



2004 NASA/DoD Conference on Evolvable Hardware

June 24 - 26, 2004, Grand Hyatt, Seattle, Washington, USA

Conference Web Site: <http://ehw.jpl.nasa.gov/events/nasaeh04>



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The 2004 NASA/DoD Conference on Evolvable Hardware (EH-2004) builds upon the tradition of the successful series of NASA/DoD Workshops (the first Workshop hosted by JPL in Pasadena, 1999; the second Workshop hosted by NASA Ames in Palo Alto, 2000; and the third Workshop hosted by JPL in Long Beach in 2001) and Conferences (2002 hosted by NASA Goddard in Washington, DC and 2003 hosted by AMES in Chicago) on Evolvable Hardware. Evolvable Hardware is an emerging field that applies evolution to automate design and adaptation of physical reconfigurable and morphable structures such as electronic systems, antennas, MEMS and robots. The purpose of this conference is to bring together leading researchers from the evolvable hardware community, representatives of the automated design and programmable/reconfigurable hardware communities, technology developers and end-users from the aerospace, military and commercial sectors. EH-2004 will be co-located with the Genetic and Evolutionary Computation Conference (GECCO-2004, June 26 - 30).

Evolvable hardware techniques enable self-reconfigurability, adaptability and learning by programmable devices and thus have the potential to significantly increase the functionality of deployable hardware systems. Evolvable Hardware is expected to have major impact on deployable systems for space systems and defense applications that need to survive and perform at optimal functionality during long duration in unknown, harsh and/or changing environments. It is also expected to greatly enhance the capability of systems that need modification, upgrade and learning without interrupting their operation.

Registration & check-in information

The meeting will begin at 9:00 A.M. on Thursday, June, 24, at the Grand Hyatt Seattle Hotel, (Seattle, WA) in the Eliza Anderson Amphitheater. On-site check-in will begin on Wednesday, June 23rd from 6:00 P.M. to 8:00 P.M and Thursday, June 24 at 8:00 A.M. at the meeting site. At this time, you will be given your meeting badge and receipt for the registration fee, plus a packet of meeting materials.

All participants will be expected to pay the Conference registration fee of \$400 which covers the cost of the conference, plus break service, a reception, lunch and a group dinner in the Seattle Museum of Flight. Note that no purchase orders, foreign checks or foreign currency can be accepted. Credit Cards (VISA, MASTER and AMERICAN EXPRESS) and US dollar traveler's checks are accepted. Pre-registration with payment of fees is appreciated.

Accommodation

A limited block of rooms has been set aside at the Grand Hyatt Seattle Hotel at the rate of \$136/single or \$161/single double. The hotel will hold the room block until May 25, 2004 or until it is filled, after which time they will honor the rate on a space available basis only. You can make your reservations on-line at: <http://grandseattle.hyatt.com/groupbooking/nasa>

Transportation

The Seattle area has one major airport: Seattle-Tacoma International Airport. The airport is approximately 20 minutes away from the Seattle Grand Hyatt Hotel. Cab costs \$28. Gray Line Express Shuttle will take approximately 40 minutes — \$8.50 one way or \$14.00 round trip, (206) 626-5208. Please call Hotel for further information, (206) 774- 1234. Directions from airport: Take the WA-518 EAST/(15)/Renton(1405), Take the I-5 NORTH exit towards SEATTLE, Take the MELROSE AVE exit towards OLIVE WAY, exit #166, Right on first traffic light MELROSE AVE, Right on PINE ST. Grand Hyatt Hotel is located on the Corner of 8th ST and PINE ST.

For further information please check the conference web site or contact

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8:00 - 9:00 **Registration**

9:00 - 9:15 **Ricardo S. Zebulum**, Jet Propulsion Laboratory, USA
David Gwaltney, NASA MSFC, USA
Gregory Hornby, NASA AMES, USA
Welcome and Organizational Remarks

9:15 - 10:15 **Neville Marzwell**, Jet Propulsion Laboratory, USA
Human and Robotic Technologies in NASA vision for Space Exploration

10:15 - 10:25 **Break**

10:25 - 11:10 **Tetsuya Higuchi**, AIST, Japan
Evolvable Hardware for Industrial Applications

Session 1: Evolution of Analog Systems Part I

11:10 - 11:35 **Joerg Langeheine, Karlheinz Meier, Johannes Schemmel, and Martin Trefzer**, University of Heidelberg, Germany
Intrinsic Evolution of Digital-to-Analog Converters Using a CMOS FPTA Chip

11:35 - 12:00 **Sina Balkir, Gunhan Dunder, and Guner Alpaydin**, University of Nebraska-Lincoln, USA
Evolution Based Synthesis of Analog Integrated Circuits and Systems

