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Education

1998-2005: Ph.D., Stanford University, Electrical Engineering. Research focus: cyberinfrastructure and high-availability mechanisms for satellite operation systems.

1996-1998: M.S., Stanford University, Electrical Engineering. Research focus: innovative small satellite technologies and radiation hardening of off-the-shelf electronics.

1992-1996: B.S., Purdue University, Computer and Electrical Engineering. Research focus: low power microprocessors and self-contained, biological life support systems. Graduated with distinction.

Professional Distinctions

2006: Stanford AIAA Award For Excellence in Teaching

2001: NASA Graduate Student Fellowship (3-year merit-based renewable award, 300 students per year)

1996: NSF Graduate Research Fellowship (three-year merit-based renewable award)

1992-1996: Purdue Engineering Department Dean's List (all semesters)

1992: Purdue Engineering Department, Dean's Engineering Scholar Award

Research Experience

Remote Sensing and Data Fusion: Stanford University/QuakeFinder, LLC, Jan 2002—Present

I am principal investigator on a network of magnetometers deployed in California that consists of ten triaxial search-coil magnetometer systems measuring ultra low frequency (ULF), 0.001 - 16 Hz, magnetic field fluctuations. The network provides data for comprehensive multi-point measurements of specific events in the Pc1-Pc5 range at mid-latitudes as well as a systematic, long-term study of ULF signals in active fault regions in California. We are fusing this data with a variety of other space and ground-based sensors including total electron content (TEC) measurements derived from GPS receivers and space-based sensors such magnetic/electric field sensors and Langmuir probes. We are doing algorithm development to automatically detect and characterize typical wave events such as geomagnetic micropulsations and resonant structures of the Ionospheric Alfvén resonator.

Near Space Technologies—Stanford University, Space Systems Development Laboratory: Feb 2007—Present

I am principal investigator on a NASA-sponsored project called BioLaunch. Our goal is to develop a low-cost launch system using high altitude balloons to fly astrobiology experiments to near space, ~100K feet. We combined two Stanford classes, AA236--Space Craft Design and HUMBIO 183--Astrobiology and Space Exploration, to train both science and engineering students on how to build and perform near space research missions. We have flown four missions in 2007 and have 6-8 flights scheduled for 2008. Our primary payloads were a spectrometer measuring UV radiation as a function of altitude and several biological samples that were analyzed post-flight for near-space related damage. These experiments seek to answer two questions: 1) Is UV penetrating deeper than we think into the atmosphere? And 2) How high does the biosphere extend? Secondary payloads flight-test a variety of new satellite technologies as well. We also fly payloads for regional K-12 schools. These younger students fill up extra lift capacity with a variety of experiments relevant to their course work. Our goal is to help inspire future generations of scientists and engineers.

Space Technologies—Stanford University, Space Systems Development Laboratory: Mar 1997—Present

As a consulting professor at Stanford University, I am developing technologies to increase the capability and accessibility of satellites. On the *OPAL Project*, I was project manager and systems engineer for this student-built satellite mission that explored mothership/daughtership technologies and deployed six picosatellites. With the

CubeSat Project, we developed a standard for deploying small satellites (with California Polytechnic State University). There is now a global CubeSat community involving institutions in North/South America, Europe, Asia, and Africa. As lead developer on the *Mercury Project*, we are developing an open source ground station control system to provide network accessibility, flexible multi-mission support, and end-to-end IP accessibility to satellites. The *Mercury Ground Station Network* is a federated, international ground station network providing a testbed for experimental space operations techniques. With the *Katysat Program*, we are developing a novel educational program that includes K-12 students, undergraduates, graduates, and continuing education engineers to build and operate a satellite. Several experimental technologies are also under development: a drag-sail deorbiting module, a lunar rover, and reconfigurable ground stations based on software-defined-radios.

