# Nebraska Research Expo

## March 29, 2006

The Cornhusker Marriott
Lincoln, Nebraska

*sponsored by*
Nebraska EPSCoR

## AGENDA

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|---|---|---|
| 7:30 - 8:00 a.m. | Pick up registration packets | **Lower Level Lobby** |
| 8:00 - 8:10 a.m. | Introduction and welcoming remarks: Fred Choobineh, Director, Nebraska EPSCoR and Karen Sandberg, Program Director, NSF EPSCoR | **Lancaster Room** |
| 8:10 - 8:50 a.m. | Welcome by Sherry Farwell, Head, NSF EPSCoR<br>"EPSCoR 'tis Partnerships" | **Lancaster Room** |
| 9:00 - 10:30 a.m. | Track/mini-track speakers | |
| 10:30 - 11:00 a.m. | Coffee Break | |
| 11:00 - 12:30 p.m. | Track/mini-track speakers | |
| 12:30 - 1:30 p.m. | Lunch | |
| 1:30 - 3:00 p.m. | Track/mini-track speakers | |
| 3:00 - 3:30 p.m. | Coffee Break | |
| 3:30 - 5:00 p.m. | Track/mini-track speakers | |
| 5:00 - 7:00 p.m. | Reception concurrent with poster presentations, research center & high-tech business displays including hors d'oevres and cash bar | **Lancaster Room** |

## PLENARY SESSION TRACKS

**Full Day Sessions**

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| Future of Bridge Engineering in the U.S. | **Hawthorne** |
| Integrated Structural Biology and Bioinformatics | **Arbor** |
| Metabolite Signaling: Genomic Responses to Dietary Molecules in Mammals | **Garrat** |

**Morning Sessions**

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| Basic Biological Research on Aging and Longevity | **Yankee Hill I&II** |
| Genome-wide Gene Regulatory Networks | **Yankee Hill III** |
| Nanoscale and Nanostructured Semiconductors: Materials and Devices | **Olive Branch** |

**Afternoon Sessions**

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| Biosensors and Networks | **Yankee Hill III** |
| Nanomanufacturing Engineering | **Olive Branch** |
| Wireless Networks and Distributed Sensors | **Yankee Hill I&II** |

# Future of Bridge Engineering in the U.S.

## PROGRAM

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|---|---|
| Introduction<br>9:00-9:15 | **Atorod Azizinamini**<br>"Introduction" |
| Speaker 1<br>9:15-9:35 | **John Craig**<br>"Public Demand and Future of Bridge Engineering" |
| Speaker 2<br>9:35-10:05 | **Ted Galambos**<br>"Trends in Code Development" |
| Speaker 3<br>10:05-10:30 | **Vasant Mistry**<br>"Accelerated Bridge Construction: Should we be on Board?" |
| Coffee Break<br>10:30-11:00 | |
| Speaker 4<br>11:00-11:30 | **Conn Abnee**<br>"Latest Developments in the Steel Bridge Front" |
| Speaker 5<br>11:30-12:00 | **Mark Lafferty**<br>"Latest Developments in the Concrete Bridge Front" |
| Speaker 6<br>12:00-12:30 | **Lyman Freemon**<br>"Nebraska Contribution" |
| Lunch<br>12:30-1:30 | |
| Speaker 7<br>1:30-2:00 | **Doug Grewcock**<br>"Contractor's Perspective on the Future of Bridge Engineering" |
| Panel Discussion<br>2:00-3:00 | **Panel Discussion**<br>"Looking at the Crystal Ball: Nebraska Perspective"<br>**Sam Fallaha,** Bridge Division, NDOR<br>**Amy Starr,** Research Section, NDOR<br>**Mark Traynowicz,** Construction Division, NDOR<br>**Greg Kolle,** FHWA, Nebraska Division |
| Coffee Break<br>3:00-3:30 | |
| Speaker 8<br>3:30-4:00 | **Ed Power**<br>"Consultant's Perspective on the Future of Bridge Engineering in the U.S." |
| Speaker 9<br>4:00-4:30 | **Bill Halsband**<br>"Case Studies on Advanced Bridge Construction Techniques" |
| Speaker 10<br>4:30-5:00 | **Will Smith**<br>"Case studies on Accelerated Bridge Construction" |
| Poster Session<br>5:00-7:00 | Reception concurrent with poster presentations, research center & high-tech business displays |

## ABSTRACTS

**"Introduction"**
Dr. Azizinamini is director of National Bridge Research Organization (NaBRO) at the University of Nebraska-Lincoln (UNL), Civil Engineering. He will provide a brief overview of the major activities at UNL in the bridge engineering field.

**"Public Demand and Future of Bridge Engineering"**

The Nebraska Department of Roads is one of the most progressive such departments when it comes to taking initiatives. John Craig will touch on what the public demand will be in the future for bridges, and how NDOR is planning to meet the upcoming challenges.

**"Trends in Code Development"**

Dr Galambos' talk will concentrate on the history of the LRFD code development and what future codes will look like. He is considered the "father" of the LRFD code.

**"Accelerated Bridge Construction: Should we be on Board?"**

Accelerated bridge construction is a major issue for the Federal Highway Administration. Mr. Mistry's talk will provide the audience with reasons that accelerated construction began and explain what the federal government is doing to promote this construction.

**"Latest Developments in the Steel Bridge Front"**

The National Steel Bridge Alliance, in recent years, has provided national leadership to promote the use of steel in bridge construction. Mr. Abnee's presentation will provide the audience with a national picture of the issues surrounding steel bridges and what the future holds for steel bridges.

**"Latest Developments in the Concrete Bridge Front"**

Mr. Lafferty is well known to the Nebraska concrete industry. He is also very active at the national level. Mr. Lafferty will explain trends and new developments in concrete bridges in Nebraska and the nation. He is well known at state and national levels in the concrete industry.

**"Nebraska Contribution"**

Nebraska is home to many new developments in the area of bridge engineering, steel and concrete. The Nebraska Bridge Division is among the most progressive and is well respected nationally and internationally. Mr. Freemon will summarize what NDOR sees for the future and how Nebraska's work fits into the bigger picture.

**"Contractor's Perspective on the Future of Bridge Engineering"**

Kiewit is perhaps the largest construction company in the world and its headquarters are located in Nebraska. Mr. Grewcock will provide a contractor's perspective on what the future holds for bridge engineering and the challenges that contractors and the entire civil engineering profession have to address.

**"Looking at the Crystal Ball: Nebraska Perspective"- Panel Discussion**

The Nebraska Department of Roads (NDOR) has led a coordinated and coherent program in the bridge engineering field encompassing issues related to research, design, and construction. The Federal Highway Administration (FHWA) has been very helpful, working alongside the bridge division and academia. This presentation provides an overview of the NDOR and FHWA activities in the bridge engineering area and future possibilities. Members of the panel will give short presentations, followed by discussion with audience participation.

**"Consultant's Perspective on the Future of Bridge Engineering in the U.S."**

Future changes will affect the consultants. Mr. Ed Power, Vice President of HDR will provide the consultant's perspective on the impact of future changes, how they will affect consultants, and what the consulting world should be doing to prepare for future demands.

**"Case Studies on Advanced Bridge Construction Techniques"**

This presentation will provide an overview of the major bridge projects worldwide utilizing the principles of accelerated bridge construction. There are only a few companies in the world that have the capabilities needed for moving heavy pieces. This capability is most needed when it comes to Accelerated Bridge Construction. Mammoet has carried out major bridge projects worldwide.

**"Case studies on Accelerated Bridge Construction"**

Barnhart Crane is one of the major companies involved in Accelerated Bridge Construction. Mr. Smith's presentation will concentrate on case studies. Nebraska is in the process of designing two projects that will use the principles of Accelerated Bridge Construction.

## SPEAKER BIOS

**William Conn Abnee** received his B.S. in Mechanical Engineering from the University of Kentucky. He has held the titles of Project Engineer, Construction Manager, Marketing and Advertising Manager, Executive Director of the Geothermal Heat Pump Consortium and CEO of the GeoExchange Financing Company. In 2002 Mr. Abnee came to the American Institute of Steel Construction where he was appointed the Executive Director of the National Steel Bridge Alliance in Chicago. He has initiated a campaign to ensure that the design community, construction industry and government entities recognize the steel bridge industry as a leader in U.S. bridge markets.

**Atorod Azizinamini** is Professor of Civil Engineering at University of Nebraska-Lincoln (UNL), a registered professional engineer, and Director of National Bridge Research Organization (NaBRO) at UNL. He has published more than 200 technical articles and is active in teaching short courses to design professionals on designing steel bridges. He is Chair of the ASCE Bridge Technical Administrative Committee which oversees the activities of all ASCE committees on bridges and the ASCE Bridge Engineering Journal. He has received numerous awards, most recently the FHWA achievement award for advancing the use of High Performance Steel in bridge construction in the U.S.

**John L. Craig** has been the Director of the Nebraska Department of Roads since 1999. The Department is the surface transportation agency responsible for highway, rail public transportation, and other programs throughout Nebraska. He is on the Board of the Directors of the American Association of State Highway and Transportation Officials (AASHTO), Chair of the Nebraska Railway Council, and on the Advisory Board, Nebraska Logistics Council. Mr. Craig has an M.S. from the University of Alaska.

