THE NATIONAL ACADEMIES

RESEARCH ASSOCIATESHIP PROGRAMS

The Postdoc

Autumn 2012

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"The Postdoc" highlights research and activities of NRC Associates and Advisers in participating federal government agency laboratory programs with the NRC. Our newsletters are available in print and on our website: http://sites.nationalacademies.org/PGA/RAP/PGA_047804.
Newsletter manager: Suzanne White (swhite@nas.edu)

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

NRC Representation at Remaining 2012 Meetings

NAME OF MEETING	DATES	LOCATION	
American Chemical Society - Fall Meeting	09/10-12/2012	Philadelphia	PA
National Organization of Black Chemists and Chemical Engineers	09/25-28/2012	Washington	DC
Florida Education Fund-McKnight Fellows Conference	10/01/2012	Tampa	FL
Mexican American Engineering and Science Society	10/12-13/2012	Las Vegas	NV
Soc. for Advancement of Chicanos and Native Americans in Science	10/11-14/2012	Seattle	WA
Hispanic Association of Colleges and Universities	10/20-22/2012	Washington	DC
American Indian Science and Engineering Society	11/01-03/2012	Anchorage	AK
Annual Biomedical Research Conference for Minority Students	11/07-10/2012	San Jose	CA
American Society of Tropical Medicine and Hygiene	11/11-15/2012	Atlanta	GA
American Geophysical Union	12/03-07/2012	San Francisco	CA

S.T.E.M. Career Fair

Participating Agencies and Resources

Hiring Companies

AAAS Science & Technology Policy Fellowships

American Journal Experts (AJE)

Astrix Technology Group

BioHealth Innovation, Inc.
Bronze Sponsor

Center for Veterinary Medicine

Children's National Medical Center

DRC

Editage/Cactus Communications, Inc.

MedImmune
Platinum Sponsor

Michelin North America
Silver Sponsor

National Institute of Standards and Technology (NIST)

Silver Sponsor

Naval Research Laboratory

Oak Ridge Associated Universities

RTI International

Schafer Corporation, Technology Management Division (TMD)
Bronze Sponsor

Technology Security Associates, Inc.
Support Sponsor

The CNA Corporation

The Henry M. Jackson Foundation

U.S. Patent and Trademark Office

Westat

Resource Organizations

American Society for Biochemistry and Molecular Biology

American Society for Engineering Education (ASEE)
Support Sponsor

Build for Success (B4S) - The Incubator's Incubator

Center for New Technology Enterprise

Ewing Marion Kauffman Foundation
Diamond Sponsor

Federal Laboratory Consortium for Technology Transfer - Mid-Atlantic Region
Bronze Sponsor

Foundation for Advanced Education in the Sciences
Support Sponsor

German Academic Exchange Service/Research in Germany

Institute of International Education (IIE)/Council for International Exchange of Scholars (CIES)

Keck Graduate Institute of Applied Life Sciences

Leavy, Frank & Delaney, LLC
Support Sponsor

Maryland Technology Development Corporation (TEDCO)
Bronze Sponsor

MinorityPostdoc.org

Montgomery County Department of Economic Development
Platinum Sponsor

National Postdoctoral Association

National Research Council of the National Academies

naturejobs.com

Rockville Economic Development, Inc.
Gold Sponsor

Science • Technology • Engineering • Math
Postdoc Conference & Career Fair

- **450 postdocs attended the 2012 Postdoc Conference and Career Fair.**
- **The following fields were strongly represented at the 2010 career fair:**
  - Biochemistry
  - Pharmacology
  - Chemical and Biomolecular Engineering
  - Cancer Research
  - Polymers
  - Conservation Ecology

2012 Postdoc Conference and Career Fair attracts top science, technology, math and engineering talent and local hiring companies

More than 400 postdoctoral fellows in the science, technology, engineering and math (S.T.E.M.) fields, networked with 38 recruiting and resource organizations, as well as resume reviewers, immigration experts, industry leaders and panelists, at the 7th Annual Postdoc Conference and Career Fair held July 12, 2012 at the Bethesda North Marriott Conference Center.

"This annual conference, supported by our federal and university labs, recruiting corporations, and economic development agencies, connects some of the best STEM talent in the country with local companies seeking world-class talent to help them advance technologies and grow their companies," said Laurie Boyer, Executive Director of Rockville Economic Development, Inc. (REDI), which hosts the event. ***"This unique event provides post doctoral fellows with tools they need for a successful job search, and insights into the various career paths available to this highly educated workforce, including starting their own company. It also provides local businesses with access to a uniquely qualified, highly skilled and exceptional talent pool."***

The award-winning educational conference and recruitment fair opened with a keynote address by Dr. Jian Wang, CEO of Columbia-based BioFortis. The former postdoc turned entrepreneur provided the audience with personal details of lessons learned through his transition from academia to industry and how these experiences helped him build a successful enterprise software solution company. BioFortis provides several key applications to improve translational research, biobanking, biomarker discovery and clinical research.

Following the keynote address, attendees participated in a plenary session geared toward building job search skills, and breakout sessions related to working for existing companies, following an entrepreneurial path, and jobs beyond the bench. Attendees also took part in prescheduled meetings to review their resumes.

As might be expected from a region that hosts the National Institutes of Health, fully half of the attendees had expertise in the biological sciences, while 21% cited expertise in chemistry, and engineering and neuroscience each claimed more than 10% of participants. Significantly, nearly half of the participants had expertise in two or more fields. A number of them are proficient in fields that seem divergent at first glance, such as computing and neuroscience, or biological science and physics.

"In today's competitive marketplace, companies need to hire the best and the brightest," said RTI International's Jennie Hunter-Cevera. ***"The folks here are at the top of the top, and can contribute significantly to a company's bottom line: that's why we are here."***

"Despite the weaknesses in some areas of our economy, this conference and the number of hiring and resource companies providing job opportunities and information to new career seekers is a testament to the strength of the Rockville, Montgomery County and greater DC area market," said Boyer. ***"Companies unable to attend and recruit onsite can still take advantage of this program, and access a resume database to search for local job candidates. This service enables companies to take advantage of this talent pool beyond the one-day event."***

Postdoc Conference and Career Fair
www.postdocconference.org.

See videos and photos
facebook.com/RockvilleREDI

ABOUT REDI

The mission of Rockville Economic Development, Inc. (REDI) is to assure the City's future economic vitality. From accessing funding sources to workforce development…from educational programming to market intelligence…from advisory services to introductions to key decision-makers… REDI helps companies grow by providing knowledge, access, resources, and direction to companies at all stages of growth. REDI offers its resources to the community free-of-charge, and welcomes inquiries and referrals.

www.RockvilleREDI .org

Rockville
Economic Development, Inc.
Known for the Companies We Keep

Spotlight on Podcasts

Check out the VIDEOS and PODCASTS on the PGA website!
(National Academy of Sciences, National Ressearch Council, Division on Policy and Global Affairs (PGA)

http://sites.nationalacademies.org/PGA/PGA_048195

Rockville Economic Development, Inc. shared a link.
July 30

Did REDi's StartRight! Business Plan competition change how see things? Lloydie has a strong response...

" We are women entrepreneurs!" - Lloydie Zaiser, Tuko Pamoja
youtu.be

Finalist Lloydie Zaiser explains why she enjoyed the StartRight! Business Plan Competition.

Start Right Testimony
http://www.youtube.com/watch?feature=player_embedded&v=ArTIVjS_xCM

Host your own YouTube success

Redi's START RIGHT Business Plan

A plethora of videos!!!!!!!!!!!!

http://www.facebook.com/RockvilleREDI

Did REDi's StartRight! Business Plan competition change how you see things? Lloydie has a strong response...

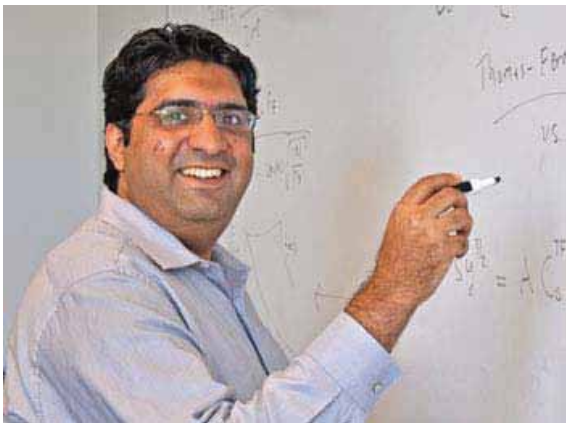
Shaffique Adam — Singapore National Research Foundation Fellowship

Dr. Shaffique Adam, a **NRC Postdoctoral Research Associate in the NIST Center for Nanoscale Science and Technology**, has been awarded a 2012 Singapore National Research Foundation (NRF) Fellowship. The Fellowship provides an opportunity for a small number of "brilliant young researchers from all over the world to carry out independent research" in Singapore, and includes a five-year research grant totaling approximately $3 million to support research on a topic of the Fellow's choice.

The NRF Fellowship is a globally competitive program, open to all nationalities, aimed at recruiting outstanding young scientists and researchers to conduct independent research in Singapore. Ten fellows were chosen out of 120 applicants from all areas of science and technology, including life sciences, physical sciences, computer science, and engineering.

Shaffique received a B.S. in Physics from Stanford University, with departmental honors and a university distinction, and a Ph.D. in Theoretical Physics from Cornell University, where he studied the properties of nanoscale magnetic materials. Prior to joining the NIST, he was a Postdoctoral Research Associate in the Department of Physics at the University of Maryland, College Park.

At the CNST, Dr. Adam worked with NIST Fellow Mark Stiles on theoretical studies of the physical mechanisms at play in a variety of technologically important nanomaterials, including graphene and topological insulators. His research seeks to understand these systems, and also to find a pathway to control their behavior in order to enable the development of future electronic devices.



Dr. Shaffique Adam, NRC Associate at NIST

Shaffique has published over 30 manuscripts in prominent journals, including *Nature*, *Nature Physics*, the *Proceedings of the National Academies of Sciences*, and *Physical Review Letters*.

In July, Shaffique will join the inaugural faculty of Yale-NUS College as an Assistant Professor of Science, with a joint appointment in the Department of Physics at the National University of Singapore (NUS). Yale-NUS College is a joint project of Yale University and NUS, designed to create a twenty-first century model of undergraduate liberal arts and sciences education for Asia that draws on the best elements of the American liberal arts tradition.

NATIONAL RESEARCH FOUNDATION
Research, Innovation and Technology Administration (RITA) System

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The National Research Foundation (NRF) in Singapore is inviting scientists under 40 years of age to apply for a generous fellowship to carry out independent research in the country.