Recovery-Oriented Computing—Stanford University, Software Infrastructure Group: July 2000—January 2005

We investigated innovative techniques for building highly dependable distributed software systems emphasizing fast recovery rather than solely fault avoidance. The project was conducted jointly with Prof. Armando Fox at Stanford University and Prof. David Patterson at U.C. Berkeley. I worked on two efforts: 1) *Recursive Restartability* focuses on multi-level reactive and proactive restarts as a structured method of realizing high availability including the software structures to support it. We developed a recursive, application-generic approach that transforms the sledgehammer-like reboot into a scalpel-like microreboot that scales from recovering a minimal set of components to progressively larger sets. 2) *Satellite IP Infrastructure* applies these techniques to the design of a robust and affordable federation of globally distributed ground stations. Our combination of virtualization and ROC techniques enables the development of economical and robust COTS-based applications for space communication systems. In addition, we developed an XML-based command and control language that supports control of heterogeneous ground stations. We developed a mechanism based on virtual machine technology that enables extensive end-user customization of station services while simplifying overall ground station systems.

Low Power VLSI Design: Purdue University, January 1995—May 1996

I conducted research with Prof. Kaushik Roy at Purdue University in low-power VLSI design with emphasis on control store optimization and high-level digital design. We developed techniques to reduce processor power consumption through properly designed control store codes to reduce superfluous bit changes. Funded by National Science Foundation (NSF) research grant.

Controlled Ecological Life Support Systems: Purdue University, NSCORT, June 1991—December 1994

I supported the research of Prof. Cary Mitchell to design and develop bioregenerative and controlled ecological life-support systems for long-duration manned space and terrestrial applications. I designed and installed a computer data acquisition system for monitoring plant seedling growth and used it to experimentally verify proper nutrient supplements that minimize the negative effects of mechanical stress on dark-grown seedlings. The research was conducted at a NASA Center of Research and Training (NSCORT).

Publications

1. Cutler, J. W., J. Bortnik, C. Dunson, T. Bleier, J. Doering, CalMagNet - An Array of Search Coil Magnetometers Monitoring ULF Activity in California, to appear in *Natural Hazards and Earth System Sciences*, expected 2007.
2. Bortnik J., J. W. Cutler, C. Dunson, T. E. Bleier, R. L. McPherson, Characteristics of low latitude Pc1 pulsations during geomagnetic storms, to appear in the *Journal of Geophysical Research*, expected 2007.
3. Bortnik J., J. W. Cutler, C. Dunson, T. E. Bleier (2007), An automatic wave detection algorithm applied to Pc1 pulsations, *J. Geophys. Res.*, 112, A04204, doi:10.1029/2006JA011900.
4. Chandler, G., D. McClure, S. Hishmeh, J. Lump, Jr., J. Carter, B. Malphrus, D. Erb, W. Hutchinson, G. Strickler, J. Cutler, R. Twiggs, Development of an Off-the-Shelf Bus for Small Satellites, the 2007 IEEE Aerospace Conference, Big Sky, Montana, 10 March 2007, DOI: 10.1109/AERO.2007.352752.
5. Cutler, J., A. Fox, A Framework for Robust and Flexible Ground Station Networks, *Journal of Aerospace Computing, Information, and Communication*, 2006, vol.43 no.5 (73-92).
6. Swartwout, M., C. Kitts, J. Cutler, Sapphire: Case Study for Student-Built Spacecraft, *Journal of Spacecraft and Rockets*, Vol.3 No.3, pages 1136-1139, 2006.

