International Society of Biomechanics Newsletter

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AFFILIATE SOCIETIES OF ISB:
American Society of Biomechanics; British Association of Sports Science; Canadian Society of Biomechanics; China Sports Biomechanics Association; Czechoslovak Committee on Biomechanics; Korean Society of Biomechanics; French Société de Biomécanique; Polish Society of Biomechanics; Sports Commission of the Soviet Union; Japanese Society of Biomechanics.

ISB news

MESSAGE FROM THE PRESIDENT, Robert Norman

The Council met at the end of August for two days in San Diego immediately prior to the First World Congress of Biomechanics. Many items were discussed. A summary of the Minutes of the Council Meetings will appear in a future issue of the Newsletter. I will address three in this article, the most important matter for the ISB, the XIIIth Congress to be held in Perth, Australia in December of 1991; the second most important, the venue of the XIVth ISB Congress; and the third, the official relationship between the ISB and future World Congresses.

The XIIIth ISB Congress in Perth, Australia

Graeme Wood and the other members of the Organising Committee are developing a program and venue that may well prove to be the most unique that ISB members have had the opportunity to experience in the history of the Society. It will be the first summer that many of us have ever experienced in December; the program and state of invited speakers will pose a challenge to all future Congresses; the pre-Congress meeting of the ISB Working Group on Computer Simulation will be the best ever and will be held in the host city, Perth; pre-Congress educational sessions are being planned; several satellite meetings will be held in other parts of Australia, namely the east-coast cities Sydney, Melbourne and Wollongong. Moreover, the hospitality of the hosts is guaranteed to be un-paralleled. PLAN TO ATTEND AND START MAKING TRAVEL PLANS NOW. With no slight to the tremendous meetings that ISB has had before, this Congress will be one of the most memorable ever !

The ISB and future World Congresses

A number of ISB members from several different countries have expressed grave concern and, in some cases anger, that yet another international biomechanics congress and, possibly, society was being unnecessarily developed. Their major point was that already there are far more congresses than most had money, time, or research productivity to attend, considering all of the continental, national, special interest, local and international meetings with biomechanical content. Was it not possible for the world congress organizers to integrate with the ISB rather than add "World Congresses" to an over-burdened congress schedule ? Indeed, the ISB had discussed collaboration on several occasions, beginning as early as 1983 with members of the United States National Committee on Biomechanics, from which the World Congress emanated. For the first world congress the organising committee preferred to go it alone.

The First World Congress was extremely successful in attracting a large number of scientists from a wide range of sub-fields of biomechanics. About 1300 papers were presented in oral or poster format in ten simultaneous sessions. I congratulate Drs. Y.C. Fung, Savio Woo, Richard Skalak and the other organisers. Obviously many biomechanists perceived a need for the wide scope World Congress.

The ISB is strong in many aspects of biomechanics such as muscle mechanics, dynamic modelling, including computer simulation, of human body segment motion and whole body locomotion, occupational biomechanics, some aspects of orthopaedic mechanics, rehabilitation, neural control of motion and sport biomechanics. However, we have never attracted large numbers of physicians, cardiovascular, tissue or respiratory biomechanists. The San Diego Congress attracted these scientists in addition to the many ISB members who contributed to the program.

I believe that the World Congress was good for the development of biomechanics. It high-lighted several areas of biomechanics that are normally not seen in a large biomechanics international forum, such as gene regulation by mechanical stimuli in skeletal muscle, passive and active cell mechanics, ciliary mechanics and the mechanics of endothelial and arterial wall transport. It drew attention to the large number of sub-areas of biomechanics; approximately 25 were represented. It brought together many outstanding scientists who do not usually attend the same congresses, such as cardiovascular and locomotion biomechanists. This increased opportunities for interaction. Dr. Fung, deservedly proudly stated at both opening session and at the closing banquet that this was a land mark event for biomechanics because it was the first time that a large number of biomechanists sat down under the banner of a World Congress. This is true if scope and numbers attending are the criteria. However, I believe that it does not diminish the accomplishment of the 1st world congress if I remind readers that large numbers of biomechanists from many countries (more than 500 participants from 31 countries at UCLA), representing very diverse sub-fields of biomechanics have sat down every two years at the International Society of Biomechanics Congresses, Officially since 1979.

What of the future ? Will the ISB be involved ? Both the ISB and the World Congress Organising Committee has the common objective of assisting in the continued development of the quality of biomechanics research and its application to the solution of important societal problems. In addition to the many papers presented by ISB members at the World Congress, the ISB was well represented at planning meetings of the Steering Committee by Drs. Paul, Cappozzo and Nigg. I arranged for Dr. Fung to discuss plans with the ISB Council prior to the beginning of the Congress. This meeting was very useful for all involved.

