As electronics have become more prevalent in everything from biomedicine to transportation, the need for advanced assessment of electronics reliability has become a necessity. For example, Cochlear Inc. was forced to recall its cochlear implants due to moisture-induced failure in the electronics, resulting in major surgeries, explants, and losses of more than $150 million. Similarly, Medtronic Inc. recalled its pacemakers due to electrical ‘opens’ of interconnection electronics. Since 2011, GM has recalled over 19 million vehicles and Toyota has recalled over 25 million vehicles due to electrical problems. The Boeing 787 Dreamliner fleet, certified to achieve a battery failure of no more than 1 per every 10,000,000 flight hours, was taken out of operation for more than 14 weeks due to two Li-ion battery fires in a two-week span (2 failures in less than 52,000 flight hours), and then allowed to resume flying without identification of the root cause of failure. Unfortunately, many of these electronics systems failures are in some sense inevitable, because the current methods to assess such systems have fundamental flaws due to unique application environments, complex degradation mechanisms, and interactions between performance parameters. CALCE is working on solving these problems by researching new test and failure analysis methods, advanced supply chain approaches, and real-time self-cognizant capabilities that will allow systems to continuously assess their own performance and health, estimate their own remaining useful life, and adaptively enhance their sustainment with real-time personalized risk-mitigation actions.

Since CALCE started in 1985, we have believed that the challenges facing the electronics reliability field are best met by drawing upon the combined strengths of diverse, international teams. As a world leader in electronics reliability and sustainment research, CALCE has always drawn top international faculty, researchers, post-doctoral students, and interns. Each year, these engineers come to CALCE to conduct leading-edge research in electronics reliability, failure analysis, supply chain management, and prognostics and health management for electronic systems. They take advantage of CALCE’s advanced research and analysis technology and learn and share skills with CALCE faculty, staff, and students. Together, we learn about and contribute to scientific methods and rigorous research processes. We also share our expertise and provide insights from our experiences. And when visits are concluded, we maintain our close connections and seek to foster further research collaboration and exchange of personnel. Through international exchange, research is advanced, educational opportunities are enhanced, and new friends and future research partners are made.
CALCE International Visiting Faculty and Researchers

In the past several years, visiting scholars and researchers have come to CALCE from Canada, China, Finland, Israel, Korea, Sweden, and the UK. They have conducted research on a wide range of topics, such as lead-free solders, lithium-ion batteries, reliability modeling, and return on investment, among others. CALCE’s faculty, staff, and students benefit greatly from this international exchange. Our visitors often bring with them unique experiences and expertise that CALCE can leverage to provide an even greater level of service to its many industry and government clients. They also contribute toward curriculum development and take part in teaching. Long-term institutional collaborations are often established through these visits.

Dr. David Baglee is a project manager and senior lecturer in the Department of Computing, Engineering and Technology at the University of Sunderland (UK). During his stay at CALCE he worked with CALCE in the field of lithium-ion battery reliability. In his role at the University of Sunderland, Dr. Baglee has managed several European and UK government-funded projects examining maintenance within the automotive and other industrial sectors. There are plans for Dr. Baglee and CALCE researchers to coauthor multiple publications on Li-ion batteries and related topics.

Dr. Young-Rae Cho is a full professor of material science at Pusan National University in Korea. As a visiting professor to CALCE, he conducted studies on identifying and characterizing barrier coatings used in flexible electronics.

Mr. Eli Dolev is a manager at the Nuclear Research Center Negev (NRCN) in Israel. While at CALCE, Mr. Dolev mentored students and collaborated on research in prognostics and health management (PHM). Mr. Dolev’s work at CALCE focused on degradation detection and parameter selection for health monitoring of electronic products. He also served as a guest editor for a special issue of the IEEE Transactions on Reliability dedicated to PHM.

Dr. Diego Galar is a professor of condition monitoring in the Division of Operation and Maintenance at Lulea University of Technology in Sweden. He has authored more than hundred journal and conference papers, books, and technical reports in the field of maintenance. His research at CALCE involves maintenance cost modeling and PHM for manufacturing equipment and systems.

Dr. Junbao Geng is an associate professor at the Huazhong University of Science and Technology, Wuhan, China. He holds a Ph.D. in thermal engineering from the Huazhong University of Science and Technology. His research interests include life cycle costing, reliability, and maintainability. At CALCE, Dr. Geng conducted studies on life cycle cost assessment for materials selection for marine seawater pipelines.

Dr. Zhenyu Gu is an associate professor of mechanical engineering in the School of Automation at Chongqing University. His research interests include energy efficiency optimization of mechanical and electrical equipment, advanced detection and control technology for manufacturing equipment, and PHM for manufacturing systems. He has published over a dozen scholarly publications, and is currently involved in four research projects in China on topics related to energy consumption and optimization for manufacturing equipment.

Dr. Suk-Jin Ham is a senior researcher at Samsung Electro-Mechanics. He is the former director of the Measurement & Analysis Group, Corporate R&D Center. He investigated the warpage of coreless substrates at CALCE.