12:00 - 1:00 **Lunch**

Session 2: Evolution of Digital Systems Part I

1:00 - 1:25 **Lukas Sekanina and Stepan Friedl**, Bmo University of Technology, Czech Republic
On Routine implementation of Virtual Evolvable Devices Using COMBO6

1:25 - 1:50 **Carlos A. Coello, Erika Luna, and Arturo Aguirre**, CINVESTAV-IPN, Mexico
A Comparative Study of Encodings to Design Combinational Logic Circuits

1:50 - 2:00 **Break**

Session 3: Special Session of Revolutionary Technologies for Space Part I

2:00 - 2:25 **Yoseph Bar-Cohen**, Jet Propulsion Laboratory/Caltech, USA
Electroactive Polymers (EAP) as Actuators for Potential Future Planetary Mechanisms

2:25 - 2:50 **Anthony Colozza, C. Smith, M. Shahinpoor, K. Isaac, P. Jenkins, and T. DalBello**, OA/Northland Scientific, Inc., USA
Solid State Aircraft Concept Overview

2:50 - 3:15 **Marc G. Mills**, NASA Glenn Reserach Center, USA
Prospects for Breakthrough Propulsion from Physics

3:15 - 3:30 **Break**

Session 4: Fault Tolerance and Survivability

3:30 - 3:55 **Evangelos F. Stefatos and Tughrul Arslan**, The University of Edinburgh, UK
An Efficient Fault-Tolerant, VLSI Architecture Using Parallel Evolvable Hardware Technology

3:55 - 4:20 **Garrison W. Greenwood, David Hunter, and Ed Ramsden**, Portland State University, USA
Fault Recovery in Linear Systems via Intrinsic Evolution

4:20 - 4:45 **Michael Harrison and James Foster**, University of Idaho, USA
Improving the Survivability of a Simple Evolved Circuit through Co-evolution

4:45 - 5:10 **Lucian Prodan, Mihai Udrescu, and Mircea Vladutiu**, Politehnica University of Timisoara, Romania
Self-Repairing Embryonic Memory Arrays

5:10 - 5:20 **Break**

5:20 - 8:30 **Reception Cocktail and Poster Session**
 Location: Grand Hyatt Seattle Hotel, Room Princessa I

5:20 - 8:30

Thursday, June 24, 2004
Group Posters

EHW@FIT - Evolvable Hardware at FIT

Lukas Sekanina, Richard Ruzicka, Vladimir Drabek, Stepan Friedl, Michal Bidlo
Faculty of Information Technology, Brno University of Technology, Czech Republic
<http://www.fit.vutbr.cz/~sekanina/ehw/index.html>

Evolvable Hardware at JPL

Adrian Stoica, Didier Keymeulen, Ricardo S. Zebulum, Michael I. Ferguson
Jet Propulsion Laboratory, USA
<http://ehw.jpl.nasa.gov>

Evolvable Systems Group at NASA Ames Research Center

Jason Lohn, Al Globus, Matt Hancher, Gregory Hornby, Rusty Hunt, Bill Kraus, Gregory Larchev, Anna Pryor
NASA Ames Research Center, USA
<http://ic.arc.nasa.gov/projects/esg>

Guided and Unconstrained Self-Assembled Silicon Circuits

Sean Stauth, Christopher Morrisssss, Babak Parviz
Department of Electrical Engineering, University of Washington, USA
<http://www.ee.washington.edu/research/parviz/html/index.html>

Hardware Evolution of Control Electronics

David A. Gwaltney, K. King, E. Corder, MSFC, Michael I. Ferguson, JPL, K. Dutton, Sverdrup
Marshall Space Flight Center and Jet Propulsion Laboratory, USA
<http://www.msfc.nasa.gov/>

Incremental Evolution of Real-World Applications

Knut Arne Vinger, Vidar Engh Skaugen, Aleksander Gundersen, Tonje Aanonsen, Jim Torresen
University of Oslo, Norway
<http://heim.ifi.uio.no/~jimtoer/ehwpage.htm>

Neuromorphic Evolvable Hardware for Embedded Control and Automated Pattern Recognition

The WSU Evolvable Hardware Research Group
Wright State University, USA
<http://ehrg.cs.wright.edu/>

Friday, June 25, 2004

8:00 - 8:30

Registration

8:30 - 9:20

John Koza, Martin Keane, and Matthew Streeter, Stanford University, USA
Routine High-Return Human-Competitive Evolvable Hardware

