

1st Annual

Iowa State University
Undergraduate
Research Symposium

April 11, 2007



SYMPOSIUM OVERVIEW

8:00-8:45 am	Registration and Refreshments	Pioneer Room, Memorial Union
8:45-9:00 am	Opening Remarks – Gene Takle , Interim Faculty Director, University Honors Program, and Elizabeth Hoffman , Executive Vice President and Provost, ISU	Pioneer Room, Memorial Union
9:15-10:30 am	Session I (<i>concurrent presentations in 4 rooms</i>) IA – SOCIAL SCIENCE & EDUCATION IB – BIOSYSTEMATICS & PATHOLOGY IC – ENGINEERING & COMPUTER TECHNOLOGY ID – COMPUTATIONAL THEORY & APPLICATIONS	Room 3505, Memorial Union Room 3538, Memorial Union Room 3534, Memorial Union Room 3558, Memorial Union
10:30-10:45 am	Break and Refreshments	
10:45 am-12:00 noon	Session II (<i>concurrent presentations in 5 rooms</i>) IIA – METEOROLOGY & ENVIRONMENTAL ANALYSIS IIB – EDUCATION & MOTOR/VISUALIZATION SKILLS IIC – STRESS RESPONSE, GENETICS, & PROCESSING IID – COMPUTER & NETWORK TECHNOLOGY IIE – SOCIAL SCIENCE & DESIGN	Room 3505, Memorial Union Room 3538, Memorial Union Room 3534, Memorial Union Room 3558, Memorial Union Room 3540, Memorial Union
12:15-1:30 pm	Closing Remarks - John Brighton , Vice President for Research and Economic Development, ISU and Luncheon for presenters, research mentors and invited guests	Great Hall, Memorial Union

A Message from the University Honors Program

Welcome to Iowa State University's First Annual Undergraduate Research Symposium! The Symposium is organized by the University Honors Program to provide undergraduates from all academic disciplines with the opportunity to share their research with the university community and other guests through oral presentation sessions. All Iowa State University undergraduates involved in research—both Honors and non-Honors students—were encouraged to present their work. The Symposium represents part of a larger effort of Iowa State University and its Honors Program to enhance, support, and celebrate undergraduate research activity. The 39 students presenting research results at this 2007 symposium represent all of the Colleges at ISU with undergraduate programs. We hope that you enjoy this inaugural Undergraduate Research Symposium.

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Acknowledgements

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Jessica Orlofske, Carolyn Payne, Greg Phillips, Christopher Pilson, Raj Raman, Karl Schindel,
Daniel Sordelet, Bennett Swiniarski, Robert Weber, and Susan Yager

PROGRAM – Session I

CONCURRENT SESSIONS I.A, I.B, I.C, I.D

SESSION I.A

SOCIAL SCIENCE & EDUCATION

9:15-10:30 am

Memorial Union, Rm. 3505

Moderator: Hongli Hennessy, Center for Agricultural and Rural Development

I.A.1 Examining the Role of Female Traditional Leaders in Development Partnerships: The Queen Mothers in Manya Krobo, Ghana

KARIN BRANDT, Political Science and International Studies, College of Liberal Arts and Sciences
(Mentor: Robert Mazur)

I.A.2 Reeducation Camps and the Southern Vietnamese Veterans' Experiences

LAN PHUNG, French and Spanish, College of Liberal Arts and Sciences (Mentor: Eugenio Matibag)

I.A.3 American Midwifery: A Study of Two Iowa Midwives

DAWNIECE TRUMBO, Marketing, College of Business (Mentor: Lori Patton)

I.A.4 Art Smarts: Invigorating Education through the Integration of the Arts

MARIA WITTE, Graphic Design, College of Design (Mentor: Debra Satterfield)

SESSION I.B

BIOSYSTEMATICS & PATHOLOGY

9:15-10:30 am

Memorial Union, Rm. 3538

Moderator: Greg Phillips, Dept. of Veterinary Microbiology & Preventive Medicine

I.B.1 Genetic Relationships between Nicaraguan and North American Freshwater Mussels

STEPHEN ROBINSON, Biochemistry, College of Liberal Arts and Sciences (Mentor: Kevin Roe)

I.B.2 Production of Equine Plasma Containing High Neutralizing Antibody Titers to Porcine Reproductive and Respiratory Syndrome Virus (PRRSV)

MARK MOGLER, Microbiology, College of Agriculture (Mentor: D.L. Hank Harris)

I.B.3 Assessment of *Bacillus Subtilis* PB6 in Horses

KIRSTY HUSBY, Animal Science, College of Agriculture (Mentor: Peggy Miller)

I.B.4 A Taxonomic Checklist of the Mosquitoes of Iowa

BRENDAN DUNPHY, Zoology, College of Liberal Arts and Sciences, and Animal Ecology and Entomology, College of Agriculture (Mentor: Lyric Bartholomay)

SESSION I.C

ENGINEERING & COMPUTER TECHNOLOGY

9:15-10:30 am

Memorial Union, Rm. 3534

Moderator: Robert Weber, Dept. of Electrical and Computer Engineering

I.C.1 Microprocessor-Powered Motor Control System

MICHAEL PETERSON, Meteorology and Spanish, College of Liberal Arts and Sciences (Mentors: Brian Hornbuckle and Matt Nelson)

I.C.2 Microcantilever Biosensor Calibration

JANICE MARQUARDT, Mechanical Engineering, College of Engineering, and Communication Studies, College of Liberal Arts and Sciences (Mentor: Pranav Shrotriya)