**Sam Fallaha** is with the Bridge Division, Nebraska Department of Roads, Lincoln, Nebraska.

**Lyman Freemon** is a Bridge Engineer with the Nebraska Department of Roads, Lincoln, Nebraska.

**Ted Galambos,** emeritus professor of structural engineering at the University of Minnesota in Minneapolis, received a Ph.D. in civil engineering from Lehigh University. His research areas are: the behavior and design of steel structures, the reliability of structures, structural design standards, and the stability of steel structures. He has authored books and scores of published articles, and is a member of the National Academy of Engineering, the Structural Stability Research Council and the International Association of Bridge and Structural Engineering.

**Doug Grewcock** joined Kiewit full-time in 1981. After receiving a BS in Construction Engineering from Iowa State University, he held several field jobs including field engineer, office engineer, and field superintendent. In the eighties, Mr. Grewcock worked on I-70, and in Glenwood Spring Canyon, Colorado, on several large cast-in-place box girder bridges, pre-cast twin tee erection and post tensioned slabs. In 1997 Mr. Grewcock transferred to Kiewit Engineering Division where he is the estimating manager.

**Bill Halsband** is the Vice President of Business Development for Mammoet, one of the largest engineered transport and heavy life firms in the World. He is responsible for North America in searching out clients, projects and promotion for Mammoet. He has over 25 years of international experience in heavy life and transport working on a variety of projects worldwide. Mr. Halsband has a BA in Economics and International Marketing from Concordia University.

**Greg Kolle,** is a Bridge Engineer with the Federal Highway Adminstration, Nebraska Division, Lincoln.

**Mark D. Lafferty, PE** is the Vice President/General Manager of Concrete Industries, Inc., Lincoln, Nebraska. He has been in the concrete industry since 1973, specializing in precast/prestressed concrete. He started his career with the General Testing Laboratory where he developed knowledge of the many uses for and behavior of concrete. He has been involved in structural design of various types of concrete structures using both cast-in-place and precast concrete. Mr. Lafferty is a member of the Precast/Prestressed Concrete Institute, Midwest Precast Association, Prestressed Concrete Association of Nebraska, Nebraska Concrete Pipe Association, and the Kansas Prestressed Concrete Association.

**Vasant Mistry** is the Senior Bridge Engineer, U.S. Department of Transportation, Federal Highway Administration (FHWA), Office of Bridge Technology, Washington, D.C. He serves as the national technical expert and review authority for all steel bridge and structural matters for the FHWA bridge program. He is responsible for promoting High Performance Steel for bridge construction, Accelerated Bridge Construction technology and cost effective steel bridge design and construction. He has been with the FHWA for 25 years. He is a member of the AASHTO Technical Committee for Steel Designs (T-14) and serves as a technical committee member for six national committees. He has an M.S. in Structural Engineering, has written papers, made over 60 presentations related to steel bridges, and chaired conferences.

**Ed Power** is a Senior Vice President and National Technical Director of Bridges for HDR Engineering, Inc. He has 35 years of consulting experience, 33 of which have been with HDR. His responsibilities include technical and quality oversight; strategic planning and operations; and coordinating interoffice design activities among the company's 28 bridge design centers. He also serves as project principal and senior project manager responsible for directing design work, client coordination, and project quality control for major bridge projects.

**William H. Smith,** Barnhart Crane & Rigging, Project Sales – Heavy Civil/Nuclear Services Group. He is a 1983 graduate of the US Naval Academy at Annapolis, where he earned a B.S. in Applied Science/Resources Management. During 10 years as a naval officer he served in a variety of positions. During his final tour, he was responsible for coordinating Navy Reserve Officer Training Corp (NROTC) training around the world. Mr. Smith joined Barnhart Crane in 2003.

**Amy Starr** is with the Research Division, Nebraska Department of Roads, Lincoln, Nebraska. She received a B.S. in industrial engineering from UNL. She has worked with the Nebraska Department of Roads for nearly 10 years in the Roadway Design Division and the Research Section of the Materials and Research Division for 6 years.

**Mark Traynowicz** is an Assistant Construction Engineer with the Nebraska Department of Roads. His areas of responsibility include bridges, culverts and grading. Mark started with the Department in 1990 and has worked in the Bridge Division, Materials & Research Division, and the Construction Division. He received a B.S. in Civil Engineering from UNL.

# Integrated Structural Biology and Bioinformatics

## PROGRAM

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|---|---|
| Introduction<br>9:30-9:45 | **Simon Sherman**<br>Director, Nebraska Informatics Center for the Life Sciences |
| Speaker 1<br>9:45-10:30 | **Walter J. Chazin**<br>"Using NMR to Understand Protein Machines That Replicate and Repair DNA" |
| Coffee Break<br>10:30-11:00 | |
| Speaker 2<br>11:00-11:45 | **Wah Chiu**<br>"Electron Cryomicroscopy of Biological Nano-Machines" |
| Speaker 3<br>11:45-12:30 | **Gerald Meininger**<br>"Using Atomic Force Microscopy as a tool in Biological Research: From Cell to Molecule" |
| Lunch<br>12:30-1:30 | |
| Speaker 4<br>1:30-2:15 | **Tahir H. Tahirov**<br>"Structural Studies of DNA-binding Transcriptional Factors by Combination of X-ray Crystallography with Biophysical and Biochemical Methods" |
| Speaker 5<br>2:15-3:00 | **Ilya A. Vakser**<br>"Modeling of Protein-Protein Interactions in Structural Genomics" |
| Coffee Break<br>3:00-3:30 | |
| Speaker 6<br>3:30-5:00 | **Panel Discussion**<br>Center for Integrative Structural Biology (CISB) |
| Poster Session<br>5:00-7:00 | Reception concurrent with poster presentations, research center & high-tech business displays |

## ABSTRACTS

**"Using NMR To Understand Protein Machines That Replicate and Repair DNA"**
The replication and repair of DNA are fundamental multi-step processes that are performed by protein machines (large assemblies of proteins). Structural biology approaches are providing information about the organization and interactions between various components of these assemblies in the form of snapshots of different steps in the overall process. However, there is very limited information available about the transitions between the various steps. Our ultimate goal is to develop a deeper understanding of the mechanisms that enable the coordination of the many activities that must be performed by DNA processing machines through the integrated application of structural biology techniques.

**"Electron Cryomicroscopy of Biological Nano-Machines"**
Electron cryomicroscopy is a structural tool well suited to resolve structures of biological nano-machines at resolution range of 5-10 Å without using crystals. At this resolution, we are able to resolve long alpha helices and large beta sheets of protein components or subunit domains of the nano-machines. In addition, structural variations of the nano-machines at different function states can also be detected. Examples of ion channel and spherical viruses will be presented.

**"Using Atomic Force Microscopy as a tool in Biological Research: From Cell to Molecule"**
As part of our investigations we constructed a novel hybrid imaging system that involved combining an atomic force microscope (AFM) with an optical fluorescence microscope. The combination of these two modalities of microscopy has provided a unique tool that combines the high spatial resolution offered by AFM with advanced imaging approaches. Our principal application of this hybrid instrumentation has been aimed at the study of mechanotransduction with an emphasis on extracellular matrix-integrin-cytoskeletal interactions. In our studies, the hybrid AFM - optical microscopy system was used to measure the adhesion force between $a_5b_1$ integrins and various extracellular matrix proteins on the surface of isolated vascular smooth muscle cells (VSMC). Also, the AFM was used to apply force to extracellular matrix – integrin attachment sites analogous to single focal contacts. In experiments where AFM probes were conjugated with fibronectin (FN) and then physically interacted with the VSMC membrane we found that RGD-containing peptides and function blocking antibodies against $a_5$ or $5_1$ integrins were able to selectively block the FN-VSMC adhesions. This demonstrated selectivity for FN binding to $a_5b_1$ integrins. Adhesion strength between FN and $a_5b_1$ integrin was 39±8 pN. It was also determined that the probability of adherence of FN to $a_5b_1$ integrin (i.e. single molecule receptor ligand interaction) was reduced by platelet-derived growth factor (PDGF-BB) while lysophosphatidic acid (LPA) increased this probability. None of the treatments changed adhesion strength between the integrin and extracellular matrix protein. AFM cantilevers with a 5 µm diameter bead on the tip were coated with FN and used to establish individual focal contacts with VSMC. Application of a pulling force to the cells through these bead matrix contacts induced a force generating response from the cells. By comparison, application of force to beads coated with collagen I, vitronectin, or laminin did not induce a cellular contractile response. These studies demonstrate the utility of AFM investigations of cellular responses to mechanical forces and for studies of ligand-receptor interactions at the single molecule and cellular level. (Supp NIH HL58960 and HL062863 to GAM)

**"Structural Studies of DNA-binding Transcriptional Factors by Combination of X-ray Crystallography with Biophysical and Biochemical Methods"**

Assembly of stereospecific, multiprotein complexes on enhancers and promoters is essential for the activation or repression of transcription. The formation of such a complex is tightly controlled by sequence specific transcription factors, which bind to adjacent and/or distant sites on promoter DNA. Physical interaction between transcription factors in response to various signals, chemical modifications, binding of ligands, etc., are supposed to control their DNA binding. However, due to difficulties in crystallization of multiprotein-DNA complexes, as well as the weak and highly elusive nature of protein-protein interactions, mechanisms of the cooperation of transcription regulatory factors are still poorly studied. Often, the combination of X-ray crystallography with several biophysical and biochemical methods (EMSA, GST pull-down assays, light scattering, surface plasmon resonance, isothermal titration calorimetry, CD and UV melting experiments, atomic force microscopy, etc.) with functional/mutational studies is necessary to reveal the true mechanism of transcription factor function. Here, we will provide some examples of our related studies, including the cases of the AML1-CBFâ and c-Myb-C/EBPâ cooperation for trans-activation of myeloid genes and the NikR, a transcriptional repressor which is activated in response to the high content of nickel.

