Research Fellowships for
Community and State College Faculty
Summer 2007

Funded by a grant to Nevada from NSF EPSCoR:
Research Infrastructure for Nevada's Growth – Targeting Research with Uniqueness and Excellence (RING TRUE III)

Introduction

The Nevada System of Higher Education (NSHE) is offering a small number of Summer Research Fellowships to Nevada Community and State College instructors through the NSF EPSCoR Ring True III Project to enrich the body of knowledge in three specific research areas: Sensor Technology (SENSORS), Scaling Environmental Processes in Heterogeneous Arid Soils (SEPHAS), and Cognitive Information Processing (CIP). This summer research experience may be conducted at any of the three research institutions in Nevada: UNLV, UNR, or DRI (North and South). Each Fellow is expected to bring the knowledge gained as a result of their research experience back to Community and State College classrooms in Nevada.

Fellowship Program Details

This NSF EPSCoR Fellowship Program welcomes applications from Community and State College faculty currently working in physical and biological sciences, environmental science, computer science, mathematics, or engineering. The duration of the Fellowship program will be approximately 8 to 10 weeks over the summer depending on the length of the research project. Each Research Fellow selected to participate in this program will receive a $9,000 award. Additional funds will be provided to cover fringe costs calculated at the appropriate institutional summer rate, and, if necessary and on a case-by-case basis, relocation expenses for the summer. At the conclusion of the Fellowship period, each Fellow must submit a final report describing their research and detailing how their insights will be integrated into Community and State College curricula.

Each Research Fellow must work with at least one Faculty Sponsor in one of three research areas supported by Nevada's current NSF EPSCoR grant, SENSORS, SEPHAS, or CIP. Sponsors must be faculty at UNLV, DRI, or UNR engaged in research in one of these three areas. Fellowship applicants are expected to contact prospective sponsors to discuss possible research projects prior to submitting an application. For your convenience, contact information for faculty members directly involved in this program is provided below.

In collaboration with their Faculty Sponsors, Fellows will be expected to develop and conduct specific research projects in an area of mutual interest. As part of their Fellowship, they may operate scientific instruments, analyze data, or develop computer models. Each Fellow is expected to spend some time applying new insights to the enhancement of science education at their home institutions. Prior research experience is desirable, but not required.

Research Program Details

Introduction to the SENSORS Group

A unique aspect of the SENSORS research program is a "vertically integrated" approach focused on scientific and technological issues of sensor development, system integration, and deployment, using actual performance (*e.g.*, sensitivity, specificity, robustness, and failure modes) to feed back directly to scientists and engineers in the program. The formation of new collaborations, bringing together a number of interdisciplinary teams, is the foundation for the program. For further information on the SENSORS program, contact Dr. Alan Gertler (775-674-7061; Alan.Gertler@dri.edu). Key research components of the SENSORS program include:

Preparation of biological detector molecules for biosensors. The Hunter and Kozel laboratories at UNR collaborate on genetic engineering of biological detector molecules, in particular monoclonal antibodies, for a variety of chemical and biological agents (*e.g.*, nerve gas, T-2 toxin, and anthrax) and environmental contaminants such as pesticides and heavy metals.

Synthesis of detector molecules and interfacial chemistry. Design and synthesis of receptor molecules (*e.g.*, Hg_2^{2+} chelators) and signaling reporters (*e.g.*, fluorescent and redox probes), and the properties of their interfaces to sensor substrates, are critical to sensor design and function. The Bell, Hatchett, and Tam-Chang laboratories at UNLV and UNR work interactively in these areas.

Electrochemical, fluorescence, and optical fiber-based analysis techniques. The Das and Hatchett laboratories at UNLV work on a variety of electrochemical and fluorescence-sensing techniques. The Publicover laboratory at UNR and the Moosmüller laboratory at DRI have expertise in the design of optical-fiber microarrays and a variety of optical-sensing systems, including systems for measuring single-molecule fluorescence. Promising combinations of these techniques are being explored.

Sensor materials, system integration, and microdevices. Sensor materials (micro- and nano-materials, in particular), polymer coatings for analyte specificity, construction of sensor platforms, connectivity to microelectronic systems, and the delivery of small volumes of analyte-containing fluids represent additional challenges in sensor design. Micro-robotic approaches will play an important role in the fabrication of sensor platforms. The laboratories of Das and Hatchett at UNLV and Kim at UNR collaborate in these areas.