I.C.3 Quality Control Software System for Colonoscopy

BANCHA DOUNGRATANAEX-CHAI, Computer Science, College of Liberal Art and Sciences (Mentors: Johnny Wong and Wallapak Tavanapong)

I.C.4 Fairness in Wireless Mesh Networks

NISHANTH GADDAM, Electrical and Computer Engineering, College of Engineering (Mentor: Arun Somani)

PROGRAM – Session I (*continued*)

SESSION I.D COMPUTATIONAL THEORY & APPLICATIONS

Memorial Union, Rm. 3558

9:15-10:30 am

Moderator: Raj Raman, Dept. of Agricultural and Biosystems Engineering

I.D.1 Evolution of Cooperative Agents through Genetic Programming

JACE OTTING, Computer Science, College of Liberal Arts and Sciences; AND MICHAEL ROBERTS, Computer Science, College of Liberal Arts and Sciences (Mentor: Dimitris Margaritis)

I.D.2 Implementation of Distributed Learning Algorithms using Statistical Queries

MATTHEW MILLER, Computer Science, College of Liberal Arts and Sciences (Mentor: Vasant Honavar)

I.D.3 Survey of Qualitative Matrix Stability

KEITH COLEMAN, Mechanical Engineering, College of Engineering, and Mathematics, College of Liberal Arts and Sciences (Mentor: Leslie Hogben)

I.D.4 Studying the Binding of Silver and Gold Cations to Ethene through Computational Chemistry

NINA BARNETT, Chemistry, College of Liberal Arts and Sciences (Mentor: Mark Gordon)

PROGRAM – Session II

CONCURRENT SESSIONS II.A, II.B, II.C, II.D, II.E

SESSION II.A METEOROLOGY & ENVIRONMENTAL ANALYSIS

Memorial Union, Rm. 3505

10:45 am-12:00 noon

Moderator: Manimaran Govindarasu, Dept. of Electrical and Computer Engineering

II.A.1 Coherence of Rainfall Propagation as Simulated in the Weather Research and Forecasting Model Using Two Different Convective Schemes

ANDREW ANSORGE, Meteorology, College of Liberal Arts and Sciences (Mentors: Adam Clark and James Correia, Jr.)

II.A.2 Effectiveness of Conservation Practices on Water Quality: A State-Level Analysis at the Watershed Scale

JOSHUA PARCEL, Economics, College of Liberal Arts and Science, and Accounting, College of Business (Mentor: Hongli Hennessy)

II.A.3 Effects of the Acid Rain Program on Power Plants: Case Studies about Power Production and Fuel Purchase in Iowa

SULIANET ORTIZ, Electrical Engineering, College of Engineering (Mentor: James McCalley)

II.A.4 Tornado, Hail, and Wind Reports in Comparison to Upper-Level Linear Jet Streak Quadrants

KAJ JOHNSON-O'MARA, Meteorology, College of Liberal Arts and Sciences (Mentors: William Gallus, Jr. and Adam Clark)

SESSION II.B EDUCATION & MOTOR/VISUALIZATION SKILLS

Memorial Union, Rm. 3538

10:45 am -12:00 noon

Moderator: Jessica Orlofske, Dept. of Ecology, Evolution, and Organismal Biology

II.B.1 Effect of Support Surface on Walking Stability in Healthy Young Adults

NICOLE LOKENVITZ, Health and Human Performance, College of Human Sciences (Mentor: Ann Smiley-Oyen)

II.B.2 Touch/Visual 3-D Interaction with Superquadric Shapes

TYLER GUSTAFSON, Computer Engineering, College of Engineering (Mentor: Chris Harding)

PROGRAM – Session II (*continued*)

II.B.3 **Easing the Pain of Calculus III Students: Visualizing in Three Dimensions**

JASON BOGGESS, Mechanical Engineering, College of Engineering (Mentor: Wolfgang Kliemann)

II.B.4 **Gender and Career Assessment: Methodological Effects in Interest Measures**

WYNDOLYN ALLISON, Psychology, College of Liberal Arts and Sciences; AND HEATH SCHECHINGER, Psychology, College of Liberal Arts and Sciences (Mentor: Patrick Armstrong)

SESSION II.C **STRESS RESPONSE, GENETICS, & PROCESSING**

Memorial Union, Rm. 3534

10:45 am -12:00 noon

Moderator: Joan Cunnick, Dept. of Animal Science

II.C.1 **Stress Reactivity in Overweight and Normal Weight 8-18 Year Old Boys**

YOLANDA COIL, Health and Human Performance, College of Human Sciences (Mentor: Joey Eisenmann)

II.C.2 **Analysis of Transcriptional Changes of *Mycoplasma hyopneumoniae* of High and Low Culture Passage Number**

MICHAEL ONEAL, Genetics, College of Liberal Arts and Sciences (Mentors: Melissa Madsen and F. Chris Minion)

II.C.3 **Examining Oxidative Stress Response in *Mycoplasma hyopneumoniae* Using Microarrays**

ERIN SCHAFER, Genetics, College of Agriculture (Mentor: F. Chris Minion)

II.C.4 **Rheological Properties of Cream and Soy Protein Isolate Produced by Aqueous Extraction Processing of Soybean Oil**

MELANIE GOERING, Chemical Engineering, College of Engineering (Mentor: Stephanie Jung)

SESSION II.D **COMPUTER & NETWORK TECHNOLOGY**

Memorial Union, Rm. 3558

10:45 am -12:00 noon

Moderator: Mark Hargrove, Dept. of Biochemistry, Biophysics, & Molecular Biology

II.D.1 **Gossip-Based Algorithms for Distributed Sensor Networks**

JOSEPH SLOAN, Computer Engineering and Electrical Engineering, College of Engineering (Mentor: Srikanta Tirthapura)