The Singapore NRF Fellowships offer tenure-track faculty positions that come with a salary package equivalent to that of a local assistant professor and a research grant of up to $2.4 million over 5 years. These are individual fellowships, so researchers get to choose the host institution; NRF Fellows will be able to lead their own teams at the institution of their choice, as long as it's in Singapore. Shortlisted candidates will be invited in January to visit local research organizations for a week, before the final interview, so they may discuss support for their research and choose potential host institutions.

Now in its sixth round, the Fellowship scheme welcomes research proposals in computer science, all branches of engineering, medicine, life sciences, and natural/physical sciences. To apply you must have a Ph.D. and postdoctoral experience. Scientists of all nationalities are eligible.

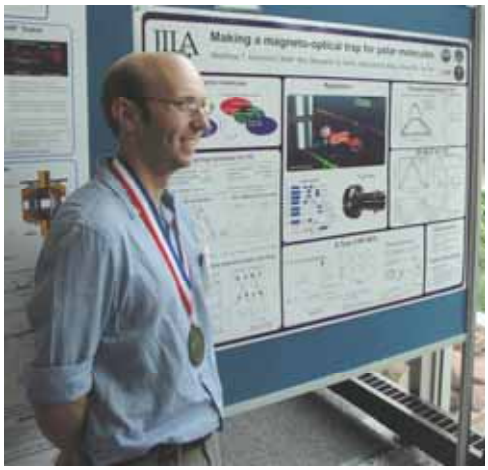
More information about the scheme and how to apply can be found on the NRF Web site.

Deadline for 2012 was 15 August 2012. The announcement of short-listed candidates will be no later than 30 November 2012.

Science Careers Blog Science Career Magazine

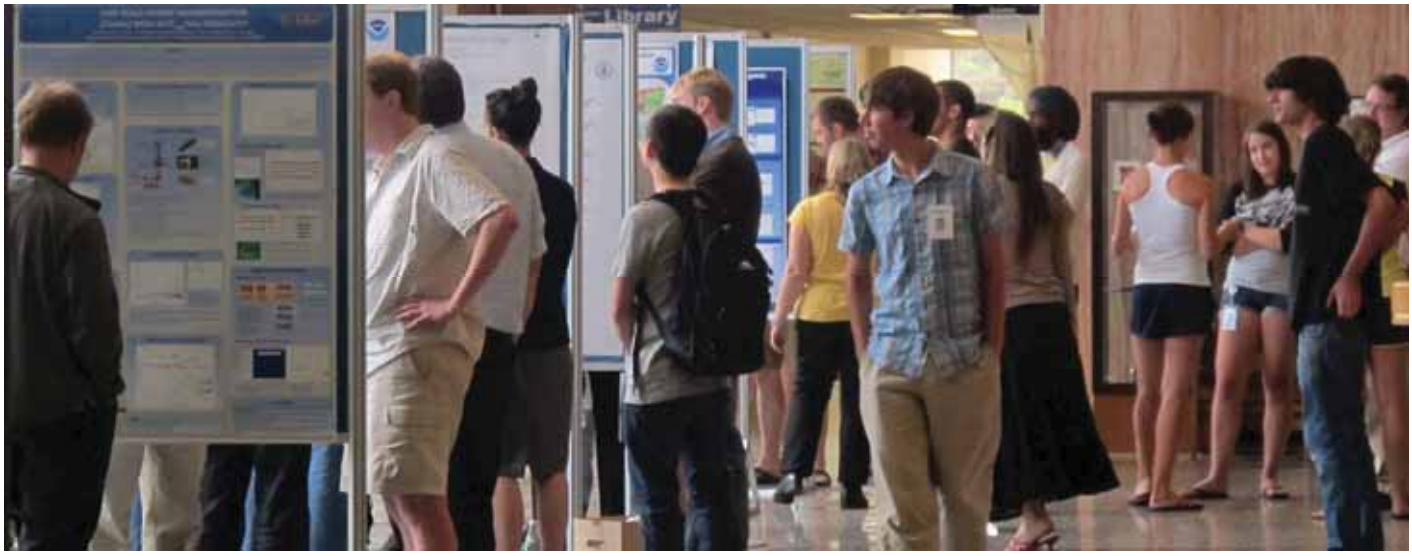
NIST Postdoc Poster Symposium

On July 18, the 2012 Boulder Laboratories Postdoctoral Poster Symposium was held in the Building 1 lobby. The postdoc symposium program consisted of a round of short talks and a poster session with a total of 26 presentations. The event promoted networking among early career researchers, especially students and postdoctoral affiliates. Attendees at the event gained a greater appreciation for the important contributions of postdoctoral affiliates and students to the research environment of the Boulder Laboratories, while they enjoyed refreshments that were provided by volunteers from the Boulder Labs Diversity Council.



Dr. Matthew Hummon, former NRC/NIST Associate Photo courtesy Marilyn Yetzbacher

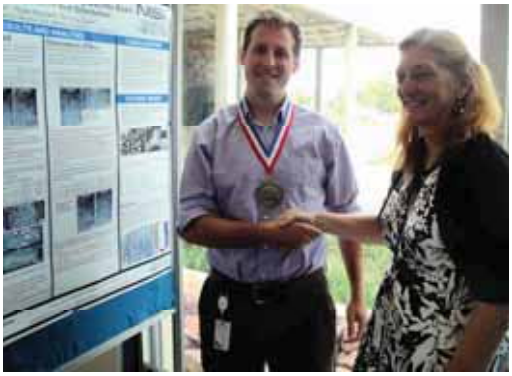
Dr. Ray Gamble, NRC Associateships Director, with Dr. Peter Hsieh, NRC /NIST ARRA Associate. Photo courtesy Marilyn Yetzbacher



Boulder Laboratories Postdoctoral Poster Symposium, July 18, 2012, NIST Boulder, Colorado Photo courtesy Marilyn Yetzbacher

Since its beginning in 2004 to honor both the Boulder Labs 50 Year Celebration and the 50 Year Anniversary of the NIST/NRC Postdoctoral Associateship Program, the postdoc symposium has been organized annually under the leadership of Joseph W. Magee, Ph.D. (former NRC Associate). Its most unique attribute is its broad-based participation by early career researchers who represent one of three DOC agencies (NIST, NOAA, or NTIA) located on the Boulder Labs campus or their joint institutes (JILA, CIRES, or CIRA) which are located on nearby university campuses (University of Colorado at Boulder and Colorado State University).

The 2012 postdoc symposium was co-chaired by Joseph Magee and Jason A. Widegren, Ph.D. (former NRC Associate). The symposium opened with a series of two -minute, two-slide talks in rapid succession. Each talk provided a synopsis of a poster.

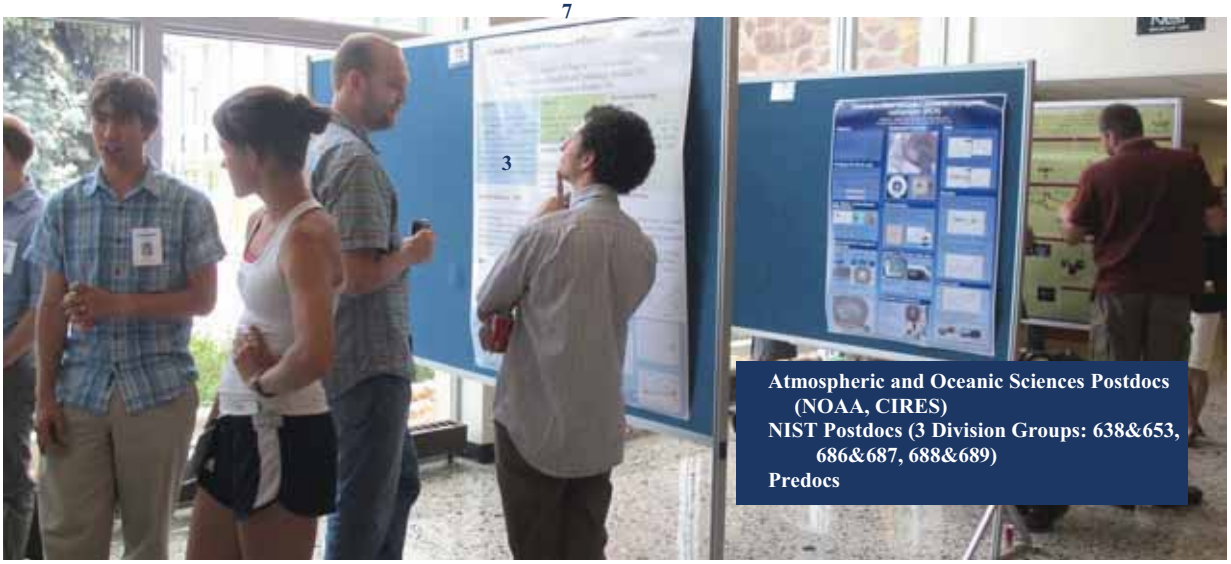


Dr. Nikolas Hrabe NRC/NIST ARRA Associate being congratulated by Dr. Susan Heller-Zeisler, International and Academic Affairs Office, NIST Laboratory NRC Program Representative. Photo courtesy Marilyn Yetzbacher

This session, often called a lightning round, was lively and well-attended. About 150 attendees were present in the Building 1 Auditorium, where they listened intently to speakers, but held their questions and discussion for the poster session. At its conclusion, the audience spilled out into the Main Lobby for the poster session.

In 2003 – 2004, while planning to conduct this event for the first time, Joe Magee received invaluable advice from Barbara C. Levin, Ph.D., who was instrumental in starting NIST Gaithersburg's successful series of postdoctoral poster presentations some 10 years earlier. Two key decisions were made as a result of these conversations. One was to give the Boulder event a unique name that would prevent confusion. Another, due to the diversity of research topics present in

the Boulder Labs, was to present awards for the most outstanding posters in different categories. As a result, With the awards are presented in a number of categories, including physics, chemistry, materials science, engineering science, mathematical science, oceanic science, and atmospheric science. The actual research topics presented in abstracts in a given year determine the final list of categories and whether they are subdivided further or combined.