Dr. Jin-Won Joo is a full professor of mechanical engineering at Chung-Buk National University in Korea. He has been working on various topics in the area of numerical modeling. He applied an optical technique called moire interferometry to non-linear model validation at CALCE.

Dr. Bing Long came as a visiting researcher from the University of Electronic Science and Technology of China, which is located in the city of Chengdu. His work at CALCE focused on diagnostics and prognostics for analog electronic circuits.

Dr. Toni Mattila is an adjunct professor at Aalto University in Helsinki, Finland, and is an international expert in solder joint metallurgy and mechanics. As a visiting researcher at CALCE, Dr. Mattila coordinated a co-operative project.
CALCE International Visiting Faculty and Researchers cont.

between Aalto University, CALCE, and several industrial partners with a focus on reliability assessment of novel MEMS devices used in portable consumer electronic applications. He also participated in a study on evaluating the effect of addition of trace elements into SAC105 solder on its creep response and cyclic mechanical durability.

Dr. Qiang Miao obtained his Ph.D. from the University of Toronto in 2005. He is currently an associate professor in the Department of Industrial Engineering, School of Mechanical, Electronic, and Industrial Engineering, University of Electronic Science and Technology of China, located in Chengdu. His current research focuses on machinery condition monitoring, maintenance decision-making, and PHM. He has published more than 40 research papers. At CALCE, Dr. Miao focused on fault diagnosis for cooling fan bearings using vibration signals and on developing signal processing techniques for fault diagnosis.

Dr. Wai Ming is a lecturer in engineering at the Department of Mechanical and Construction Engineering at Northumbria University, UK. Previously, he was a post-doctoral research officer at the University of Bath, UK, where he conducted research on through-life costing in designing defense electronic systems. At CALCE, Dr. Ming worked on design refresh planning for obsolescence management.

Dr. Ho-Jeong Moon is a senior researcher at Samsung Electronics. He has been involved in the development of various packaging, including package-on-package. He also investigated the reliability issues of Low-K Cu circuits at CALCE.

Dr. V. N. A. Naikan is a professor and head of the Reliability Engineering Center at the Indian Institute of Technology Kharagpur (India). His work at IIT includes a rotating machinery fault simulation laboratory and reliability modeling, analysis, and prediction of 21 NA (absolute) pressure transducers. He is the Asia Pacific editor for the International Journal of Performability Engineering and an editorial board member for the International Journal of Systems Assurance and Management.

Mr. Menahem Ratzker is a materials technologist and expert in failure analysis from Israel who worked on the degradation of contacts in electromechanical switches at CALCE.

Mr. Haw Soo Shin is a senior researcher at Samsung Electronics. He has extensive engineering experience in the area of assembly and reliability. He investigated the adhesion strength of die attach films at CALCE.

Dr. Prabhakar Varde is a senior scientist at the Bhabha Atomic Research Center and professor of engineering science at Homi Bhabha National Institute in Mumbai, India. Dr. Varde is an acknowledged global expert in probabilistic risk assessment for nuclear power plants. At CALCE, Dr. Varde worked on PHM for life extension of electronic systems. He is the chief editor for the International Journal of Life Cycle Reliability and Safety Engineering.

Dr. Yi Wan is a visiting researcher and professor of electronics engineering at Wenzhou University in Wenzhou, China. His expertise is in the optimization of electronics design and intelligent control. At CALCE, Dr. Wan has focused on optimizing the design parameters of FSBGA packages.

Dr. Limeng Yin is a professor at Chongqing University of Science and Technology. As a visiting researcher at CALCE, Dr. Yin conducted studies on the effect of joint size on the creep properties of microscale lead-free solder joints at elevated temperatures.

Dr. Shunong Zhang is a professional engineer and professor at the School of Reliability and Systems Engineering at Beihang University in Beijing, China. She has implemented nearly 30 projects that concern failure analysis of electronic parts, PHM technologies for electronic products, design of accelerated life test, reliability assessment and verification technologies for products or systems, and software development for airplane engine monitoring systems. At CALCE, she also conducted studies into the corrosion mechanisms on printed circuit cards.

Dr. Xiao-min Zhao is an associate professor of logistics management and supply chain management at Shanghai University, China. At CALCE, Dr. Zhao conducted research on supply chain topics associated with availability.
CALCE International Post-doctoral Researchers

CALCE frequently hosts post-doctoral researchers with backgrounds in a wide range of areas. These researchers come from many different countries in order to work at a world-class research center and learn vital skills, such as how to obtain funding, manage projects, and guide graduate students in their work. CALCE provides an ideal setting for the post-doctoral experience, as it gives international researchers the chance to acclimate themselves to the American university research environment and enables them to work with some of the most influential companies in the electronics industry. We particularly seek researchers who bring in ideas and skills for new areas of research that expand the horizon for the center.

Dr. Moustafa Al-Bassyiouni was a post-doctoral researcher working for Prof. Abhijit Dasgupta. Dr. Al-Bassyiouni’s research at CALCE was on testing and modeling of mechanical loading on electronic circuit cards and electronic materials. He is currently employed in the Reliability Engineering Department at Microsoft.