**"Modeling of Protein-Protein Interactions in Structural Genomics"**

An important problem in structural genomics is recreating the network of connections between proteins in a genome. The major aspects of this problem are: (1) the number of protein-protein interactions is very large, and (2) most protein structures will be models of limited accuracy. Thus, the structure-based methods for building this network have to be (a) fast, and (b) insensitive to the inaccuracies of modeled structures. The docking program GRAMM has been shown to adequately address these issues. The procedure predicts the structure of protein complexes at variable resolutions, depending on the accuracy of the structural components. Systematic studies showed a high degree of tolerance to the structural inaccuracies of protein models. The methodology is being applied to modeling of protein-protein interactions in entire genomes.

## SPEAKER BIOS

**Walter J. Chazin** received a B.Sc. in chemistry from McGill University and a Ph.D. in chemistry from Concordia University in Montreal. He was a postdoctoral fellow in the lab of 2002 Nobel laureate Kurt Wüthrich at the E.T.H. in Switzerland. After 13 years on faculty in the Department of Molecular Biology at the Scripps Research Institute, he moved to Vanderbilt in 1999 where he is Chancellor's Professor of Biochemistry and Physics, Ingram Professor of Cancer Research, and Director of the Center for Structural Biology and the Molecular Biophysics Training Program. He has published nearly 150 papers, book chapters and reviews, and serves on a number of advisory committees and editorial boards. His honors include American Cancer Society Junior Faculty and Faculty Research Awards, National Academy of Science International Travel Fellow (in Poland), Regents Visiting Professor at the University of Naples in Italy, and appointment as a Fellow of the American Association for the Advancement of Science.

**Wah Chiu** is the Alvin Romansky Professor of Biochemistry at Baylor College of Medicine. He is a leading investigator in the structural determination of biological nanomachines using electron cryomicroscopy towards atomic resolution. His laboratory has pioneered various experimental and computational methods in biological electron cryomicroscopy. He is the founding director of two NIH supported research Centers: National Center for Macromolecular Imaging (http://ncmi.bcm.tmc.edu/) and Center for Protein Folding Machinery (http://proteinfoldingcenter.org). Both Centers involve investigators from diverse disciplines in biology, medicine, physics, chemistry, engineering and computing from different academic institutions and industries. He is the founder of the Graduate Program in Structural and Computational Biology and Molecular Biophysics at Baylor College of Medicine with 68 faculty members from 6 academic institutions in the Greater Houston Area to train scientists at the interface between biomedicine and physical, chemical, mathematical, computational and engineering sciences. He is the co-founder of the Gulf Coast Consortia in the Houston Area (www.gulfcoastconsortia.org), which promotes interdisciplinary and collaborative research and training in quantitative biomedicine with over 350 participating faculty members from 6 academic institutions.

**Gerald Meininger** is Professor and Director of the Dalton Cardiovascular Research Center at the University of Missouri. Prior to assuming the directorship, Dr. Meininger was a Regents Professor and Associate Head of the Department of Medical Physiology and Director of the Division of Vascular Biology at Texas A&M University System Health Science Center. Dr. Meininger's research career has focused on mechanisms of microvascular control, the vasculature during hypertension and regulation of vascular smooth muscle function. Recent research efforts are directed at understanding the mechanisms by which cells of the cardiovascular system sense and respond to mechanical forces. These studies have provided strong evidence supporting an active role for integrins and their interactions with the extracellular matrix in vascular control. Dr. Meininger has approximately 100 publications and has received more than 50 invitations to speak at national and international symposia and more than 70 invitations to present seminars. His research has been continuously funded for 25 years.

**Tahir H. Tahirov** obtained the Ph.D. from Rostov State University and Institute of Chemical Physics, USSR Academy of Sciences, Russia in 2989. Dr. Tahirov has held such positions as: postdoctoral researcher at National Tsing Hua University, Taiwan; visiting scientist at the Himeji Institute of Technology; research scientist at the Institute for Protein Research, Osaka University; senior scientist at Kangawa Acad. of Science and Tech. and Yokohama City University School of Medicine; and laboratory head at RIKEN Harima Institute. In 2005, Professor Tahirov joined the faculty at the Eppley Institute for Research in Cancer and Allied Diseases at UNMC.

**Ilya A. Vakser** earned his PhD in biophysics at Moscow State University in 1989 and received further training at the Weizmann Institute, Washington University, and the Rockefeller University. He served on the faculty of the Medical University of South Carolina as an Assistant and Associate Professor and SUNY Stony Brook as an Associate Professor. In 2005, Dr. Vakser joined the University of Kansas as the Director of the Center for Bioinformatics (Bioinformatics Program) and a Professor of Bioinformatics and Molecular Biosciences. Dr. Vakser is the author of many scientific papers resulting from research funded by the National Institutes of Health, the National Science Foundation, and other agencies. His scientific community activities include organizing conferences and serving on advisory and steering committees.

# Metabolite Signaling: Genomic Responses to Dietary Molecules in Mammals

## PROGRAM

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|---|---|
| Speaker 1<br>9:00-9:45 | **Al Merrill**<br>"Cell regulation by sphingolipid mediators" |
| Speaker 2<br>9:45-10:30 | **John S. Parks**<br>"Using gene targeting for nutritional research: The role of ATP-binding cassette transporter A1 in lipid trafficking and inflammation" |
| Coffee Break<br>10:30-11:00 | |
| Speaker 3<br>11:00-11:45 | **Michael McIntosh**<br>"Conjugated Linoleic Acid (CLA) Signaling in Human Adipocytes" |
| Speaker 4<br>11:45-12:30 | **James Fleet**<br>"Modulating the Molecular Actions of Vitamin D by Ras/MAPK signaling: Implications for calcium metabolism and cancer prevention" |
| Lunch<br>12:30-1:30 | |
| Speaker 5<br>1:30-2:15 | **Diane Birt**<br>"Strategies and mechanisms for colon cancer prevention by plant phenolics" |
| Speaker 6<br>2:15-3:00 | **Janos Zemplini**<br>"Molecular responses to biotin" |
| Coffee Break<br>3:00-3:30 | |
| Poster Session<br>5:00-7:00 | Reception concurrent with poster presentations, research center & high-tech business displays |

## ABSTRACTS

**"Cell regulation by sphingolipid mediators"**

Sphingolipids are vital components of cell membranes, lipoproteins and cell signaling pathways. Dr. Merrill will discuss how studies of these compounds using "sphingolipidomic" technologies are uncovering surprising features of the sphingolipid metabolic pathways that are likely to be important to cell regulation and disease.

**"Using gene targeting for nutritional research: The role of ATP-binding cassette transporter A1 in lipid trafficking and inflammation"**

Gene targeting of mice is a powerful approach to examine the interaction of one or more genes with environmental factors, such a macronutrients, which impact the development of chronic diseases. The ATP-binding cassette transporter A1, which is essential for the formation of high density lipoproteins (HDL), has been deleted in specific tissues in mice to study its impact on HDL formation and inflammation. These novel animal models can be used in future studies to help elucidate the molecular mechanisms by which dietary interventions and drug therapy effect HDL concentration and metabolism.

**"Conjugated Linoleic Acid (CLA) Signaling in Human Adipocytes"**

Recent studies suggest that supplementing animals or humans with an equal mixture of two CLA isomers, cis-9, trans-11 and trans-10, cis-12, or trans-10, cis-12 CLA alone, decreases adiposity. However, the isomer-specific mechanism by which CLA decreases body fat is unclear. Our group has identified an isomer-specific signaling cascade that triggers delipidation in primary cultures of human adipocytes, which will be the focus of this presentation.

**"Modulating the Molecular Actions of Vitamin D by Ras/MAPK signaling: Implications for calcium metabolism and cancer prevention"**

We study the transcriptional activation of genes induced by interaction of the hormonally active form of vitamin D, 1,25 dihydroxyvitamin D, with the nuclear vitamin D receptor (VDR). Recently, we and others have observed that VDR-mediated gene activation can be modified by the Ras/MAPK signaling pathway. This interaction occurs mechanistically at multiple levels and is dependent upon the target cell. I will present two mechanistic scenarios related to this interaction and explain how this is relevant to the role of vitamin D and health.