7. Billet, O., W. Storck, M. Jambusaria, A. Sadhwani, P. Jammes, J. Cutler, A Survey of Micropropulsion for Small Satellites, In Proceedings of the 20th Annual Small Satellite Conference, Ogden, Utah, August, 2006.
8. Cutler, J., Ground Station Markup Language, in Proceedings of the 2004 IEEE Aerospace Conference, Big Sky, Montana, March, 2004.
9. Cutler, J., Ground Station Virtualization, in Proceedings of The Fifth International Symposium on Reducing the Cost of Spacecraft Ground Systems and Operations (RCSGSO), Pasadena, CA, July 8-11, 2003.
10. Candea, G., J. Cutler, A. Fox, Improving Availability with Recursive Micro-Reboots: A Soft-State System Case Study, in Performance Evaluation Journal, Summer 2003.
11. Cutler, J., P. Linder, A. Fox, A Federated Ground Station Network, in Proceedings of the SpaceOps 2002, Houston, Texas, October 2002.
12. Candea, G., J. Cutler, A. Fox, R. Doshi, P. Garg, R. Gowda, Reducing Recovery Time in a Small Recursively Restartable System, in Proceedings of the International Conference on Dependable Systems and Networks (DSN-2002), Washington, D.C., June 2002.
13. Patterson, D., A. Brown, P. Broadwell, G. Candea, M. Chen, J. Cutler, P. Enriquez, A. Fox, E. Kiciman, M. Merzbacher, D. Oppenheimer, N. Sastry, W. Tetzlaff, N. Treuhaft, Recovery Oriented Computing (ROC): Motivation, Definition, Techniques, and Case Studies, by D. Patterson, in UC Berkeley Computer Science Technical Report UCB/CSD-02-1175, Berkeley, CA, March 2002.
14. Cutler, J., A. Fox, K. Bhasin, Applying the Lessons of Internet Services to Space Systems, in Proceedings of the IEEE Aerospace Conference, Big Sky, Montana, March 9-16, 2002.
15. Cutler, J., G. Hutchins, C. Kitts, R. Twiggs, Infrastructure for Internet Based Operations in Proceedings of the 14th Annual Small Satellite Conference, Ogden, Utah, August, 2000.
16. Cutler, J., G. Hutchins, OPAL: Smaller, Simpler, and Just Plain Luckier in Proceedings of the 14th Annual Small Satellite Conference, Ogden, Utah, August, 2000.
17. Cutler, J., R. Twiggs, G. Hutchins, J. Williams, OPAL: A First Generation Microsatellite Providing Picosat Communications for the Amateur Radio Community, in Proceedings of the 1999 AMSAT-NA Symposium, San Diego, CA, October, 1999.
18. Sacristan, C., J. Cutler, B. Palmintier, F. Pranajaya, C. Ktts, MEMS Work at SSDL, 2nd International Conference on Integrated Micro-Nanotechnology for Space Applications: Enabling Technologies for New Space Systems, Pasadena, CA, April 11-15, 1999.

Presentations/Posters (Independent of publications)

1. Cutler, J., J. Bortnik, C. Dunson, J. Doering, T. Bleier, CalMagNet - an Array of Search Coil Magnetometers Monitoring ULF Activity in California, Eos Trans. AGU, 87(52), Fall Meet. Suppl., Abstract T31A-0434.
2. Dautermann, T., J. Cutler, E. Calais, C. Dunson, Comparison of GPS Integrated Electron Content Measurements with Electron Density Values acquired by the DEMETER Satellite in Japan, Eos Trans. AGU, 87(52), Fall Meet. Suppl., Abstract T31A-0425.
3. Bortnik, J., C. Dunson, J. Cutler, T. Bleier, Statistical analysis of ELF/VLF magnetic data from the DEMETER/IMSC instrument for large Earthquakes, Eos Trans. AGU, 87(52), Fall Meet. Suppl., Abstract T34B-07.
4. Bleier, T., J. Cutler, J. C. Dunson, J. Bortnik, E. Calais, T. Dautermann, M. Maniscalco, A Strategy for Collecting and Analyzing Multiple Electromagnetic (EM) Data Sets for Pre- Earthquake Signal Investigations, Eos Trans. AGU, 87(52), Fall Meet. Suppl., Abstract T31A-0439.
5. Ford, C., J. Bortnik, J. Cutler, C. Dunson, T. Bleier, An automatic wave detection algorithm applied to Pc1 pulsations in California, and results of a 6-year statistical survey, Eos Trans. AGU, 87(52), Fall Meet. Suppl., Abstract SM43D-06.
6. Dunson, J. C., J. Doering, T. Bleier, J. Cutler, J. Bortnik, ULF Pc 3-4 Pulsations: Observations, Processing, and Characterization in the California Region, Eos Trans. AGU, 87(52), Fall Meet. Suppl., Abstract SM43D-06.