9:20 - 9:30

Break

Session 5: Evolution of Analog Systems Part II

9:30 - 9:55

Claudio Mattiussi and Dario Floreano, Autonomous Systems Laboratory, EPFL, Switzerland
Evolution of Analog Networks using Local String Alignment on Highly Reorganizable Genomes

9:55 - 10:20

Pedro F. Vieira, Leonardo B. de Sa, Joao P. B. Botelho, and Antonio Mesquita, LPC/PEE/COPPE/Federal University of Rio de Janeiro, Brazil
Evolutionary Synthesis of Analog Circuits Using Only MOS Transistors

10:20 - 10:45

Jose Franco M. do Amaral, Jorge Luís Machado do Amaral, Cristina C.Santini, Ricardo Tanscheit, Marley Maria R. Vellasco, and Marco Aurélio C. Pacheco, UERJ - Rio de Janeiro State University, Brazil
Towards Evolvable Analog Artificial Neural Networks Controllers

10:45 - 10:55

Break

Session 6: Embryonics and Bio-Inspired Architectures Part I

10:55 - 11:20

J. Manuel Moreno, Y. Thoma, E. Sanchez, O. Torres, and G. Tempesti, Technical University of Catalunya, Spain
Hardware Realization of a Bio-inspired POetic electronic tissue

11:20 - 11:45

Piet van Remortel, Bernard Manderick, and Tom Lenaerts, Vrije Universiteit Brussel VUB, Belgium
Gene Interaction and Modularisation in a Model for Gene-Regulated Development

11:45 - 12:10

Felix Streichert, Christian Spieth, Holger Ulmer, and Andreas Zeil, University of Tubingen, Germany
How to evolve the Head-Tail Pattern from Reaction-Diffusion Systems

12:10 - 1:10

Lunch

Session 7: Revolutionary Technologies for Space Part II

1:10 - 1:35

William Herbert Sims III and J. Boise Pearson, NASA, Marshall Space Flight Center, USA
Radio Frequency (RF) Trap for Confinement of Ion Plasmas in Antimatter Propulsion Systems Using Rotating Wall Electric Fields

1:35 - 2:00

Robert Winglee, University of Washington, USA
Advances in Magnetized Plasma Propulsion and Radiation Shielding

2:00 - 2:10

Break

Session 8: Evolvability

2:10 - 2:35

Jim Torresen, University of Oslo, Norway
Exploring Knowledge Schemes for Efficient Evolution of Hardware

2:35 - 3:00

Martin Trefzer, Jorg Langeheine, Johannes Schemmel, and Karlheinz Meier, University of Heidelberg, Germany
New Genetic Operators to Facilitate Understanding of Evolved Transistor Circuits

3:00 - 3:25

Gregory R. Kramer, John C. Gallagher, and Michael L. Raymer, Wright State University, USA
*On the Relative Efficacies of *cGA Variants for Intrinsic Evolvable Hardware: Population, Mutation, and Random Immigrants*

5:00 - 8:00

Banquet
Seattle Museum of Flight

Featuring 54 of the world's most awe-inspiring airplanes—authentic and in mint condition. In the steel and glass Great Gallery, the history of aviation soars past, with dozens of full-size aircraft flying in formation six stories above. Sit in the cockpit of a real SR-71 Blackbird or F/A-18 Hornet. Board America's first presidential jet—Air Force One. Step back 85 years in the magnificently restored Red Barn®, birthplace of The Boeing Company. From hands-on kid's workshops, to fly-ins, to interaction with the people who made aviation history, the Museum of Flight has something to offer every member of your family or group. Come experience the story of flight from the dawn of aviation to the Space Age.