**"Strategies and mechanisms for colon cancer prevention by plant phenolics"**

Apigenin [5,7,4'-trihydroxyflavone], a common dietary flavonoid, and resveratrol, a phytoalexin are found in fruits and vegetables that have been associated with a reduced incidence of colon cancer. These phytochemicals have been shown to induce cell cycle arrest in colon cancer cells. Apigenin induced $G_2$/M cell cycle arrest in three different colon cancer cell lines and correction of APC mutations reduced sensitivity of one of these lines to apigenin. Thus, apigenin may have a stronger effect on tumors with certain genetic mutations. Ongoing studies are assessing the ability of genetically modified alfalfa that accumulates resveratrol glucoside in colon cancer prevention and evaluating the mutations that confer sensitivity to resveratrol.

**"Molecular responses to biotin"**

This presentation will discuss a novel mechanism by which the vitamin biotin affects chromatin structure. The speaker will present recent findings with regard to novel biotinylation sites in human histones. Putative biological functions in DNA repair and gene silencing will be discussed.

## SPEAKER BIOS

**Diane Birt** has conducted research into mechanisms whereby dietary factors modulate carcinogenesis for 30 years. Her research emphasizes identifying and studying mechanisms for cancer prevention by novel dietary constituents and studying mechanisms for cancer enhancement by overeating and obesity. She received a Bachelors degree from Whittier College, Whittier, California in 1971 and a Ph.D. from Purdue University, West Lafayette, in 1975. She was Assistant Professor at the Eppley Institute for Research in Cancer at the University of Nebraska Medical Center, Omaha, NE in 1976 and she was subsequently promoted to Full Professor in the Eppley Institute and in the Departments of Biochemistry and Pharmaceutical Sciences in 1988. She was interim Chairman of Biochemistry and Molecular Biology at the University of Nebraska Medical Center from 1991 to 1994. She was appointed Chairman of the Department of Food Science and Human Nutrition and Director of the Center for Designing Foods to Improve Nutrition, Iowa State University, Ames, IA July 1, 1997. She served as Center Director until 2002 and as department chair until 2004. In 2002 Dr. Birt led the effort to establish the Iowa Center for Research on Dietary Botanical Supplements at Iowa State University and the University of Iowa with funds from the Office of Dietary

Supplements (NIH). This center focuses on *Echinacea* and *Hypericum*, assessing genetic and developmental impacts of these plants on their chemical composition and resulting medicinal properties and potential toxicity. The American Association for Cancer Research named Diane Birt the winner of the 2001 DeWitt Goodman Memorial Lectureship. She was named Distinguished Professor at Iowa State University in 2004. Dr. Birt has served on National Academy of Sciences and Institute of Medicine committees and she was a scientific advisor for the ILSI N.A. Food, Nutrition and Safety Committee. She is presently a member of the Board of Scientific Counselors for the National Toxicology Program (US Department of Health).

**James C. Fleet** received his Ph.D. in Nutritional Biochemistry from Cornell University, conducted post-doctoral training at Tufts University, and has held faculty appointments at Tufts and the University of North Carolina at Greensboro. He is currently an Associate Professor in the Department of Foods and Nutrition at Purdue University and a member of the Purdue Cancer Center and the Bindley Biosciences Center in Purdue's Discovery Park. In 2001 he received the Mead Johnson Research Award from the American Society for Nutrition and in 2003 he was honored as a University Faculty Scholar by Purdue University for his achievements.

**Michael K. McIntosh** is a Professor in the Department of Nutrition at The University of North Carolina at Greensboro**.** He received his B.S. in Zoology from Ohio University, M.S. in Nutrition from the University of Alberta, and Ph.D. in Nutrition from the University of Georgia. The long term goal of Michael's research group is to develop novel dietary strategies for the control of human obesity, the most common nutritional disease in America. The specific aims of his obesity research are to 1) *identify the mechanism by which certain fatty acids (e.g., CLA, omega-3 fatty acids) affect cell signaling and the expression of genes and proteins that regulate fat cell maturation and metabolism*, and 2) *determine how increased body fat promotes inflammation and insulin resistance observed in type 2 diabetes.*

**Al Merrill** holds the Smithgall Institute Chair in Molecular Cell Biology in the School of Biology and the Petit Institute for Bioengineering and Bioscience at Georgia Tech. He received his Ph.D. from Cornell University (Ithaca) and has published approximately 200 primary research papers and reviews, most of which deal with the analysis, metabolism and functions of sphingolipids, including their roles in disease etiology and prevention. He is the Director of the Sphingolipid and Glycosphingolipid Core of the Lipid MAPS Consortium (www.lipidmaps.org) and has produced a working pathway map for sphingolipids (www.sphingomap.org).

**John S. Parks** is a Professor of Pathology in the Section of Lipid Sciences at Wake Forest University School of Medicine and Director of the Molecular and Cellular Pathobiology Graduate Program at the Wake Forest University Graduate School of Arts and Sciences. Dr. Parks earned his M.S. and Ph.D. in Experimental Pathology and Biochemistry at Wake Forest University and performed postdoctoral studies at the Biophysics Institute at Boston University School of Medicine. His career has focused on the effect of dietary cholesterol and polyunsaturated fats on the structural properties and metabolism of plasma lipoproteins. After a sabbatical at the University of North Carolina at Chapel Hill in the laboratories of Drs. Nobuyo Maeda and Oliver Smithies, Dr. Parks has employed gene targeting and transgenic approaches to understand the molecular mechanisms by which dietary macronutrients interact with gene expression to influence lipid and lipoprotein metabolism and the development of atherosclerosis.

**Janos Zempleni** earned his B.S. and Ph.D. in Nutritional Science at the University of Giessen in Germany. After receiving postdoctoral training in biochemistry and molecular biology at Innsbruck University (Austria), Emory University, and Arkansas Children's Hospital Research Institute he joined the University of Nebraska-Lincoln in 2001. He is currently an Assistant Professor in the Department of Nutrition and Health Sciences. Dr. Zempleni's research focuses on biotin-dependent remodeling of chromatin.

# Basic Biological Research on Aging and Longevity

## PROGRAM

| | |
|---|---|
| Speaker 1<br>9:00-9:45 | **Arlan Richardson**<br>"Using Transgenic/Knockout Mice to Test the Oxidative Stress Theory of Aging" |
| Speaker 2<br>9:45-10:30 | **Marjorie Lou**<br>"Eye Lens as a Model for Studying the Association of Oxidation and Aging" |
| Coffee Break<br>10:30-11:00 | |
| Speaker 3<br>11:00-11:45 | **Robert Floyd**<br>"Action of Nitrones in Aging and Age-Related Diseases" |
| Speaker 4<br>11:45-12:30 | **Adam Salmon**<br>"Cell Stress Resistance, DNA Repair and Mouse Longevity" |
| Lunch<br>12:30-1:30 | |

## ABSTRACTS

**"Using Transgenic/Knockout Mice to Test the Oxidative Stress Theory of Aging"**
Using knockout and transgenic mice we are studying the effect of altering components of the antioxidant defense system on the levels of oxidative damage and lifespan of mice. Mice deficient in glutathione peroxidase 1 (*Gpx1*$^{-/-}$) and both *Gpx1*$^{-/-}$ and *Sod2*$^{+/-}$ were found to show increased sensitivity to oxidative stress (paraquat) and to have increased levels of oxidative damage to DNA, and life spans similar to wild type mice. We have also studied the effect of overexpressing thioredoxin 1 (Trx1) on resistance to oxidative stress, oxidative damage, and life span. The increase in Trx1 levels was associated with increased resistance to oxidative stress, reduced oxidative damage to protein, and an increase in survival to date. Our findings suggest that alterations in certain components of the antioxidant defense system will increase the life span of mice, while alterations in other components will have no effect on life span.

**"Eye Lens as a Model for Studying the Association of Oxidation and Aging"**
The eye lens is an ideal model for aging study as the turnover rate of lens proteins is extremely slow, with half-life measured in decades. The lens is rich in the natural antioxidant of glutathione (GSH), which protects lens protein thiols from oxidation, and to maintain lens transparency. However, during aging, human lens gradually loses GSH to < 40% in the 8$^{th}$ decade in comparison to a new-born; the thiols in proteins are oxidized to protein-nonprotein and protein-protein disulfides; and thioltransferase (TTase) and thioredoxin, the oxidation damage repair enzymes decrease. TTase knockout mouse developed lens protein aggregation faster than the wild type. In contrast, the lifespan extension models of caloric restriction in Drosophila and dwarf Snell mouse, both GSH and oxidation defense enzymes, are enriched and show more resistance to oxidative stress.

**"Action of Nitrones in Aging and Age-Related Diseases"**
Studies on biological aging have shown that reactive oxygen species are important. Nitrones have the ability to "trap" free radicals. They are valuable tools to probe mechanisms involved in aging and age-related diseases. Nitrones have potent biological activity. Certain studies demonstrated they prolong life span but others contradict these findings. Our research has shown that they offer neuroprotective activity in stroked brain. Development of one nitrone is now in Phase III trials for stroke. Our latest research demonstrated that nitrones have anti-cancer activity.

