2002 NASA/DoD Conference on Evolvable Hardware

July 15 - 18, 2002
Alexandria, Virginia, USA

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Defense Advanced Research Projects Agency

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Life Detection Science and Technology, JPL
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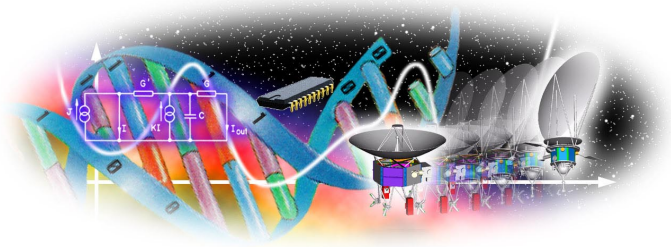
Hajime Shibata, Analog Devices (Japan)
Moshe Sipper, Ben-Gurion University (Israel)
Stephen Smith, Quicksilver Technology (USA),
Andre Stauffer, Swiss Federal Inst. of Technology (Switzerland)
Stephen Trimberger, Xilinx (USA)
Adrian Thompson, University of Sussex (UK)
Benny Toomarian, Jet Propulsion Laboratory (USA)
Jim Torresen, University of Oslo (Norway)
Andy Tyrrell, University of York (UK)
Xin Yao, The University of Birmingham (UK)
Tina Yu, Chevron Information Technology Company (USA)



The 2002 NASA/DoD Conference on Evolvable Hardware (EH-2002) will be hosted by NASA Goddard Space Flight Center in the Washington DC area. The Conference builds upon the tradition of the successful series of NASA/DoD Workshops on Evolvable Hardware (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). 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.

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.

The focus of this year's conference will be evolvable hardware for safer systems. Safety aspects range from reliable and survivable NASA/DoD systems operating in extreme environments to intelligent adaptive and learning systems for protection of areas and security of communications.

Registration & check-in information

The meeting will begin at 9:00 A.M. on Monday, July, 15, at the Holiday Inn Select (Old Town Alexandria, VA) in the Carlyle Ball Room. This room is located on the fifth floor of the Holiday Inn Select building, adjacent to the lobby. There is covered parking at $10.00/day; access is off of Pitt street (crossing street: King Street) west of the Holiday Inn Select Hotel building. On-site check-in will begin on Sunday, July 14 from 6:00 p.m. to 8:00 p.m. and Monday, July 15 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 workshop registration fee of $300.00 which covers the cost of the conference, plus break service, a reception and a group dinner. Please make checks payable to Jet Propulsion Laboratory and forward per instructions on the registration form. 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. For our planning purposes, pre-registration with payment of fees is appreciated. A limited number of student grants are available. Please contact Ricardo S. Zebulum at Ricardo.S.Zebulum@jpl.nasa.gov or by phone at +1 (818) 354-7623 for further information with subject line EH-2002 student grant. Registration form is available on line at the Conference Web Site.

Accommodation

A limited block of rooms has been set aside at the Holiday Inn Select Hotel at the current government rate of $150 single or double occupancy plus tax. The hotel will hold the room block until June 20, 2002 or until it is filled, after which time they will honor the rate on a space available basis only. You are responsible for making you own arrangements directly with the hotel.

Holiday Inn Select Hotel, Old Town Alexandria
480 King Street, Alexandria, VA 22314
Phone: +1 (703) 549-6080 Fax: +1 (800) 368-5047
Reference: EH-2002

Transportation

The Alexandria area is served by three major airports: Washington National Airport (Ronald Reagan National)(DCA) (5 miles – 15 to 40 min from the hotel – cab: 20$ – shuttle: free hotel van), Washington Dulles International (IAD) (45 min from the hotel – cab: 50$ – shuttle: 27$) and Baltimore-Washington International (BWI) (60 min from the hotel – cab: 75$ – shuttle: 35$). From Washington National Airport (Ronald Reagan National)(DCA), the Holiday Inn Select Hotel has a free on-call shuttle service which provides door-to-door from 7 a.m. until 10 p.m. Please contact the hotel for further information. There are several shuttles which provide door-to-door, on-call van service from the airports to Holiday Inn Select Hotel. For further information, call: Super Shuttle: (800) 258-3826. Taxis and rental cars are also readily available at the airports.

