

Preliminary Program

BIOMECHANICS AND NEURAL CONTROL OF MOVEMENT

***NEURO-MECHANICAL CONTROL: INTERACTION
BETWEEN NEURAL CIRCUITS AND BIOMECHANICS***

June 1-6, 1996
Mt. Sterling, Ohio, USA



Conference Chair:

Patrick Crago

**Biomedical Engineering Department
Case Western Reserve University
Applied Neural Control Laboratory
Charles B. Bolton Building #3480
Cleveland, OH 44106
Phone: 1-216-368-3977
Fax: 1-216-368-4872
E-mail: pec3@po.cwru.edu**

Conference Co-Chair:

Jack Winters

**Biomedical Engineering Program
Catholic University of America
Room 105 Pangborn Hall
620 Michigan Avenue
Washington, DC 20064
Phone: 1-202-319-5843
Fax: 1-202-319-4499
E-mail: winters@pluto.ee.cua.edu**

**Engineering Foundation Conferences
345 East 47th Street New York, NY 10017
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Deer Creek Resort and Conference Center

Mt. Sterling, Ohio, USA

(40 miles south of Columbus)

ORGANIZING COMMITTEE

**Zev Rymer
Rehabilitation Institute of Chicago
Chicago and Northwestern University, USA**

**Dick Stein
University of Alberta
Edmonton, Alberta, Canada**

**Gerald Loeb
Queen's University
Kingston, Ontario, Canada**

**Tamar Flash
Weizmann Institute of Science
Rehovot, Israel**

**Frans van der Helm
Delft University of Technology
Delft, The Netherlands**

POSTER COORDINATOR

**Robert F. Kirsch
Case Western Reserve University
Cleveland, OH, USA**

SATURDAY, JUNE 1, 1996

3:00 pm - 6:00 pm

Registration

6:00 pm - 7:30 pm

Dinner

7:30 pm - 10:00 pm

Opening Reception

SUNDAY, JUNE 2, 1996

NEURO-MUSCULOSKELETAL MODELING

9:30 am - 11:30 am

Sunday Brunch

11:45 am - 12:00 noon

Welcome and Introduction

Chair: Pat Crago, Case Western Reserve University

Co-Chair: Jack Winters, Catholic University of America Engineering

Foundation: Will Durfee, University of Minnesota

12:00 noon - 3:00 pm

SESSION IA: Neural and Muscular Properties Related to Control

Session Chair:

Dick Stein, University of Alberta

Speakers:

Marc Binder, University of Washington

Rick Lieber, University of California, San Diego

Dick Stein, University of Alberta

Discussant:

Peter Huijing, Vrije Universiteit Amsterdam

Light Refreshments

3:00 pm - 5:00 pm

Ad hoc Discussions/Free Time

5:00 pm - 6:15 pm

Dinner

6:30 pm - 9:30 pm

SESSION IB: Creating Neuro-Musculoskeletal Models

Session Chair:

Jerry Loeb, Queen's University, Kingston

Speakers:

Felix Zajac, Stanford University

Rob Kearney, McGill University

Jiping He, Arizona State University

Discussants:

A.J. Van Soest, Free University of Amsterdam

Pat Crago, Case Western Reserve University, OH

9:45 pm - 11:00 pm

POSTER SESSION with Social Hour

MONDAY, JUNE 3, 1996

7:00 am - 8:30 am

Breakfast

8:45 am - 12:00 noon

SESSION IIA: Rhythmic Movements in Natural and Artificial Systems

Session Chair:

Robert Full, University of California, Berkeley

Speakers:

Robert Full, University of California, Berkeley

Orjan Ekeberg, Royal Institute of Technology, Stockholm James Abbas,
University of Kentucky

Discussants:

Holk Cruise, University of Bielefeld, Germany

Blake Hannaford, University of Washington

12:15 pm - 1:30 pm

Lunch

1:30 pm - 4:30 pm

Ad hoc Discussions/Free Time

4:30 pm - 5:30 pm

POSTER SESSION with Cash Bar

5:30 pm - 6:45 pm

Dinner

7:00 pm - 9:30 pm

SESSION IIB: Posture And Balance On Earth And In Space

Session Chair:

Fay B. Horak, RS Dow Neurological Sciences Institute

Speakers:

Fay B. Horak, RS Dow Neurological Sciences Institute

William H. Paloski, Space Biomedical Research Institute, NASA

Dava Newman, MIT

Discussants:

Arthur Kuo, University of Michigan

Ron Jacobs, University of Twente

9:30 pm - 11:00 pm

POSTER SESSION with Social Hour

TUESDAY, JUNE 4, 1996

POSTURE AND GOAL-DIRECTED MOVEMENTS

7:00 am - 8:30 am

Breakfast

8:45 am - 12:00 noon

SESSION IIIA: Neural and Mechanical Contributions to Posture and Movement Control

Session Chair:

W.Z. Rymer, Northwestern University

Speakers:

Reza Shadmehr, John Hopkins University

Daniel Wolpert, Institute of Neurology, London, England

Robert F. Kirsch, Case Western Reserve University

Discussants:

Gerald Gottlieb, Boston University

12:15 pm - 1:30 pm

Lunch

1:30 pm - 4:30 pm

Ad hoc Discussions/Free Time

4:30 pm - 5:30 pm

POSTER SESSION with Cash Bar

5:30 pm - 6:45 pm

Dinner

7:00 pm - 9:30 pm

SESSION IIIB: Movement Control in Relation to Dynamically Changing Postural Force Fields

Session Chair:

Tamar Flash, Weizmann Institute of Science, Israel

Speakers:

Andy Schwartz, LaJolla Neurosciences Institute

Bob Sainburg, Columbia University

Discussants:

Sandro Mussa-Ivaldi, Northwestern University

Lina Massone, Northwestern University

9:30 pm - 11:00 pm

SESSION with Social Hour

WEDNESDAY, JUNE 5, 1996

MULTI-LEVEL MOVEMENT CONTROL

7:00 am - 8:30 am

Breakfast

8:45 am - 12:00 noon

**SESSION IVA: Computational Approaches to Biological
Sensorimotor Systems**

Session Chair:

Frans van der Helm, Delft University of Technology

Speakers:

Frans van der Helm, Delft University of Technology

Herbert Hatze, University of Vienna, Austria

Yasuharu Koike, ATR Human Information Proc. Labs, Kyoto, Japan

Discussants:

A.J. VanSoest, Vrije Universiteit Amsterdam, The Netherlands

12:15 pm - 1:30 pm

Lunch

1:30 pm - 4:30 pm

Ad hoc Discussions/Free Time

4:30 pm - 5:30 pm

POSTER SESSION with Cash Bar

5:30 pm - 6:45 pm

Dinner

7:00 pm - 9:30 pm

**SESSION IVB: Optimizing Human-Machine Interaction: Applications
in Rehabilitation**

Session Chair:

Jack Winters, Catholic University

Speakers:

Steve Lehman, University of California, Berkeley

Neville Hogan, Massachusetts Institute of Technology

Discussants:

Scott Delp, Northwestern University

Jack Winters, Catholic University

9:30 pm - 11:00 pm

POSTER SESSION with Social Hour

THURSDAY, JUNE 6, 1996

SYNTHESIS, WRAP-UP, AND PLANNING

7:30 am - 9:30 am

Breakfast and Speaker

9:45 am - 11:00 am

Synthesis and Wrap-up Session

11:00 am - 11:45 am

New Chairpersons' Planning Session

12:00 noon

Lunch and Departure
(Boxed Lunches Available with Prior Notification)

POSTERS

A Planar Manipulator for the Study of Multi-Joint Human Arm Posture and Movement Control

Acosta, A. and Kirsch, R.F., Case Western Reserve University

Two-Thirds Power Law and Control Models

Baraduc, P., Université Pierre et Marie Curie

Kinematic Changes in Proprioceptive Placing After Spinal Cord Contusions in Rats

Basso, D.M., Ohio State University

Sensorimotor Interactions in the Haptic Perception of Virtual Objects

Beauregard, G. L., and Srinivasan, M.A., Massachusetts Institute of Technology

On the Curvature of Goal-Directed Hand Movements

Boessenkool, J.J., Nijhof, E.-J., and Erkelens, C. J., Utrecht University

'Preflexes' - programmable, high-gain, Zero-Delay Intrinsic Responses of Perturbed Musculoskeletal Systems

Brown, I.E., and Loeb, G.E., Queens University

Is Adaptive Learning Independent of Movement Kinematics?

Condit, M.A., Gandolfo, F., and Mussa-Ivaldi, F.A., Northwestern University

Modeling Directional Selectivity of Corticospinal Neurons Using Equilibrium Point Control

Crowe, A., University of Sheffield

Index-Finger Motion, Forces and EMG During Touch-Typing: Is It a Ballistic Process?