II.D.2 **Smart Home**

GUILLERMO HERNANDEZ, Computer Engineering, College of Engineering (Mentor: Johnny Wong)

II.D.3 **Achieving a Scalable and Practical Implementation of a Wireless Sensor Network**

KYLE BYERLY, Computer Engineering, College of Engineering, and Mathematics, College of Liberal Arts and Sciences; AND SHANE GRIFFITH, Computer Engineering, College of Engineering (Mentor: Daji Qiao)

II.D.4 **Touch Sensitive Table for Command and Control Applications in Virtual Reality**

THOMAS DOHSE, Computer Science, College of Liberal Arts and Sciences (Mentor: Derrick Parkhurst)

SESSION II.E **SOCIAL SCIENCE & DESIGN**

Memorial Union, Rm. 3540

10:45 am -12:00 noon

Moderator: Leslie Hogben, Dept. of Mathematics

II.E.1 **Manual of Practice for Roadway Maintenance Workers**

CHRISTIAN SAX, Civil Engineering, College of Engineering (Mentor: Duane Smith)

II.E.2 **Role of State Policies on Net Migration and Population Change**

EMILY KNUTSON, Economics, College of Liberal Arts and Sciences (Mentor: Daniel Otto)

II.E.3 **Digital Art on Campus Project – A Virtual Art Tour**

GRANT THOMPSON, Horticulture, College of Agriculture, and Landscape Architecture, College of Design (Mentor: Allison Sheridan)

II.E.4 **Urban Overflow: The Gentrification of a Prominent Denver Neighborhood**

LISA WILLMAN, Architecture, College of Design, and Spanish and Psychology, College of Liberal Arts and Sciences (Mentor: Mikesch Muecke)

ABSTRACTS

Gender and Career Assessment: Methodological Effects in Interest Measures

Wyndolyn Allison and Heath Schechinger (Session II.B.4)

Effective research must be conducted to ensure that career-related assessments being used to give direction to students preparing for their future are effective and accurate representations of students' interests and career aspirations. A substantial body of research has emerged regarding the interest assessment process, but there has been relatively little examination of how methodological issues related to the use of self-report measures may lead to potential gender and structural biases in assessment results. To evaluate methodological effects, students were given three types of vocational interest assessments: (1) Three sets of cards with 60 different occupations in each set, where students were asked to sort them in the form of a normal distribution, ranging from ones that they strongly disliked to ones that they strongly liked; (2) a survey instrument with 180 career-related activities, where students were asked to indicate how much they would like to perform the activity using a 5-point Likert-type response format; and (3) a survey instrument with the 180 occupations from the card sorting task using the response format from the activity survey. With these results, there is the potential to make improvements to current interest assessment tools in order to better assist clients with career-related decisions.

Coherence of Rainfall Propagation as Simulated in the Weather Research and Forecasting Model Using Two Different Convective Schemes

Andrew Ansonge (Session II.A.1)

Numerical Weather Prediction (NWP) models continue to make advances and improvements to weather forecasts; however, convective precipitation remains poorly forecasted in mesoscale models. This study examines two convective schemes and whether one performs better in mostly strongly forced cases over a two-month period where convective propagating precipitation occurred. Observations were compared to precipitation forecasts for the 0-48 hour forecast generated by the Weather Research and Forecasting model using the Betts-Miller-Janjic and Kain-Fristch convective schemes. Propagation speed, beginning and ending longitude, beginning and ending time were measured by using Hovmöller diagrams for both convective schemes and observations. Results show that both the BMJ and KF have longer duration when compared to observations and are slower to propagate when compared to observations. However, both the BMJ and KF are close to observed data for beginning and ending longitude, with the difference being no greater than 0.4°. Examination of the diurnal averaged Hovmöller diagrams revealed that the BMJ convective precipitation was significantly less than the KF. The statistics for hits and misses will be compared to examine if the distributions are significantly different which would discriminate between a good and bad forecast.

Studying the Binding of Silver and Gold Cations to Ethene through Computational Chemistry

Nina Barnett (Session I.D.4)

It has been discovered that while bulk-phase silver and gold is chemically inert, nanoscale particles of these transition metals are catalytically active towards alkenes. A possible first step in the catalysis is the formation of metal-alkene complexes. However, most research has focused on Ag^+ or Au^+ propene complexes. Binding energies of Ag^+ to ethene have been explored experimentally, but little done computationally. New correlation consistent basis sets for Ag and Au have overcome relativistic effects problems. Thus the basis sets could be applied to the cation-ethene complexes to obtain accurate theoretical results. Binding energies of $\text{Ag}(\text{C}_2\text{H}_4)_n^+$ ($n = 1, 2, 3$) and $\text{Au}(\text{C}_2\text{H}_4)^+$ were calculated at the Hartree-Fock, MP2 and CCSD(T) levels of theory. The HF and correlation energies were extrapolated to the complete basis set limit, yielding the binding energy. While the MP2 level gives worsening agreement with experimental results as the basis sets improve, CCSD(T) calculations provide better agreement. The complete basis set limit binding energy of $\text{Ag}(\text{C}_2\text{H}_4)^+$ agrees with experiment, however the two and three ligand systems are 2-3 kcal/mol higher in energy. An analysis of the Ag-ethene interaction energy shows that bonding is due to charge transfer. This is in agreement with the Dewar-Chatt-Duncanson model of alkene-TM interaction.