Dr. Chaochao Chen received his Ph.D. in mechanical engineering at Kochi University of Technology, Japan. He served as a member of the research staff at CALCE, conducting research in fault diagnosis and failure prognosis, prediction uncertainty management, and PHM software implementation. Prior to joining CALCE, Dr. Chen spent over three years at the University of Michigan and Georgia Institute of Technology as a research fellow, working in PHM areas in collaboration with multiple organizations in industry and the military.

Dr. Carlos Morillo received his PhD in materials engineering from Kyushu University, Japan. His areas of expertise include tribology and materials analysis. At CALCE, he has conducted research on electrolytic capacitors, bearings, and lead-free solders.

Dr. Martha Arbayani Bin Zaidan received his PhD from the University of Sheffield, UK. His research areas of interest include PHM, control systems, and machine learning. At CALCE he performs research in PHM and assists in PHM software development.

Prof. Bongtae Han has had four post-doctoral researchers, all from South Korea. Dr. Soon-Wook Kwon worked on plasma display panels. He also worked on constitutive modeling of high temperature solders with Dr. McCluskey. Dr. Samson Yoon worked on the reliability of Chip-on-Flex technology and is currently at Samsung Techwin. Dr. Changsoo Jang worked on moisture diffusion analysis and is now working at Apple. Dr. Hyunseok Oh worked on wind turbine condition monitoring and is a research professor at Seoul National University.

Two post-doctoral researchers from India have worked for Dr. Peter Sandborn at CALCE. Dr. Varun Prabhakar studied electronic parts supply chain management, and he now works for Toyota Research. Dr. Pameet Singh studied obsolescence and now works for General Electric.

Prof. Patrick McCluskey has had two post-doctoral researchers who worked with him. Dr. Peter Hansen is from Denmark, and his focus at CALCE was on power electronics thermal and reliability analysis. He is currently Lead Mechanical Engineer at Premium Power Corporation. Dr. Peng Wang is from China and worked on power electronics thermal management at CALCE. He is currently Senior Engineer, QCT Architecture at Qualcomm Technologies.

PhD recipients who are interested in gaining exposure to the American academic research environment are welcome to apply for a limited number of post-doctoral positions at CALCE. For more information on post-doctoral research opportunities at CALCE, please contact Prof. Michael Pecht at pecht@calce.umd.edu.
CALCE International Exchange Students and Interns

Each year, undergraduate and graduate engineering students from top international universities come to CALCE as exchange students or interns. Their stay at CALCE provides them with exposure to the American academic research environment. They benefit from the ability to work with the latest technology and have the opportunity to work on projects and learn from expert professors and research staff. These students come from diverse geographical and technical backgrounds and help us to think of traditional problems from new viewpoints. We have had students from Ukraine, Macedonia, Mongolia, Russia, and Morocco, as well as from more traditional places such as Germany, France, China, and India. Their backgrounds have included materials, energy, environment, and mechatronics, in addition to electrical and mechanical engineering fields.

CALCE draws students from several engineering schools in Germany. Interns frequently come from the Mannheim University of Applied Sciences. Mannheim places a strong emphasis on cooperative agreements with companies, universities, and research institutions from around the world, and has 4900 students. The University of Applied Sciences Düsseldorf has nearly 8000 students and around 30 international university agreements designed to promote the international exchange of students. Reutlingen University is one of Germany’s leading universities, offering international academic programs with close ties to industry and commerce. It has around 5500 students across five different schools. The Technical University of Berlin (TU Berlin) is one of the largest and most prestigious research and education institutions in Germany. It has nearly 30,000 students across seven schools, and boasts ten Nobel Prize winners among its faculty and alumni. In 2013, TU Berlin ranked 41st in the world in Engineering & Technology.

CALCE hosts students from the Institut National des Sciences Appliquées de Lyon (INSA Lyon) in France. INSA Lyon is an elite Grande École d’Ingénieurs and is ranked among the top engineering schools in Europe. It has 5,400 students, 78% of whom spend at least six months studying abroad at world-class institutions such as the University of Maryland. INSA Lyon is part of the INSA Group, which consists of five schools located across France. Each year, the graduates of the INSA group represent 10% of all the engineering graduates in France.

The American University of Beirut frequently sends exchange students to CALCE. AUB has around 8,000 students and 700 faculty members. The university ranks as the number one university in Lebanon and among the top 250 universities in the world. AUB also has the distinction of being the first American university located outside of the U.S.

For several years, Prof. Pecht served as a visiting professor at the City University of Hong Kong. While there, he established the CityU PHM Centre. CityU has 20,000 students and nearly 1000 full- and part-time faculty members. CityU has sent many exchange students to CALCE. CityU was recently rated first in greater China and 25th worldwide in Engineering/Technology and Computer Sciences in the Academic Ranking of World Universities 2013. Recent interns at CALCE from CityU have been involved in research on LEDs and battery testing.

Selected CALCE Papers Coauthored by Visiting Faculty and Students


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