

**2nd International Symposium on Adaptive Motion of Animals and Machines
(AMAM2003)
March 4-8, 2003, Kyoto, Japan**

Tuesday March 4, 2003

14:00 – Registration Desk Open

Opening Remarks

15:00 – 15:15

Tutorial I

Chair *H. Kimura*, Univ. of Electro-Communications

15:15 – 16:00 TuP-K-1

Control principles for locomotion - looking toward biology

A.H. Cohen

University of Maryland

<COFFEE BREAK>

Tutorial II

Chair *A.H. Cohen*, University of Maryland

16:15 – 17:00 TuP-K-2

Purposive Locomotion of Insect in Indefinite Environment

M. Yano

Tohoku University

Welcome Party

17:30 – 19:00

Wednesday March 5, 2003

09:05 – Registration Desk Open

Special Lecture

Chair *A.H. Cohen*, University of Maryland

09:30 – 10:30 WeA-K-3

Higher Nervous Control of Quadrupedal vs Bipedal Locomotion in Non-Human Primates; Common and Specific Properties

S. Mori

National Institute for Physiological Sciences, Japan

<COFFEE BREAK>

Session WeA-I: Higher Level Control of Bipedal Locomotion

Chairs *N. Ogihara*, Kyoto University
A.E. Patla, University of Waterloo

Invited Talk

10:45 – 11:30 WeA-K-4
Coupling static and dynamic environmental information from the visual system to locomotor action
A.E. Patla
University of Waterloo

Contributed Paper

11:30 – 11:50 WeA-I-1
Higher Nervous Control System in Bipedally Walking Japanese Monkey, *Macaca fuscata*
F. Mori and S. Mori
National Institute for Physiological Sciences, Japan

11:50 – 12:10 WeA-I-2
Visuomotor Coordination in Walking Machines
M.A. Lewis
Iguana Robotics, Inc.

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Session WeP-I: Analysis & Control of Bipedal Locomotion

Chairs *K. Hosoda*, Osaka University
M.A. Lewis, Iguana Robotics, Inc.

13:15 – 13:35 WeP-I-1
Design and Construction of MIKE; a 2D autonomous biped based on passive dynamic walking
M. Wisse and J. van Frankenhuyzen
Delft University of Technology

13::35 – 13:55 WeP-I-2
Motion Generate and Control of Quasi-Passive-Dynamic-Walking based on the concept of Delayed Feedback Control
Y. Sugimoto and K. Osuka
Kyoto University

13:55 – 14:15 WeP-I-3
Minimum Input Walking Gait of Four-DOF Biped Model Solved by Optimal Trajectory Planning Method
C. Peng and K. Ono
Tokyo Institute of Technology

14:15 – 14:35 WeP-I-4
Static balance control and external force estimation using ground reaction forces
S. Ito^{1,2}, Y. Aoyama¹ and H. Kawasaki¹
¹Gifu University and ²Bio-mimetic Control Research Center, RIKEN

14:35 – 14:55 WeP-I-5
Analysis of Dynamics of Passive Walking from Energy Function and Eigenvalues
Y. Ikemata, A. Sano and H. Fujimoto
Nagoya Institute of Technology

<COFFEE BREAK>

Session WeP-II: Rhythmic Motion Analysis & Implementation

Chairs *K. Ono*, Tokyo Institute of Technology
K. Senda, Kanazawa University

15:10 – 15:30 WeP-II-1

Measurement and Numerical Simulation of a Flapping Butterfly
K. Senda, T. Tanaka and M. Sawamoto
Kanazawa University

15:30 – 15:50 WeP-II-2

An Analog CMOS Circuit Implementing CPG Controller for Quadruped Walking Robot
K. Nakada, T. Asai and Y. Amemiya
University of Hokkaido

15:50 – 16:10 WeP-II-3

A Bidirectional Weak Coupling Approach To Rhythmic Movement
H. Hirai and F. Miyazaki
Osaka University

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Session WeP-II (OS): Control Principles from Biologically Inspired Mechanics

Chairs *F. Matsuno*, Tokyo Institute of Technology
J.G. Cham, Stanford University

16:25 – 16:45 WeP-III-1

Simulation study of self-excited walking of a biped mechanism with bent knee
K. Ono and X. Yao
Tokyo Institute of Technology