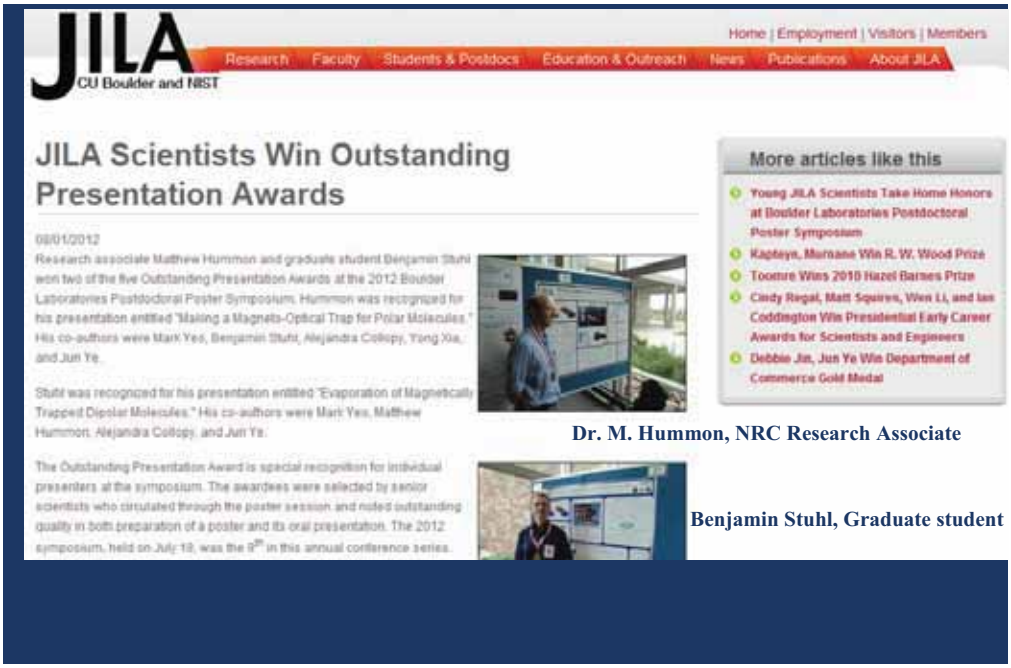
Atmospheric and Oceanic Sciences Postdocs (NOAA, CIRES)
NIST Postdocs (3 Division Groups: 638&653, 686&687, 688&689)
Predocs

For 2012, five presenters were selected for their Outstanding Presentations. The selections were made by a panel of senior scientists who had listened to each presentation. Each judge was assigned one of five categories, organized according to research disciplines and academic status of the presenters, as follows:

- Atmospheric and oceanic sciences (NOAA, CIRES) Postdocs
- Physical measurement (NIST 686, 687) Postdocs
- Physical measurement (NIST 688, 689) Postdocs
- Material measurement (NIST 638, 653) Postdocs
- Predoctoral students

The panelists independently selected the presenters who would receive **Outstanding Presentation** awards. Awards, in the form of custom-made brass medallions on ribbons, were presented for the best presentation(s) in each section, in the order listed above, to Shona C. Smith, Ph.D., Jacob W. Alldredge, Ph.D., Matthew T. Hummon, Ph.D. (former NRC Associate) , Nikolas Hrabe, Ph.D. (an NRC ARRA Associate), and Mr. Benjamin K. Stuhl.

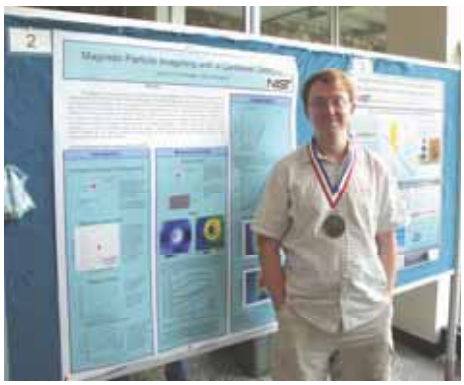
The event's sponsor is the Boulder Labs Diversity Council:



Dr. M. Hummon, NRC Research Associate

Benjamin Stuhl, Graduate student

http://jila.colorado.edu/content/jila-scientists-win-outstanding-presentation-awards



Dr. Jacob Alldredge, NIST Professional Research Experience Program (PREP) postdoc, Electromagnetics Division with NRC Adviser Dr. John Moreland.

Dr. Shona Smith, congratulated by Dr. Joseph Magee, former NRC Associate

Chemical-oxidation research impacts national EPA ground water sampling protocol

Dr. Saebom Ko has been an **NRC Post-Doctoral Fellow since February, 2009 at the U.S. Environmental Protection Agency, Robert S. Kerr Environmental Research Center (EPA-RSKERC),** and will complete her 4th year NRC appointment in January, 2013.

Dr. Ko has been conducting research involving multidisciplinary chemical oxidation research studies that extend from fundamental process mechanisms in the lab to applied research involving field studies.

Ground Water Sample Preservation at ISCO Sites

In-situ chemical oxidation (ISCO) involves the introduction of a chemical oxidant into the subsurface for the purpose of transforming ground water and/or soil contaminants into less harmful chemical byproducts. Often, ground water samples collected specifically to analyze organic contaminants may contain the oxidant and the organic contaminants in a "binary-mixture".

When organic contaminants and oxidants are commingled in the ground water sample, there is significant potential for oxidative transformation of contaminants to occur after the sample is collected. Consequently, the quality of the ground water sample is compromised and false negative results misguide important remedial decisions at hazardous waste sites.

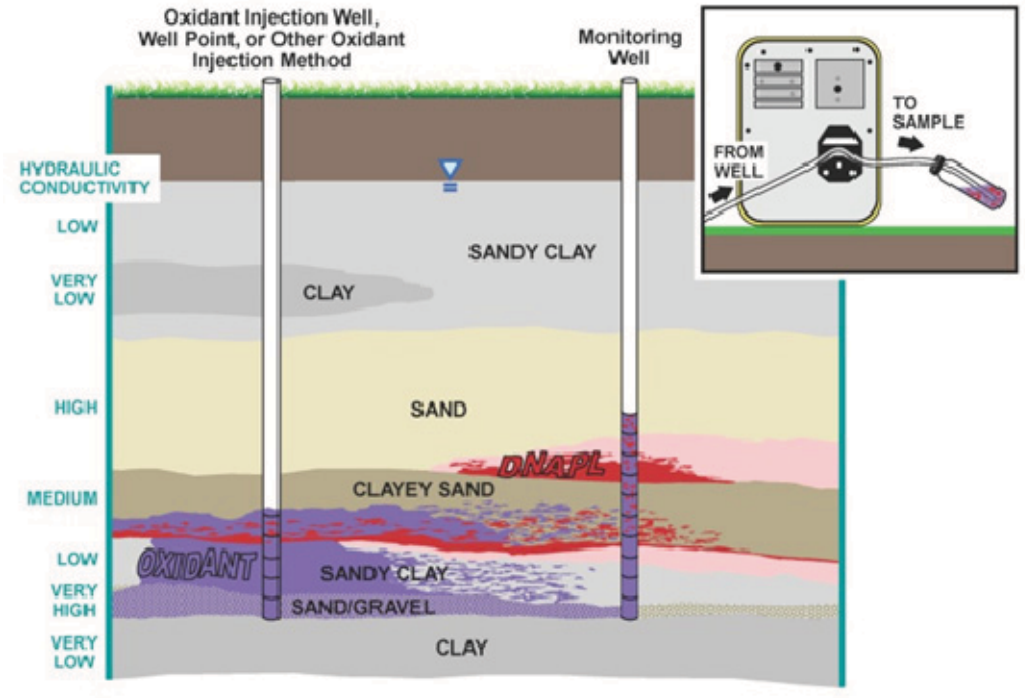
In depth studies revealed that after samples are collected in the field, transformation of environmental contaminants occurs prior to the analysis, and during the analysis using GC, GC/MS, or HPLC. An effective and practical remedy of the impact of binary mixtures on ground water quality was mitigated through the addition of various reductants, specifically ascorbic acid. Additionally, the amendment of excess ascorbic acid to sample vials did not negatively impact the analytical results or the analytical instruments used in the analysis.

Chemical Oxidation Regeneration of Spent-Granular Activated Carbon (GAC)

GAC is the most common adsorbent to treat a broad spectrum of contaminants in air and water associated with domestic water supplies, and industrial and municipal wastewaters as well as combustion products from industries and power plants. Methyl *tert*-butyl ether (MTBE) and chloroform spent GAC was regenerated using persulfate oxidation reactions. The accumulation of sulfur species was responsible for the blockage of sorption sites and interferred with post-oxidation MTBE sorption. However, the sorption loss was fully reversed by raising the pH in the GAC slurry to the pH point-of-zero charge of GAC.

Half of the GAC consumed in the US is used to remove natural organic matter (NOM), a precursor in the formation of disinfection byproducts. Currently, thermally activated persulfate is being used to chemically regenerate NOM -spent GAC. In a companion study, a pilot-scale demonstration is underway to investigate the thermally activated persulfate regeneration of TCE-spent GAC at the Massachusetts Military Reservation (Otis ANG Base, Bourne, MA).

Figure 1. Conceptual model of hydrogeologic, and oxidant and contaminant fate and transport conditions that contribute to binary-mixture ground water samples.



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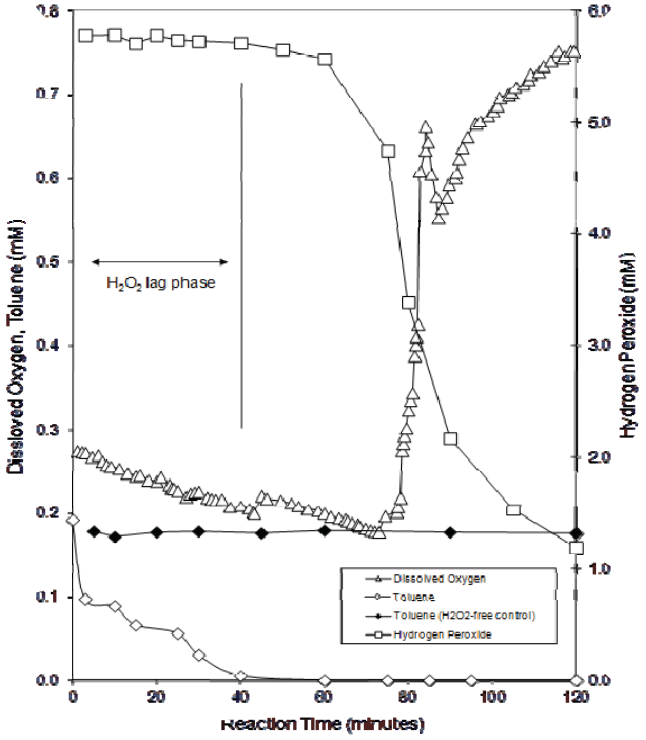
The Fenton-like (H_2O_2/Fe(III)) Reaction Mechanism.