Dennerlein, J.T., Mote, Jr. C.D., and Rempel, D.M., University of California, Berkeley

Position Feedback Estimation Procedure in a Large-Scale Musculoskeletal System Via Extended Linearization

Dhaher, Y.Y., Michigan State University

Investigating Intermittent Control of Human Arm Movements

Doeringer, J.P., and Hogan, N., Massachusetts Institute of Technology

A Method for the Quantitative Assessment of the Contribution of Correlated Motor Unit Discharges to Posture and Movement

Donohoe, M., Rosenberg, J.R., Breeze, P., Halliday, D.M., and Conway, B.A., University of Glasgow

The Use of Mechanical Properties of the Human Body in CNS Control Strategies

Dounskaia, N.V., Swinnen, S.P., Spaepen, A.J., and Verschueren, S.M.P., Russian Academy of Science

Is Spontaneous Rupture of the Human Achilles Tendon Related to Biomechanical and Neural Factors?

Engstrom, C., Morgan, D., Neal R., Kippers, V., and Buckley, R., University of Queensland

Stability and Control of Passive Locomotion in 3-D

Fowble, J.V., and Kuo, A.D., University of Michigan

Shoulder and Elbow Muscle Activity in Goal-Directed Arm Movements

Gabriel, D.A., Mayo Clinic

Regulation of Force-Field Magnitude and Structure in the Reflex Responses of Spinal Frogs

Giszter, S., Davies, M.R., and Kargo, W., Medical College of Pennsylvania, Hahneman University

Variation of Finger Tip Impedance in Pinch Grip

Hajian, Aram Z., and Howe, R.D., Harvard University

POSTERS (continued)

Altered Gait Dynamics in the Elderly: Fractal Analysis of the Stride Interval

Hausdorff, J.M., Mitchell, S.L., Edelman, H.K., Wei, J.Y., and Goldberger, A.L., Beth Israel Hospital

EMG Responses to Multidirectional Surface Translations

Henry, S.M., Fung, J., and Horak, F.B., R.S. Dow Neurological Sciences Center

Is the Force Constraint Strategy Used by Humans to Maintain Stance and Equilibrium?

Horak, F., Fung, J., and Henry, S.M., R.S. Dow Neurological Sciences Center

A Simplified Control Strategy for Postural Coordination in Human

Jacobs, R., Koopman, B., Veltin, B., Huijing, P., Nene, A., van der Kooij, H., and Grootenboer, H. University of Twente

Nonlinear Analysis of Central Pattern Generators Used for Controlling Locomotion: Characterizing Stability Regions, Bifurcation, Synchronization and Periodicity

Jayasundera, S.P., and Abbas, J.J., Catholic University

The Inverted Pendulum Model - A Tool for Postural Control Analysis

Karlsson, A., Persson, T., and Lanshammar, H., Uppsala University

Interrelation of Posturographic Parameters During Standing

King, D.L., Zatsiorsky, V.M., The Pennsylvania State University

Identification of Multi-Input Dynamic Systems: Limb Stiffness Dynamics

Kirsch, R.F., Perreault, E.J., and Acosta, A.M., Case Western Reserve University

Natural Joint-Rotations Applied in Human Arm-Movement Control

Laczko, J., and Tihanyi, J., Hungarian University of Physical Education

Control of the Finger Intrinsic Muscles Using Functional Electrical Stimulation

Lauer, R.T., Kilgore, K.L., and Peckham, P.H., Case Western Reserve University

Modeling and Simulation of Human Walking: Using a Neuro-Musculo-Skeletal Model to Design a Neural Prosthetic Device

Leung, P.K., and Blum, E.K., University of Southern California

Change in Variability During Prolonged Downhill Running

Li, L., Hardin, E., van Emmerik, R., Caldwell, G.E., and Hamill, J., University of Massachusetts

Lengthening Muscle Exhibits Minimal Damping Properties

Lin, D.C., and Rymer, W.Z., Northwestern University

Shortening Induced Alterations in Isometric Length-Force Properties of Muscle

Meijer, K., Grootenboer, H.J., Koopman, H.F.J.M., and Huijing, P.A., University of Twente

Anatomic Parameter Measurements for Use in the Modeling of Human Gait and in the Development of Lower Limb Neural Prostheses

Miles, Douglas, J., Leung, P., and Blum E.K., University of Southern California

Elbow Muscle Architecture and Moment Arms in Differently Sized Specimens

Murray, W.M., Wyles, D.L., Buchanan, T.S., and Delp, S.L., Northwestern University

Dynamic Simulation and Computer Animation of Extra-Vehicular Activity (EVA)- Spartan Payload Manipulation

Newman, D., and Schaffner, G., Massachusetts Institute of Technology

Estimator Based Control Model of Human Adaptation to Reduced Gravity

Newman, D., and Schultz, K.U., Massachusetts Institute of Technology

On Estimating Relative Postural Stability

Paloski, W.H., and Nicholas S.C., NASA / Johnson Space Center

Is Spasticity the Primary Cause of Contractures in Post Stroke Hemiplegia?