**"Cell Stress Resistance, DNA Repair and Mouse Longevity"**
Recent studies on the genetics of aging reveal that cytotoxic stress resistance may play an important role in the regulation of the aging process. We have shown that cells isolated from long-lived mutant mice exhibit resistance to multiple cytotoxic agents in spite of the fact that the fibroblast cell lines have been in cell culture for dozens of generations. An understanding of the persistent stress-resistant state of these cells from long-live mice may help delineate the mechanisms that regulate the aging process.

## SPEAKER BIOS

**Robert Floyd** holds The Merrick Foundation Chair in Aging Research (2000) at The Oklahoma Medical Research Foundation where he has been for 30 years. He has adjunct academic appointments in The Department of Biochemistry and Molecular Biology and in The Oklahoma Center for Neurosciences at the adjoining University of Oklahoma Health Science Center. His research focuses on the effects of reactive oxygen species in aging and the diseases of aging, especially carcinogenesis and neurodegeneration. The research has produced approximately 200 refereed papers, 40 book chapters and the editorship of three books. He has recruited seven new professor-level scientists to the Free Radical Biology and Aging (FRBA) Research Program at the Oklahoma Medical Research Foundation.

**Marjorie Lou** is a biochemist. She received her BS degree from National Taiwan University, her MS from Virginia Tech and her PhD from Boston University. She did a 2-year postdoctoral at the Harvard Medical School before working at the Dupont Institute in Wilmington, Delaware. She then spent 12 years in the private sector in Texas before joining the University of Nebraska in 1994 as a full professor, and now is a Willa Cather Professor in Biomedical Sciences. Dr. Lou has focused her research on the mechanism of cataractogenesis and aging throughout her career, and has published over 100 papers and book chapters.

**Arlan Richardson** is a biochemist who has devoted 30 years to research and education. He currently directs the Barshop Institute for Longevity and Aging and holds the Methodist Hospital Foundation Chair in Aging Studies and Research. The present focus of Dr. Richardson's research is two-pronged. The first is to use transgenic and knockout mice with alterations in the antioxidant defense system to study the effect of oxidative damage on survival and age-related pathology. The second focus is the development of assays that measure oxidative damage to specific macromolecules, particularly to proteins. The goal is to use these assays to investigate age-related diseases such as cancer, Alzheimer's and Parkinson's disease.

**Adam Salmon** is an alumnus of the University of Nebraska-Lincoln (B.S., M.S.; biological sciences) where he began working on environmental stress resistance in the context of longevity. He currently is a doctoral candidate in the laboratory of Dr. Richard Miller at the University of Michigan at Ann Arbor where he works on the cellular basis of extended longevity using long-lived dwarf mice. Research in Richard Miller's laboratory focuses on a number of problems related to the genetics of aging in mammals including projects involving slow aging mouse mutations and genes, pathways of cell stress resistance, and the signaling pathways that regulate immunoaging.

# Genome-wide Gene Regulatory Networks

## PROGRAM

| | |
|---|---|
| Speaker 1<br>9:00-9:45 | **Karen Cone**<br>"All wrapped up: chromatin-level regulation in maize" |
| Speaker 2<br>9:45-10:30 | **Erich Grotewold**<br>"Plant regulatory networks" |
| Coffee Break<br>10:30-11:00 | |
| Speaker 3<br>11:00-11:45 | **Richard Amasino**<br>"Vernalization: remembering winter with an environmentally induced epigenetic switch" |
| Speaker 4<br>11:45-12:30 | **Robin D Dowell**<br>"High Resolution Models of Eukaryotic Transcriptional Regulation" |
| Lunch<br>12:30-1:30 | |

## ABSTRACTS

**"All wrapped up: chromatin-level regulation in maize"**

Eukaryotes can control gene expression using epigenetic mechanisms that involve changes in chromatin packing. However, much remains to be learned about how those changes are regulated. To address this problem, we are using genetic and genomics approaches to analyze the expression of an epigenetically-regulated gene, which controls the synthesis of purple anthocyanin pigments in maize. Our results thus far implicate multiple classes of chromatin genes, including several involved in histone acetylation.

**"Plant regulatory networks"**

About 5% of all plant genes encode for transcription factors (TFs), which can be grouped into families, based on the presence of conserved DNA-binding domains. We are interested in understanding how TF with similar DNA-binding preferences acquire regulatory specificity *in vivo*, and in establishing the regulatory networks that participate in the spatial and temporal expression of all plant genes. The independent regulation of two branches of the maize flavonoid biosynthetic pathways by similar R2R3-MYB TFs showed that TF combinatorial interactions play a central role in determining which target genes each TF regulates. To investigate and visualize plant regulatory networks, AGRIS (*Arabidopsis* Gene Regulatory Information Server, http://arabidopsis.med.ohio-state.edu) was developed as a collection of databases that combine 1,600+ TFs, 28,000+ promoters and the corresponding interactions, with the visualization of the resulting regulatory motifs. We have initiated the analysis of *Arabidopsis* core promoters, as a first step to linking TFs and the basal transcriptional machinery.

***"Vernalization: remembering winter with an environmentally induced epigenetic switch"***

Certain plants require relatively long periods of cold exposure during winter to initiate flowering the following spring. Cold exposure renders the meristem of such cold-requiring species competent to flower, and this acquisition of competence is known as vernalization. A vernalization requirement ensures that flowering does not occur prematurely before the onset of winter. A similar cold response is bud dormancy; in many species that grow in temperate climates, bud dormancy is not broken until a the plant has “counted” a sufficient number of days of cold to ensure that any subsequent warn weather actually indicates that spring has arrived. Our studies of vernalization in Arabidopsis have revealed that meristem competence is a function of the expression level of certain MADS-box genes such as FLOWERING LOCUS C (FLC) that act as repressors of flowering. Exposure to prolonged cold causes an epigenetic switch of these MADS box genes to an unexpressed state, thus rendering the shoot apical meristem competent to flower. This epigenetic switch is caused by covalent modifications to histones of the chromatin of the flowering repressors.

**"High Resolution Models of Eukaryotic Transcriptional Regulation"**

Chromatin immunoprecipitation followed by DNA microarray hybridization (ChIP-chip) has emerged as a powerful tool for studying in vivo genome-wide binding events including transcription factor binding, nucleosome occupancy, and histone modification state. We have developed a new method, Joint Binding Deconvolution (JBD) which improves the spatial accuracy of the transcription factor binding locations inferred from ChIP-chip data. The resulting high resolution binding information has been used to discover transcription factor DNA binding motifs and to construct large-scale regulatory network models.

## SPEAKER BIOS

**Richard Amasino** received a Ph.D. from Indiana University where he worked with Carlos O. Miller. After postdoctoral work in the laboratories of Milt Gordon and Gene Nester at the University of Washington, he joined the faculty in the Department of Biochemistry at the University of Wisconsin-Madison. His current research program is directed towards understanding the mechanisms by which plants have evolved the ability to regulate flowering in response to environmental variables that report seasonal change such as changes in day-length or temperature.

**Karen Cone** earned her BS and MS in Microbiology from the University of Georgia and her PhD in Biochemistry and Genetics from Duke University. She began her work with maize as a postdoctoral fellow with Dr. Benjamin Burr at Brookhaven National Laboratory. She then joined the faculty in the Division of Biological Sciences at the University of Missouri-Columbia, where her research now focuses on chromatin-level regulation of plant gene expression.

**Robin D. Dowell** is currently a postdoc in the Computational Genomics Group under the supervision of Dr. David K. Gifford at the MIT Computer Science and Artificial Intelligence Laboratory (CSAIL). We focus on the development of new machine learning techniques to model the transcriptional regulatory networks of eukaryotes, focusing on leveraging chromatin immunoprecipitation coupled with DNA microarray hybridization (ChIP-chip) to study regulatory network conservation across species. She completed her doctorate in Biomedical Engineering at Washington University in the fall of 2004. Her doctoral work was in the laboratory of Dr. Sean Eddy where she developed an efficient algorithm for pairwise simultaneous fold and alignment of RNA sequences.

**Erich Grotewold** obtained his Ph.D. in Chemistry from the University of Buenos Aires (1985). He initiated his research on the control of gene expression of maize flavonoid genes as a postodc with Dr. Thomas Peterson at Cold Spring Harbor Lab (until 1993), where he continued as an Assistant Professor until 1998, when he joined Dept. of Plant Cellular & Molecular Biology at The Ohio State University, where he is currently an Associate Professor.