The Second World Congress will be held in Amsterdam in July 1994. Several present or former ISB Council Members will sit on the congress steering committee, including Dr. Huiskes, one of the co-chairs of the congress. In addition, the Steering Committee of the First World Congress was reconstituted as a World Committee for Biomechanics (or by some other name) and will be chaired by Dr. Fung. This committee also includes a number of ISB members. Moreover, the ISB will have representation on a subcommittee of the "World Committee" chaired by Dr. Nerem of Atlanta, USA, whose task is to present a proposal

"for forming an international group for promoting all aspects of biomechanics and for the continuation of World Congresses".

Thus, the ISB will be involved in the World Congress concept, as it should be. The ISB will contribute the substantial experience that it has acquired in the complex problems of organisation and sustenance of a large international biomechanics society. The ISB has been, and will continue to be, devoted to providing a forum for its members, who represent many countries, to regularly present their research, learn from each other and thereby continue, as they have done for nearly 20 years, to develop biomechanics at the international level. The "World Congresses" will simply provide us all with an opportunity to expand our contribution.

The XIVth ISB Congress

The ISB will not spend all of its energies on world congresses. I am delighted to announce that the XIVth CONGRESS OF THE INTERNATIONAL SOCIETY OF BIOMECHANICS will be held in France in 1993. The Organising Committee will be chaired by Professor Dr.Simon Bouisset. I congratulate Dr. Bouisset and his colleagues for a well written and convincing proposal and look forward to the evolution of the French ISB Congress. This Congress will be the 30th anniversary of the ISB and will mark a special occasion.

XIIIth INTERNATIONAL CONGRESS ON BIOMECHANICS - ORGANISERS' UPDATE

The **Final Announcement and Call For Papers** booklet has now been distributed to all ISB members as well as to those of many other societies and groups. Contained in that booklet is all the necessary information and forms for intending participants. A number of satellite meetings are planned in conjunction with the XIIIth Congress and the details of these are provided in the booklet as well.

Qantas and **Ansett Australia** have been appointed the official Congress carriers for international and domestic routes respectively. **ORBA Travel** has been appointed as the Congress's travel agents and will assist participants with special travel arrangements, hotel accommodation, rental cars, holiday plans, etc. ORBA Travel have also prepared two pre- and post-Congress sightseeing tours of the South-West of Australia for those who want to complement their Congress activities with some sights and tastes of the country areas to the south of Perth.

It is strongly recommended that intending delegates plan their itinerary very soon and make the appropriate airline bookings early, as December is peak time for travel to, from, and within Australia.

See you in Perth, December '91.

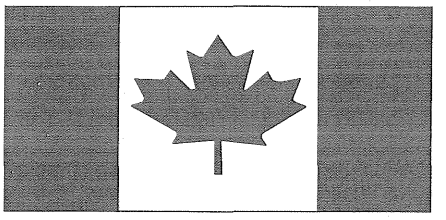
Affiliate society news

A number of Biomechanics Societies are affiliated with ISB (see list on front cover), and it has been suggested that the ISB Newsletter could carry brief reports of the affairs of these Societies. The first of these, written by Micheline Gagnon, an ISB Council Member and former President of CSB/SCB, follows.

Canadian Society of Biomechanics/Société Canadienne de Biomécanique (CSB/SCB)

The CSB/SCB was officially formed on August 28, 1973 at the International Biomechanics Séminar, at Pennsylvania University. It was formed to foster research and the exchange of ideas in the study of biomechanics of human movement. The field is interdisciplinary and includes scientist from diverse backgrounds: therapists, physicians, engineers, sport researchers, ergonomists among others. The Society is affiliated with the International Society of Biomechanics.

The main activity of the Society is the organisation of a biennial scientific conference held the years opposite those of the International Society of Biomechanics. The latest Conference, the sixth biennial Conference (Human Locomotion VI) was held in Quebec City and organised by Dr. Carol Richards. A joint meeting of the American Society of Biomechanics with the CSB/SCB has also been organised for the first time in 1986 in Montreal and was called the North American Congress on Biomechanics (NACOB). A second joint meeting is planned to be held in Chicago in 1992. The CSB/SCB also publishes several documents including the proceedings of the conferences and a newsletter twice a year. The membership is presently 115 members including 85 regular members and 30 student members. The executive, elected by the membership for a two year term, is comprised of the president, the secretary-treasurer, the conference chairperson, the past conference chairperson and the newsletter editor. The secretariat is appointed by the Society. The past presidents were Robert Jensen (1973-75), Keith Hayes (1976-77), Pierre Lagassé (1978), David Dainty (1981-82), Arthur Quanbury (1983-84), Gavin Reid (1985-86), Micheline Gagnon (1987-88) and Aftab Patla (1989-90).