8:30 - 9:20	Marc Schoenauer , INRIA Futur, France <i>Adaptive Evolutionary Algorithms</i>
9:20 - 9:30	Break
	Session 10: From Biology to Robotics and Sensors
9:30 - 9:55	Lars Olsson, Chystopher L. Nehaniv, and Daniel Polani , University of Hertfordshire, UK <i>Sensory Channel Grouping and Structure from Uninterpreted Sensor Data</i>
9:55 - 10:20	James Hereford and Charles Pruitt , Murray State University, USA <i>Robust Sensor Systems Using Evolvable Hardware</i>
10:20 - 10:45	Josh C. Bongard and Hod Lipson , Cornell University, USA <i>Automated Robot Function Recovery after Unanticipated Failure or Environmental Change Using a Minimum of Hardware Trials</i>
10:45 - 11:00	Break
11:00 - 12:00	Panel Discussion Moderator Andy Tyrrell
12:10 - 1:10	Lunch
	Session 11: Special Session on Multi Objective Optimization
1:00 - 1:25	Erika Luna, Carlos A. Coello, and Arturo Aguirre , CINVESTAV-IPN, Mexico <i>On the Use of a Population-Based Particle Swarm Optimizer to Design Combinational Logic Circuits</i>
1:25 - 1:50	Guiseppe Ascia, Vincenzo Catania, Maurizio Palesi, and Davide Patti , University of Catania, Italy <i>Multi-Objective Optimization of a Parameterized VL/W Architecture</i>
1:50 - 2:15	Arturo Aguirre, Ricardo S. Zebulum, and Carlos A. Coello , Center for Research in Mathematics, Mexico <i>Evolutionary Multiobjective Design Targeting a Field Programmable Transistor Array</i>
2:15 - 2:30	Break
	Session 12: Evolution of Bio-Inspired Architectures - Part II
2:30 - 2:55	Andrew J. Greensted and Andy M. Tyrrell , University of York, UK <i>An Endocrinologic-Inspired Hardware Implementation of a Multicellular System</i>
2:55 - 3:20	David Basanta, Peter J. Bentley, Mark A. Miodownik, and Elizabeth A. Holm , King's College, UK <i>Evolving and Growing Microstructures of Materials Using Biologically Inspired CA</i>
	Session 13: Evolution of Digital Systems - Part II
3:20 - 3:45	Nasri Sulaiman and Tughrul Arslan , The University of Edinburgh, UK <i>A Genetic Algorithm for the Optimisation of a Reconfigurable Pipelined FFT Processor</i>
3:45 - 4:10	Yang Zhang, Stephen L. Smith, and Andy M. Tyrrell , The University of York, UK <i>Digital Circuit Design Using Intrinsic Evolvable Hardware</i>
4:10 - 4:20	Break
	Session 14: New Avenues for Evolvable Hardware
4:20 - 4:45	Hugo de Garis and Thayne Batty , Utah State University, USA <i>The Evolution of Robust, Reversible, Nano-Scale, Femto-Second-Switching Circuits</i>
4:45 - 5:10	Simon Harding and Julian Miller , The University of York, UK <i>Evolution in materio: Initial Experiments with Liquid Crystal</i>
5:10 - 5:30	Conclusion and Remarks

<i>Multiplier Block Synthesis Using Evolutionary Graph Generation</i> Naofumi Homma, Takafumi Aoki, and Tatsuo Higuchi , Tohoku University, Japan
<i>Swarm Intelligence for Digital Circuits Implementation on Field Programmable Gate Arrays Platforms</i> Ganesh K. Venayagamoorthy and Venu G. Gudise , University of Missouri, USA
<i>Evolving Digital Circuits Using Multi Expression Programming</i> Mihai Oltean and Crina Grosan , Babe-Bolyai University, Romania
<i>Enhancing the Development Based Evolution of Digital Circuits</i> A. Shanthi, P. Muruganandam, and Ranjani Parthasarathi , Anna University, India
<i>An Intrinsic Evolvable and Online Adaptive Evolvable Fuzzy Hardware Scheme for Packet Switching Network</i> Ju Hui Li, Meng Hiot Lim, and Qi Cao , Nanyang Technological University, Singapore
<i>An Immune Inspired Fault Diagnosis System for Analog Circuits Using Wavelet Signatures</i> Jorge Luis M. do Amaral, José Franco M. do Amaral, Ricardo Transcheit, and marco Aurelio C. Pacheco , UERJ - Rio de Janeiro State University, Brazil
<i>Circuit Self-Recovery Experiments in Extreme Environments</i> Adrian Stoica, Didier Keymeulen, Tughrul Arslan, Vu Duong, Ricardo S. Zebulum, Michael I. Ferguson, and Xin guo,* Jet Propulsion Laboratory, USA, *Chomatic, USA
<i>Unsupervised Adaptation to Improve Fault Tolerance of Neural Network Classifiers</i> Alex Nugent, Garret. Kenyon, and Reid Porter , Los Alamos, NM, USA
<i>Organization of the Information Flow in the Perception-Action Loop of Evolved Agents</i> Alexander S. Klyubin, Daniel Polani, and Chrystopher L. Nehaniv , University of Hertfordshire, UK
<i>Design Space Issues for Intrinsic Evolvable Hardware</i> James hereford and David A. Gwaltney , Murray State University, USA
<i>Processor Architectures for Ontogenesis</i> Gianluca Tempesti , Swiss Federal Institute of Technology at Lausanne, Switzerland
<i>Self-Replication of 3D Universal Structures</i> André Stauffer, Daniel Mange, Enrico Petraglio, and Gianluca Tempesti , Swiss Federal Institute of Technology, Switzerland