Easing the Pain of Calculus III Students: Visualizing in Three Dimensions

Jason Boggess (Session II.B.3)

One of the most important aspects of doing math is being able to visualize what is going on in the calculations. As students in Math 265, it occurred to us early on that visualizing lines, planes, and surfaces in multiple dimensions was fairly challenging. To help minimize that challenge, I wanted to design a tool to help Math 265 students to quickly and easily visualize mathematical curves and surfaces in three dimensions. The result was a program written in C# using the managed DirectX API. It is a simple visualization utility that works under the same syntax as a graphing calculator. It first graphs a 3D shape, then allows the user to rotate the graph, and then can even animate it using two independent variables. It also incorporates common functions such as trig, and log functions, and it can graph on all major coordinate systems to account for multifaceted problems. Soon we will have a polished version ready for student use.

Examining the Role of Female Traditional Leaders in Development Partnerships: The Queen Mothers in Many Krobo, Ghana

Karin Brandt (Session I.A.1)

Development projects involving partnerships among local communities, non-governmental organizations (NGO), and government agencies that foster high levels of community participation tend to have more positive and sustainable development outcomes. Key components include local knowledge, peer mentoring and evaluation, transparency, and capacity building. Projects which build upon these factors through partnership with traditional institutions empower community members to take ownership of development initiatives; and more importantly, to progressively continue management after the donor departs. A case study from rural Ghana, West Africa analyzes the potential effectiveness of partnerships with female traditional leaders as a basis for understanding components that better facilitate effective sustainable livelihoods.

Achieving a Scalable and Practical Implementation of a Wireless Sensor Network

Kyle Byerly and Shane Griffith (Session II.D.3)

Wireless sensor networks (WSN) composed of large numbers of small sensors with wireless capabilities are being tested for a wide variety of applications. Commercial applications, such as building data acquisition, energy management, or even surveillance can benefit a great deal from research in WSN areas. The use of WSNs in the commercial industry is greatly increasing, estimated to be a \$7 billion market by 2010, although the difficulty of creating and maintaining a WSN has also greatly increased. The newfound complexity of implementing such network solutions can only lead to a higher cost-benefit ratio. We present the SmartHome system, a four-tier plug and play WSN that can be set up and fully operable within minutes. The system's functionality is not sacrificed for the ease of implementation. The system takes advantage of sensor readings to keep a record of building energy trends, while also informing users of critical readings. Ideas behind the developed system will be introduced, with technical details of the network operation following. Lastly, ideas fostering the movement of WSNs to the market will be discussed.

Stress Reactivity in Overweight and Normal Weight 8-18 Year Old Boys

Yolanda Coil (Session II.C.1)

Pediatric obesity has dramatically increased over the last few decades. Childhood obesity has psychological and physical costs such as cardiovascular disease risk factors. Previous research shows relationships between stress and the Metabolic Syndrome (insulin resistance, abdominal obesity, dyslipidemia, and hypertension) with emphasis on psychological and physical stress with adult populations. Several factors including diet and exercise determine dispositions for these conditions. The purpose of this research is to examine cardiovascular reactivity and recovery to physical stress in school-aged boys by level of body fatness. Thirty-eight male subjects ages 8 to 18 were used in the data analysis. Cardiovascular measures (heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure) were taken at baseline, stress tasks (submaximal handgrip and forehead cold pressor) and during recovery 5, 20, and 30 minutes post stress tasks. Weight, height, waist circumference and body fat percent were measured preceding the challenges and subjects then stratified into three groups by level of fatness (lean, normal, overweight) Stress tasks elicited increases in heart rate and blood pressures in all subjects. The results showed no significant cardiovascular response differences by level of fatness.

The overweight boys did show some reactivity differences in systolic and diastolic blood pressure and mean arterial pressure than the other two groups.

Survey of Qualitative Matrix Stability

Keith Coleman (Session I.D.3)

Systems of differential equations describe the behavior of dynamical systems in many areas of application, including biology, chemistry, engineering, and economics. Linearization at an equilibrium point leads to the study of matrix stability. A sign pattern matrix is a matrix whose entries are elements of $\{0, +, -\}$ and is used to describe a family of real matrices whose signs match the pattern. Qualitative matrix theory is the study of properties of the family of matrices described by the sign pattern and arose from applications to economics. This presentation will discuss qualitative stability and its applications. A complete analysis for systems of size 2 using a theoretical stability test will be presented. Approaches for larger sizes will be discussed.

Touch Sensitive Table for Command and Control Applications in Virtual Reality

Thomas Dohse (Session II.D.4)

Ongoing research at the Virtual Reality Application Center is focused on the development of command and control applications. The final goal of this research is to create a table-top interface for viewing and interacting with military conflict area visualizations. The project has yielded a touch sensitive table which acts as both the screen and user interface and allows users to directly interact with on screen objects. One of the key goals of the project is to develop an interface which is intuitive and effective for users of varying levels of experience. Using a rear-projection screen mounted on acrylic as a table surface and a technique known as frustrated total internal reflection, the table can register and track multiple finger touch points simultaneously by capturing infrared light reflected out of the acrylic at points where a user touches. The system tracks these points using an infrared camera and an open-source computer vision library we developed. We also developed an extensible open-source architecture to recognize gestures. This will allow other developers to easily utilize the touch table for their own applications. The system also has the benefit of allowing multiple users to simultaneously control and view the visualizations in a shared workspace.