Announcements

Research Collaboration in Diving

The University of Kentucky has recently completed the construction of a 10m platform diving tower in its new aquatic center (Lancaster Aquatic Center). As part of the construction, a Kistler Force Platform has been permanently installed in the 10m tower. This installation is transparent to divers. Data collection will be done by AT type computers. University staff would very much like to collaborate with researchers or students interested in using this capability. In addition, high speed video (5, 200Hz cameras, currently only 2 remote high speed recorders) and cinematography (2 Locam 16mm cameras) is available. The video can be synchronised with the forceplate. The video capability includes a "Motion Analysis System" for digitizing and analysis. Further information about the exciting potential for this facility can be obtained by contacting:

Dr. Robert Shapiro, PhD
Biodynamics Laboratory
100 Seaton Building
University of Kentucky
Lexington, Kentucky 40506-0219
U.S.A.

Biomechanics Position Available

School of Physical Education
University of Otago
Dunedin, New Zealand

LECTURERS IN PHYSICAL EDUCATION

The School of Physical Education has recently increased its intake and is undergoing further expansion. Accordingly, applications are invited from suitably qualified women and men for several lectureships (equivalent to North American tenure track Assistant Professor). The main criteria for appointment are distinction in research and scholarship and demonstrated teaching effectiveness. The areas of research and teaching specialisation are open, except that **one position will be in Biomechanics**. The School supports productive research programmes in movement-related life science and social science. Good relationships exist with other Schools and Departments and there is considerable collaborative research. The undergraduate degree of Bachelor of Physical Education is offered in both Kinesiology and in Sport and Leisure Studies with additional papers in various professional areas. The honours degree is currently available only in Kinesiology. Post graduate degrees of Master of Physical Education and Doctor of Philosophy are also offered.

Enquiries may be made to the Acting Dean, Professor L.R.T. Williams, electronic mail to psed0l@otago.ac.nz or telephone (64) (3) 4798995; fax (64) (3) 4778811.

Initial appointments will be made at a step on the Lecturers scale within the salary range $NZ37,440 - $NZ49,088 with a bar at $NZ45,448, according to qualifications and experience. Exceptionally well qualified candidates may be considered for appointment at a higher level.

Intending applicants should write for further particulars, available from the Registrar, P.O. Box 56, Dunedin, New Zealand. Applications quoting A90/63 close in New Zealand on 15 December, 1990. Equal opportunity in employment is University policy.

Conference Report

Sixth International Symposium on Biomechanics and Medicine in Swimming *(Report by John Troup)*

Liverpool Polytechnic hosted the VIth International Symposium on Biomechanics and Medicine in Swimming at the Britannia Adelphi Hotel, 7-11th September, 1990. The Symposium was attended by about 170 delegates from 30 different countries. The programme consisted of 60 oral communications, 27 posters, 4 keynote addresses, 4 work-shops and one seminar. A half-day was set aside for demonstrations pool-side: these included electromyography during swimming using the techniques developed by Cabri, Clarys and colleagues at Brussels, measurement of active drug using the MAD system shown by Hollander, Toussaint and co-workers from Amsterdam and a two-speed "lactate test" orchestrated by Malcolm Robson. The scientific programme of the Symposium was of a high standard and all keynote addresses were outstanding. David Costill related lactate metabolism to swimming and outlined the variety of factors influencing the interpretation of lactate concentration values. Huub Toussaint explained the most important factors determining swimming performance and placed his own work on efficiency in context. Kurt Wilke provided a systematic analysis of sprint swimming while Terry Dennison gave the audience an insight into the redoubtable tasks associated with coaching an Olympic champion. The work-shops provided a forum for debate about broader aspects relating science and swimming than those covered in the formal sessions. Topics included 'hydrodynamics and swimming' (Mike Hughes and Bodo Ungerechts), the child swimmer (Diane Jameson, Deryk Snelling, Kurt Wilke), biological rhythms and swimming (Claire Dickenson and Tom Reilly) and nutrition (Don MacLaren). The seminar on "coach education: the links between theory and practice" chaired by Jan Clarys and sponsored by British Coal Enterprise included expositions from Terry Dennison and Deryk Snelling covering the U.K. and Canadian scenes, respectively. The prestigious Archimedes award, presented to new outstanding researchers every four years at this Symposium, this time was shared, the first occasion the award did not have an outright winner. The prize went to Delia Roberts (University of Calgary) for her paper on "Serum erythropoetin (EPO) training at moderate altitude" and to Veronique Colman (Leuven University) for her work on "Relation between physical characteristics and the degree of undulation in the breast-stroke". A special ambience was created during the Symposium by the social events. These included a

competitive swim round the Albert Dock, a Beatles Tour (Penny Lane, Strawberry Fields, the Beatles Museum and so on), an evening of sea-shanties and Liverpool songs and a "pub crawl". At the Symposium Banquet, Professor T. Reilly paid tribute to the work of Don MacLaren as Organiser and to Jan Clarys for co-ordinating the series of Symposia on behalf of the World Commission of Sports Biomechanics. Special awards were presented to members who were at the First Symposium in Brussels in 1970 and at the Sixth in Liverpool - John Atha, Jan Clarys, Jurgen Klauck, Mitsamasa Miyashita, Ulrich Persyn and Bob Stallman. Delegates were able to look ahead with confidence to the Seventh Symposium (Organiser, John Troup) which is scheduled for September 1-5, 1994 at Colorado Springs. The contact address for the Symposium is:

Dr. J.P. Troup
VII International Symposium: Biomechanics and Medicine in Swimming
1750 East Boulder Street, Colorado Springs
Colorado 80900-5770, U.S.A.