For further information please check the conference web site or contact

Web Site: http://cism.jpl.nasa.gov/ehw/events/nasaeh02

Technical: Adrian Stoica
Jet Propulsion Laboratory, MS 303-300
4800 Oak Grove Drive
Pasadena, CA 91109, USA
adrian.stoica@jpl.nasa.gov
Tel: (818) 354-2190 Fax: (818) 393-1545

Conference Logistics: Pat McLane
Ph: 818/354-5556
Fax: 818/393-4992
conf.admin@jpl.nasa.gov

Monday, July 15, 2002

8:00 - 9:00	Registration
9:00 - 9:15	**Adrian Stoica,** Jet Propulsion Laboratory, USA **Jason Lohn,** AMES Research Center, USA *Welcome and Organizational Remarks*
9:15 - 10:00	**Brian Snow,** National Security Agency, USA *We Need Assurance*
10:00 - 10:15	*Break*
10:15 - 11:00	**Rich Katz,** Goddard Space Flight Center, USA *The Failure of a Small Satellite and the Loss of a Space Science Mission*
11:00 - 11:45	**Tetsuya Higuchi,** AIST, Japan *Evolvable Hardware for Industrial Applications*
11:45 - 1:15	*Lunch*
1:15 - 2:00	**Subhasish Mitra,** Intel Corporation and Stanford University; **Edward J. McCluskey,** Stanford University, USA *Dependable Reconfigurable Computing Design Diversity and Self Repair*
2:00 - 2:15	*Break*
2:15 - 5:00	Group Posters and Demos (For more details, see Group Posters Sheet.) *Evolvable Systems* *NASA Ames Research Center, USA* *Evolvable Hardware* *Jet Propulsion Laboratory, USA* *Hardware Evolution of Control Electronics* *Marshall Space Flight Center, USA* *Evolvable Hardware for Image Data Mining* *Los Alamos National Laboratory, USA* *Adaptive Systems* *Naval Research Laboratory (NRL), Navy Center for Applied Research in Artificial Intelligence (NCARAI), Intelligent Systems Section, USA* *Adaptive Microsystems Laboratory* *Electrical and Computer Engineering Department, Johns Hopkins University, USA* *Applying Evolutionary Methods to Reversible and Quantum Logic Design, Robot Soccer and on FPGA-Based Emulator of Quantum Logic* *Portland State University, USA* *Evolvable Hardware Research Group* *University of Birmingham, UK* *Reconfigurable and Custom High Performance Systems for VLSI and System on Chip Applications* *The University of Edinburgh, UK* *Bio-Inspired and Bio-medical Engineering Research Group* *The University of York, UK* *Complex Adaptive Organically-Inspired Systems* *Norwegian University of Science and Technology, Norway* *Electronic Vision(s) Group* *Kirchhoff-Institut fuer Physik, Heidelberg University, Germany*
5:00 - 7:00	*Reception Cocktail* Holiday Inn Select, Alexandria Old Town