16:45 – 17:05 WeP-III-2

On Recent Bio-mimetic Studies of Legged Locomotion --- Diversity, Adaptability and Energy Consumption for Hexapod, Quadruped and Biped
Z.W. Luo, T. Odashima, F. Asano and S. Hosoe
Bio-mimetic Control Research Center, RIKEN

17:05 – 17:25 WeP-III-3

Necessity of Body Image in Applying Reinforcement Learning to Redundant Robots
K. Ito¹, A. Gofuku¹ and M. Takeshita¹, and F. Matsuno²
¹Okayama University and ²Tokyo Institute of Technology

17:25 – 17:45 WeP-III-4

Control of Snake Like Robot for Locomotion and Manipulation
M. Yamakita^{1,2}, T. Yamada¹ and K. Tanaka¹
¹Tokyo Institute of Technology and ²Bio-mimetic Control Research Center, RIKEN

17:45 – 18:05 WeP-III-5

Experimental Study on Control of 3D Redundant Snake Robot based on Kinematic Model
F. Matsuno and K. Suenaga
Tokyo Institute of Technology

Thursday March 6, 2003

09:05 – Registration Desk Open

Keynote Speech I

Chair *K. Osuka*, Kyoto University

09:30 – 10:15 ThA-K-5

Biorobotics in the Age of Integration

R.J. Full

University of California at Berkeley

<COFFEE BREAK>

Session ThA-I: Dynamic & Adaptive Locomotion

Chairs *M. Buehler*, McGill University

K. Tsujita, Kyoto University

10:30 – 10:50 ThA-I-1

Adapting Work Through Actuator Phasing in Running

J.G. Cham and M.R. Cutkosky

Stanford University

10:50 – 11:10 ThA-I-2

On the Dynamics of Bounding and Extensions Towards the Half-Bound and the Gallop Gaits

I. Poulakakis, J.A. Smith and M. Buehler

McGill University

11:10 – 11:30 ThA-I-3

Exploiting Friction for the Locomotion of a Hopping Robot

F. Iida

University of Zurich

11:30– 11:50 ThA-I-4

The Influence of Friction on Gait and Energy Efficiency of the Walking Robot Based on Rhythmic Control

H. Takemura, J. Ueda, Y. Matsumoto and T. Ogasawara

Nara Institute of Science and Technology

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Keynote Speech II

Chair *K. Tsuchiya*, Kyoto University

13:00 – 13:45 ThP-K-6

Control of hexapod walking in biological systems

**H. Cruse, V. Durr, J. Schmitz, A. Schneider*

University of Bielefeld

<COFFEE BREAK>

Session ThP-I (OS): Mobiligence

Chairs *A. Ishiguro*, Nagoya University
H. Cruse, University of Bielefeld

14:00 – 14:20 ThP-I-1
A Turning Strategy of a Multi-Legged Locomotion Robot
K. Tsuchiya, S. Aoi and K. Tsujita
Kyoto University

14:20 – 14:40 ThP-I-2
Dynamics Based Integration of Motion Adaptation for a Quadruped Robot
H. Kimura, Y. Fukuoka and T. Mimura
University of Electro-Communications

14:40 – 15:00 ThP-I-3
Toward "well-balanced" design: a robotic-case study - How should control and body dynamics be coupled?
A. Ishiguro¹, K. Ishimaru¹, K. Hayakawa¹ and T. Kawakatsu²
¹Nagoya University and ²Tohoku University

15:00 – 15:20 ThP-I-4
Development of a Hexapod Robot focusing on Leg Compliance
H. Hayashi, T. Kondo and K. Ito
Tokyo Institute of Technology

15:20 – 15:40 ThP-I-5
Learning Energy Efficient Walking with Ballistic Walking
M. Ogino, K. Hosoda and M. Asada
Osaka University

<COFFEE BREAK>

Session ThP-II: Neural Control & Learning

Chairs *A.J. Ijspeert*, Swiss Federal Institute of Technology
R. Pfeifer, University of Zurich

15:55 – 16:15 ThP-II-1
Gait transition from swimming to walking: investigation of salamander locomotion control using nonlinear oscillators
A.J. Ijspeert¹ and J.-M. Cabelguen²
¹Swiss Federal Institute of Technology
²The French Institute of Health and Medical Research