ISB CONGRESS PROCEEDINGS AVAILABLE

The Proceedings from the XIIth International Congress of Biomechanics held at UCLA in June, 1989 in Los Angeles, California USA are now available. The 850-page volume contains two-page abstracts of 413 free communications (oral and poster sessions) presented at the ISB Congress. Since the two-volume hardbound series will not be published as for previous ISB Congresses, these proceedings are an important literature source.

The cost of the Proceedings is as follows:

$30.00 (U.S.) for ISB members
$40.00 (U.S.) for non members

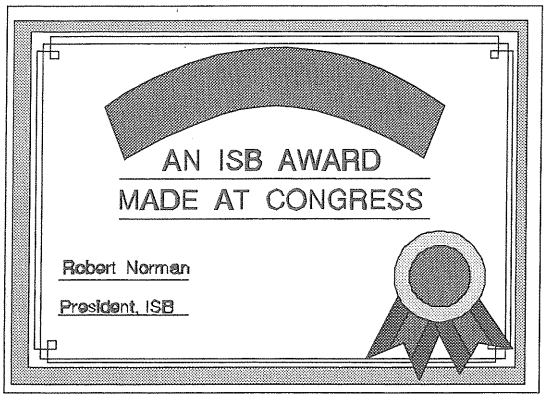
plus postage and handling:

$2.50 (U.S.) for US and Canada
$10.00 (U.S.) for all other countries

To order the Proceedings write to the Treasurer enclosing payment and postage:

Dr. Richard C. Nelson
ISB Treasurer
Penn State University
200 Biomechanics Laboratory
University Park, PA 16802
USA

Payment must be in U.S. dollars by check written on a bank in the United States; by international postal money order; or by international traveller's check, payable to: International Society of Biomechanics. Please allow 6-8 weeks for delivery.



ISB Awards made at Congress

The ISB presents a number of special awards at its biennial Congresses in recognition of excellence in various aspects of scientific endeavour in biomechanics. The Muybridge Medal is the most prestigious of these and is awarded to those who have made outstanding contributions to the development of biomechanics. These contributions may be through good scientific publications and/or methodological developments and/or application. The recipient(s) of this award is chosen by the ISB Honours Award Committee and an announcement will soon be made for the XIIIth Congress.

Other awards are presented on the basis of the excellence of papers presented at the Congress itself. There will be three such awards made at the XIIIth Congress, and authors who qualify for any of these awards are invited to indicate their wish to compete for an award by completing the appropriate part of the Abstract Submission Form. Recipients of these awards must be present at the special Congress ceremony organised for the presentation of awards. These awards are:

* ***Young Investigator Awards***

Two awards, each to the value of US$500, will be made for the best podium and poster presentations made at the Congress by two young investigators. The ISB Council has decided that to qualify for these awards a person must be under 30 years at the time of the congress, and that the abstract must have no more than three authors with the competitor as the first named. A statement from the competitor's thesis supervisor of lab. director identifying the contribution of each author must accompany the abstract. Competitors who are short-listed on the basis of their abstracts will be required to submit a full length paper and curriculum vitae to the ISB Awards Committee prior to the Congress. Each short-listed competitor will be judged on the quality of their paper and on their competence in presenting at the podium or by poster.

* ***Clinical Biomechanics Award***

An award of US $500 donated by the journal of Clinical Biomechanics for the best paper presented in the area of clinical biomechanics. Competitors will be short-listed based on the quality of their abstracts, and those people will be required to submit a full length paper and curriculum vitae to the ISB Awards Committee prior to the Congress.

New Book in Human Movement Biomechanics

Title: **BIOMECHANICS OF HUMAN MOVEMENT Applications in Rehabilitation, Sports and Ergonomics**

Editors: Necip Berme and Aurelio Cappozzo

Motivation: This book collects the contributions of experts in human movement biomechanics from different research areas and interests which present and discuss the various aspects of the subject matter in order to establish the state-of-the-art in this field, and give a concrete contribution to the rationalization of the relevant knowledge. Significant space is allotted to chapters covering the basics and reviewing the developments of practical applications of this discipline. This is complemented by a number of research papers. The material reflects the content of a week Study Institute and Conference held in Formia, Italy, in 1986.