Quality Control Software System for Colonoscopy

Bancha Doungratanaex-chai (Session I.C.3)

Colonoscopy is an endoscopic technique that allows a physician to inspect the inside of human's colon and perform therapeutic operations such as polyp removal. Colonoscopy has become the preferred screening modality for prevention of colorectal cancer—the second leading cause of cancer-related deaths in the US, claiming more than 50,000 lives in 2005. However, recent data suggest that there is a significant miss-rate for the detection of even large polyps and cancers. Large prospective studies or preventive measures related to the study of miss-rates were thought as the impossible task since automated tools with the ability to objectively measure the quality of a colonoscopic procedure do not exist. Now, the new software system can make the impossible possible. The effectiveness of colonoscopy in prevention of colorectal cancers depends on the quality of inspection of the colon. In general, the quality can be evaluated in terms of the screening time and the thoroughness of the inspection. EndoMetric aims to develop a novel software system that: 1) transparently captures video signals generated during colonoscopy; 2) automatically derives quality measures that reflect the quality of the examination of the colon; and 3) generates an electronic report in a standard interoperable format.

A Taxonomic Checklist of the Mosquitoes of Iowa

Brendan Dunphy (Session I.B.4)

Since the 1960's, the Medical Entomology Laboratory at Iowa State University has conducted a surveillance program to monitor the activity of mosquitoes and mosquito-borne viruses in Iowa. A single comprehensive report on the species in the state has not been compiled since an Iowa State University extension publication produced in 1969. The goal of this project is to catalog every mosquito species that has ever been recorded in Iowa with particular emphasis on biological characteristics that might facilitate disease transmission. In order to build a truly comprehensive database, we collated 30+ years of raw data from Iowa mosquito surveillance. These data provide insight into mosquito seasonality, distribution,

abundance, infection status, etc. These data were supplemented with an extensive review of the primary literature. Data were entered into Microsoft Access, a relational database system. It is anticipated that this comprehensive database will result in a publication that provides a taxonomic checklist of the mosquitoes of Iowa (as of 2006) that includes spatio-temporal distributions and an indication of the potential for each species to transmit diseases.

Fairness in Wireless Mesh Networks

Nishanth Gaddam (Session I.C.4)

Wireless Mesh Network (WMN) is a dynamically self-organized and self-configured setup with the nodes automatically establishing an ad-hoc network and mesh connectivity as the backbone. Fairness in accessing channel resources becomes critical in any shared-medium. In multi-hop networks, inherent conflict exists between achieving fairness and maximizing channel resource utilization. Incorporating multi-hop fairness among flows by removing spatial bias is the issue discussed in this work. In the proposed model, multiple priorities need to be satisfied before allotting a channel to any node (Mesh Router) for its transmission to the gate way. Each node in the network keeps track of all the ongoing transmissions in the radius of Transmission Zone (TZone). It maintains a flowchart consisting of all the flow information in that zone. Multiple Contending Flows (MCFs) are identified and given less priority since they reduce the overall throughput of the system. To account for distant nodes a field called 'HC' (Hop Count) is included in the control packet. A separate field called 'NRC' (Number of Requests per Channel in certain time interval) is also included to identify hot spots in the system and dynamically allocate channel resources. Based on all these parameters a value is calculated which is exchanged regularly among neighbor nodes and BW is shared accordingly.

Rheological Properties of Cream and Soy Protein Isolate Produced by Aqueous Extraction Processing of Soybean Oil

Melanie Goering (Session II.C.4)

Soybean oil is currently extracted using hexane, which poses a number of safety and environmental concerns. Aqueous Extraction Processing (AEP) shows promise as an alternative to hexane extraction. AEP uses water instead of hexane as the medium for extraction. Extrusion and high pressure processing (HPP) are potential mechanical methods for pretreatment of soybeans before AEP. After mechanical treatment of the soybeans, AEP is performed with or without an enzyme to evaluate the ability of the enzyme to increase oil extractability. Two products of aqueous extraction are cream and skim milk. The skim milk is high in soy protein which can be recovered to obtain soy protein isolate (SPI). The rheological properties of SPI indicate its functionality in food systems, while those of the cream indicate the stability of the cream. The rheological properties of the cream and SPI were analyzed using a rheometer. The viscosities and model parameters of the samples were calculated using the power law model. Results indicated that cream samples extracted using enzymatic treatment were less viscous than samples which had not undergone enzymatic extraction. Furthermore, SPI samples which had undergone high pressure processing had a higher viscosity than those samples that had been extruded.

Shane Griffith (see K. Byerly and S. Griffith above)

Touch/Visual 3-D Interaction with Superquadric Shapes

Tyler Gustafson (Session II.B.2)

Our research involves interacting with different types of parametric shapes (such as ellipsoids) via a haptic (touch sensitive) device call a Phantom. The phantom allows for the creation of virtual objects that simulate some qualities of real objects: hardness, texture, friction, and ability to be deformed. The user interacts with these virtual objects via a stylus attached to the phantom. The phantom's motors produces a force that makes users believe that they are interacting with a three-dimensional object. The main focus has been around superquadrics. Superquadrics are a family of mathematically defined 3D objects that can take many different shapes, according to its base parameters. These base parameters can be manipulated to morph a superquadric into a whole family of related shapes. Our research aims to create a prototype application that would allow a user to not only see the superquadric 3-D shape but also feel its properties. The user can also gain insight into the nature of superquadrics by changing (morphing) its shape in real time via several sliders. This research could be useful to help to teach the concept of superquadric shapes to students with visual impairments.

Smart Home

Guillermo Hernandez (Session II.D.2)

A smart home is a house that is equipped with specialized equipment that allows the automation of daily tasks in order to increase the resident's quality of life. At Iowa State University, the Smart Home project aims to help the elderly and those with special needs by finding novel ways to integrate technology into their homes. To achieve this goal we need to incorporate a myriad of systems that all work as one cohesive unit. As a result the Smart Home can provide the targeted audience a greater feeling of independence by assisting them in their everyday lives. This in turn will alleviate the dependency on caregivers and increase the potential for in-home aging. This area of research is a rapidly growing field that is motivated by predictions of shortage in health care givers and increases in elderly population in the upcoming years.