Air, water, and biological sampling technology. The Arnone, Gertler, Moosmüller, and Papelis laboratories at DRI are pooling their expertise in a variety of sampling technologies important for analyte sensing.

Deployment. The Arnone, Gertler, Moosmüller, and Papelis laboratories work with the other core teams to develop deployment techniques, initially in conjunction with existing monitoring stations and environmentally sensitive sites throughout Nevada. In addition, Prof. Eun-Woo Chang (Physical Science Division) is participating in both sensor research and sensor education.

SENSORS Group Contact Information:

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UNLV

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DRI

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Introduction to the SEPHAS Group

The vision of the SEPHAS research area (http://hydro.nevada.edu/sephas) is to stimulate collaboration among student and faculty researchers to better understand the response of various hydrological and biological processes at different distance scales in arid soils. Relevant research areas include: (1) influence of soil structure on desert environmental processes; (2) flow and solute transport in arid soils; (3) energy and mass partitioning in arid-soil ecosystems and the role of biogeochemical cycling; (4) development of new computational and theoretical methods to understand various physical processes; (5) discrepancies among laboratory and field measured and numerically simulated variables at different scales; and (6) the creation of a facility to test and benchmark sensors. For further information on the SEPHAS program, contact Dr. Michael Young (702-862-5489; Michael.Young@dri.edu). Key research components of the SEPHAS program include:

Lysimeter installation. During the summer 2007, at least two large weighing lysimeters will be installed in Boulder City, NV. These large soil tanks will be filled with soil and fully instrumented. This activity, led by Young (DRI) and Yu (UNLV), offers an excellent opportunity to participate directly in the setup of a unique research facility.

Soil hydraulic properties and water movement. Soil hydraulic properties have a significant influence on short-term water balances and plant-water availability. The laboratories of Young (DRI) and Buck (UNLV) specialize in the characterization of soil hydraulic and physical properties through

laboratory experiments. Field experiments are also conducted by these faculty as a means to upscale the laboratory results to more realistic field scales.

Water use and conservation. Demands for water by urban areas are placing greater pressures on desert ecosystems. The labs of Devitt (UNLV) and Young (DRI) are assessing water use of native plant communities. In particular, they are assessing how water is partitioned between evaporation, transpiration, and soil moisture redistribution.

Desert restoration. Arid landscapes disturbed by human activities are very difficult to restore, especially in short time frames. Work by Caldwell and McDonald (DRI) is focused on landscape characterization and landscape restoration, using both field and numerical techniques.

Physiological response of plants to environmental change. Changes in global climate will lead to an increase in atmospheric CO_2 levels; other possible changes include higher precipitation and nitrogen inputs. The laboratories of Smith (UNLV) and Nowak (UNR) seek to quantify these changes through field experiments, to better predict how desert ecosystems will function in the future.

Numerical modeling of water flow in deserts. The research of Yu (UNLV) and Zhu (DRI) mainly deals with computer modeling that aggregates field/lab soil hydraulic property measurement to more realistic field scales.

Soil carbon sequestration and global climate change. Soils play an important role in the global carbon cycle and can act as either sources or sinks for atmospheric CO_2. The laboratory of Verburg (DRI) is assessing the response of organic and inorganic carbon to global climate change using manipulative field and laboratory experiments.

SEPHAS Group Contact Information:

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DRI

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Introduction to the CIP Group

Cognitive information processing (CIP) systems and techniques provide common tools to research the four interconnected application areas of security and surveillance, modeling and inversion, bioinformatics, and bio-robotics within the CIP focal area. For further information on the CIP program, contact Dr. Sushil Louis (775-784-4315; sushil@sce.unr.edu). Key research components of the CIP program include:

Evolutionary computation and machine learning. The Evolutionary Computing Systems Laboratory (ECSL) at UNR (http://ecsl.cse.unr.edu/) investigates new CIP tools and techniques and helps apply them to problems in science, engineering, and the arts. Algorithms developed in the lab have been used in decision support, engineering design, modeling and inversion, computer vision, bio-informatics, robotics, and computer games. This area is collaborative with all four application areas listed below

Security and surveillance. The Bebis and Louis laboratories at UNR have experience using machine learning and evolutionary computing techniques to create better vision systems to detect, recognize, and track objects (including people), and interpret their actions. Better vision systems are a must for developing autonomous robots to effectively operate in real-world environments and interact with humans and other robots. This work is collaborative with *modeling and inversion* researchers at DRI (see below).