Readership: Both a reference book and a text book.
Pages: 529
Figures: 199
Publisher: Bertec Corporation, Worthington, Ohio, U.S.A.
Price: US $ 56.50 (Free surface mailing; for air shipment add $4.50 in U.S.A and Canada, and $16.50 elsewhere.)
Available: November 1, 1990
Contents:

To order, send check or money order drawn on a US bank, and payable to Bertec Corporation, to:

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Thesis abstract corner

CONTROL OF VOLUNTARY TRUNK MOVEMENTS IN MAN
Mechanisms for postural equilibrium during standing

by

Lars Oddsson

A Dissertation from the Department of Physiology III
Karolinska Institutet, Box 5626
S-114 86 Stockholm, Sweden

Supervisor: Dr Alf Thorstensson

The relatively large mass of the upper body and its elevated position in relation to the area of support during standing accentuates the importance of an accurate control of trunk movements for the maintenance of equilibrium. This fact has often been emphasised but never studied in detail. In this thesis the kinematics and motor patterns of simple voluntary trunk movements are investigated during standing. The analysis integrates neurophysiology and biomechanics using electromyographic (EMG) and optoelectronic techniques.

Both the voluntary (primary movement) and the involuntary (associated postural adjustment) components of the movement are considered. The results demonstrate how the central nervous system (CNS) in its control of equilibrium utilises biomechanical principles such as mechanical leverage of the different muscles and the interaction of active (muscle force) and passive forces (e. g. gravity and forces in stretched ligaments and/or muscles). Both primary and associated movements were found to be controlled by task specific and flexible muscle synergies which adapt to the mechanical demands of the situation. These task specific synergies were related to the amplitude, velocity and direction of the movement. Slow movements were often initiated through the action of gravity after a decrease or cessation of activity in postural muscles. Fast movements, however, were always initiated by a marked burst of activity in the agonist muscles. Significant relationships were observed between kinematical parameters (amplitude, duration and velocity) of fast trunk movements and temporal aspects of the EMG pattern. Multiple regression analysis indicated that the time to onset of muscle activity braking the ongoing trunk movement contained more information regarding the amplitude of the movement than did the duration of the initiating burst of activity in the prime mover. This supports the view that the initiating agonist burst is preprogrammed, whereas the braking antagonist burst may be influenced by peripheral feedback such as from muscle stretch receptors.

In the early phase of a fast trunk flexion an unexpected flexion of the knees was observed. It is suggested that this knee flexion is a fast postural adjustment passively initiated as a mechanical consequence of the activation of muscles controlling the primary movement. This mechanism, which for anatomical reasons cannot act during an extension of the trunk, simplifies the feed-forward control of equilibrium during voluntary trunk flexion movements. For fast trunk extension movements a preactivation of ankle muscles occurred which resulted in a delay in the onset of the prime mover muscles when measured during a simple reaction time task. This further supports the concept of a more complex postural control of trunk extension movements.

During trunk movements phases of reciprocal activation, as well as co-activation of antagonistic muscles, controlling movements at the ankle joint were present. By recording the H-reflex, the electrical analog of the monosynaptic stretch reflex, and the maximal twitch response of the triceps surae muscles during different conditions of standing, it was demonstrated that the CNS, by co-contracting antagonistic ankle muscles, can regulate the degree of stiffness at the ankle joint. During voluntary trunk movements the CNS appears to integrate these different modes of control into the motor program for an accurate control of equilibrium.

It is concluded that the postural control of voluntary trunk movements is of a feed-forward nature. In certain situations the activation of the prime movers initiates both the primary movement and indirectly the associated movement. Different task specific muscle synergies are integrated by the CNS to control both the primary and the associated postural component of the movement in a way optimally suited for the mechanical demands of the situation.

This thesis was based on the following original papers:

Thorstensson, A., Oddsson, L. & Carlson, H. 1985. Motor control of voluntary trunk movements in standing. *Acta Physiol Scand* **125**, 309-321.

Oddsson, L. & Thorstensson, A. 1986. Fast voluntary trunk flexion movements in standing: primary movements and associated postural adjustments. *Acta Physiol Scand* **128**, 341-349.

Oddsson, L. & Thorstensson, A. 1987. Fast voluntary trunk flexion movements in standing: motor patterns. *Acta Physiol Scand* **129**, 93-106.

Oddsson, L. & Thorstensson, A. 1987. Reaction time and pattern of muscle activation in trunk flexion and extension movements. In *Biomechanics* X, ed. Jonsson B. Human Kinetics Publishers, 431-436.

Oddsson, L. 1988. Coordination of a simple voluntary multi-joint movement with postural demands: trunk extension in standing man. *Acta Physiol Scand* **134**, 109-118.

Oddsson, L. 1989. Motor patterns of a fast voluntary postural task in man: trunk extension in standing. *Acta Physiol Scand* **136**, 47-58.