Assessment of Bacillus Subtilis PB6 in Horses

Kirsty Husby (Session I.B.3)

The bacteria *Clostridium perfringens* and *Clostridium difficile* have been associated with colic and diarrhea in horses. *Bacillus Subtilis* PB6 is a non-pathogenic bacterium that promotes the growth and maintenance of healthy intestinal microflora and inhibits clostridial growth. This study involves three parts: 1) All horses owned by Iowa State University will be cultured for *Clostridium perfringens* and *Clostridium difficile*. 2) Eight horses will be fed a concentrate diet that includes a top dressing of *Bacillus Subtilis* PB6. Fecal samples will be obtained weekly and tested for *Bacillus Subtilis* PB6 and levels of normal intestinal flora. 3) Foals born during 2007 at ISU will receive a treatment of *Bacillus Subtilis* PB6 for the first seven days of age. Both mare and foal will be monitored for health status for thirty days. Dietary supplementation with *Bacillus Subtilis* PB6 may be beneficial to horse owners and veterinarians concerned about colitis and infectious diarrhea related to *Clostridium perfringens* and *Clostridium difficile* infections.

Tornado, Hail, and Wind Reports in Comparison to Upper-Level Linear Jet Streak Quadrants

Kaj Johnson-O'Mara (Session II.A.4)

As a Meteorologist, this research was carried out in hopes to increase the accuracy of severe weather forecasting. A similar previous study focused solely on tornadoes whereas this study focused on tornadoes, hail and wind. Forecasting severe weather is oftentimes a challenge, and the more a forecaster knows, the higher their confidence level. This study focuses on the quadrants of wind maximums within the jet stream (known as jet streaks) and their relationship to severe weather reports. Surface severe weather reports were analyzed and overlaid onto upper level wind maps where jet streak quadrants were defined by hand within a computer program. The goal of this study was to test the quadrants of jet streaks in hopes to discover a potentially useful forecasting tool for severe weather. In total, 1,134 jet streaks were analyzed encompassing 27,826 storm reports. It was found that the left front quadrant of the jet streak is favored for tornadoes and hail while the right rear quadrant is favored for strong winds. When looking at jet streak orientation, around 70% of all storm reports are noted when the winds in the jet streak have a southerly component.

Role of State Policies on Net Migration and Population Change

Emily Knutson (Session II.E.2)

The role of state policies on affecting net migration and population change for a set of upper Midwest counties is being studied using novel economic research methods. Our study focuses on the role of cross-state differences affecting migration rates for border counties in 9 Midwestern states. This quasi-experimental design approach can control for climate and quality of life factors in the migration decision because counties that are contiguous, but in different states, should have very similar environmental conditions and locational characteristics. A person who is moving to the region would be indifferent on environmental conditions, but more concerned with state policy issues. In our procedure, observations consist of comparing performance of pairs of county based on being contiguous across state boundaries. Because county borders seldom coincide across state lines, weights are developed and used to allocate relative performance in the paired comparisons. An econometric model is developed and used to analyze relative rates of net migration and population growth against several economic and policy variables such as tax rates, wage rates and government payments.

Effect of Support Surface on Walking Stability in Healthy Young Adults

Nicole Lokenvitz (Session II.B.1)

Motivation for this research comes from my background of living in the Midwest and from previous gait studies I have helped with in the Motor Control and Learning Research Laboratory. Each winter we are subjected to walking on ice and I became curious to see if the accelerometers we were using could detect changes in gait while walking on ice. Several recent studies have been published using harmonic analyses of trunk acceleration patterns to quantify the overall smoothness and coordination of the walking pattern. The main purpose of this study is to further validate the use of harmonic ratios as a measure of walking balance. We will compare the harmonic ratios of healthy young adults during ordinary walking and balance-challenging situations. If harmonic ratios quantify walking balance, and specifically stability, we expect lower harmonic ratios in the conditions that challenge the subjects' balance. An accelerometer placed at the waist was used to measure differences in gait while the subjects walked at their preferred pace for two trials in each of the four conditions. Harmonic ratios will be calculated based on a Fourier analysis of the acceleration signals for each stride. In addition, stride length, velocity, and cadence will be calculated.

Microcantilever Biosensor Calibration

Janice Marquardt (Session I.C.2)

Microcantilever sensors have far-reaching applications in the fields of security, medicine, and many other fields to detect small quantities of substances such as chemicals or proteins. Microcantilever sensors, measuring on the order of 450 μm long and 2 μm thick, use the bending reaction from surface stress changes to detect very small quantities of specific substances. In present work, experiments were conducted to calibrate a specific set of sensors based on a varying thermal input. Detection and thermal changes were both attained through use of a variable power laser, and the data was processed using known equations to calibrate the system. As a result of these experiments, the sensor response was characterized. This characterized sensor will be used in future experiments for the detection of the drug cocaine and the coagulation protein thrombin.

Implementation of Distributed Learning Algorithms using Statistical Queries

Matthew Miller (Session I.D.2)

There exists a growing need for practical data mining techniques for very large data sets. Several emerging data-rich scientific fields could benefit from the application of standard machine learning algorithms to their data. However, current machine learning software typically requires the entire data set to be cached into memory, which is often impractical or impossible given size and sometimes privacy constraints. Caragea, Silvescu and Honavar recently published a result showing that a large set of standard machine learning algorithms could be altered so as not to need direct access to the data. Instead, they could be trained based on statistical information about the data, such as counts. These statistics can be obtained through remote database queries. The purpose of this research is to implement this solution in a practical, usable way. We built a machine learning software package capable of querying an SQL database, and re-implemented a standard machine learning algorithm to learn from statistics obtained through queries. The classifier was trained on a benchmark data set, and its prediction accuracy was compared to a popular open source implementation of the same algorithm. The two performed identically, however our implementation did not have to load the data set into memory.

