NASA/DoD SECOND BIOMORPHIC EXPLORERS WORKSHOP
BIO-INSPIRED ENGINEERING OF EXPLORATION SYSEMS 2000
December 4-6, 2000
Jet Propulsion Laboratory
Auditorium: Von Karman and 180-101

WORKSHOP PROGRAM

Monday
December 04, 2000

Key Note Session (Location: 180-101)
Session Chair: **Steve Zornetzer, Director, Information Sc. And Tech., NASA AMES Research Center**

08:30 Welcome ..... **Edward Stone, Director Jet Propulsion Lab**

Opening Remarks & Workshop Goals .... **Steve Zornetzer, Director Information Sc. And Tech., NASA AMES Honorary Chair, BEES 2000 Workshop**

Introductions ..... **Ron Salazar, Workshop Organization Chair Jet Propulsion Lab**

09:10 Overview of Biology and Bio-Inspired Engineering at JPL and potential NASA applications .....**Barbara Wilson Chief Technologist, Jet Propulsion Lab**

09:30 Tactical Robot Technology Applications for Extra-Terrestrial Exploration……..…… **LTC John Blitch(Invited) Program Manager, DARPA(ATO)**

10:00 ~ Break ~

Monday
December 04, 2000

Session: Biomorphic Surface/Subsurface Systems
(Location: 180-101)
Session Chairs: ***Nikolaos P. Papanikolopoulos, University of Minnesota and Mark Yim, Xerox*** **Palo Alto**

10:30 *User Interfaces for a Robotic Distributed System:*
Sascha A. Stoeter, Nikolaos P. Papanikolopoulos, Paul E. Rybski, Donald G. Krantz, Kemal B. Yesin, Maria Gini, Dean F. Hougen, Florent Nageotte, Brad Nelson, Center for Distributed Robotics,Department of Computer Science and Engineering,University of Minnesota

11:00 *A serpentine locomotion system for biomorphic robotics:*
Gary L. Haith, Silvano P. Colombano and Charles Noveau, , NASA Ames Research Center

11:30 *Bio-inspired Locomotion with a Reconfigurable Robot:*
Mark Yim, Xerox , Ying Zhang, Xerox PARC, David Duff, Xerox PARC, Kimon Roufas, Xerox PARC, Sam Homans, Xerox PARC, Arancha Casal, Xerox PARC, John Suh, Xerox PARC

12:00-01:00 ~Lunch ~

Session: Enabling Systems for Biomorphic Missions
(Location: 180-101)
Session Co-Chairs: Butler Hine, Deputy Manager, **Intelligent Systems** ***Program, NASA AMES and Robert Ambrose, NASA Johnson Space Center***

01:00 *Planetary Exploration Requirements and Their Impact on Biomorphic Research:*
Butler Hine, NASA Ames Research Center

01:30 *Shape Based Object Recognition Using a Fast Analog Convolution Processor:*
Curtis Padgett, Ayanna Howard, Suraphol Udomkesmalee, Jet Propulsion Laboratory

Monday
December 04, 2000

02:00 *Aerial Imaging System Design Considerations:*
Kenneth P. Klaasen, Jet Propulsion Laboratory

02:30 *Carbon Nanotube based Nanotechnology for Biomorphic Exploration:*
M. Meyyappan, R. Stevens, C. Nguyen, A. Cassell, L. Delzeit, Jun Li, and J. Han, NASA Ames Research Center

03:00 *Articulated Upper Bodies for Dexterous Manipulation:*
Robert O. Ambrose, NASA Johnson Space Center and William Bluethman, Hernandez Engineering, Johnson Space Center

03:30 ~ Break ~

Short Paper Session (Location: 180-101)
Session Co-Chairs: Anna-Maria R. McGowan, LARC and Sarita Thakoor, JPL

04:00 *Electroactive Polymers and Their Applications in Biomorphic Exploration Systems*:
Ji Su and Joycelyn S. Harrison, Advanced Materials and Processing Branch, NASA Langley Research Center (+ Poster)