Oddsson, L. & Thorstensson, A. 1990. Task specificity in the control of intrinsic trunk muscles in man. *Acta Physiol Scand* **139**, 123-131.

Key words: biomechanics, electromyography, humans, motor control, postural mechanisms, synergies, task specificity, trunk muscles, voluntary multijoint movements

STOCKHOLM 1990 ISBN 91-628-0078-7

SURGERY SIMULATION: A COMPUTER GRAPHICS SYSTEM TO ANALYZE AND DESIGN MUSCULOSKELETAL RECONSTRUCTIONS OF THE LOWER LIMB

by

Scott L. Delp

A Ph. D. Dissertation submitted to the
Mechanical Engineering Department
Stanford University, 1990

Supervisor: Felix E. Zajac

Function can sometimes be restored to patients with movement disabilities via surgical reconstruction of musculoskeletal structures. Surgical reconstructions, however, often compromise the capacity of muscles to generate force and moment about the joints. Patients that cannot generate sufficient joint moments are left with weak or dysfunctional limbs. The goal of this dissertation is to understand the connection between the parameters of various surgical procedures and the moment-generating capacity of the lower limb muscles.

A graphics-based model of the human lower limb was developed to study the effects of musculoskeletal reconstructions on muscle function. The lines of action of forty-three muscle-tendon complexes were defined based on their relationships to three-dimensional bone surface models. A model for each muscle-tendon complex was formulated to compute its force-length relation. The kinematics of the lower limb were defined by modeling the hip, knee, ankle, subtalar, and metatarsophalangeal joints. Thus, the maximum isometric force and joint moments that each muscle-tendon complex develops can be computed at any body position. Since the model is implemented on a computer graphics workstation, the model parameters can be graphically manipulated according to various surgical techniques. For example, the origin-to-insertion path of a muscle-tendon complex can be altered to simulate a tendon transfer. The results of the simulated surgeries are displayed in terms of presurgery and postsurgery muscle forces, joint moments, and other biomechanical variables.

The model of the lower limb has been used to analyze tendon surgeries and pelvic osteotomies. The analysis of tendon lengthenings indicated that the forces generated by the ankle plantar flexors are extremely sensitive to surgical lengthening of tendon; other muscles are much less sensitive. Quantifying the sensitivity of the muscle forces and joint moments to changes in tendon length provides important new data needed to design effective tendon surgeries. Simulations of the Chiari pelvic osteotomy suggest that osteotomies performed with high angulation shorten the hip abductors and may lead to the commonly observed weakness of the hip abductors. Simulated surgeries showed that horizontal osteotomies preserve the moment-generating capacity of the hip abductors and may therefore decrease the number of patients who limp after surgery.

Just as computer graphics systems have enhanced other areas of design and analysis, an interactive, graphics-based model of the human lower limb can facilitate the design and analysis of surgical procedures.

TRIDIMENSIONAL KINEMATIC AND KINETIC ANALYSIS OF ASYMMETRICAL MANUAL MATERIALS HANDLING TASKS

by

Denis Gagnon

A Thesis in Biomechanics submitted to the Faculté des études supérieures
Université de Montréal
in Partial Fulfilment of the Requirements for the Degree of
Doctor of Philosophy

Supervisor: Micheline Gagnon

Manual materials handling (MMH) is a frequent and physically demanding activity in industry. The majority of MMH tasks involve asymmetrical body movements consisting of torsion and flexion or extension of the trunk. A high risk of low back injury is believed to be present with this type of motion.

In order to evaluate the triaxial (3D) loading at the lumbar spine level (L5/Sl), a set of FORTRAN computer programs was developed and validated. The body segment kinematics and kinetics were estimated using a 3D dynamic approach. The software was then used to assess the effects of different manoeuvres during asymmetrical box handling on the net loading at the LS/Sl joint.

A system using two high speed Locam cameras and two large mirrors provided the 3D kinematic data, while the external forces were collected by two AMTI force plates. The triaxial net muscular moments at the LS/S 1 joint were computed for each experimental condition and the maximal values were selected for statistical analysis (ANOVA with repeated measures).

In a first experiment, three execution conditions (Slow, Fast and Accelerated) of an 11.6 kg box lifting task and two execution conditions (Slow and Fast) of a box lowering task were performed twice by each of five subject. The results demonstrated that the velocity and acceleration conditions increased the majority of the net muscular moment components at the LS/Sl joint for the lifting tasks. However, the velocity effect was minimal for the lowering tasks. Comparisons between the lifting and the lowering tasks showed minimal differences between the two, suggesting an equivalent loading for the two types of operation.

In a second experiment, two execution conditions for the operation of box receiving and its subsequent loading on a shelf, were investigated. Two variations of the width of the support base (Normal and Narrow) and two variations involving task continuity (Continuous and Interrupted) were

performed twice by each subject. The results showed a negligible effect of both the width of the support base and the task continuity on the net muscular moment components at the LS/Sl joint.