Pandyan, A.D., Granat, M.H., Cameron, M., and Stott, D.J., University of Strathclyde

A Portable Evaluation System Used to Study Postural Coordination During Seated Functional Tasks

Pieters, T., Catholic University of America

The Coordination of Arm and Trunk Movements During Pointing in the Absence of Vision

Pigeon, P., Feldman, A.G., and Yahia, L.'H., Ecole Polytechnique de Montreal

Determination of Preserved Working Space in Humans with Tetraplegia

Popovic, M., and Popovic D., University of Miami

Development of a Method to Approximate the Pronation/Supination in a Dynamic Model of Rigid Bodies

Reich, J., Daunicht, W.J., Hefter, H., and Freund, H.J., Universitaet Deusseldorf

A Device for Quantifying Workspace Deficits and Abnormal Synergetic Control After Stroke

Reinkensmeyer, D.J., Lorber, D.M., and Rymer, W.Z., Rehabilitation Institute of Chicago

Trajectory Generation by Parametric Optimization to Predict the Kinematics and Kinetics of a Subject Rising from a Chair

Riener, R., Bahrami, F., and Schmidt, G., Technical University of Munich

Physiologically Based Multi-Input Model of Artificial Muscle Activation

Riener, R., Quintern, J., and Schmidt, G., Technical University of Munich

A Comparison of Single and Multi-Joint Arm Movements in the Horizontal Plane

Scheidt, R.A., and Rymer, W.Z., Northwestern University

Reduced Reliance on Visual Feedbacks as a Function of Practice

Seidler, R.D., and Stelmach, G.E., Arizona State University

The Visible Human Project- Applications in Biomechanical Modeling

Sellberg, M., Engineering Animation, Inc.

A Quantitative Model for Implementation of Control Strategies During Postural Movements

Sherkat, M.R., Barin K., Hemami, H., and Parnianpour, M., Ohio State University

The Effect of Estimation of Maximum Muscle Stress on the Predictions of an EMG-Based Model of Spinal Loading

Sparto, P.J., Parnianpour, M., Marras, W.S., Granata, K.P., Reinsel, T.E., Simon, S.R., Ohio State University

Multivariate Measures of Postural Control in Eight Astronauts

Speers, R.A., Paloski, W.H., and Kuo A.D., University of Michigan

Phase Plane Analysis to Predict Onset of 'Preventive Stepping

Srikrishna, P., Krebs, D., and Young, L., Harvard Medical School

Learning Control of a Human Arm Model

Stroeve, S., Delft University of Technology

POSTERS (continued)

The Effects of Load and Unexpected Delays, on Stretch Reflexes of Human Elbow Muscles

Tsaousidis, N., Pennsylvania State University

Artificial Neural Network Approaches to Pattern Recognition for Synergy Analysis of Electromyographic Data

Tucker, C.A., State University of New York at Buffalo

Task-Dependent Activation Strategies of the Motoneuron Pool

van Bolhuis, B.M., Medendorp, W.P., and Gielen, C.C.A.M., University of Nijmegen

Model Study of Fiber Behavior in Dynamic Pennate Skeletal Muscle

van der Linden, B.J.J.J., Huijing, P.A., Koopman, H.F.J.M., and Grootenboer, H.J. University of Twente

A Possible Purpose of Naturally Occurring Cell Death, Modeled by Pruning a Neural Network

van Heijst, J.J., and Vos J.E., University of Groningen

Muscle Spindle Ensemble Encoding of Human Movement: A Combined Experimental and Simulation Investigation of Goal Directed Movement

Wallace, K.R., and Kerr, G.K., University of Oxford

An Algorithm for Controlling Three-Dimensional Arm Movements

Weber, D.J., He, J., Arizona State University

Inverse Dynamics Analysis of Joint Torques Used in Balance Recovery After a Forward Fall

Wojcik, L.A., Thelen, D.G., Ashton-Miller, J.A., Schultz, A.B., and Alexander, N.B. University of Michigan

Cutaneous Reflexes in Leg Muscles After Electrical Stimulation of the Dorsal Surface of the Foot Functionally Modify Human Walking

Zehr, E.P., Komiyama, T., and Stein, R.B., University of Alberta

Numerical Stability in Direct Dynamics Simulation

Zhao, W., and Wu, G., Pennsylvania State University