# *Nanoscale and Nanostructured Semiconductors: Materials and Devices*

## PROGRAM

| | |
|---|---|
| Introduction<br>9:00-9:10 | **Ned Ianno**<br>"Introduction" |
| Speaker 1<br>9:10-9:50 | **Vikram Dalal**<br>"Nanocrystalline Silicon Materials" |
| Speaker 2<br>9:50-10:30 | **Shireen Adenwalla**<br>"Semiconducting Boron Carbide: Neutron Detector Applications" |
| Coffee Break<br>10:30-11:00 | |
| Speaker 3<br>11:00-11:45 | **Michael Santos**<br>"Narrow-Gap Semiconductor Nanostructures" |
| Speaker 4<br>11:45-12:30 | **Brian Robertson**<br>"Semiconducting Boron Carbide Devices and Nanofabrication" |
| Lunch<br>12:30-1:30 | Reception concurrent with poster presentations, research center & high-tech business displays |

## SPEAKER BIOS

**Vikram Dalal** was raised in Bombay, India. After receiving his B.Eng.(EE) in Bombay, he came to the U.S. in 1964, and received his M.S. and Ph.D. degrees in Electrical Engineering from Princeton University in 1966 and 1969 respectively. He received an M.P.A. in Economics from Princeton in 1975. Since 1988, Dr. Dalal has been at Iowa State University as Professor of Electrical and Computer Engineering. Since 1999, he has also served as Director of Microelectronics Research Center at Iowa State. He currently holds the Thomas Whitney Chair in Electrical and Computer Engineering. He has played a major role in establishing Iowa State's research programs in semiconductor and opto-electronic materials and devices. His current research focuses on thin film semiconductors, nanocrystalline Si materials and photovoltaic energy conversion materials and devices.

**Michael Santos** has been a member of the physics faculty at the University of Oklahoma since 1993. His research interests are focused on the epitaxial growth and electronic properties of narrow gap semiconductor structures. He is a member of the Center for Semiconductor Physics in Nanostructures, an NSF Materials Research Science and Engineering Center. He was a postdoctoral researcher at AT&T Bell Laboratories (Holmdel, NJ) and spent a sabbatical leave at NTT Basic Research Laboratories (Japan). Prof. Santos earned a Ph.D. from Princeton University (Electrical Engineering, 1992) and a B.S. from Cornell University (Electrical Engineering & Materials Science, 1986).

# Biosensors and Networks

## PROGRAM

| | |
|---|---|
| Speaker 1<br>1:30-2:00 | **Steve Ragsdale**<br>"Carbon monoxide sensing" |
| Speaker 2<br>2:00-2:30 | **Jonathan Kipnis**<br>"Regulatory and autoimmune T cells in neuroprotection: potential role of differential redox regulation" |
| Speaker 3<br>2:30-3:00 | **Steve Reichenbach**<br>"Comprehensive Two-Dimensional Gas Chromatography (GCxGC)" |
| Coffee Break<br>3:00-3:30 | |
| Speaker 4<br>3:30-4:00 | **Jaekwon Lee**<br>"Homeostasis of Nutritional and Toxic Metals" |
| Speaker 5<br>4:00-4:30 | **Ravi Saraf**<br>"Electronic Nanodevice for Biosensing" |
| Speaker 6<br>4:30-5:00 | **Vadim Gladyshev**<br>"Protein thiol networks and hydrogen peroxide sensing" |
| Poster Session<br>5:00-7:00 | Reception concurrent with poster presentations, research center & high-tech business displays |

## ABSTRACTS

**"Carbon monoxide sensing"**

Besides being a toxic gas, carbon monoxide is a signaling molecule in organisms. In bacteria, CO is sensed by a heme containing transcriptional factor that activates expression of genes involved in CO metabolism. In humans, CO sensing is tied to chemoreception of oxygen concentrations, which is involved in response of cells to hypoxic conditions. The presentation will discuss how CO is generated, how it is sensed, and why it is important as a signaling molecule.

**"Comprehensive Two-Dimensional Gas Chromatography (GCxGC)"**

Comprehensive Two-Dimensional Gas Chromatography (GCxGC) is a powerful new technology for chemical separations. GCxGC provides: unparalleled separation capacity via two-dimensional separations; improved signal-to-noise via thermal focusing; and enhanced chemical identification via multi-dimensional structure-retention information. GCxGC methods are being developed for a variety of health-care applications.

**"Homeostasis of nutritional and toxic metals"**

Metabolism of metal ions is a fundamental biological process in all living organisms. Metal ions such as iron, copper and zinc serve as essential catalytic and structural cofactors of a number of enzymes and proteins, but excess accumulation of these metals is toxic and has been linked to human genetic and degenerative diseases. Detrimental effects of non-physiological metals are also serious public health concerns. Dr. Lee reports recent progress in understanding mechanisms that control expression, subcellular localization, and activities of proteins involved in copper and cadmium homeostasis in *Saccharomyces cerevisiae*.

**"Electronic Nanodevice for Biosensing"**

Design of biosensors has evolved to detect unknown target biomolecules by capturing them with specifically binding probe molecules. Broadly, four methods of transduction have emerged to determine the specific binding between the probe and the target – optical, electrochemical, micro-gravimetric and electrical. Although optical sensors are the most sensitive, electrical transduction is most attractive in terms of speed, size and portability. Nanostructured materials offer a unique platform to make highly sensitive electronic devices. I will discuss a new principle of making nanoparticle-based electronic biosensors.

**"Protein thiol networks and hydrogen peroxide sensing"**

Cellular physiology is underlined by discrete functional systems and modules that are coordinately regulated. To understand the biology of cells and organisms, it is essential to define and then characterize these cellular subsystems. Thiol-based signaling and regulation emerged as a major mechanism to control cellular function. Thiol networks are present in all living organisms. We will present a combination of bioinformatics, genomics and proteomics approaches to describe basic components of thiol networks in yeast cells.

## SPEAKER BIOS

**Vadim Gladyshev** is the Charles Bessey Professor of Biochemistry at UNL and an Adjunct Professor at the Eppley Cancer Research Center at UNMC. Dr. Gladyshev is a member of the NIH Integrative Nutrition and Metabolic Processes study section and chair of the 2006 Gordon Research Conference on Thiol-based Regulation and Signaling. His research interests are in the areas of redox biology and selenium biology. A biochemist by training, he applies bioinformatics and high throughput methods using various model systems.

**Jonathan Kipnis** is an Assistant Professor of Pharmacology and Chief, Laboratory of Neuroprotection, Center for Neurovirology and Neurodegenerative Disorders at UNMC. He was awarded a Distinguished Prize for excellence in doctoral studies by the Israeli Knesset. His research is in the area of neuroimmunology.

**Jaekwon Lee** is an Assistant Professor in the Department of Biochemistry at the University of Nebraska-Lincoln. Dr. Lee's research program has focused on identification and characterization of nutritional and toxic metal transporters.

**Stephen Ragsdale** is the Charles Bessey Professor of Biochemistry at UNL. He received the Outstanding Research and Creativity Award from the University of Nebraska System. Dr. Ragsdale has research programs in the areas of metallobiochemistry and environmental biochemistry relating to the removal of xenobiotics and reversing global warming.

**Stephen Reichanbach** is Professor of Computer Science and Engineering at UNL. His research interests span computer science, chemistry and biology. Dr. Reichenbach has developed innovative informatics for advanced chemical separations technologies, particularly comprehensive two-dimensional gas chromatography (GCxGC) and GCxGC paired with high-speed mass spectrometry (GCxGC-MS). GCxGC informatics was licensed to GC Image, LLC, for commercialization by prominent laboratories in Asia, Europe, and the Americas.

**Ravi Saraf** is the Lowell E & Betty Anderson Professor in the Department of Chemical Engineering at UNL. He is author/coauthor of 31 US patents and 64 scientific publications. His research has been in basic sciences to solve practical problems. He is the recipient of several innovation and research awards. His research interests include interfacial properties of materials, nanometer scale devices and their processing, biosensors, biophysics and bioengineering.

# Nanomanufacturing Engineering

## PROGRAM

| | |
|---|---|
| Introduction<br>1:30-1:40 | **Yuris Dzenis**<br>"Introduction" |
| Speaker 1<br>1:40-2:10 | **James Lee**<br>"Polymer Nanoengineering for Biomedical Applications" |
| Speaker 2<br>2:10-2:35 | **Yuris Dzenis**<br>"Continuous Nanofibers – A Novel Class of Nanomaterials" |
| Speaker 3<br>2:35-3:00 | **Darrell Reneker**<br>"Advances in Electrospinning (2006)" |
| Coffee Break<br>3:00-3:30 | |
| Speaker 4<br>3:30-3:55 | **George Chase**<br>"Nanofiber Enhanced Filter Media" |
| Speaker 5<br>3:55-4:20 | **Miko Cakmak**<br>(presenting for Dr. Baris Yalcin)<br>"A Novel Electrospinning/Casting Hybrid Process" |
| Speaker 6<br>4:20-4:45 | **Joe Turner**<br>"Mechanical Characterization of Heterogeneous Nanostructured Materials" |
| Panel<br>4:45-5:00 | **Panel Discussion**<br>"Unresolved Issues and Need for Collaborative Interdisciplinary Effort; Prospects for National Center" |
| Poster Session<br>5:00-7:00 | Reception concurrent with poster presentations, research center & high-tech business displays |

## ABSTRACTS

**"Polymer Nanoengineering for Biomedical Applications"**

Current nanotechnology is largely based on silicon (Si), owing to extensive micro/nanofabrication methods in the electronics industry; but the properties of Si-based materials are inappropriate for many structural components and photonic and biomedical devices. In contrast, polymeric materials possess properties such as high toughness, optical clarity, and recyclability, but commercialization is hindered by a need for mass-producible, reliable, and affordable synthesis methods and manufacturing processes. Partnership in research and commercialization of polymer nanotechnology among academia, industries and government is explored.