Tuesday, July 16, 2002

8:00 - 9:00	Registration
9:00 - 9:50	Adrian Stoica, Jet Propulsion Laboratory, USA *Evolving Circuits in Seconds: Experiments with a Stand-Alone Board-Level Evolvable System*
9:50 - 10:05	*Break*
	Session 1: Evolution of Analog Systems Part 1 — *Chair: Tim Edwards*
10:05 - 10:30	Jörg Langeheine, Karlheinz Meier, Johannes Schemmel, Heidelberg University, Germany *Intrinsic Evolution of Quasi DC Solutions for Transistor Level Analog Electronic Circuits Using a CMOS FPTA Chip*
10:30 - 10:55	Hajime Shibata, Soji Mori, and Nobuo Fujii, Tokyo Institute of Technology, Japan *Automated Design of Analog Circuits Using Cell-Based Structure*
10:55 - 11:10	*Break*
	Session 2: Evolution of Analog Systems Part 2 — *Chair: Karlheinz Meier*
11:10 - 11:35	L.A. Zinchenko, (1) Taganrog State University of Radioengineering, Russia, H. Mühlenbein, (2) Theoretical Foundation GMD Lab, GMD FZ Informationstechnik, Germany, V.M. Kureichik, (1), T. Mahnig, (2) *Application of the Univariate Marginal Distribution Algorithm to Analog Circuit Design*
11:35 - 12:00	A. Mesquita, Fabio A. Salazar, P. Paulo Canazio, Federal University of Rio De Janeiro, Brazil; C.C. Santini, Fed *Chromosome Representation through Adjacency Matrix in Evolutionary Circuits Synthesis*
12:00 - 1:30	*Lunch*
	Session 3: Evolution of Controllers — *Chair: Xin Yao*
1:30 - 1:55	Martin Keane, Econometrics Inc., USA; John R. Koza, Stanford University, USA; Matthew J. Streeter, Genetic Programming Inc., USA *Automatic Synthesis Using Genetic Programming of an Improved General Purpose Controller of r Industrially Representative Plants*
1:55 - 2:20	Jose Franco Machado do Amaral, J.L.M. do Amaral, Rio de Janeiro State University, Brazil; C.C. Santini, R. Transcheit, M.M.R. Vellasco, M.A.C. Pacheco, Catholic University of Rio De Janiero, Brazil *Towards Evolvable Analog Fuzzy Logic Controllers*
2:20 - 2:35	*Break*
	Session 4: New Avenues for Evolvable Hardware — *Chair: Andy Tyrrell*
2:35 - 3:00	Julian Miller, University of Birmingham, UK; Keith Downing, The Norwegian University of Science and Technology, Norway *Evolution in materio: Looking beyond the Silicon Box*
3:00 - 3:25	Martin Lukac, Marek Perkowski, Portland State University, USA *Evolving Quantum Circuits Using Genetic Algorithm*
3:25 - 3:40	*Break*
3:40 - 4:45	Panel Discussion *Organizer and Moderator: TBD*
4:45 - 5:00	*Break*
	Session 5: Real World Applications — *Chair: Barry Shackleford*
5:00 - 5:25	Jiangning Xu, Tughrul Arslan, The University of Edinburgh, UK; Qing Wang, Dejun Wan, Southeastern University, China *An EHW Architecture for Real-Time GPS Attitude Determination Based on Parallel Genetic Algorithm*
5:25 - 5:50	Derek S. Linden, Linden Innovation Research, USA *Optimizing Signal Strength In-Situ Using an Evolvable Antenna System*
5:50 - 6:15	Magdalena D. Bugajska, Alan C. Schultz, Naval Research Laboratory, USA *Coevolution of Form and Function in the Design of Micro Air Vehicles*
6:45 - 9:00	Banquet *Holiday Inn Select, Alexandria Old Town* *Speaker:* John D. Rummel, NASA, USA *Life, the Universe, and Everything: 4.5 Billion Years of Evolvable Hardware*

Wednesday, July 17, 2002

8:00 - 8:30 Registration

8:30 - 9:20 Peter Athanas, Virginia Polytechnic Institute and State University, USA
Physical Support for Evolution in Reconfigurable Devices

Session 6: Evolution of Digital Systems Part 1 — *Chair: Julian Miller*

9:20 - 9:45 Robert Thomson, Tughrul Arslan, University of Edinburgh, UK
Evolvable Hardware for the Generation of Sequential Filter Circuits

9:45 - 10:10 Piet van Remortel, Tom Lenaerts, Bernard Manderick, Vrije Universiteit Brussel VUB, Belgium
The Robustness of Small Developed SBlock Circuits Using Different Clocking Schemes

10:10 - 10:25 *Break*

Session 7: Evolution of Digital Systems Part 2 — *Chair: Tughrul Arslan*

10:25 - 10:50 Morten Hartmann, Pauline Haddow, Frode Eskelund, Norwegian University of Science and Technology, Norway
Evolving Robust Digital Designs

10:50 - 11:15 Nicholas J. Macias, Lisa J.K. Durbeck, Cell Matrix Corporation, USA
Self-Assembling Circuits with Autonomous Fault Handling

Session 8: Cellular Automata — *Chair: Tina Yu*

11:15 - 11:40 Barry Shackleford, Motoo Tanaka, Richard J. Carter, Greg Snider, Hewlett-Packard Laboratories, USA
High-Performance Cellular Automata Random Number Generations for Embedded Probabilistic Computing Systems

11:40 - 12:05 Chrystopher Nehaniv, University of Hertfordshire, UK
Self-Reproduction in Asynchronous Cellular Automata

12:30 - 1:15 *Lunch*
The National Mall, Washington, D.C.