Fenton (H_2O_2/Fe(II)) or Fenton-like (H_2O_2/Fe(III)) reactions have been widely used to treat toxic organic contaminants. The reaction generates hydroxyl radicals (·OH) that are capable of oxidizing a wide range of environmental organic pollutants. In a seemingly simple system, multiple parameters affect the reaction mechanism through side and competing reactions. Specifically, MTBE transformation was negatively impacted by several parameters typical in chemical oxidation systems including the counter ion of the iron catalyst (i.e., sulfate and nitrate), H_2O_2, radical scavengers including chloroform and isopropyl alcohol (IPA). For example, SO_4^{2-} interferes in the formation of the ferro-peroxy intermediate species, thus inhibiting ·OH formation. The combined affect of inhibiting the H_2O_2 reaction, ·OH formation, and MTBE transformation was achieved by the addition of SO_4^{2-} to a ferric nitrate-amended Fenton system confirming the interfering role of SO_4^{2-}. Improvements in understanding the fundamental mechanisms involved in oxidative treatment systems allows for improvements in the further development of these remedial technologies.

Additional research is being conducted to investigate a novel mechanism involving the role of functional group(s) (FG) (i.e., electron-donating FG (-CH_3) vs. electron-withdrawing FG (-Cl or -NO_3)) on the aromatic ring on the oxidation kinetics of aromatic compounds. This mechanism is evident through detailed investigations which examined H_2O_2 decomposition rates, and the presence and consumption of dissolved oxygen (DO). Further, GC/MS/MS analysis of spin trap compounds was used to identify reaction byproducts and to formulate reaction pathways. H_2O_2 decomposition in oxidative systems involving aromatic compounds with electron donating FG's (i.e., -CH_3) was delayed until aromatics were completely transformed (Figure 2), while the H_2O_2 decomposition in systems including aromatic compounds with electron-withdrawing FG's (-Cl or -NO_3) follow conventional first-order kinetics. The role of DO in these systems as an alternate electron acceptor is now evident and provides further insight in reaction mechanisms and processes.

Figure 2. Simultaneous decline in toluene and dissolved oxygen while H_2O_2 remains relatively stable.



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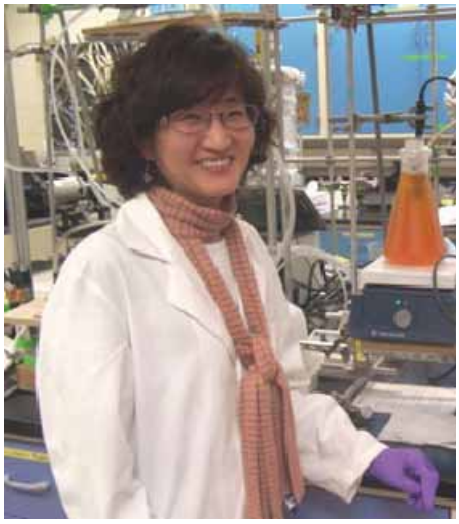

Dr. Saebom Ko, NRC Research Associate at EPA

Ko, S., Huling, S.G., Pivetz, B. 2012. Ground Water Sample Preservation at In-Situ Chemical Oxidation Sites – Recommended Guidelines, EPA Ground Water Issue Paper. US Environmental Protection Agency, National Risk Management Research Laboratory, R.S. Kerr Environmental Research Center, Ada, OK. EPA/600/R-12/049.

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Huling, S.G., S. Hwang, D. Fine, Ko, S. 2011. "Fenton-like initiation of a toluene transformation mechanism." *Wat. Res.* 45, 5334-5342.

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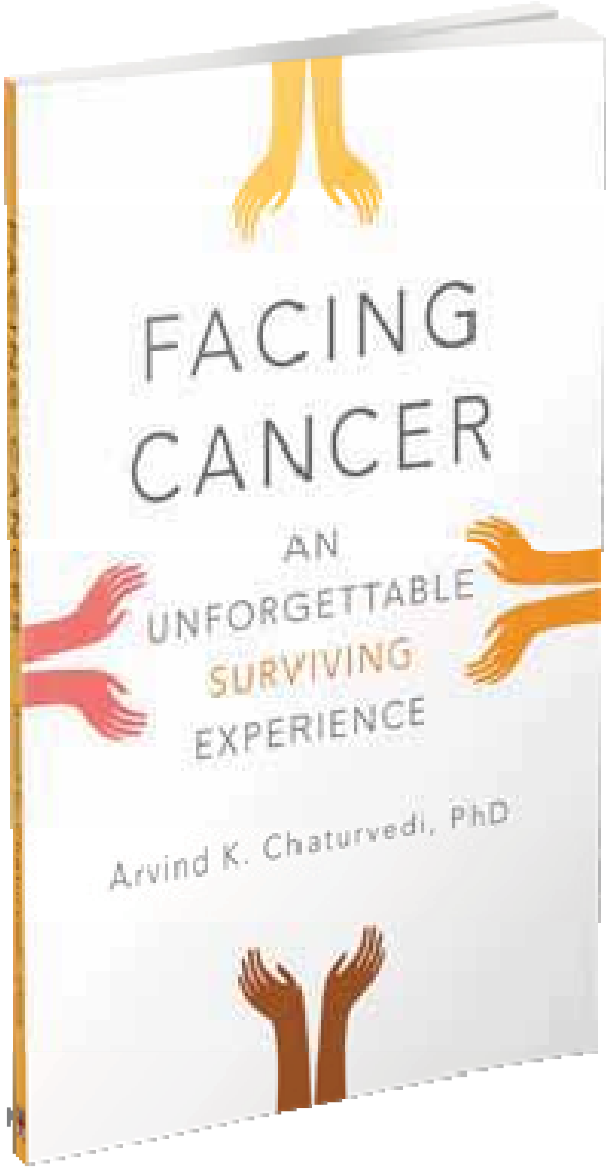
Book nook: NRC Adviser/Patient Facing Cancer

When one gets the frightening news from his/her doctor that he/she has cancer, the fundamental question emerges. Now what? Dr. Arvind Chaturvedi has been there, and he knows what one goes through in that situation.


Dr.Arvind Chaturvedi, NRC Adviser

Based upon his own personal experiences, Dr. Chaturvedi shows readers the emotional, medical, and spiritual journey one goes through when faced with the life-threatening situation cancer can bring. In the book, he also effectively summarizes the cancer-related process so that patients and their family members will have a better understanding of the methods of healing. The other side of healing—human touch—and positive roles of family and friends are signified. Importance is expressed for those outstanding people who dedicate themselves and their compassion to those they do not even know and who have chosen paths where every day, when they awake for work, they serve people in medical and spiritual need.



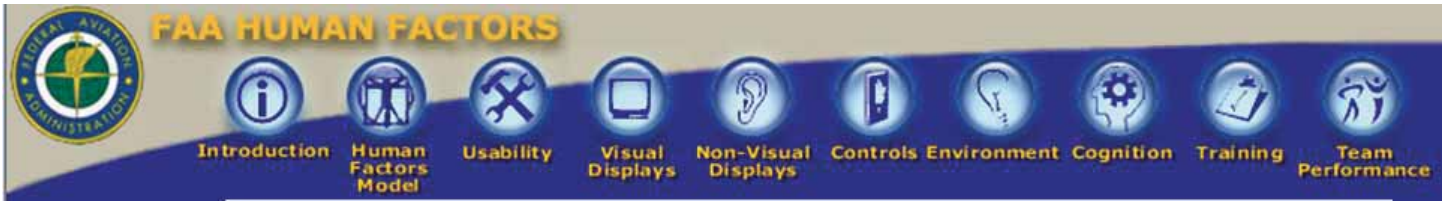
Harmful effects of chemotherapy, biomedical changes during treatment, and frustrations/depressions that the patient had faced are covered. Philosophical and religious views are included in light of the seriousness of the disease and associated consequences. Through this book readers would enhance their understanding, thus improve their knowledge, of the treatment of cancer, including personal and spiritual aspects of living and life.

Whether you are *Facing Cancer* yourself or know someone who is, know that all hope is not lost for you or your loved one. This is a must-read for those mired in a struggle with cancer. The author has provided a compassionate glimpse into the world of a father and his family fighting side by side with love, faith, and determination. Delve into Dr. Chaturvedi's incredible survivor story and be encouraged.

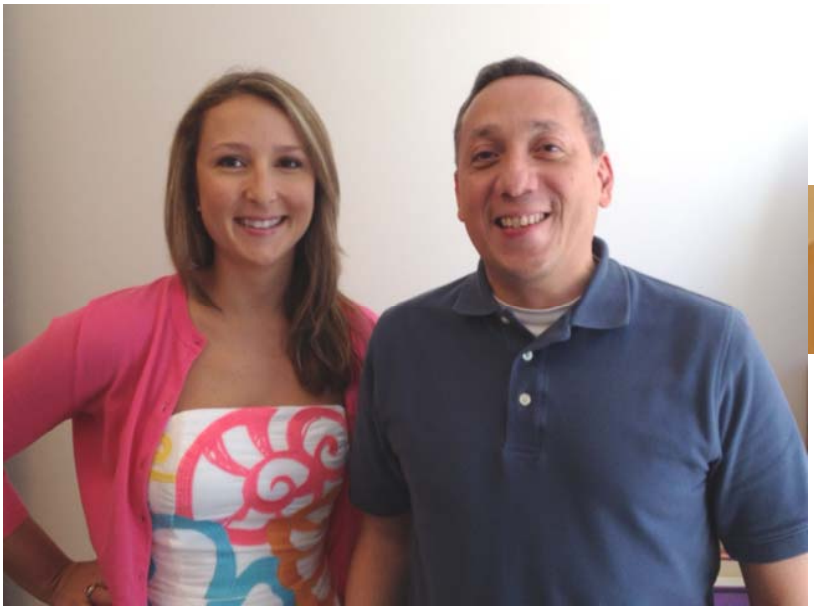
Published by Tate Publishing, the title of the book is *Facing Cancer: An Unforgettable Surviving Experience*. Additional information about the book can be obtained from the web link:

www.facingcancer.tateauthor.com

Dr. Chaturvedi is an **NRC Research Adviser**, an aerospace medicine scientist at the US Federal Aviation Administration, and adjunct professor at the University of Oklahoma Health Sciences Center.



Welcome, new NRC Associateship Staff!



Morgan Mounts, NRC Fiscal; Christopher Del Cid, NRC Travel

Morgan Mounts joined the Fellowship Office in August 2011. She is the financial associate for the Ford Fellowships Program, Jefferson Science Fellows, and the Research Associateship Programs with the Defense Threat Reduction Agency and Air Force Research Laboratories.

Prior to joining the National Academies, Morgan worked as an accountant with the U.S. Army Corps of Engineers in Wilmington, North Carolina.

She received a B.S.B.A. in Accounting and a M.B.A. in International Business from the University of North Carolina Wilmington, along with a M.S. in Development Economics from Euromed Management in Marseille, France. **Welcome, Morgan!**

Christopher Del Cid joined the Fellowship Office in March. In his current role as a Travel Expense Coordinator, he has audit responsibility for FO Travel Expense Reports including: domestic travel, relocation, and international travel.