Production of Equine Plasma Containing High Neutralizing Antibody Titers to Porcine Reproductive and Respiratory Syndrome Virus (PRRSV)

Mark Mogler (Session I.B.2)

Previous studies have indicated that passive immunization of pigs with hyperimmune swine plasma can confer complete or partial protection to virulent Porcine Reproductive and Respiratory Syndrome Virus (PRRSV) challenge. While horses historically have been used to raise large volumes of antibody to different organisms and toxins, there is currently no published data regarding the inoculation of horses with live PRRSV. The objective of our research was to produce high-titer antiserum in horses which could be used to passively immunize pigs for prevention of PRRS. Two horses were inoculated with four different live PRRSV strains by intramuscular injection. Serum was taken at various times after each inoculation. Antibody response was determined by fluorescent focus neutralization (FFN) against one of the strains used. Horses did not become febrile or develop other clinical signs of disease during the study, and viremia was not detected.

FFN titers increased from <1:4 initially to 1:256. These results indicate that horses are able to produce high neutralizing antibody titers to PRRSV following inoculation with live virus.

Analysis of Transcriptional Changes of Mycoplasma hyopneumoniae of High and Low Culture Passage Number

Michael Oneal (Session II.C.2)

Mycoplasma hyopneumoniae, the pathogen responsible for swine enzootic pneumonia, is responsible for millions of dollars of economic loss to swine farmers worldwide. However, study of the pathogen in the laboratory has been difficult due to the fastidious media requirements of the organism and loss of pathogenicity as the organism adapts to liquid media. To study what, if any, transcriptional changes occur during this adaptation, RNA from *Mycoplasma hyopneumoniae* strain 232 was collected from cultures that had been passaged in Friis media four and fifty-four times. The high-passage and low-passage RNA samples were converted to cDNA, coupled to a fluorescent probe, and compared using microarrays containing 91% (632/691 genes) of the *Mycoplasma* genome. Comparisons were by T-tests for significant difference between the fluorescence of the low and high culture passage cDNA. These differences indicate differences in RNA levels, therefore transcription, at the time of harvest. Statistically significant differences in transcription were found in genes for DNA repair, regulatory factors, and cell membrane-associated proteins. However, the actual differences between them were less than 2-fold, indicating very minor transcriptional changes are occurring. Future directions include characterization of hypothetical proteins, and analysis of transcriptional and post-transcriptional changes in the organism.

Effects of the Acid Rain Program on Power Plants: Case Studies about Power Production and Fuel Purchase in Iowa

Sulianet Ortiz (Session II.A.3)

The United States Clean Air Act Amendments (CAAA) of 1970 and 1990 are attempts to reduce gas emissions in order to handle air quality problems in the United States. In the 1980s sulfur dioxide and nitrogen oxides were of high national concern; their emission into the atmosphere is known to be a source of acid rain. In order to diminish the environmental threats posed by acid rain, the Title IV of the 1990 CAAA established the acid rain program. The program sets a limit on the overall annual emissions by implementing a market-based cap-and-trade method to control sulfur dioxide emissions produced by coal-burning power plants. In this study the Title IV of the 1990 CAAA will be considered in order to determine its influence and effects on electric generating units in Iowa. It is believed the emission constraints influence the movement of electric energy which begins with coal mining, follows with coal transportation, continues with coal burning at generating units, and ends with electricity transportation to the users through the power grid. This project attempts to capture the acid rain program's influence on power production and fuel purchase in Iowa and identify the mechanism(s) through which this influence is exerted.

Evolution of Cooperative Agents through Genetic Programming

Jace Otting and **Michael Roberts** (Session I.D.1)

We seek to investigate the use of genetic programming to design systems of cooperative agents. This work is chiefly motivated by two areas of computer science research: genetic programming (a subclass of genetic algorithms) and multi-agent systems. Genetic algorithms apply principles of Darwinian evolution (fitness-based selection, mutation, and recombination) to solve difficult computational problems involving optimization. Multi-agent systems are an area of research that attempts to solve problems using collections of autonomous agents, each operating with a limited viewpoint. Our project combines these two methods to the example problem of food collection in a simulated ant colony. A solution to this problem would demonstrate the "emerging behavior" of a collection of agents that is produced by the simple behaviors of many single agents. We will design a computer program to simulate an ant colony whose goal is to collect all food in the environment. Simulated ants will be driven by programs evolved using genetic programming. The colony's fitness will be judged by the amount of food collected in within a given time limit. This project represents a small step towards automatically programming multi-agent systems. Future work includes examining other programming language constructs and which genetic operators are most successful.

Effectiveness of Conservation Practices on Water Quality: A State-Level Analysis at the Watershed Scale

Joshua Parcel (Session II.A.2)

Over the last two decades, conservation on cropland has attracted tremendous amount of attention and various conservation practices have been adopted on American farmland. However, our understanding is incomplete as to the extent of the use of many of these practices and their effectiveness on the environment. Knowledge on these issues is badly needed when the society decides how much more, if any, we must do to improve environmental quality to a desired level. We try to provide some insights into the issues by examining what conservation practices are currently in place in Iowa, what is their coverage, and what is the cost of these practices? County-level data was gathered for some major conservation practices with regard to their costs and coverage. A database of county average cost is established for terraces, grass waterways, land retirement, sediment control basins, grade stabilization structures, filter strips, wetland restoration, riparian buffers, contour buffer strips, and nutrient management. We estimated statewide cumulative annual cost was about \$435 million for seven major conservation practices.