1:15- 5:00 Visit to Smithsonian National Air and Space Museum
Washington, D.C.

Highlights of the National Air and Space Museum
Follow in the footsteps of aviators, astronauts, astronomers, and other scientists as you discover an unrivaled collection of flying machines, spacecraft, scientific instruments, and other objects documenting the major achievements – both historical and technological – of air and space flight. Guided by docents, we will relive the 59-second flight of the Wright brother's 1903 Flyer, recall Charles Lindbergh's historic solo flight from New York to Paris in the "Spirit of St. Louis," visit Amelia Earhart's bright red Lockheed Vega, view planetary probes, see inside the Apollo 11 spacecraft, and touch a moon rock.

Thursday, July 18, 2002

8:00 - 9:00 Registration

9:00 - 9:50 **Xin Yao,** University of Birmingham, UK; **Yong Liu,** University of Aizu, Japan
Getting Most Out of Evolutionary Approaches

9:50 - 10:05 *Break*

10:05 - 12:00 Poster Session

Channakeshav, K. Zhou, R. Kraft, J.F. McDonald, Rensselaer Polytechnic Institute, USA
Gigahertz FPGAs With New Power Saving Techniques and Decoding Logic

Hugo de Garis, Jonathan Dinerstein, Ravichandra Sriram, Utah State University, USA
Reversible Evolvable Networks: A Reversible Evolvable Boolean Network Architecture and Methodology to Overcome the Heat Generation Problem in Molecular Scale Brain Building

Jonathon Dinerstein, Hugo de Garis, Utah State University, USA
"TiPo"-A "Timed Pointer" Neural Net Model with Superior Evolvabilities for Implementation in a Second-Generation Brain-Building Machine BM2

Jonathan R. Evans, Tughrul Arslan, University of Edinburgh, UK
The Implementation of an Evolvable Hardware System for Real Time Image Regitration on a System-on-Chip Platform

Jennifer Golbeck, University of Maryland, College Park, USA
Evolving Optimal Parameters for Swarm Control

Garrison W. Greenwood, X. Song, Portland State University, USA
How to Evolve Safe Control Strategies

Felix Schürmann, Steffen Hohmann, Johannes Schemmel, Karlheinz Meier, Heidelberg University, Germany
Towards an Artificial Neural Network Framework

Adrian Stoica, Didier Keymeulen, Ricardo S. Zebulum, M.I. Ferguson, Xin Guo, Jet Propulsion Laboratory, USA
On Two New Trends in Evolvable Hardware: Employment of HDL-based Structuring, and Design of Multi-functional Circuits

A. Surkan, A. Khuskivadze, University of Nebraska, USA
Evolution of Quantum Algorithms for Computer of Reversible Operators

Alexander Tarakanov, Dipankar Dasgupta, The University of Memphis, USA
An Immunochip Architecture and its Emulation

Igor Vasiltsov, Institute of Computer Informational Technology, Ukraine
Evolutionary Technique to Elementary Coding of the Internal States of the State Machine

Tina Yu and Seong Lee, ChevronTexaco Information Tech Comp., USA
Evolving Cellular Automata to Model Fluid Flow In Porous Media

12:00 - 1:30 *Lunch*

Session 9: Embryonics and Bio-Inspired Architectures Part 1 — *Chair: Hugo de Garis*

1:30 - 1:55 **Gianluca Tempesti, Daniel Mange, Andre Stauffer, Christof Teuscher,** Swiss Federal Institute of Technology, Switzerland
The Bio Wall: An Electronic Tissue of Prorotyping Bio-Inspired Systems