Prior to joining the National Academies, Christopher lived and worked for two years in Seoul, South Korea, providing travel expense auditing, invoicing and accounts receivable support to a consulting business working on the Army Corps of Engineers "Yongsan Base Relocation" program.

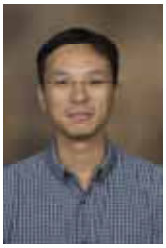
He is currently working on completion of a B.S in Computer and Information Science with a minor in Accounting at the University of Maryland University College. Personal pursuits in his spare time generally involve travel, and he is always looking for the next vacation opportunity to visit an exotic location he has never seen before. **Welcome Christopher!**

Heads up! NRL's Palmsten

NRC Associate Meg Palmsten works to create a flat initial bed for an experiment designed to study shear stress and sediment transport a stream meander bend at the University of Minnesota Saint Anthony Falls Laboratory (SAFL) Outdoor Stream Lab (OSL). The OSL is a unique field scale laboratory for studying the physics and ecology of streams.

Pathfinding for mobile sensor networks on the fly

Dr. Khanh Pham



Dr. Yunjun Xu

Dr. Khanh Pham, NRC Research Adviser at the AFRL Space Vehicles Directorate in Kirtland Air Force Base, had a successful year with the AF Summer Faculty Fellow from the University of Central Florida, Dr. Yunjun Xu . His frontlines on the tech area of bio-inspired controls with fast path planning are featured in a recent issue of SPIE "Newsroom".

An algorithm inspired by hoverfly flight helps mobile sensor devices to navigate their surroundings by finding optimal trajectories through their environment.

As computing power continues to increase and embedded electronic applications go beyond what was once thought possible, cyber–physical systems (CPSs) are becoming a significant area of interest. A CPS comprises a closely interacting network of physical and computational components that responds rapidly and automatically to physical inputs with physical outputs. One category of CPSs is mobile sensor networks (MSNs) that, through the action of the physical components of the system, can autonomously investigate and report on their environment. MSNs a variety of potential applications. For example, a ground-based MSN could be used to identify hazardous contaminants,[1] and a ground and air MSN can be used in the localization of targets.[2] A network of satellites has also been used to monitor air quality.[3]

Efficient management of MSNs relies on computing local instructions in real time for each physical component, or agent, of the MSN to enable it to freely navigate its environment. This is a challenging task that must consider nonlinear dynamics, various different constraints, and changing environments.[4] A method – virtual motion camouflage (VMC) – has been developed for rapidly generating optimal agent trajectories, inspired by the motion camouflage phenomenon observed in mating hoverflies,[5, 6] and the performance of this method in controlling an MSN has been assessed using a robot testbed.

VMC is a varying subspace method. The subspace is constructed by a constant but optimizable reference point and a virtual prey motion that is represented by B-spline curves. Within the subspace, the actual trajectory of an agent (i.e. translational motion) is controlled by a single-degree-of-freedom vector (the so-called "path control parameter"). In the achieved nonlinear programming problem, both the subspace and the path control parameters are optimized simultaneously. Also, to effectively find obstacle-free trajectories, the VMC method can be augmented with some fast path planning algorithms, such as the wave front approach.[7]

Although the new method has been evaluated in space-, air- , and ground-based application simulations,[5, 6, 8] it makes more sense to have an intermediate testbed instead of directly applying it to a high-cost and high-risk real system. Such a testbed can be controlled so that different aspects of the new algorithm can be tested with minimal losses or costs in the event of a failure. Recently, a low-cost robot testbed has been developed at the Air Force Research Laboratory – Space Vehicles Directorate (Fig. 1). Built around a modular robot platform, the robots can carry different sensors and the robot dynamics can be heterogeneous. The robots exchange data with laptops using BluetoothR ˪ communication. (˪ **BluetoothR word mark and logos are registered trademarks of Blutooth SIG, Inc.**

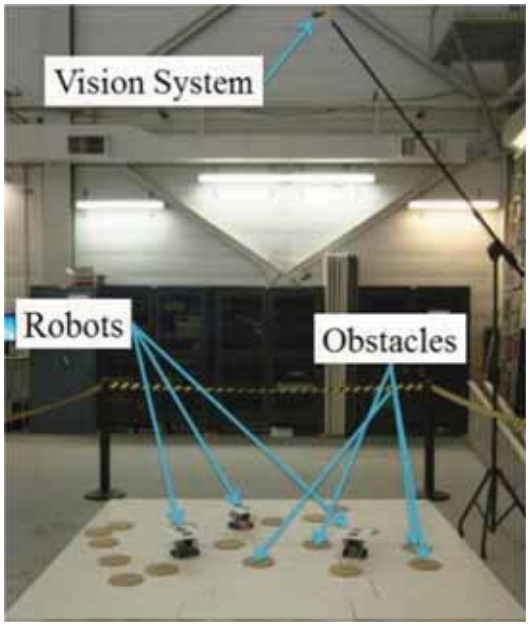


Figure 1. Low-cost, vision-based robot testbed for the development and verification of trajectory-planning and other algorithms to support cyber–physical systems.

The number of robot agents that can be connected is limited by the communication hardware (currently, this limit is 7). In the current design, an overhead webcam provides environment data, such as the obstacle and robot locations, to the robots using a template matching technique.[9] Images captured from the webcam are processed at a rate of 7Hz using a prediction strategy for the localization of robots and searching the entire frame for new obstacles.

The testbed has been used to demonstrate that the VMC algorithm is capable of rapidly computing the optimal trajectories of multiple robots operating in varying dense obstacle environments. Starting with a single robot agent and increasing to three, the algorithm is applied to a number of scenarios including: randomly distributed, dense obstacle environments; clustered, dense obstacle environments; and close-quarters environments, all with different initial and final conditions. These test scenarios are considered a success if a trajectory for each agent is achieved within a few seconds. Typical tests for the algorithm can be seen in Figs. 2–4.

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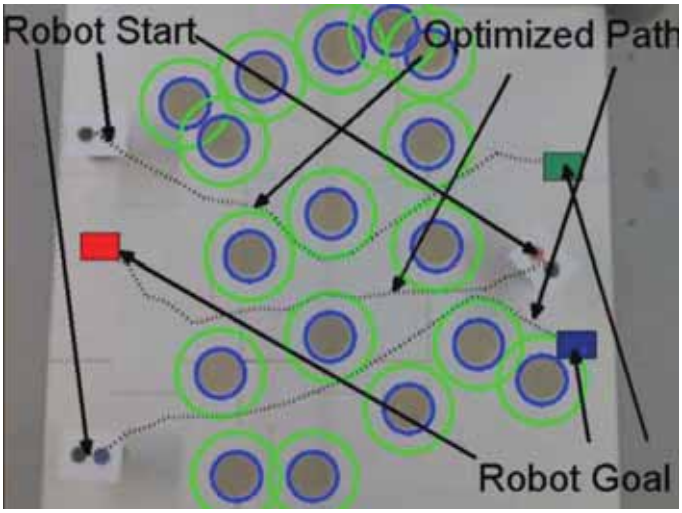


Figure 2. Typical testbed run with three robots in a randomly distributed, dense obstacle environment.

A graphical user interface for the testbed allows users to change the trajectory planning method used and the parameters used (Fig. 5). Also, robot connections can be managed, onboard sensors can be viewed and desired robot localization can be modified.

In addition to the optimal trajectory planning algorithm for MSNs, the testbed could also be used in many other applications. With proper enhancements in communication and software developments, the testbed can test scalable and decentralized planning algorithms and study the communication architecture for MSNs. With rigorous analysis and hardware validation, the new algorithm could be used in many MSN applications such as formation flying, border security, wind farms, etc.

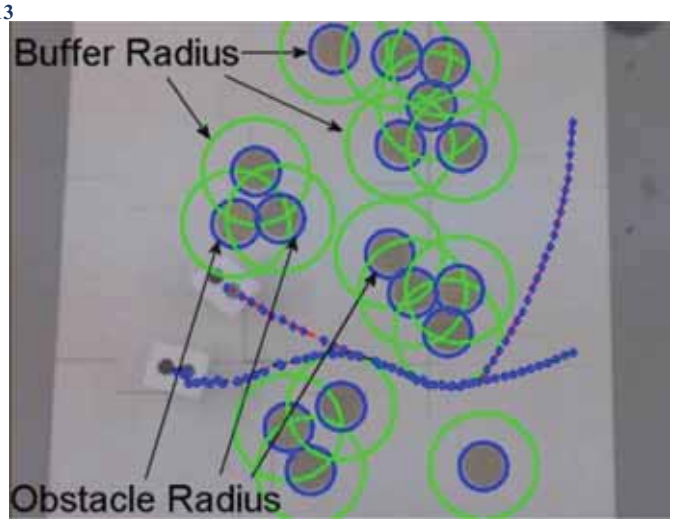


Figure 3. Typical testbed run with two robots in a clustered and dense obstacle environment.

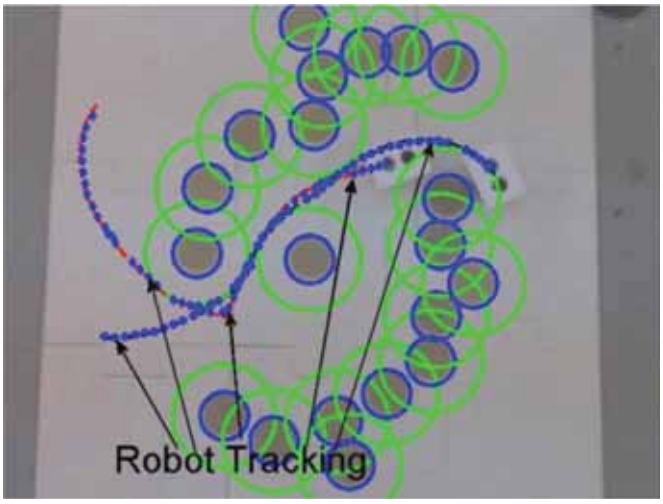


Figure 4. Typical testbed run with two robots in close quarters.