7. Bortnik J., C. Dunson, J. W. Cutler, and T. E. Bleier, Comparison of ELF/VLF magnetic data from the DEMETER/IMSC instrument for large earthquakes with and without preseismic activity, International Symposium DEMETER, Toulouse, France, June 14-16, 2006.
8. Bortnik J., J.W. Cutler, C. Dunson, and T. Bleier, Observations of residual ULF signals from the Parkfield magnetometer surrounding large earthquakes, Eos Trans. AGU, 86 (52), Fall Meet. Suppl., Abstract T51B-1344, Dec. 2005.
9. Cutler, J., A Data Fusion Center For the Seismo-Electromagnetic Community, presented the 3rd Annual Meeting of GEON, San Diego, CA, May, 2005.
10. Cutler, J., Global CubeSat Operations, CubeSat Developers Workshop, San Luis Obispo, CA, April 2004.
11. Cutler, J., Flexible Application Support in Ground Stations, Ground Systems Architecture Workshop (GSAW) 2004, Manhattan Beach, CA. March 2004.
12. Cutler, J., Recovery-Oriented Ground Systems, Ground Systems Architecture Workshop (GSAW) 2003, Manhattan Beach, CA. March 2003.
13. Cutler, J., Invited Speaker and Lecturer, Norwegian CubeSat Workshop. Provided tutorials and consulting on small satellite design and development to Norwegian universities building CubeSats, Sept. 2002.
14. Cutler, J., IP Infrastructure for Space Systems, NASA Space Communications Symposium, Cleveland, Ohio, September 2002.
15. Cutler, J., Applying the Lessons of Internet Services to Space Systems, Ground Systems Architecture Workshop (GSAW) 2002, Redondo Beach, CA. March 2002.
16. Cutler, J., Applying the Lessons of Internet Services to Space Systems, Space Internet Workshop 2002, Greenbelt, MD. March 2002.
17. Cutler, J., Applying the Lessons of Internet Services to Space Communication Systems, High Rate Data Delivery Workshop, Cleveland, Ohio. August 2001.
18. Cutler, J. Testbed for Internet-Based Operations, Space Internet Workshop 2000, Greenbelt, MD, 2000.

Related Work Experience

Stanford University—Department of Aeronautics and Astronautics; *Stanford, CA*

Consulting Professor: June 2005 –Present

Researcher and lecturer in the Space and Systems Development Laboratory, which is dedicated to the advancement of space technology and training of the next generation of space engineers. On nanosatellite missions, we are developing cold-gas thruster technology, drag-sail mechanisms for deorbit capabilities, off-the-shelf satellite bus systems, and global ground station networking technologies. Our current missions include Katysat, an educational outreach mission, and technology development for distributed ionospheric monitoring.

QuakeFinder,LLC; *Palo Alto, CA*

Research Scientist/Spacecraft Designer: Jan 2002 – Present

Research scientist and systems engineer for a small research company studying electromagnetic activity in active earthquake regions. I was a systems engineer for QuakeSat-1, a nanosatellite launched in 2003 to study the very-low-frequency (VLF) environment from low-earth orbit, and developed its communication systems and ground support software. I am currently the program manager for QuakeSat-2, a potential follow-on mission that is under concept study. I am also developing a data fusion center to analyze multiple concurrent data stream from both ground and space sensors. Ground-based sensors include ULF magnetometers in California and total electron content (TEC) measurements derived from GPS receivers. Space-based sensors include typical plasma wave sensors (electric and magnetic) and ion particle sensors such as Langmuir probes.

Lockheed Martin Corporation; *Sunnyvale, CA*

Research engineer: June 2001 – October 2002

Developed infrastructure to support distributed computing experiments by integrating STK, Matlab, and a network simulator to simulate satellite cluster communications. Developed web services for space missions. Wrote research grants to support our R&D efforts.