**"Continuous Nanofibers – A Novel Class of Nanomaterials"**

Continuous nanofibers with much smaller diameters than those of conventional advanced fibers can revolutionize existing applications and create new ones. Examples include super-strong/tough and transparent composites and coatings and structural elements in MEMS/NEMS. Progress in these and other areas depends on development of reliable methods of nanofiber manufacturing, assembly, and processing into nanocomposites and on ability to predict/optimize their mechanical properties. Progress on theoretical and experimental analysis of electrospinning process of manufacturing of continuous nanofibers will be discussed.

**"Advances in Electrospinning (2006)"**

A hierarchical network structure of carbon fibers was made to connect metal nanoparticles with diameters as small as ten nanometers to external electrical circuitry. Nanofibers, electrospun from a solution of polyacrylonitrile that also contained a metal-organic compound, were pyrolized to carbon. The metal atoms were reduced by heating in hydrogen. At temperatures above the melting point of the metal, droplets formed on the surface of the carbon fibers. These metal droplets were used to catalyze the growth of fullerene multiwall carbon nanotubes from hexane vapor. Each nanotube carried a metal particle at its tip. The spaces between the nanotubes provided pathways for gases and liquids to flow past the metal particles. This unique hierarchical carbon structure, with dimensions that can be controlled during synthesis, promises to become important in fuel cells, redox-reaction electrodes, and nanoscale engineering.

**Nanofiber Enhanced Filter Media"**

Submicron sized fibers enhance filter media capture efficiency. Recent advances in electrospinning provide easy access to nanofibers. An overview of electrospinning is provided along with a discussion of nanofiber properties. Nanofiber diameters may be controlled, to an extent, by adjusting field strength or by changing solvent concentration. Nanofibers may be made of organic polymers or organic oxides (ceramics). The nanofibers enhance the capture of the most penetrating particle sizes (100 to 500 nm) while slip-flow effects moderate the increases in pressure drop. Quality Factor calculations show an optimum mix of micro and nanofibers, and experimental results agree.

**"A Novel Electrospinning/Casting Hybrid Process"**

We have invented a method for producing hybrid materials of thin polymer films with complete or partially embedded multilayer nanofibers to obtain products with unique functional properties. We have combined two process technologies: a thin film solution casting process and an electrospinning process. In this combined process nanofibers can easily be embedded in films with judicious choice of electrospinning conditions and substrate polymer solutions. Potential uses for such films will be discussed.

**"Mechanical Characterization of Heterogeneous Nanostructured Materials"**

In this presentation, a variety of characterization techniques will be discussed with regard to their applicability for heterogeneous nanostructured materials. Because such materials typically include many length scales, techniques that cover specific length scales are needed. Nanoindentation and atomic force microscope techniques are of particular use in this presentation. Specific materials to be discussed include single nanofibers (polymer, carbon, and ceramic), nanofiber assemblies, fiber composites, and polymer nanocomposite systems.

## SPEAKER BIOS

**Miko Cakmak** is a polymer engineering professor, director of the Center for Multifunctional Polymer Nanomaterials and Devices, and associate director of Akron Global Polymer Academy. Identification, modeling and simulation of complex structural mechanisms, particularly stress induced crystallization that takes place during the course of polymer processing operations of wide range of polymers, are subjected to melt as well as rubbery state deformation. The range of materials includes high temperature thermoplastics and their blends as well as nano particle filled systems. Of particular interest is the relationship between thermo-mechanical history applied by fiber spinning, film blow-

ments of true mechano-optical and mechano-electrical properties of polymers undergoing uni and biaxial deformation for photonics applications.

**George G. Chase** is a chemical engineering professor at the Univeristy of Akron where he received a B.S. in 1978 and a Ph.D. in 1989. His research applies a framework of volume averaged continuum equations to fluid/solid separations and flows through porous media. Specific applications include cake and depth filtration, coalescence filtration, and adsorption of H2 and NH3 onto fibrous filter media. This research includes development of polymer and ceramic nanofibers for the above applications. His publications include 73 refereed journal papers, 6 patents, 89 proceedings papers, and 3 book chapters.

**Yuris A. Dzenis** is a Robert C. McBroom Professor of Engineering Mechanics at UNL. He has earned his Ph.D. in Aerospace and Mechanical Engineering from the University of Texas-Arlington (1994), another Ph.D. in Materials Science and Engineering (Physics and Mechanics of Polymers) from Latvian Academy of Sciences (1990), and an M.S. in Physics (Elec-trodynamics of Continua) from Latvian University (1982). He joined UNL in 1994. Dr. Dzenis' current research interests are in design, manufacturing, characterization, and modeling of advanced nanomaterials and nanomanufacturing processes. He has served as a PI/PD on over 20 federal projects totaling over $7M and developed a unique interdisciplinary laboratory on Advanced Nanomaterials and Nanomanufacturing. He serves as founding Director of the newly established National Nanofiber Facility at UNL. He and interdisciplinary colleagues collaborate on developing and manufacturing novel functional nanofi-bers.

**L. James Lee** is the Helen C. Kurtz Professor of Chemical and Biomolecular Engineering at The Ohio State University (OSU). He established the NSF I/UCR Center for Advanced Polymer and Composite Engineering (CAPCE) at Ohio State in 1997. He now serves as the Director of NSF Nanoscale Science and Engineering Center for Affordable Nanoengineering of Polymer Biomedical Devices (CANPBD), NSF IGERT Program on Molecular Engineering of Microdevices, and Ohio Center for Multifunctional Polymer Nanomaterials and Devices (CMPND) at OSU. He received a BS in chemical engineering from National Taiwan University in 1972, and a PhD in chemical engineering from University of Minnesota in 1979. Before joining OSU in 1982, he worked as a research scientist at General Tire and Rubber Company for 4 years. His research interests include BioMEMS/NEMS, polymer and composite processing, and micro-/nanofabrication. He has more than 200 refereed journal publications, 11 patents and 8 book chapters. Dr. Lee has received 12 Best Paper Awards from the Society of Plastics Engineers and Society of Plastics Industry Annual Conferences. He was awarded the OSU Distinguished Scholar Award in 2000.

**Darrell H. Reneker** is presently Professor of Polymer Science at the University of Akron. He is principal investigator on an NSF-NIRT that investigates ways to utilize waste head to generate electrical power by a thermo-photo-voltaic process that uses nanofibers. He was manager of the Center for Materials Science, one of the four major organizational units of the National Institute of Standards and Technology (NIST). He served as Executive Secretary of the Committee on Materials of the White House Science Office during the Reagan administration. Dr. Reneker became Professor of Polymer Science and Director of the Institute of Polymer Science of the University of Akron in 1989. He established the first scanning probe microscopy laboratory devoted to examination of polymer morphology and served on the Board of Directors of the Edison Polymer Innovation Corporation, an Ohio agency aimed at research and technology transfer. Several of his patents are licensed to industry. Dr. Reneker's paper on electrospinning of polymer fibers was identified by "Essential Science Indicators", Thomson ISI, as the frequently cited paper in "the fast moving front" of materials science in September 2003. See: http://esi-topics.com . He received the Outstanding Researcher Award, University of Akron, in 2002, and the Silver Medal Award of the U. S. Department of Commerce.

**Joseph A. Turner** is Associate Professor of Engineering Mechanics at the University of Nebraska-Lincoln. He has a Ph.D. in Theoretical and Applied Mechanics from the University of Illinois at Urbana-Champaign. His research interests include the examination of the fundamentals as well as applications of a variety of materials characterization techniques including ultrasound, nanoindentation, and atomic force microscopy.

# Wireless Networks and Distributed Sensors

## PROGRAM

| | |
|---|---|
| Speaker 1<br>1:30-2:15 | **Nitin H. Vaidya**<br>"Multi-Channel Wireless Networks: Capacity and Protocols" |
| Speaker 2<br>2:15-3:00 | **Shivakant Mishra**<br>"CenWits: A Sensor Based Loosely Coupled Search and Rescue System Using Witnesses" |
| Coffee Break<br>3:00-3:30 | |
| Speaker 3<br>3:30-4:00 | **Hesham Ali**<br>"Design and Development of Secure and Robust Network Infrastructure for Critical Medical Applications: Achieving Medical Quality Care through Advanced IT" |
| Speaker 4<br>4:00-4:20 | **Steve Taylor**<br>“Wearable Patient Monitoring Application (EKG) for Wireless Sensor Networks" |
| Speaker 5<br>4:20-4:40 | **Nam Pham**<br>"Tracking and Routing in Medical Environment" |
| Speaker 6<br>4:40-5:00 | **Eric D. Manley**<br>"Learning-Based Approaches to Indoor Tracking" |
| Poster Session<br>5:00-7:00 | Reception concurrent with poster presentations, research center & high-tech business displays |

## ABSTRACTS

**"Multi-Channel Wireless Networks: Capacity and Protocols"**

Wireless technologies, such as IEEE 802.11a, provide for multiple non-overlapping channels. Typical multi-hop wireless network configurations have only used a single channel for the network. The available network capacity can be increased by using multiple channels. However, the number of interfaces per node is expected to remain smaller than the number of channels, and therefore a single node cannot simultaneously use all the channels. We present the capacity of general multi-channel networks wherein the number of interfaces per node may be smaller than the number of channels and show that for a random network of n nodes, there is no capacity degradation even with only one interface per node, as long as the number of channels is less than O(log n). Thus, in theory, multiple channels can improve network capacity significantly even with a small number of interfaces per node. However, in practice, many challenges have to be addressed before the capacity improvement can be realized. We present practical protocols for utilizing multiple channels that address many of these challenges. We also discuss our work on implementing selected protocols on a wireless testbed. The talk is based on joint research with graduate students Pradeep Kyasanur and Jungmin So.