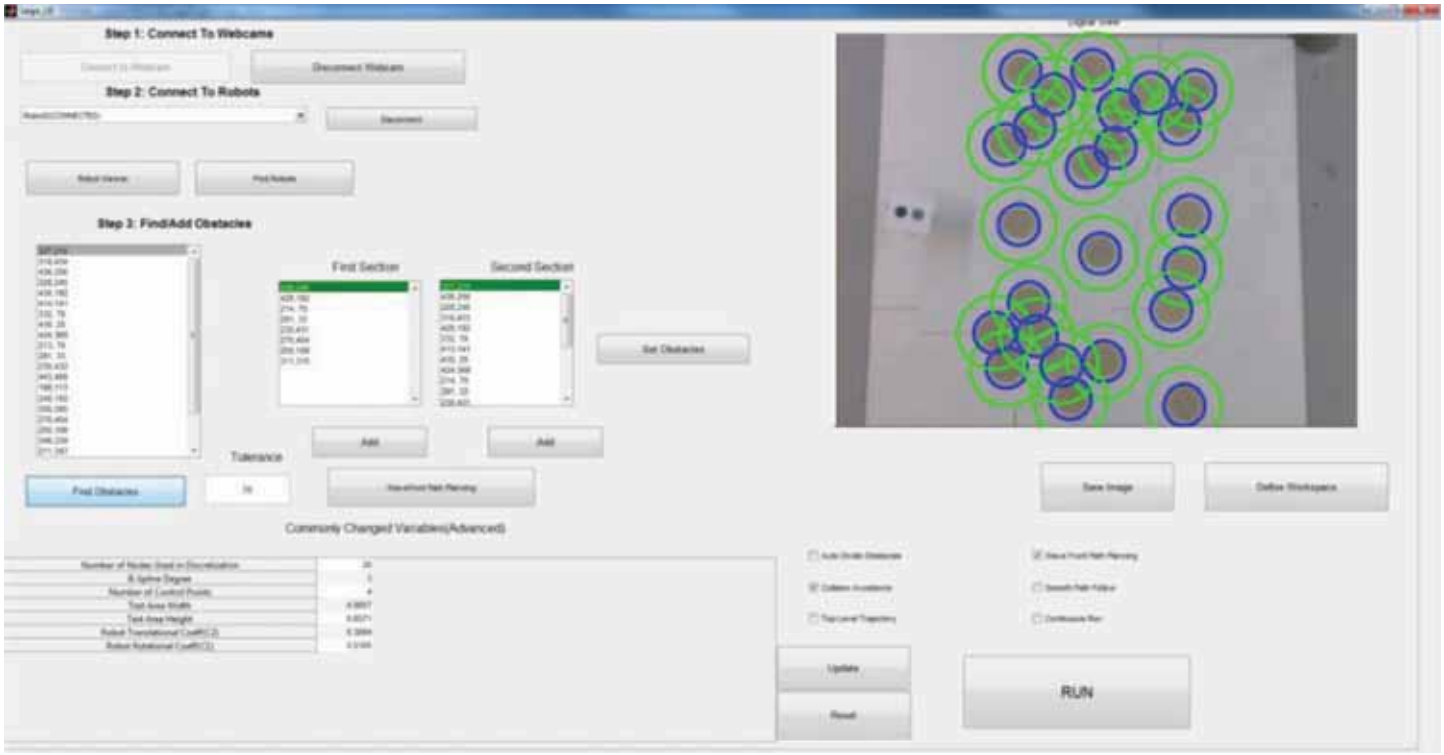


Figure 5. Graphical user interface designed for the testbed.

Highlighting

Dan Angelini

Dr. Dan Angelini, NRC Associate at ECBC

One of the most recent additions to the **National Research Council's (NRC) Postdoctoral Resident Research Associateship Program (RAP) is Dan Angelini,** Ph.D., a senior research associate in ECBC's Research and Technology (R&T) Directorate.

Angelini received his Ph.D. in Pathology from University of Maryland, Baltimore in 2004, where he examined the role of tumor necrosis factor alpha in the regulation of the pulmonary vascular endothelial paracellular pathway as it related to the acute respiratory distress syndrome. Before coming to ECBC, Angelini worked at Johns Hopkins University in the Department of Anesthesiology and Critical Care Medicine from 2005 to 2011.

Since coming to work at ECBC, Angelini has been working under the direction of Harry Salem, Ph.D., chief scientist for the life sciences. RAP postdoctoral associates are accepted for one year, with an option for renewal for another year. During the year of postdoctoral work, Angelini will complete a scientific journal article for peer review and work on a number of other research projects under the direction of Salem.

"The NRC Postdoctoral Program is a great way of recruiting new young and motivated scientists for our research programs," said Salem. ***"They come to us with the latest technologies from the best academic institutions with cutting-edge science. It's a two way street – it gives the new postdocs the opportunity to evaluate us and for us to evaluate them."***

Angelini's work for ECBC has been focused on stem cell research, primarily the use of stem cells to examine the pulmonary toxicity of chemical warfare agents and other chemical/biological agents. ***"I would say that I spend about 40 percent of my time in the lab, 40 percent of my time writing papers and articles and 20 percent of my time doing administrative things, like going to meetings and travelling,"*** Angelini said. ***"Being in a postdoctoral program is really a continuation of your training, but more independent than graduate studies. You want to publish as many papers as possible, which will help you with the career path you've chosen and the kind of research with which you'd like to be involved. Eventually, I'd like to be in the position to be a Principal Investigator (PI)."***

(A PI is the lead scientist or engineer for a particular project and is responsible for designing experiments, writing proposals and papers, managing technical efforts and meeting milestones and objectives.)

"Right now, I'm working on a review article of stem cells in the lung," said Angelini. ***"I've been working in the lab with mesenchymal stem cell cultures, which are adult stem cells that are primarily derived from bone marrow. These cells could be used for in vitro toxicology assays."***

(An "assay" is a procedure in molecular biology for testing or measuring the activity of a drug or biochemical in an organism or organic sample.)

Angelini said that he chose to study and work in pathology because the field offers ample opportunities for innovation and finding solutions to problems. ***"It's like solving a mystery," said Angelini. "I like feeling like I'm trying to figure out something that nobody's done before. After the postdoctoral program, my goal is to be able to do this type of work permanently. One great thing about being at ECBC has been the friendly, supportive environment on the team and throughout the directorate, all the way up through branch and division chiefs. They have a great network across the board. One of the best aspects of the team here is that there are so many different kinds of scientific expertise, so there's always someone who can answer any questions you may have."***

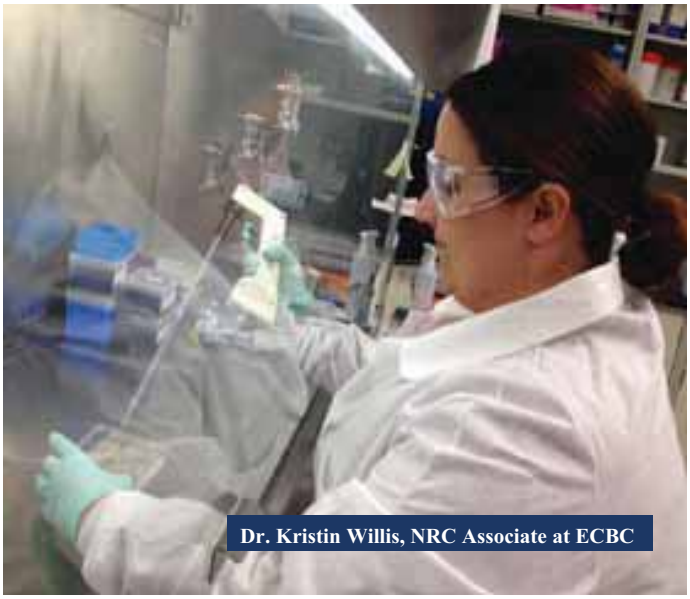
The NRC, which is part of the National Academies, promotes excellence in scientific and technical research by offering graduate, postdoctoral and senior-level research opportunities at sponsoring federal laboratories and institutions. Since 1985, ECBC has sponsored 63 postdoctoral associates through its Postdoctoral Research Associateship Programs: www.national-academies.org/rap.

S&T Conferences and Meetings

- 2012 CBRN Conference and Exhibition
  March 12-14, 2012, Baltimore, MD link
- National Bio-Threat Conference
  March 27-29, 2011, Denver, CO link
- Sample Prep 2012
  May 3-4, 2012, San Diego, CA link
- 2012 CBW Delivery Systems and Consequence Assessment Modeling Conference
  May 7-11, 2012, Charlottesville, VA
- 2nd World Congress on Proteomics and Bioinformatics
  July 2-4, 2012, Las Vegas, NV link
- 2nd World Congress on Virology
  August 20-22, 2012, Las Vegas, NV link
- World Congress on Forensic Research and Technology
  October 15-17, 2012, Chicago, IL link
- International Conference on Biothreats & Biodefense
  October 16-17, 2012, San Francisco, CA link

NRCs at ECBC

Kristin Willis


Dr. Kristin Willis, NRC Associate at ECBC

In the second of a series of articles on U.S. Army Edgewood Chemical Biological Center (ECBC) postdoctoral associates, the *R&T Connection* sat down with **Kristen Willis, Ph.D., an associate in the National Research Council's (NRC) Postdoctoral Resident Research Associateship Program (RAP)**. From her work with stem cells to her love of music to her three dogs, Willis has multi-faceted interests.

After receiving her B.S. in microbiology from Cornell University, Willis went on to the University of Illinois, where she earned her M.S. and Ph.D. also in microbiology. ***"Biology was always my favorite subject,"*** she said.

During her doctoral studies, she worked in a virology lab. ***"This was my dream come true. I'd always wanted to do virus work,"*** Willis said. ***"When the opportunity presented itself to work with stem cells here at ECBC, it was another fascinating area of science for me to experience. Both my virology work and stem cell work require the ability to culture cells, so I had the necessary skills."***

Willis said that the NRC postdoctoral program was a perfect fit for her after she completed her Ph.D. ***"The NRC program provided me with the unique opportunity to work as a postdoc in a government lab, specifically in a defense research lab,"*** she said. ***"And ECBC was a perfect fit for my husband (a chemical engineer in the R&T Directorate) and me as it provided career opportunities for both of us despite the fact that we work in different disciplines."***

She hopes to stay at ECBC after her postdoctoral residency, possibly to return to virus research merging her new stem cell experience.

Willis started with the program in October 2010 but spent her first year onsite at Johns Hopkins University. She transitioned to ECBC full time the following year. Willis is working with a stem cell team under the direction of Harry Salem, Ph.D., ECBC chief scientist for the life sciences. The project is funded by the Defense Threat Reduction Agency.

"I'm always so impressed with our talented postdoctoral associates," said Salem. ***"They arrive at ECBC with plenty of energy as well as expertise with the latest technology. It's enjoyable to work with them."***

"We're all working on stem cell related projects," said Willis. ***"My focus is toxicity of the nervous system. I'm differentiating human stem cells to create neurons, which can be used to develop an in vitro system for screening neurotoxic chemicals or chemicals of interest to the Army. Ultimately, we hope to have a system that will yield human toxicity information for both known chemicals and unknown chemicals in order to predict how these unknown chemicals will affect humans."***

Willis explained that the ECBC team works exclusively with induced pluripotent stem cells (IPSCs), which are derived from adult tissue: ***"One of the great advances in the stem cell field was the development of human induced pluripotent stem cells in 2007. This discovery allowed for the use of skin samples or other adult tissues as a source of cells, which are then reprogrammed to act like embryonic stem cells."***

ECBC obtains its cells from the Wisconsin International Stem Cell Bank (or WISC Bank), which serves researchers engaged in non - commercial research at academic or not-for-profit institutions.