Published material:

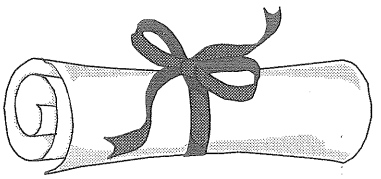
Gagnon, D. and Gagnon, M. (1990). The effect of movement velocity in asymmetrical handling tasks on triaxial net muscular moments at the lumbo-sacral joint. *Journal of Biomechanics*, 23(7), 712.

Gagnon, D. and Gagnon, M. (1989). A three-dimensional (3D) biomechanical analysis of the effect of velocity on asymmetrical manual materials handling. *Human Factors Association of Canada 22nd Annual Conference Proceedings*, Toronto, Canada, 229-233.

Gagnon, D. and Gagnon, M. (1989). The effect of movement velocity in asymmetrical handling tasks on triaxial net muscular moments at the lumbo-sacral joint. *Proceedings of the 13th Congress of the American Society of Biomechanics*, Burlington, Vermont, 8-9.

Gagnon, D. and Gagnon, M. (1987). Development and validation of a tridimensional (3D) stereophotogrammetric analysis system for the assessment of working tasks. *Human Factors Association of Canada 20th Annual Conference Proceedings*, Montréal, Canada, 159-161.

This thesis is available in French only. The complete reference is: Gagnon, Denis (1990). Analyse cinématique et cinétique tridimensionnelle de tâches asymétriques de manutention. Thése de doctorat, Université de Montréal, 362 pp.



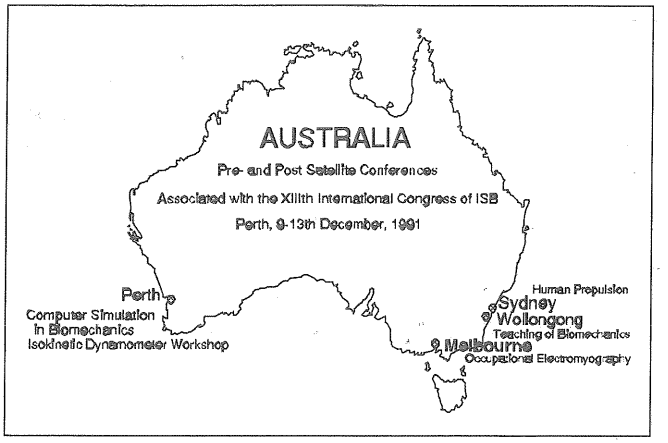
EDITOR'S NOTE

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.

Abstracts should not be more than 500 words in length, and any complex equations or graphics must be in good quality black and white form for ease of reproduction.

Conference news



Five satellite conferences are scheduled to be held in Australia in December, 1991, in association with the XIIIth Congress of ISB. Outlines of four of these have already appeared in previous issues of this newsletter, and the essential details of those are now listed in the Calendar of Scientific Events on page 10. The fifth conference, which has not been previously announced, follows the tradition established some years ago in the USA where some very successful conferences on the Teaching of Kinesiology were held. This **Teaching of Biomechanics** conference will have several themes, both in terms of technology (Computer-aided Instruction; Motion Analysis) and content (Occupational Biomechanics; Sports Biomechanics; Clinical Biomechanics; Biomechanics for the Physical Educator/Coach). Each theme will have a keynote speaker followed by free communications including provision for poster presentations. It will be hosted by the Department of Human Movement Studies at the University of Wollongong (near Sydney), and will be held on December 16 and 17 (i.e. following the ISB Congress). For further information contact:

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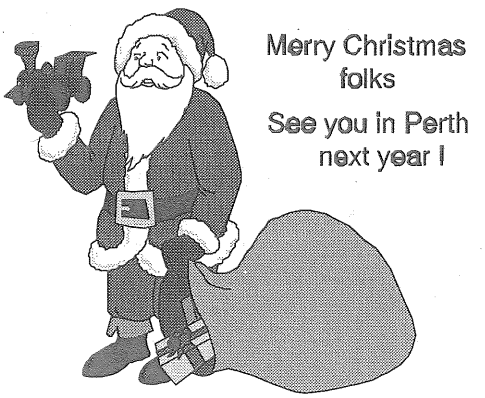

Calendar of scientific events

April 8-13, 1991
Second World Congress of Science and Football, Maastricht, The Netherlands. c/o Prof. J.M. Greep, Dept. of Surgery, Academic Hospital St. Annadel, Maastricht, The Netherlands.

April 18-19, 1991
Biomechanics Seminar, Centre for Biomechanics, Göteborg, Sweden, Contact: Gunilla Ekman, Centre for Biomechanics, Chalmers University of Technology, S-412 96 Göteborg, Sweden. Tel: +46-31-721515; Fax: +46-31-721192.