Modeling and inversion. Machine learning and data-mining techniques from CIP are designed to build models from sensor data. Once valid models are generated through the scientific process, they can be used for engineering and decision support applications – *i.e.*, model inversion. The common threads of modeling and inversion have brought together UNR and DRI faculty from the physical and natural sciences (Koracin, Wetzel, Mancini) with CIP scientists (Bebis, Louis, Varol) for building and inverting computational models of complex phenomenon for which traditional modeling techniques do not work. They are developing new collaborations and strengthening existing ones with a special emphasis on biological sciences.

Bioinformatics. The tools and techniques of CIP are well-suited for complex, nonlinear-biosystems modeling and have been used at UNR, DRI, and UNLV in phylogenetic analysis, data mining protein and nucleic-acid sequence data, discovering gene-expression patterns in DNA, and protein folding (Louis, Murray, Roberts). Nanoscale biosystems, particularly those macromolecular biological complexes and biosensors that require DNA and protein-sequence information for their design and fabrication, provide a natural connection between bioinformatics and bio-robotics.

Bio-robotics. The best functioning CIP systems are biological. Robotics research at UNLV and UNR has begun to acknowledge this and investigate building (or evolving) robotic CIP systems that closely mimic biological systems (Bebis, Kim, Louis, Yim). This application area integrates strengths in novel sensor and actuator materials with bioinformatics and CIP for modeling, reasoning, planning, and control in new bio-mimetic robotic systems. Furthermore, sensors based on electroactive polymer materials can be used to gain a better view of cell migration needed for understanding biosystem

pathways, feeding back to bioinformatics. Integrating this expertise could lead to multidisciplinary answers to research questions in CIP, bioinformatics, and bio-robotics.

CIP Group Contact Information:

UNR

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DRI

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Application Guidelines and Deadlines

Review of applications will begin on **May 7, 2007**, although applications will be accepted until the Fellowships are awarded (expected by May 31, 2007).
Please note only complete files will be reviewed.

Application Materials

1. A cover letter indicating specific areas of research interest and a brief description of the research to be conducted in conjunction with the applicant's faculty sponsor.
2. A resume indicating teaching and research experience.
3. Two recommendation letters. One letter should be from the instructional dean or department chair of the applicant's home institution. The second letter should be from the faculty sponsor.

Required Format for submission of application materials:

All application materials are to be submitted as PDF documents to Ms. Alice Ward at alice_ward@nshe.nevada.edu***. To submit your application, you MUST follow this format:***

In the "subject" line of your email, put your last name and first name initial, underscore, the acronym "CCFellowship", underscore, and the type of document you are sending. So for instance,

when Tom Rodriguez submits his cover letter, in the e-mail subject line he would type: (rodriguez t_CCFellowship_coverletter).

Sending your application materials in ONE email will reduce the chance your application file will be incomplete at the time of the review process, in which case, if Tom Rodriguez was to send his cover letter, and resume as attachments to one e-mail, the e-mail subject line for Tom Rodriquez could read: (rodriguez t_CCFellowship_coverletter_resume).

Please send all application materials to Ms. Alice Ward at:

Ms. Alice Ward
NSHE - System Sponsored Projects Office
755 E. Flamingo Rd.
Las Vegas, NV 89119-7363
Phone: (702) 862-5590 Fax: (702) 862-5594

Administrative and Reporting Details

Duration of the Fellowship program is approximately 8 to 10 weeks over the summer depending on the length of the project. Each fellow will be required to submit a two-page final report describing their research and detailing how their insights will be integrated into Community and State College curriculum materials. Each Fellowship will provide $9000 plus fringe cost for two summer months. Special requests to pay relocation expenses will be considered on a case-by-case basis.