04:10 *Cooperative Lander-Rover Biomorphic Explorers Mission:*
Sarita Thakoor, JPL (+ Poster)

04:20 *Two New Explorers For The New Millennium:*
Kumar Ramohalli, Doug Striebich, Roberto Furfaro and Mario Urdaneta, Univ of Arizona

04:30 *FLEX: A Biologically Inspired Legged Robot actuated using Electro-active Polymer Artificial Muscles*:
Subramanian V. Shastri, SRI International and Scott Stanford, Ronald E. Pelrine, John Marlow, Seijin Oh, Thomas Low, Roy Kornbluh, Joseph Eckerle, SRI International

Monday
December 04, 2000

04:40 *Insect, Machine and Almost Entirely Human:*
Nicholas Gessler, UCLA Center for Computational Social Science (+ Poster)

04:50 *Biomorphic Reinforcement Learning Agents:*
Hamid R. Berenji, David Vengerov, Intelligent Inference Systems Corp

05:00- 05:30 Von Karman Auditorium
~ Poster / Demo/ Video Viewing ~

05:30-08:00 ~ Reception: Von Karman Auditorium
Special Evening Talks:
Session Chair: ***Prof. John Paul Revel, CALTECH***

Talk (6:30 pm): **Mars Rovers: Pathfinder and Beyond**
J. Matijevic
Jet Propulsion Laboratory, California Institute of Technology

Talk (7:15 pm): **Solar System Exploration: Future Missions**
Erik Nilsen
Jet Propulsion Laboratory, California Institute of Technology

Tuesday
December 05, 2000

Key Note Session: (Location:180-101):

Session: BEES: The Vision/Motivation
(Location:180-101)
Session Chair: Steve Zornetzer, Director, Information Sc. and Tech., NASA AMES

08:30 *Why Look for Inspiration from Biology?:*
Steve Zornetzer, Director, Information Sc. And Tech., NASA AMES

09:00 *Bioinspired Engineering of Exploration Systems:*
Sarita Thakoor , JPL

09:30 *Potential application of BEES in Diagnosis of Cancer:*
S. K. Rajan, National Cancer Centre, Singapore

10:15 *Atmospheric Science with Biomorphic Explorers*:
Terry Z. Martin, JPL

10.30 ~ Break ~

Session: Biomorphic Flight Systems
(Location:180-101)
Session Co-Chairs: Paul Gelhausen, NASA Langley Research Center and **Paul MacCready, Aerovironment Inc.**

11:00 *Miniature Rotorcraft as Aerial Explorers:*
Ilan Kroo, Stanford University and Peter Kunz, Stanford University

11.30-01:00 ~Poster Viewing and Lunch ~

Session: Biomorphic Flight Systems (contd)
(Location: 180-101)
Session Co-Chairs: Paul Gelhausen, NASA Langley Research Center and **Paul MacCready, Aerovironment Inc.**

Tuesday
December 05, 2000

01:00 *Systems Analysis for Revolutionary Concepts & Technologies Status and Plans:*
William Gilbert and Paul Gelhausen, NASA Langley Research Center

01:30 *Biomimetic Flight:*
John B. Anders, NASA Langley Research Center

02:00 *Biologically Inspired Flight Systems:*
Anna-Maria R. McGowan and David E. Cox, NASA Langley Research Center

02:30 *Flapping Wing Flight for Robotic Exploration:*
Scott Stanford, SRI International and Roy Kornbluh (SRI), James DeLaurier, University of Toronto, Institute for Aerospace Studies, David Loewen (UTIAS), Patrick Zdunich (UTIAS), and Tom Low (SRI)

03:00 ~ Break ~

Short Paper Session (Both Poster and Oral) (180 -101)

Session Co-Chairs: **Ron Salazar, Deputy Section Manager, Mission and Systems Architecture Section, JPL & Paul MacCready, Aerovironment Inc.**

03:30 *Plant Inspired Techniques for Distribution of Payload*:
Sarita Thakoor, & Dara Sabahi, JPL (+ Poster)