Stanford Academic Computing; *Stanford University, CA*

Residential Computing Consultant: May 1999 – September 2003

Served as a residential computing consultant in graduate student university housing. Educated residents on computing at Stanford, consulted on computer problems, and supported in-room network connections.

Intel Corporation; *Chandler, AZ*

Summer Intern: May 1995 - August 1995

Developed a standard cell library for a new flash silicon fabrication process. Developed automation tools for porting old libraries to new processes.

Microcase Corporation; *West Lafayette, IN*

Technical Assistant: December 1991 - August 1992

Assisted in testing and development of a statistical analysis program for researchers in the social sciences.

Aurora Flight Sciences, Incorporated; *Manassas, Virginia*

Summer Intern: June 1990 - August 1990

Technical assistant during the construction of a high-altitude, atmospheric, research aircraft for NASA.

Relevant Skills and Courses

Major courses of my degree programs included the following: semiconductor devices, physics of waves, statistical signal processing, spacecraft design, database system principles, Internet technologies, analog/digital integrated circuit design, space environment, RF circuit design, fault tolerance systems, error correcting codes, safety critical systems, energy processes, multimedia networking, computer networks, modern physics, linear algebra, electromagnetic fields, computer architecture, integrated circuit design, VLSI design, operating system, digital signal processing, control theory, microprocessor design, aeromechanics, signals and systems. Relevant technical skills include extensive programming (C, PHP, Perl, Java, shell scripts), Matlab development, Linux installation and administration, virtual machines (VMware, Xen), Apache/MYSQL/PHP system administration, Mambo development, web server development, circuit and PCB design.

Teaching and Mentorship Activities

Spacecraft Design—AA 236(A-D) in the Department of Aeronautics and Astronautics (AA). Since 2005, I have been the instructor for this four-quarter series teaching satellite design. During 2001-2004, I lectured several times per quarter on spacecraft operations, ground stations, communication systems, and overall satellite system engineering issues.

Electrical Engineering (EE) Courses: With a formal EE educational background, I am comfortable teaching all core EE classes and laboratories including digital circuit design, analog circuit design, device physics, programming, signals and systems, control theory, networking, operating systems, computer architecture, electromagnetic waves, remote sensing, communication systems.

Aeronautics and Astronautics (Aero/Astro) Courses: I am comfortable teaching many Aero/Astro classes since the application of my research has been on satellite and space systems. These classes include aerospace information systems, spacecraft system design statics, dynamics, and control theory.

Writing Intensive Senior Projects—CS 191W, 2002-2004, in the Department of Computer Science. Advised multiple students on senior design projects related to our recovery-oriented ground stations.

SSDL Mentor's Program, 2000-2004. Weekly mentored undergraduates and graduate students on electronic systems (especially satellites) in the Space and Systems Development Laboratory (SSDL).

Youth Soccer Coach, 1990-1996, and 2000-2005. Kids aged from 10-14 years.

Professional Activities

- Program Committee member of Ground Systems Architecture Workshop (GSAW) 2003-2005, annual workshop that brings together an international forum to discuss architecture and design of space ground systems.

- Technical reviewer for NASA NRA's including NASA Glenn Research Center's Computing, Information and Communications Technology Program (CICT), Space Communication Project, 2002, and NASA ROSES 2005 Earth and Surface Interior.
- Technical reviewer for the IEEE Transactions on Aerospace and Electronic Systems, 2004-present.
- Director of the Mercury Ground Station Network, a federation of networked ground stations supporting university satellite missions. The initial beta test team consists of Stanford University (Prof Robert Twiggs), Julius-Maximilians Universitat Würzburg in Germany (Prof. Klaus Schilling), Norwegian University of Science and Technology (Dr. Egil Eide), California Polytechnic State University (Prof. Jordi Puig-Suari), Aalborg University in Denmark.
- Participant in the University Space Systems Symposium of The Japan-US Science, Technology and Space Application Program (JUSTSAP), 1998 and 1999. Led the effort to coordinate Japanese and US ground stations to provide mutual satellite contact support.

References

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