What constitutes a typical day for a postdoctoral associate? Willis said that she spends about half her day working in the lab, with the rest of the day focused on reading, writing papers, participating in meetings and updating lab notebooks.

While her academic career has been focused on biology, Willis noted that, in high school, she briefly considered becoming a musician and she played the oboe and clarinet through college. Although she does not have the time to play now, she would like to pick it up again as a hobby in the future. ***"I see connections between music and science,"*** she said. ***"They both require a lot of dedication and practice. I'm a type A personality who enjoys structure."***

S&T Conferences and Meetings

- 2012 CBRN JIIM-IA Conference & Exhibition, June 26-27, 2012, Ft. Leonard Wood, MO link
- 2nd World Congress on Proteomics and Bioinformatics, July 2-4, 2012, Las Vegas, NV link
- 6th Annual Chemical Sector Security Summit & Expo, July 30 – August 1, 2012, Baltimore, MD 21201 link
- 2nd World Congress on Virology, August 20-22, 2012, Las Vegas, NV link
- 3rd World Congress on Biotechnology, September 13-15, 2012, India link
- World Toxicology Summit and Expo, September 17-19, 2012, San Antonio, TX link
- Federation of Analytical Chemistry and Spectroscopy Societies 39th Annual Meeting, September 30 – October 4, 2012, Kansas City, KS link
- World Congress on Forensic Research and Technology, October 15-17, 2012, Chicago, IL link
- International Conference on Biothreats & Biodefense, October 16-17, 2012, San Francisco, CA link
- 3rd World Congress on Analytical and Bioanalytical Techniques, November 22-24, 2012, India link

NRC postdoctoral program a win-win for NPS campus and researchers

Dr. Timour Radko (left), Oceanography Associate Professor and NRC Adviser for NRC Postdoctoral Research Associate Jason Flanagan (right). Flanagan, one of dozens of postdocs at NPS at any given time, provides invaluable support to the department's research in ocean ring stability.

Research has long been a cornerstone of the Naval Postgraduate School (NPS) mission – it is a simple, straightforward requirement at any graduate level university. At NPS, students and faculty from across departments apply their expertise to solving real-world defense challenges, but are joined in their efforts by roughly two dozen top young scientists from around the world and across disciplines.

These bright young minds come to NPS via the **National Research Council (NRC) Research Associateship Program**, and are selected to join various departments across campus providing invaluable support to diverse research efforts.

NPS Vice President and Dean of Research, Dr. Jeffrey Paduan, has seen firsthand the value that postdoctoral fellows can bring to a department. In his 21 years with the NPS oceanography department, Paduan has seen that the postdoc relationship can be a mutually beneficial one.

"The NRC program is a truly win-win proposition"* Paduan explained. *"For the fellow, the program provides access to some of the government's most cutting-edge laboratory groups. For the sponsoring laboratory, including NPS, the program handles all of the application, review, and matching activities needed to identify the most promising fellows."

The program provides postdoctoral fellows a unique opportunity to apply their experience in the lab, working on research that could potentially directly reach the defense community. As valuable as the experience is for the students, the faculty also see the postdocs as a valuable asset for their departments, and NPS as a whole.

"Unlike most research universities, in which the graduate student population contains a large fraction of Ph.D. students, NPS is mostly focused on master programs," explained Oceanography Associate Professor Dr. Timour Radko. ***"This creates a significant void in terms of technical and specialized projects, a void that NRC postdocs help to fill. In addition to the critical support they provide to faculty members, NRC postdocs help to create the synergy and environment much needed for the professional development of graduate students. The presence of young ambitious scientists enriches and invigorates the department as a whole."***

Radko serves as an advisor for postdoctoral fellow Jason Flanagan, who is continuing his doctoral research in ocean ring stability. Flanagan previously attended the University of Limerick, Ireland, where he received his Ph.D. in Applied Mathematics and Statistics.

Flanagan is just one of several fellows serving in the oceanography department, a part of campus that has hosted numerous postdocs over the years, but his unique research helps generate interest and discussion around a topic that the maritime community has a growing interest in.

"To date, research has been focused on developing a theoretical framework to explain the interaction of small-scale, large-scale, mesoscale and basin-scale ocean processes," explained Flanagan. ***"One motivation for this research is the desire to better understand, predict and potentially utilize processes that affect naval operations. For instance, mesoscale activity plays a role in the determination of undersea warfare activity whilst surface signatures may be enhanced or diminished by small/large scale processes. Both recently completed and ongoing numerical simulations have provided validation of theory and insight into previously little-understood phenomena.***

"Conducting research here at NPS has provided invaluable experience on several complementing fronts," he continued. ***"Given the nature of the student populace, a high level of professionalism, enthusiasm and motivation exists which is invigorating and sustaining. Additionally, the opportunity to work alongside vastly experienced faculty members who are internationally-recognized researchers has been both humbling and inspiring for a researcher at the early stages of career development."***

Dr. Michal Kopera, NRC Associate, serves in the applied mathematics department, after receiving his Ph.D. in Engineering from the University of Warwick, U.K. His research explores adaptive mesh refinement techniques for non-hydrostatic unified models of the atmosphere

Like Flanagan, NRC Fellow Michal Kopera of the applied mathematics department traveled halfway around the world to pursue his NRC fellowship. Kopera received his Ph.D. in Engineering from the University of Warwick, U.K., and has been at NPS for 10 months. His research explores adaptive mesh refinement techniques for non-hydrostatic unified models of the atmosphere. His work can be applied to weather forecast models for the Navy and the National Oceanic and Atmospheric Administration.

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"Working in the Department of Applied Mathematics is a great experience, which allows me on one hand to continue working with methods I learned during my Ph.D., and on the other, it exposes me to a whole world of new concepts in high-order numerical methods," Kopera noted. ***"I feel that my work can contribute to the research goals of the department, NPS and Navy in general."***

Kopera's advisor, Applied Mathematics Professor Frank Giraldo, echoed that sentiment, noting that in addition to enriching their own experiences through applied research, the postdocs offer a unique resource for students studying at NPS.

"The value that NRC postdocs bring to the departments is that they form the 'corporate memory' that tends to be lacking at NPS," said Giraldo. ***"For example, in my group, the postdocs may be on campus anywhere from two to three years and so they are able to disseminate the knowledge that they acquire to the Ph.D. and master's students. The value of this 'corporate memory' cannot be overstated as this is extremely important in the educational process of an institution.***

"Also, it is a very effective way to introduce and train future researchers to the sorts of problems that are of importance to the DOD," he added. ***"They develop an expertise and interest in these areas which they can pursue for years to come."***

NAVAL POSTGRADUATE SCHOOL

NRC Associate returns home to India Fellowship

Dr. Sakthivel Kumarasamy, a National Research Council Postdoctoral Research Associate at NPS, will soon return to his home country of India after two years of intensive research at NPS. Upon his return, Kumarasamy will begin a fellowship at the Institute for Space Science and Technology as part of the INSPIRE (Innovation of Science, Pursuit for Inspired Research) program.

Dr. Sakthivel Kumarasamy, NRC Associate

India's Institute for Space Science and Technology (IIST) is the NPS counterpart within the Indian Space Research Organization (ISRO).

"Sakthivel has been a 'model NRC Fellow' at NPS, being very hard working and a dedicated young scholar," noted DRCSI Director, Professor Sivaguru Sritharan. ***"He worked with me in my Army Research Office project developing stochastic analysis aspects of turbulence subjected to abrupt uncertainties, and also jointly with me and Professor Jim Eagle of the Operations Research department."***

India's INSPIRE program, sponsored and managed by the Indian Ministry of Science & Technology, aims to attract new talent into the sciences. The program's basic objective is to communicate to the youth of the country the excitement and creativity of the pursuit of science, attract talent to science at an early stage, and to build the required critical human resource pool for strengthening and expanding the science and technology system, and the research and development base.

SOFC cathode improves electrochem performance & reaction efficiency

A technology known as cathode infiltration has been recently demonstrated to achieve an impressive 30% + improvement in fuel cell peak power density while maintaining cell stability over continuous service lifetimes exceeding 1500 hours. The results were obtained through research completed by **NRC fellow Dr. Shiwoo Lee at the National Energy Technology Laboratory in Morgantown, WV,** who focuses on improving fuel cell performance through targeted development of enhanced cathodes, specifically through cathode infiltration. Over the course of his 3-year fellowship, Dr. Lee has developed the technology from concept to demonstration, and is now working with industrial fuel cell manufacturers that are interested in examining the technology for possible adoption.

Solid oxide fuel cells (SOFC) are devices that convert chemical energy (fuel) directly to electrical energy through a silent and efficient electrochemical reaction process. A fuel cell possesses three fundamentally important components that participate in the key reaction and transport processes: the anode, the electrolyte, and the cathode. Oxygen from the air is reduced into oxygen ions at the cathode, and the oxygen ions then traverse the electrolyte *en route* to the anode where they react with fuel molecules. The fuel/oxygen reaction releases electrons that can be used to provide energy to electricity consuming devices. A solid oxide fuel cell can convert hydrogen, natural gas, reformed fuels (including biofuel), gasified coal, and virtually any other gaseous hydrocarbon or hydrocarbon derivative into electricity. Modern SOFC are designed to operate at temperatures between 650°C and 800°C, temperatures at which the reactions occurring on the cathode are recognized as limiting the performance of the solid oxide fuel cell.

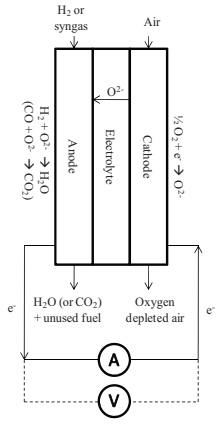

Image 1: A typical SOFC "button" cell is about 2.5cm in diameter and 1 mm thick. The green portion is the anode, the black portion is the cathode, and a translucent electrode layer is sandwiched between them.