03:40 *Summary of a Workshop: "Invertebrate Sensory Information Processing: Implications for Biologically Inspired Autonomous Systems":*
Diana E.J. Blazis, Marine Biological Laboratory, Woods Hole, MA (+ Poster)

03:50 *Software and Wetware Simulation of Real Time Chemical Identification-Evolving Electronic Insects*:
Hamid Kohen, JPL

Tuesday
December 05, 2000

04:00 *The Telepresence Real Simulator:*
Paul B. MacCready and Tyler MacCready, AeroVironment Inc. (+ Poster)

04:10 *Local Linear Models for Sensor Fusion***:**
Todd K. Leen, Dept. Computer Science and Engineering, Oregon Graduate Institute

04:20 *Fusion-Based Robust Signal Processing by Humans and Machines***:**
Misha Pavel, Dept. Computer Science and Engineering, Oregon Graduate Institute

Session: Biomorphic Navigation
(180-101)

Session Co-Chairs: Patrick W. Moore SPAWAR System Center, SAN DIEGO and Joe Guinn, Navigation and Mission Design Section, JPL

4:30 *Conventional Techniques for Mars Navigation:*
Joe Guinn, JPL

05:00 *Hardware Implementation and Evaluation of Dolphin-based Biosonar:*
Patrick W. Moore SPAWAR System Center, SAN DIEGO

05:30-08:00 ~ Reception: Von Karman Auditorium

Von Karman Auditorium
~ Poster / Demo/ Video Viewing ~

Tuesday
December 05, 2000

Von Karman Auditorium
Special Evening Talks
Session Chair: ***Prof. John Paul Revel, CALTECH***

Talk 1(6:30 pm): **From Flying Bees to Autonomous Robots**
(Video: Slide Show)
By
Prof. M.V. Srinivasan, Director,
Centre for Visual Sciences, Research School of Biological Science
Australian National University

Talk 2 (7:00 pm): **Soaring Flight Tactics and Navigation Strategies of Migrating Monarch Butterflies**
By
Prof. David Gibo, Univ of Toronto

Wednesday
December 06, 2000

Key Note Session:
Session Chair: **Steve Zornetzer, Director, Information Sc. and Tech., NASA AMES**

Key Note Address by DoD guest (Location: 180-101):

08:30 " Military Applications of Swarm Robots":
Lt. Col. Steven Suddarth, Wright Patterson Air Force Base

Session: Biomorphic Sensor Fusion/Control
Session Co-Chairs: **Lt. Col. Steven Suddarth, Wright Patterson Air Force Base** and **Anil Thakoor, JPL**

09:00 *Sensorimotor Integration and Biomorph Control***:**
Shirley Pepke* and Silvano Colombano (*QSS) NASA Ames Research Center)

09:30 *Neuroelectric Virtual Devices*:
Kevin Wheeler, Computational Sciences Division, NASA Ames Research Center & Charles Jorgensen, Computational Sciences Division, NASA Ames Research Center

10:00 *Bio-Inspired Sensing and Behavior for Planetary Surface Exploration:*
Terry Huntsberger & Paolo Pirjanian, Jet Propulsion Lab

10:30 ~ Break ~

Session: Biomorphic Optimization/Sensory Processing(Location: 180-101)
Session Co-Chairs: David Atkinson, JPL and Man Mohan Rai, NASA Ames Research Center

11:00 *A Design Optimization Procedure Based On Artificial Neural Networks:*
Man Mohan Rai, Information Sciences and Technology Directorate, NASA Ames Research Center

11:30 *Stochastic Optimization using Genetics-Inspired Search Techniques:*
Barbara Engelhardt, Jet Propulsion Laboratory
Steve Chien, Jet Propulsion Laboratory

Wednesday
December 06, 2000

12:00 *Extraction of High Level Visual Features using Unsupervised Learning:*
Marwan Jabri, Oregon Graduate Institute and the University of Sydney, Australia and Peter Stepien, The University of Sydney, Australia

12:30-2:00 ~Lunch ~

02:00-04:00 ~ **Panel Discussion** ~
Location : 180-101