



CASE WESTERN RESERVE UNIVERSITY

CASE SCHOOL OF ENGINEERING

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BIOLOGY

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RESEARCH AREAS AND APPLICATIONS

- Evolution of dynamical neural networks
- Analysis of biological control systems
- Computational neuroethology
- Biorobotics

APPROACH

- Continuous-time recurrent neural networks
- Genetic algorithms
- Dynamical systems theory
- Neuromechanical simulation

COLLABORATIONS

- DEPT OF BIOLOGY
- DEPT OF MECHANICAL AND AEROSPACE ENGINEERING
- CENTER FOR COMPUTATIONAL NEUROSCIENCE AND ROBOTICS AT THE UNIVERSITY OF SUSSEX

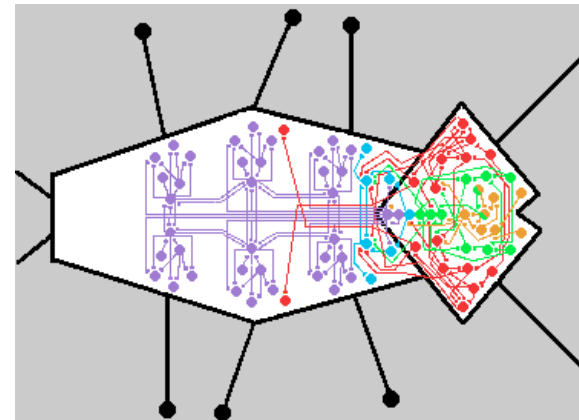
RESEARCH SPONSORS

- ONR
- NSF
- HFSP
- DARPA

RECENT ACCOMPLISHMENTS

- Development of a model of the neural control of behavior in an insect-like agent
- Development of distributed locomotion controllers for biologically-inspired 6-legged robots (built by Prof. Roger Quinn and his students)
- Evolution of neural circuits for chemotaxis, walking, sequential decision-making, reinforcement learning, and visually-guided behavior
- Analysis of evolved circuits and biologically-inspired distributed locomotion controller

An Artificial Insect





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RESEARCH AREAS AND APPLICATIONS

- Systems Approach to Global Change
- Computer Based Tools for Visioning and Future Studies
- Inter-basin Water Scarcity and Development Problematique
- Complex Systems Analysis
- Informatics Application in Medicine

APPROACH

- Systems Tools, Complex Systems,
- Merging Objective and Subjective elements
- Informatics

COLLABORATIONS

- UNESCO
- World Water Commission
- Ministry of Water, Cairo, Egypt
- Govts. of Kazak, Kyrgyz, Tajik, Turkmen, and Uzbekistan
- Polytechnic Univ of Catalunya, Barcelona
- International Baccalaureate Organization (IBO), Geneva, Switzerland
- University of Wisconsin, Madison, Cleveland Clinic Foundation

RESEARCH SPONSORS

- Packard Foundation
- NSF-IAI and NIH-NIAA

RECENT ACCOMPLISHMENTS

- Serving on the World Water Commission, Scenario Analysis Panel
- Developed a Computer Based Tool GLOBESIGHT implementation on MS Windows and Java for Strategic and Policy analysis
- Developed Vision Statement on Water for Aral Sea Basin Countries in conjunction with five government representatives (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan)

- Invited by Government of Egypt
- Managing a network of Universities and Developing a new network High Schools under the UNESCO GENie Program
- Developing a series of Workshops around the globe with IBO, Switzerland



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RESEARCH AREAS AND APPLICATIONS

MIXED-SIGNAL SENSOR INTERFACING AND COMMUNICATION

- Wireless sensor interfacing for harsh (500 °C) environments
- Analog VLSI neural network for autonomous micro-robots
- High-speed, low-power beamformer for 3-D ultrasonic imaging
- Microfluidic sensor platform with wireless data interface
- High-voltage acuation for massively parallel transducer arrays

APPROACH

- IC/MEMS/PCB design, and PCB fabrication in CWRU MSIC Lab
- IC fabrication using DARPA/NSF MOS Implementation System
- MEMS fabrication using CWRU MFL and MCNC MUMPS

•COLLABORATIONS

- NASA Glenn Research Center
- Cleveland Clinic Foundation and Queens University

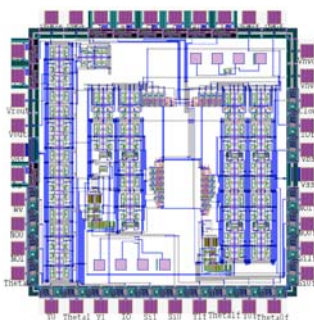
•RESEARCH SPONSORS

- Glennan Microsystem Initiative, ~ \$100K/YR

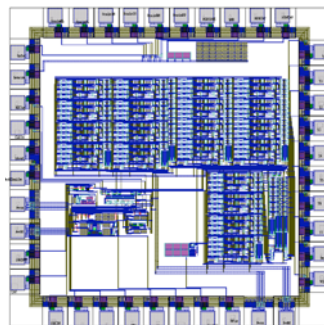
RECENT ACCOMPLISHMENTS

- aVLSI Neural Netowrk IC with EEPROM & High-Voltage Drivers
- SOI Sensor Interface IC for High-Temperature, Wireless Applications