16:15 – 16:35 ThP-II-2
Bilateral Decoupling in the Neural Control of Biped Locomotion
C. Paul
University of Zurich

16:35 – 16:55 ThP-II-3
A Motion Learning Method using CPG/NP
F. Nagashima
Fujitsu Laboratories

16:55 – 17:15 ThP-II-4
Learning to bounce: First lessons from a bouncing robot
M. Lungarella and L. Berthouze
Neuroscience Research Institute, Japan

17:15 – 17:35 ThP-II-5
Reinforcement Learning for Biped Robot
Y. Nakamura¹, M. Sato^{2,3} and S. Ishii^{1,3}
¹Nara Institute of science and technology, ²ATR and ³CREST, JST

Official Robot Demonstration

Friday March 7, 2003

09:05 – Registration Desk Open

Keynote Speech III

Chair *K. Ito*, Tokyo Institute of Technology

09:15 – 10:00 FrA-K-7
Jumping, running, dancing, flying, reaching: moving into the future.
Design principles for adaptive mobile systems
R. Pfeifer
University of Zurich

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Session FrA-I: Modeling & Analysis of Locomotion

Chairs *R.J. Full*, University of California at Berkeley
H. Witte, Technical University of Ilmenau

Invited Talk

10:15 – 10:50 FrA-K-8
Biomechatronics - how much biology does the engineer need?
H. Witte
Technical University of Ilmenau

Invited Talk

10:50 – 11:25 FrA-K-9
Towards emulating adaptive locomotion of a quadrupedal primate by a neuro-musculo-skeletal model
**N. Ogiwara¹ and N. Yamazaki²*
¹Kyoto University and ²Keio University

Contributed Paper

11:25 – 11:45 FrA-I-1
An analytical study of the cost of transport for legged locomotion
J. Nishii
Yamaguchi University

11:45 – 12:05 FrA-I-2

Modeling of Insects Legs by Inverse Kinematics Analysis

S. Laksanacharoen¹, R.D. Quinn² and R.E. Ritzmann²

¹King Mongkuts Institute of Technology North Bangkok

²Case Western Reserve University

Official Technical Tour to ATR (half day)

12:30 –

Banquet at the Rihga Royal Hotel Kyoto

19:00 – 21:00

Saturday March 8, 2003

09:05 – Registration Desk Open

Session SaA-I: Biologically Inspired Machine Design & Control Architecture

Chairs *H.H. Lund*, University of Southern Denmark

H. Kimura, Univ. of Electro-Communications

09:30 – 09:50 SaA-I-1

A Cockroach Inspired Robot With Artificial Muscles

D.A. Kingsley, R.D. Quinn and R.E. Ritzmann

Case Western Reserve University

09:50 – 10:10 SaA-I-2

The RoboCoq Project : Modelling and Design of a Bird-like Robot Equipped with Stabilized Vision

V. Hugel¹, A. Abourachid², H. Gioanni³, M. Maurice³, O. Stasse^{1,4}, P. Bonnin¹ and P. Blazevic¹

¹Laboratoire de Robotique de Versailles

²Museum National d' Histoire Naturelle

³Laboratoire de Neurobiologie des Reseaux Sensori-moteurs

⁴Laboratoire de Traitement et Transport de l' Information

10:10 – 10:30 SaA-I-3

Viki Humanoid: Towards an Integrated Approach

H.H. Lund, L. Pagliarini, L. Paramonov and M.W. Jrgensen

University of Southern Denmark

10:30 – 10:50 SaA-I-4

A Behaviour Network Concept for Controlling Walking Machines

J. Albiez, T. Luksch, K. Berns and R. Dillmann

Forschungszentrum Informatik Karlsruhe

<COFFEE BREAK>

Session SaA-II: Motion and Behavior

Chairs *J.K. Hodgins*, Carnegie Mellon University

M. Okada, University of Tokyo

11:05 – 11:25 SaA-II-1

An Approach from Motion Generation Recognition to Intelligence based on Mimesis Principle

