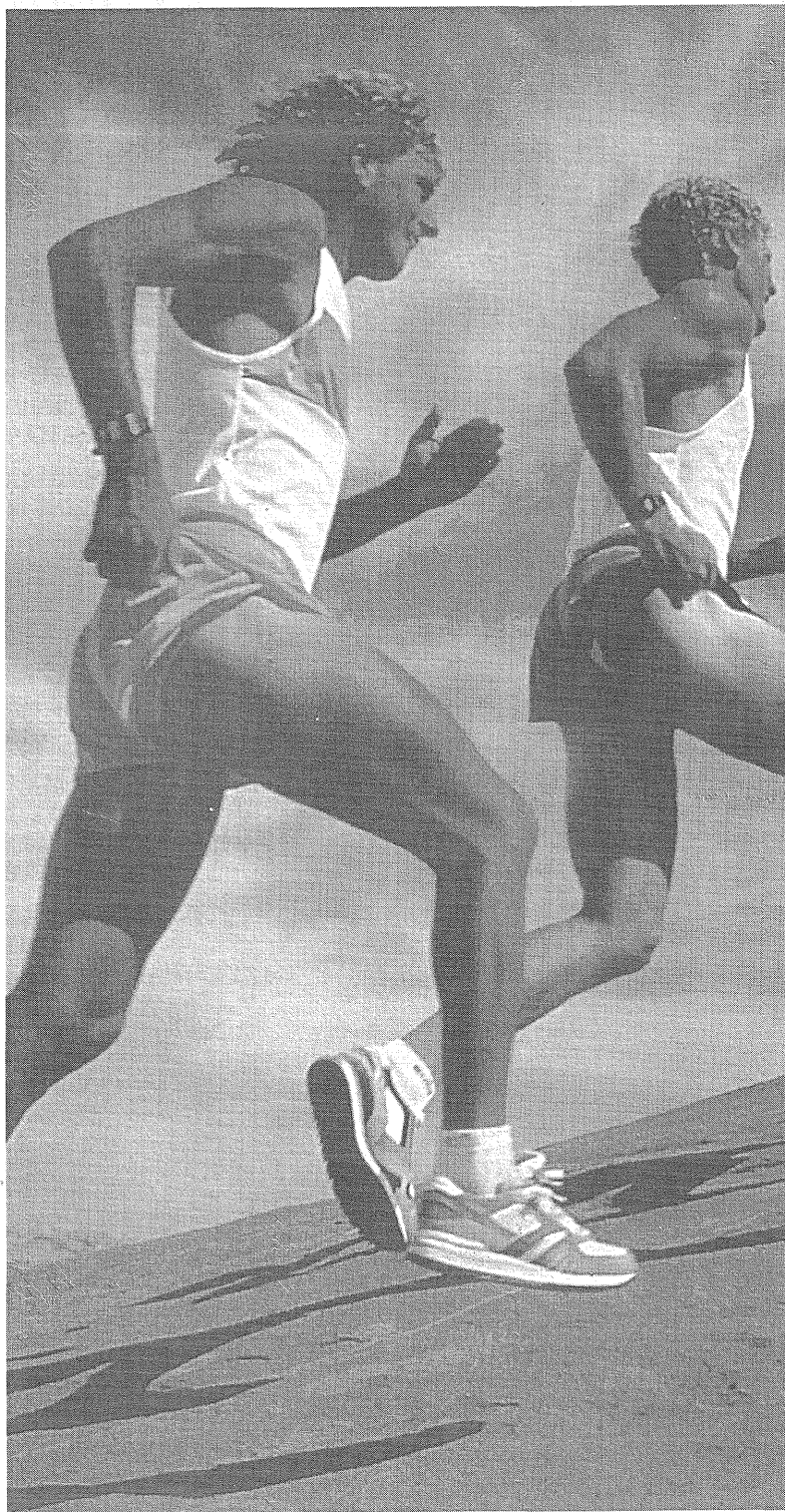


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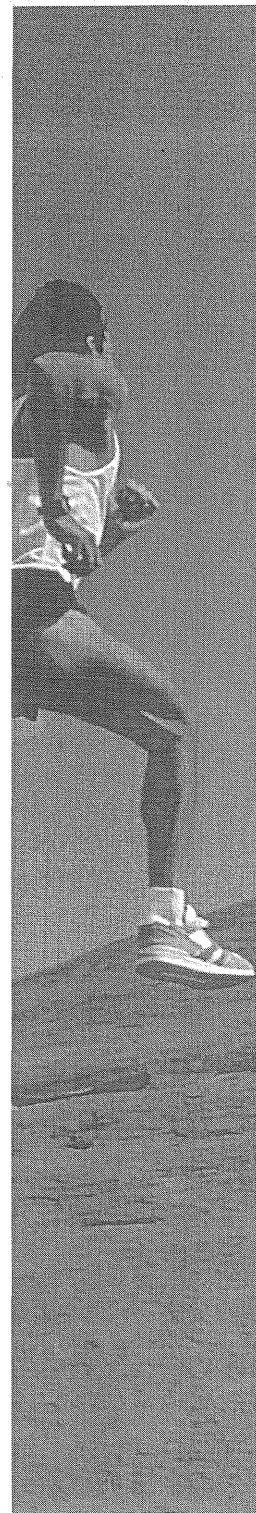
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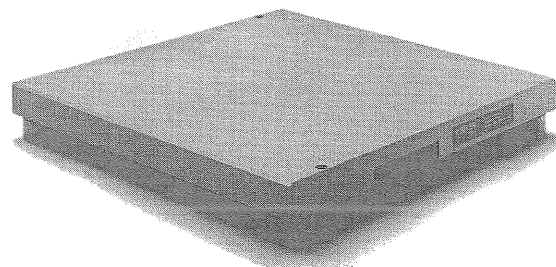
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