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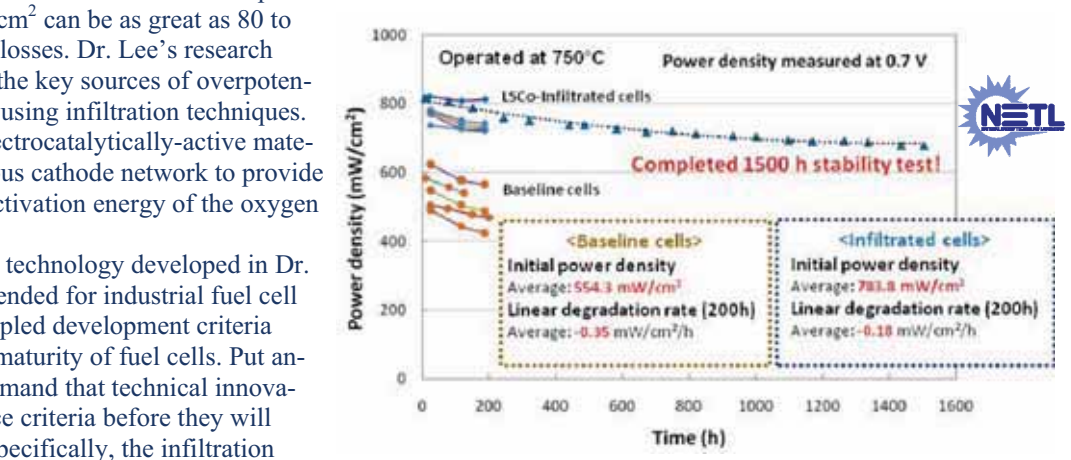
A properly designed stand-alone SOFC can be more than 50% efficient, and when thermally integrated into a larger fuel conversion and heat recovery system efficiencies can approach 60%.

A commercial SOFC cathode is typically composed of a thin layer (40-100 □m) of porous ceramic material that possesses both electrical and ionic conductivity. In a fuel cell, thermodynamic loss (inefficiency) is generally quantified in terms of *cell overpotential*, which for modern cathodes operating at current densities of 0.5 A/cm^2 can be as great as 80 to 100 mV, or 40-50% of total cell losses. Dr. Lee's research focuses on methods to diminish the key sources of overpotential (inefficiency) in the cathode using infiltration techniques. In SOFC cathode infiltration, electrocatalytically-active materials are introduced into the porous cathode network to provide additional sites and reduce the activation energy of the oxygen reduction reaction.

The cathode infiltration technology developed in Dr. Lee's research is specifically intended for industrial fuel cell systems, where significantly coupled development criteria exist as a result of the technical maturity of fuel cells. Put another way, industrial interests demand that technical innovations meet minimum performance criteria before they will consider technology adoption. Specifically, the infiltration materials and processing costs must be kept very low (minimum raw material cost, minimum material consumption), the performance improvement must significantly improve a state-of-the-art commercial cell operating at relevant conditions, the infiltrated material must be chemically compatible with the existing cathode, and the cell durability must be equal or greater than the unaltered cell over thousands of hours of operation. Given the complexity of these criteria, Dr. Lee developed a low-cost material and application process whereby nano-particles of inexpensive ceramic could be applied to the cathode's reactive zones without altering any of the state-of-the-art base cell manufacturer's technology.

To develop a superior SOFC cathode, Dr. Lee has focused on the use of a material known as lanthanum strontium cobaltite (LSCo). The material was selected in part because it possesses elements and a crystalline structure that are similar to typical SOFC cathodes, thereby enhancing the probability that it will remain stable over long operating periods. LSCo is also known to possess excellent chemical activity towards the desired cathode reaction. Since the infiltration process required insertion of the material into extremely narrow cathode pores (typical pore diameters are < 1 □m in width), an aqueous solution of pre-cursor nitrate salts and surfactants was created. The solution, known as a *slip*, was deposited onto the cathode surface, and subsequently drawn into the cathode pores via capillary action. After firing at 850°C for almost 1 hour, discrete crystallites of infiltrate were observed to grow in the active regions of the cathode. A typical crystallite is only about 20-50 nm wide after it is formed, and a wide dispersion of material across the cathode backbone is observed.

Full SOFC specimen possessing both baseline and infiltrated cathode structures were operated under typical conditions (H_2 fuel, 750°C, 0.25 mW/cm^2 or 0.7 V) in a battery of tests to ensure that a statistically significant performance increase was observable. Using data collected in more than 50 infiltrated cell tests, Dr. Lee demonstrated an average polarization resistance decrease from 0.21 ± 0.014 □cm^2 in baseline cells, to only 0.15 ± 0.010 □cm^2, an improvement of better then 28%. Power density tests of baseline and infiltrated systems established average performance values of approximately 550 and 780 mW/cm^2, respectively, an increase of more than 41%.

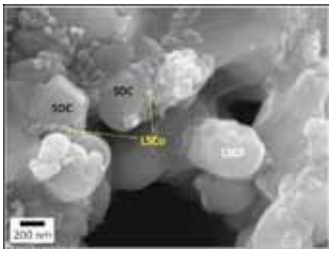


3: Performance improvements achieved through cathode infiltration demonstrated through repeated electrochemical tests, some lasting more than 1500 hrs.

The initial demonstrations of improved performance are supplemented with data indicating that the degradation rate of the infiltrated cell was statistically indistinguishable from that of the baseline cell in a test lasting more than 1500 hours. The result implies that there is no measurable negative effect of infiltrated electrocatalysts on the cells' time-dependent performance for these systems. The stable performance of the infiltrated cells is attributable to characteristics of the unique composite cathode microstructure, which requires a relatively smaller mass of infiltrate to achieve cathode activation and accordingly minimizes agglomeration and loss of electrocatalyst surface area. Dr. Lee and co-authors reported detailed findings in a publication in the Journal of the Electrochemical Society, 159 (7) F301-F308 (2012) entitled "Long-Term Stability of SOFC Composite Cathode Activated by Electrocatalyst Infiltration".

Subsequent to demonstration of the technology's low-cost, good resulting performance improvements, and excellent stability, the infiltration technique was applied to state-of-the-art industrial cells, and the performance and stability were evaluated in a fully commercial cell architecture. Significant improvements in performance were also observed for the industrial manufacturer's cells, and the results demonstrated that the infiltration methods developed through using a standard (commercial) cell were transferable to an industry team's unique cell microstructure and chemistry. Furthermore, Dr. Lee showed that up to a 40% peak power density performance increase is realizable even though the industrial base cell was "optimized". These outstanding results have attracted further interest from the industrial cell manufacturer, and larger scale tests are presently being planned for execution over the coming months.

Through his NRC fellowship, Dr. Lee has been able to pursue innovative technology development from nascent concept to complete technical demonstration. Dr. Lee hopes that cathode infiltration technology will soon be industrially deployed to produce electricity from fuel cells at even greater efficiency than available today.

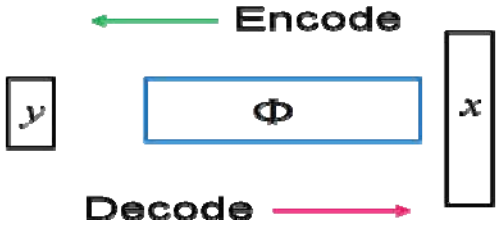


2: An image from a scanning electron microscope showing the infiltrated particles decorating the active regions of the fuel cell cathode.

Models & Algorithms of Compressive Sensing with Applications to Image Processing

Very often, we have only an incomplete set of measurements for signals of interest. This could be due to various practical limitations in acquiring a complete set of measurements. These limitations include cost of measurements, length of time of making a measurement, the difficulty of making a measurement and the associated danger in making a measurement. A natural question to ask is whether signals of interest can be extracted from a reduced or incomplete set of measurements.

Fortunately enough, the answer is a resounding Yes! We can reconstruct the signals from the incomplete set of measurements using compressive sensing, an emerging theory in applied mathematics introduced by E. Candes, D. Donoho from Stanford, and T. Tao from UCLA. The paradigm of compressive sensing consists of two parts: encoding and decoding. As shown below, in the encoding part (the left arrow), the vector "***y***" are obtained from the input signal "***x***" via a rectangular matrix Φ using matrix multiplication, while in the decoding part (the right arrow) a reconstructed version of signal "***x***" can be obtained from "***y***" using an optimization process.



Thus, compressive sensing provides a method to recover the signals of interest. Why is this possible? This is because many signals of interest have a sparse representation in the sense that the number of significant features in the signals (the information contained within the signals) is much smaller than the size of the signal itself. Compressive sensing has been applied to many applications, including magnetic resonance imaging, sensor networks, and digital photography.

There is a need for improvement by developing more efficient and accurate mathematical models and algorithms for compressive sensing problems. **Professor Lixin Shen supported by an NRC senior fellowship award with his mentor Dr. Bruce W. Suter at the Air Force Research Laboratory** have developed some next generation algorithms using advanced mathematical tools. Their method outperforms many state-of-the-art algorithms by enhancing CPU performance while reducing associated errors. To illustrate this research consider the image in the far left as the observed incomplete measurements. The middle figure is the recovered image using the current state-of-the-art algorithm and the far right image is the result of using our recently developed algorithm. A provisional patent entitled "*Nonconvex Compressive Sensing*" for this work has been filed recently.

Dr. Lixin Shen

U.S. Army Criminal Investigation Command

U.S. Army Criminal Investigation Laboratory

The newest laboratory to join the NRC Research Associateship Programs is the U.S. Army Criminal Investigation Laboratory (USACIL). Located at the Gillem Enclave in Georgia, USACIL provides forensic laboratory services to Department of Defense (DoD) investigative agencies and other Federal law enforcement agencies. USACIL is the only full service forensic laboratory in the DoD and trains and investigators from the Army, Air Force, Navy and Marines in the Special Agent Laboratory Training Course and manages the USACIDC criminalistics and visual information programs. USACIL is on the forefront of battlefield forensics and has a robust Science and Technology Program collaborating with other laboratories and researchers, customers, law enforcement, academia and industry to develop state of the art protocols in scientific investigation.

Historically, the USACIL system included a laboratory in North Africa, then Europe (1943-96), in Japan (1948-93) and in the United States (1945-present). With one remaining laboratory the USACIL now provides worldwide forensics support from its current location since 1983, at the Gillem Enclave, formerly known as Fort Gillem, Georgia. The laboratory provides state of the art forensic examinations in the following disciplines: Drug Chemistry, Trace Evidence, Serology/DNA, Latent Prints, Forensic Documents, Digital Evidence and Firearms & Toolmarks.

NRC Research Opportunities at USACIL focus on DNA analysis, specifically advanced methods for collection and numerical analysis of mixed samples. USACIL is seeking applicants with expertise in forensic DNA, genomics, chemistry, informatics, mathematics, numerical methods and/or statistics.

2012 - 2013 SCHEDULE

February Review

February 1	Application deadline
February 15	Support doc deadline
March 12-13	Panels/Review Board
March 20	Results available to applicants

August Review

August 1	Application deadline
August 15	Support doc deadline
Sept 21	Review Board
Sept 28	Results available to applicants

May Review

May 1	Application deadline
May 15	Support doc deadline
June 22	Review Board
June 29	Results available to applicants

November Review

Nov 1	Application deadline
Nov 15	Support doc deadline
January 4, 2013	Review Board
January 11	Results available to applicants