T. Inamura^{1,2}, H. Tanie¹, I. Toshima¹ and Y. Nakamura^{1,2}

¹University of Tokyo and ²CREST, JST

11:25 – 11:45 SaA-II-2

Recognition and Generation of Leg Primitive Motions for Dance Imitation

S. Nakaoka¹, A. Nakazawa², K. Yokoi³ and K. Ikeuchi¹

¹University of Tokyo

²Japan Science and Technology Corporation (JST)

³National Institute of Advanced Industrial Science and Technology (AIST)

11:45 – 12:05 SaA-II-3

Emergence of Joint Attention based on Visual Attention and Self Learning

Y. Nagai, K. Hosoda, A. Morita and M. Asada

Osaka University

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Session SaP-I (OS): Robot Brain I

Chairs *Y. Nakamura*, University of Tokyo

A.E. Patla, University of Waterloo

13:15 – 13:35 SaP-I-1

Optimizing Human Motion for the Control of a Humanoid Robot

A. Safonova¹, N.S. Pollard^{2,3} and J.K. Hodgins^{1,3}

¹Carnegie Mellon University

²Brown University

³ATR Human Information Science Laboratories

13:35 – 13:55 SaP-I-2

Dynamic Computation of Musculo-Skeletal Human Model Based on Efficient Algorithm for Closed Kinematic Chains

Y. Nakamura^{1,2}, K. Yamane³, I. Suzuki¹ and Y. Fujita¹

¹University of Tokyo, ²CREST, JST and ³Carnegie Mellon University

13:55 – 14:15 SaP-I-3

Dynamic Movement Primitives - A Framework for Motor Control in Humans and Humanoid Robotics

Stefan Schaal^{1,2}

¹University of South California and ²ATR Human Information Science Laboratories

14:15 – 14:35 SaP-I-4

Human Walk Pitch Extraction by Interactively Trainable Robot Vision for Human-Robot Synchronized Walking

*K. Okabe¹, K. Hidai¹, H. Mizoguchi², K. Hiraoka¹, T. Shigehara¹, M. Tanaka¹, T. Mishima¹
and S. Yoshizawa¹*

¹Saitamata University and ²Tokyo University of Science

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Session SaP-II (OS): Robot Brain II

Chairs *Stefan Schaal*, University of South California

M. Buehler, McGill University

14:50 – 15:10 SaP-II-1

Does the invariance in multi-modalities represent the body scheme? - a case study with vision and proprioception -

Y. Yoshikawa, K. Hosoda and M. Asada

Osaka University

15:10 – 15:30 SaP-II-2

Synthesis of Dynamics Based Information Processing System of Robot Using Synchronization in the Coupled Arnold Equations

A. Sekiguchi¹ and Y. Nakamura^{2,3}

¹Hirosaki University, ²University of Tokyo and ³CREST, JST

15:30 – 15:50 SaP-II-3

On-line dynamic obstacle avoidance

Z. Shiller

College of Judea and Samaria

15:50 – 16:10 SaP-II-4

Application of Lyapunov Function Based Synthesis of Nonsmooth Limit Cycles to Motion Generation for Humanoid Robots

M. Adachi, T. Ushio and S. Yamamoto

Osaka University

<COFFEE BREAK>

Session SaP-III (OS): Robot Brain III

Chairs *M. Asada*, Osaka University

A.J. Ijspeert, Swiss Federal Institute of Technology

16:25 – 16:45 SaP-III-1

Hierarchical Design of Dynamics Based Information Processing System for Humanoid Motion Generation

M. Okada¹, D. Nakamura¹ and Y. Nakamura^{1,2}

¹University of Tokyo and ²CREST, JST

16:45 – 17:05 SaP-III-2

Reductive Mapping for Sequential Patterns of Humanoid Body Motion

K. Tatani¹ and Y. Nakamura^{1,2}

¹University of Tokyo and ²CREST, JST

17:05 – 17:25 SaP-III-3

Humanoid Robot Mechanisms for Responsive Mobility

M. Okada¹, T. Shinohara¹, T. Gotoh¹, S. Ban¹ and Y. Nakamura^{1,2}

¹University of Tokyo and ²CREST, JST

17:25 – 17:45 SaP-III-4

Whole-body Cooperative COG Control through ZMP Manipulation for Humanoid Robots

T. Sugihara¹ and Y. Nakamura^{1,2}

¹University of Tokyo and ²CREST, JST

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Closing Remarks

18:00 – 18:30