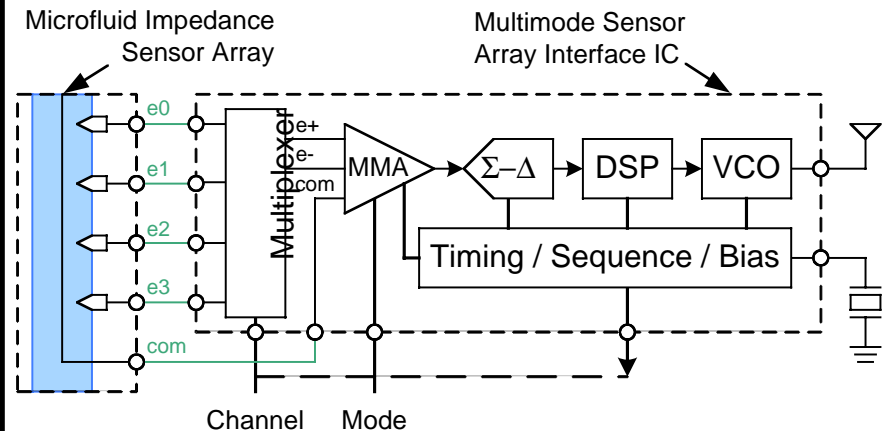
Neural Network IC



High-T Interface IC



Block Diagram of Wireless, Microfluidic Sensor Platform





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LEE J. WHITE, Ph.D. (University of Michigan)
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RESEARCH AREAS AND APPLICATIONS

- Software engineering
- Software testing
- Graphical user interface (GUI) testing
- Testing of object-oriented systems

- Development of a technique to systematically test graphical user interfaces (GUI)
- Developed firewall models for regression testing for both object-oriented systems and functional design systems in the presence of change
- Developed an approach for systematically testing global variables in both oo-systems and functional design systems
- Developed an approach for software reengineering, obtaining a method and conditions under which a specification can be shown equivalent to an existing software program

APPROACH

- Regression testing in the presence of change
- Firewall model to limit effects of change by testing
- Systematic approach to software testing
- Interested in applying theoretical results to industrial/practical problems

COLLABORATIONS

- Department of Computing, Hong Kong Polytechnic University
- Computer Science, University of Victoria, British Columbia, Canada
- Computer Science, University of Kuwait

RESEARCH SPONSORS

- NSF
- IBM
- Hughes Aircraft of Canada

- External examiner for the Hong Kong Polytechnic University (3 years)
- Served as Program Co-Chair for the International Conference on Software Maintenance (ICSM) in 1999, and Conference Chair of ICSM in 1994
- American Editor of the Journal of Software Testing, Verification and Reliability, 1990-present



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RESEARCH AREAS AND APPLICATIONS

- Software engineering methodology
- Software testing and reliability
- Computer security
- Distributed systems and applications
- Software for advanced manufacturing systems

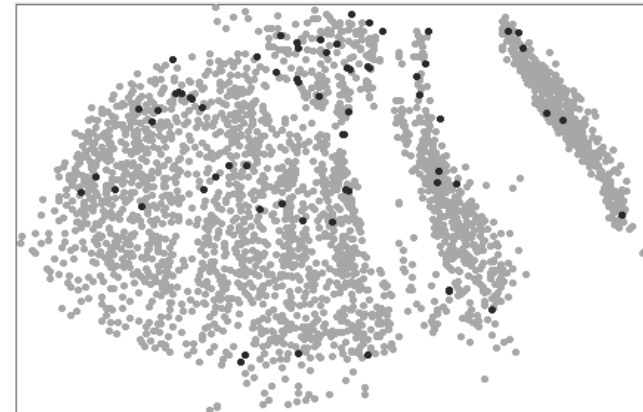
OBSERVATION-BASED SOFTWARE TESTING AND MAINTENANCE

- Employs visualization and data mining techniques in software testing, debugging, and maintenance
- Substantially automated
- Reduces testing and maintenance costs
- Reveals how software is really used
- Permits measurement of software reliability
- Permits automatic classification of reported failures

RECENT ACCOMPLISHMENTS

- Developed new approach to software testing called observation-based testing (OBT)
- Demonstrated new techniques for automatically filtering test data
- Demonstrated a new technique for automatic classification of software failure reports
- Investigating application of OBT techniques to software security

Visualization of Test Executions in OBT





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RESEARCH AREAS AND APPLICATIONS

- **Hybrid Systems:** those mixing continuous-time processes and digital logic
- **Real-Time Control over Computer Networks**
- **Engineering Hybrid Systems:** Robotic Assembly, Task and Motion Planning, Flexible Manufacturing, Flight Control, etc.
- **Learning, Large-Scale Optimization, Analog Computing**

APPROACH

- **Mathematical analysis of “hybrid systems”** (those mixing continuous-time processes and digital logic)
- **Computer modeling and optimization of such systems**

COLLABORATIONS (current and former)

- **NASA, Cleveland Clinic Foundation, Wright-Patterson AFB**
- **Ford Motor Co. Advanced Technology Division**
- **Eaton’s Advanced Manufacturing Center**
- **Siemens Corporate Research Center (Munich)**
- **MIT, U. Illinois at Urbana-Champaign, Lund Inst. Tech.**

RESEARCH SPONSORS

- **NSF, NASA**
- **Automotive, Manufacturing Firms**

RECENT ACCOMPLISHMENTS

- **Developed a new means of programming robots to exploit the sense of touch during mechanical assembly**
- **Computed maximum delays preserving stability in a networked control system**
- **Invented an algorithm for optimal control of hybrid systems**
- **Predicted flexible parts feeder throughput via GSMP models**
- **Automated manufacturing assemblies previously only accomplished by humans [as part of a CWRU team]**
- **Patented a control algorithm for continuous-casting steel mills**
- **Proved the stability of a flight control law previously only validated by simulation**

Intelligent Assembly for Automotive Applications

In the picture to the right is the ParaDex-1 (built by Micro-Dexterity Systems in collaboration with Sandia National Labs). This robot “lives” in the Glennan Bldg at CWRU and is controlled using algorithms developed by my collaborators, my students, and I.

We received Best Video Award for this work at 2002 Intl. Conf. Of Robotics and Automation. (See website for movie.)