1:55 - 2:20 **Alexander H. Jackson, Andrew M. Tyrrell,** The University of York, UK
Implementing Asynchronous Embryonic Circuits using AARDVArc

2:20 - 2:35 *Break*

Session 10: Embryonics and Bio-Inspired Architectures Part 2 — *Chair: Gianluca Tempesti*

2:35 - 3:00 **Timothy G.W. Gordon, Peter J. Bentley,** University of College London, UK
Towards Development in Evolvable Hardware

3:00 -3:25 **R. Timothy Edwards,** John Hopkins University, USA
Circuit Morphologies and Ontogenies

3:25 - 4:15 Panel Discussion

4:15 - 4:30 Conclusion and Remarks

2:45 - 5:00

Monday, July 15, 2002
Group Posters

Evolvable Systems
Jason Lohn, Bill Kraus, Al Globus, Greg Larchev
NASA Ames Research Center, USA
http://ic.arc.nasa.gov/people/jlohn

Evolvable Hardware
Adrian Stoica, Didier Keymeulen, Ricardo S. Zebulum, Michael I. Ferguson, Vu Duong
Jet Propulsion Laboratory, USA
http://cism.jpl.nasa.gov/ehw

Hardware Evolution of Control Electronics
David Gwaltney, J. Steincamp, Michael I. Ferguson
Marshall Space Flight Center, USA
http://www.msfc.nasa.gov/

Evolvable Hardware for Image Data Mining
Reid Porter, N. Harvey, M. Gokhale, C. Wolinski
Los Alamos National Laboratory, USA
http://www.daps.lanl.gov/eh/

Adaptive Systems
Alan C. Schultz, Magdalena D. Bugajska, Mitchell A. Potter, Donald A. Sofge, William Adams
Naval Research Laboratory (NRL), Navy Center for Applied Research in Artificial Intelligence (NCARAI), Intelligent Systems Section, USA
http://www.aic.nrl.navy.mil

Adaptive Microsystems Laboratory
Gert Cauwenberghs, R. Timothy Edwards
Johns Hopkins University
Electrical and Computer Engineering Department, Johns Hopkins University, USA
http://bach.ece.jhu.edu/

Applying Evolutionary Methods to Reversible and Quantum Logic Design, Robot Soccer and on FPGA-Based Emulator of Quantum Logic
Marek Perkowski
Portland State University, USA
http://www.ece.pdx.edu/~mperkows/

Evolvable Hardware Research Group
Julian Miller, Xin Yao, Thorsten Schnier, Robert Goldsmith, Simon Harding
University of Birmingham, UK
http://www.cs.bham.ac.uk/research/ehw

Reconfigurable and Custom High Performance Systems for VLSI and System on Chip Applications
Tughrul Arlsan, Robert Thompson, B. Hounsell, Jonathan Evans, Jiangning Xu, A.T. Erdogan
The University of Edinburgh, UK
http://www.ee.ed.ac.uk/~SLIg

Bio-Inspired and Bio-medical Engineering Research Group
Andy M. Tyrrell, Alexander H. Jackson
The University of York, UK
http://www.elec.york.ac.uk/staff/academic/amt.html

Complex Adaptive Organically-Inspired Systems
Pauline Haddow, Keith Downing, Snorre Aunet, Gunnar Tufte, Morten Hartmann, Diego Federici, Pavel Petrovic, Frode Eskelund, Piet ven Remortel and Katarina Jørgensen
Norwegian University of Science and Technology, Norway
http://www.idi.ntnu.no/~pauline/CAOSmain.html

Electronic Vision(s) Group
Andreas Breidenassel, Andreas Grübl, Steffen Hohmann, Jörg Langeheine, Thorsten Maucher, Karlheinz Meier, Eilif Mueller, Dominik Niedenzu, Stefan Philipp, Johannes Schemmel, Tillmann Schmitz, Anne-Catherin Schuch, Felix Schürmann
Kirchhoff-Institut fuer Physik, Heidelberg University, Germany
http://www.kip.uni-heidelberg.de/vision