July 3-5, 1991
Advances in Hydrotherapy 2: Movement and Immersion in Water, University of Nijmegen, The Netherlands. Contact: Mrs J. Koot, University of Nijmegen, P.O. Box 9111, 6500 HN Nijmegen, The Netherlands. Fax: +31-80-567-956.

July 28-31, 1991
International Symposium on 3-D Analysis of Human Movement, Hotel des Gouverneurs, Montréal, Québec, Canada. Secretariat: Laboratoire d'étude du mouvement, Centre de recherche pédiatrique, Hôpital Sainte-Justine, 3175 Côte Ste-Catherine, Montréal, PQ, H3T 1C5, Canada.

July 28-August 2, 1991
11th International Congress of the World Confederation for Physical Therapy, Barbican Centre, London. Congress Secretariat: Conference Association WCPT, 27 A Medway Street, London SW1P 2BD, England. Tel: 01-222-9493.

October 13-16, 1991
7th International Conference on Mechanics in Medicine and Biology, Ljubljana, Yugoslavia. Enquiries to: Dr Uros Stanic, Joseph Stefan Institute, Jamova 39, YU-61000 Ljubljana, Yugoslavia. Tel: +38-61-214-299; Fax: +38-61-219-385.

December 5-6, 1991
Symposium on Human Propulsion - An integration of Man and Machine, Cumberland College of Health Sciences, Sydney, Australia, c/o Rehabilitation Centre, PO Box 170, Lidcome, NSW 2141, Australia. Tel: 61-2-646 6403; Fax: 61-2-646 4853.

December 5-6, 1991
Third International Symposium on Computer Simulation in Biomechanics, Perth, Western Australia. Congress Secretariat: Ms Rosemary Ingham, Department of Human Movement Studies, The University of Western Australia, Nedlands, WA 6009, Australia. Tel: 61-9-380 2360; Fax: 61-9-380 1039.

December 9-13, 1991
XIIIth ISB Congress on Biomechanics, Perth, Western Australia. Congress Secretariat: Ms Rosemary Ingham, Department of Human Movement Studies, The University of Western Australia, Nedlands, WA 6009, Australia. Tel: 61-9-380 2360; Fax: 61-9-380 1039.

December 16-17, 1991
The Teaching of Biomechanics, University of Wollongong, NSW, Australia. Contact: Dr Peter D. Milburn, Department of Human Movement Studies, The University of Wollongong, P.O. Box 1144 (Northfields Avenue), Wollongong, NSW 2500, Australia. Tel: 61-42-27 0881; Fax: 61-42-27 0486.

February 2-7, 1992
International Scientific Congress associated with the 1992 Winter Olympic Games and devoted to sport sciences related to mountain sports. Enquiries to: CERNA, B.P. 35, 73202 Albertville Cedex, France.

May 12-14, 1992
International Scientific Conference on Prevention of Work-Related Musculosketal Disorders, Stockholm, Sweden. Conference Secretariat: Ms Gun Carlsson, National Institute of Occupational Health, S-17184 Solna, Sweden. Tel: +46-8-730-9100: Fax: +46-8-730-1967.

June 21-24, 1992
Eighth Meeting of the European Society of Biomechanics, in association with the European Society of Biomaterials. Conference Secretariat: ESB92, Istituto di Fisiologia Umana, Università 'La Sapienza', Piazzale Aldo Moro 5, 00185 Rome, Italy. Tel: 39-6-490673; Fax: 39-6-4452824.

August 3-8, 1992
Eighth International Congress of Biorheology, Yokohama, Japan. Executive Secretary: Dr. Takuo Yokose, 3rd Dept. of Internal Medicine, Jikei University School of Medicine, 3-25-8 Nishi-Shinbashi, Minato-ku, Tokyo 105, Japan. Fax: +81-3-3578-9753.

August 24-28, 1992
Second North American Congress on Biomechanics, combining the 16th Annual Meeting of the American Society of Biomechanics (ASB) and the 7th Biennial Conference of the Canadian Society for Biomechanics/Société Canadienne de Biomécanique (CSB/SCB), at the McCormick Center Hotel, Chicago, USA. Conference Co-Chairman: Dr Louis Draganich, Dept. of Surgery, University of Chicago, 5841 South Maryland Avenue, Box 421, Chicago, IL 60637, U.S.A. Tel: +1-312-702-6839.

September 4-5, 1992
International Conference on Experimental Mechanics: Technology Transfer Between High Tech. Engineering & Biomechanics, University of Limerick, Ireland. Organised by the Bioengineering Measurements Group of the British Society for Strain Measurement (BSSM) and co-sponsored by the USA Society of Experimental Mechanics (SEM). Conference Secretariat: BSSM'92; Fax: 353-61-330316 (Ireland, Eire) or e-mail at LittleT@ul.ie

ISB membership news

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