**"CenWits: A Sensor Based Loosely Coupled Search and Rescue System Using Witnesses"**

CenWits is a new system for search and rescue of people in emergency situations in wilderness areas. It is comprised of (1) several mobile, in-situ sensors that are worn by people, (2) a small number access points that collect information from these sensors, and (3) GPS receivers and location points that provide location information to the sensors. A key feature of CenWits is that it does not require a connected sensor network for its operation, and does not treat each sensor as an individual sensor node. Instead, it makes a judicious use of the combined storage capability of sensors to filter, organize and store important information, combined battery power of sensors to ensure that the system remains operational for longer time periods, and intermittent network connectivity to propagate information to a processing center. CenWits uses a concept of witnesses to convey a person’s movement and location information to the outside world. In addition to search and rescue, CenWits can be used for a variety of other applications, including monitoring the movement of wildlife, and late-night, on-campus security. In this talk, I will describe the main motivation behind CenWits and present the details of CenWits design, including CenWits security issues. A prototype of CenWits has been implemented using Berkeley Mica2 motes. I will describe this implementation and report on the performance measured from it.

**"Design and Development of Secure and Robust Network Infrastructure for Critical Medical Applications: Achieving Medical Quality Care through Advanced IT"**

One of the defining trends of the 1990s has been the explosive growth of mobile devices and wireless technology. In the next decade, ubiquitous network access is expected to be the primary communication media. However, it has been widely believed that the mobility severely limits robustness and security in wireless communications. As a result, a high degree of reliability, security and performance has been become difficult to achieve. This in turn, has prevented high performance wireless networks from replacing traditional networks in critical or demanding applications particularly in the medical domain. Moreover, it can be argued that while various aspects of Information Technology (IT) have witnessed enormous advances, the process of integrating these IT advances into many domains has been slow. One of the domains in which the integration of IT has been particularly slow is the medical domain. In fact, integration of wireless technology and convenience of mobile devices is almost absent. This is due to a number of factors including the lack of a high degree of reliability, concerns about the security of wireless networks and the lack of complete compatibility between the various wireless technologies.

**"Wearable Patient Monitoring Application (EKG) for Wireless Sensor Networks"**

The goal of this project is to develop a resilient Electrocardiogram (EKG) device that can be integrated into a suite of wearable wireless sensors used for patient monitoring. The EKG sensor hardware involves a right-leg-driver (a noise-canceling pre-amplifier) cascaded with a signal amplifier. The hardware has been designed to be low-power, low-noise, and compact enough to be manufactured on a single integrated circuit. The sensor interfaces with a Telos tMote Sky sensor platform in order to send data using the IEEE 802.15 standard. The data would be collected at a base station and relayed to relevant destinations over existing networking solutions such as high-speed Ethernet. Digital Signal Processing would be carried out either at the server or the client, depending on the application.

**"Tracking and Routing in Medical Environment"**

Many routing protocols have been developed for wireless sensor networks, and each protocol has its own problems. In this presentation, we will discuss our tracking system and three different routing protocols. The tracking system includes 20 wireless micaZ motes. The idea for our system is simple: the beacon nodes broadcast its beacon messages, the mobile mote measure the signal strength from each beacon message

and estimates its location. Afterward, the mobile sends a packet containing the estimate location to the base station. Routing protocol stacks, such as MultihopRouter, TinyAODV, and Greedy Forwarding are used to deliver packets from source to the base station. Then, the base station will forward the packet to a computer (via UART) and the estimated location is displayed on the screen.

**"Learning-Based Approaches to Indoor Tracking"**

The tracking of people and objects in indoor environments remains a challenging problem with wireless technology. While GPS has offered accurate tracking capabilities outdoors, it is difficult to achieve the same level of accuracy with a tracking system inside a hospital or commercial building. Among other problems, indoor environments present barriers like walls and crowds of people which interfere with distance-measuring equipment. Recently, tracking systems, which use radio frequency signal strengths received from fixed wireless beacons, have been used to infer location in indoor environments. The goal of this project is to adapt machine learning algorithms to improve the accuracy of such systems. These algorithms train on samples of signal strength data collected at known locations and then attempt to predict new locations based on new observed data. Learning algorithms considered include variations of instance-based learners, decision trees, and artificial neural networks.

## SPEAKER BIOS

**Hesham H. Ali** is a Professor of Computer Science and an Associate Dean for Academic Affairs of the college of Information Science and Technology (IS&T), at the University of Nebraska at Omaha (UNO). He is also the deputy director for computational sciences of the Nebraska Informatics Center for Life Center (NICLS), and a member of Nebraska Center for Bio-security. He received his Ph.D. from the University of Nebraska-Lincoln in 1988, and his BS and MS from the University of Alexandria, in 1982 and 1985, respectively, all in computer science. He has published numerous articles in computer science including scheduling, distributed systems, wireless networks, and bioinformatics. He has also published two books in scheduling and graph algorithms. He leads the IT components of a number of joint bioinformatics projects between IT and bioscience researchers. He is currently serving as the PI or Co-PI of several projects funded by NSF, NIH and Nebraska Research Initiative (NRI) in the areas of wireless networks and bioinformatics. He has been leading a Bioinformatics Research Group at UNO that focuses on developing computational approaches used to identify and classify biological organisms, with the goal of complementing the current experimental approaches in predicting a wide range of events that range from potential virus outbreaks to bio-terrorism. He also leads a project with the goal of developing secure wireless infrastructure, funded by NSF.

**Eric Manley** received a B.S. degree in computer science from the University of Nebraska at Omaha in 2004. Currently, he is pursuing an M.S. degree in Computer Science and Engineering at the University of Nebraska-Lincoln. His research interests include security in wireless communications and localization in wireless sensor networks.

**Shivakant Mishra** is an associate professor in the Department of Computer Science at the University of Colorado, Boulder. He has been involved in the design, implementation, and evaluation of dependable, distributed computing systems for over 20 years. He has published more than 100 research articles in International journals and conferences. His current research is focused on building secure and intrusion-tolerant wireless sensor networks. Recent projects include design and implementation of a secure and intrusion-tolerant routing mechanism for wireless sensor networks, key management in wireless sensor networks, secure dynamic programming of wireless sensor networks, and developing countermeasures against traffic analysis attacks in wireless sensor networks. He is also working on the design and implementation of a search and rescue system called CenWits that uses wireless sensor network technology to locate people in emergency situations in wilderness areas. His research has been funded by NSF, AFOSR and Department of Defense.

**Nam Pham** received a B.S. degree in computer science from University of Nebraska at Omaha in 2005. He has been a Graduate Research Assistant with the Wireless Infrastructure for Networks of Distributed Sensors (WINDS) group, and is currently working toward the degree of M.S. in Computer Science, University of Nebraska at Omaha.

**Steve Taylor** graduated *cum laude* and with honors from Auburn University, Auburn, AL with a B.S. in Electrical Engineering. He is currently working toward the M.S. in Engineering at the University of Nebraska at Omaha. He has worked as an enterprise administrator (2000-2003) at IPO Development Corp and as a consultant with Nortek Network Solutions (2005). While studying at Auburn University, design projects he worked on included autonomous mobile robots (light-sensing and audio-driven), wireless antenna arrays, and aerodynamic plasma technologies.

**Nitin Vaidya** received the Ph.D. from the University of Massachusetts at Amherst. He is presently an Associate Professor of Electrical and Computer Engineering at the University of Illinois at Urbana-Champaign (UIUC). He has held visiting positions at Microsoft Research, Sun Microsystems and the Indian Institute of Technology-Bombay. His current research is in wireless networking and mobile computing. He has co-authored papers that received awards at the ACM MobiCom and Personal Wireless Communications (PWC) conferences. Nitin's research has been funded by various agencies, including the National Science Foundation, DARPA, Motorola, Microsoft Research and Sun Microsystems. Dr. Vaidya is a recipient of a CAREER award from the National Science Foundation. He has served on the committees of several conferences, including as program co-chair for 2003 ACM MobiCom and General Chair for 2001 ACM MobiHoc. He has served as an editor for several journals, and presently serves as the Editor-in-Chief for the IEEE Transactions on Mobile Computing. He is a senior member of the IEEE and a member of the ACM. For more information, please visit http://www.crhc.uiuc.edu/~nhv/.