Microprocessor-Powered Motor Control System

Michael Peterson (Session I.C.1)

On an otherwise nice afternoon in the Midwest, plumes of air rising from the warm surface that would typically produce nothing more than mere cumulus clouds develop into storm systems due to the added moisture of evapotranspiration. However, there is no accurate way to measure how much of an impact evapotranspiration will have on a storm. Dr. Brian Hornbuckle and his team are working on an instrument that will be able to measure the amount of microwave radiation emitted from a typical field in the Midwest which can be related to the moisture content of the field. A crucial part of this project is the ability to measure the inclination of the apparatus. The solution is a microprocessor programmed to talk to the computer, motor control, and inclinometer versatile enough for field work, yet reliable enough to function were something to go wrong. The system also has to log the angle measurements on the laptop for later analysis. With the right tool, the radiometer team will be able to collect and analyze the data, which, after proper analysis, should help improve forecast accuracy in the Midwest due to a better approximation of water vapor introduced into the atmosphere by evapotranspiration.

Reeducation Camps and the Southern Vietnamese Veterans' Experiences

Lan Phung (Session I.A.2)

One little-known outcome of the Vietnam War was the imprisonment of the Southern Vietnamese soldiers in the sites the Hanoi government called "reeducation camps." There are few extensive studies in English on reeducation camps. This project will present and analyze first-hand narratives of three veterans who survived the camps. Data was collected in personal interviews that were conducted in Vietnamese, translated into English and analyzed. The results of this study will bring to light the treatment received by Southern Vietnamese veterans in the camps and the consequences of that experience in their lives.

Michael Roberts (see J. Otting and M. Roberts above)

Genetic Relationships between Nicaraguan and North American Freshwater Mussels

Stephen Robinson (Session I.B.1)

Freshwater mussels serve as living filters for their ecosystems and are therefore excellent indicators of water quality. Mussels also lend themselves to biogeographical mapping with their anatomically restricted mobility and sessile nature. But the mussel-harvesting industry and poor land-use practices reduced Iowa's original 36 known mussel species to 21. They have become a conservation concern. But our conservation efforts for freshwater mussels are limited because our understanding of mussels is limited. Previous research focused heavily on North American mussels, leaving Central America, for the most part, neglected. Contemporary research is serving to bridge the gap of knowledge and link the species through modern genetic analyses. Uniodid mussels were collected from Lake Nicaragua and their DNA was extracted, amplified in a Polymerase Chain Reaction, and ultimately sequenced. The Bayesian phylogenetic tree produced with these sequences and their North American counterparts showed a strong correlation between these freshwater

mussels and implied a gradual migration of Uniodids from the North to South. This research is simply the next step on the path to understanding the relationships between mussels and their relationship to the world. Further insights into these freshwater filters may aid effective conservation efforts.

Manual of Practice for Roadway Maintenance Workers

Christian Sax (Session II.E.1)

The purpose of the manual is to inform roadway workers how to do common maintenance tasks and why those tasks are important to the roadway system. This will define to a roadway worker what their role is in the overall scope of the roadway system. The information in the manual is organized into 7 chapters. The first 2 chapters cover introductory material and information to help road workers communicate effectively with the public. The next 3 chapters cover road maintenance topics "from center line out" - the roadway, shoulders, and drainage - which is how maintenance activities are generally prioritized and budgeted. The final 2 chapters cover bridge maintenance and winter maintenance. The manual focuses on why and how to perform maintenance activities. Each chapter is intended to stand alone. In general, each chapter is organized as follows; safety tips, characteristics of good maintenance (the "why"), optimum timing and conditions for maintenance, and bibliography. The future direction of this project lies with the level of satisfaction in the county workers. There are plans to create note card sized references to be carried by individuals in the field to use as a quick reference.

Examining Oxidative Stress Response in Mycoplasma hyopneumoniae Using Microarrays

Erin Schafer (Session II.C.3)

Mycoplasma hyopneumoniae, the causative agent of swine enzootic pneumonia, infects the cilia of swine lungs, causing ciliostasis and cell death. It is part of the porcine respiratory disease complex (PRDC) and especially problematic in finishing hogs causing loss of millions of dollars of farm revenue worldwide. For successful infection, this organism must effectively resist oxidative stresses from constant respiration of the lungs as well as the release of oxidative compounds from neutrophils and macrophages during the host's immune response. To gain a better understanding of the transcriptional responses of *M. hyopneumoniae* under oxidative stress, *M. hyopneumoniae* cultures of strain 232, a derivative of strain 11, were grown to early exponential phase and exposed 0.5% percent hydrogen peroxide for 15 minutes. RNA samples from these cultures were collected and compared to RNA samples from control cultures by generation of indirectly-labeled cDNA targets and spotting to two-color PCR-based microarrays containing ~91% of the *M. hyopneumoniae* genome. The arrays were analyzed for significant difference in the presence of transcriptional products. This study revealed significant down-regulation of glycolytic pathway genes and gene transcription proteins. This study has also contained significantly different genes common to other environmental stress responses, and may merit further study as universal stress response genes of the organism.

Heath Schechinger (see W. Allison and H. Schechinger above)

Gossip-Based Algorithms for Distributed Sensor Networks

Joseph Sloan (Session II.D.1)

The greater availability of low-power and low-cost embedded systems has allowed for a growing number of new and exciting applications for sensor networks. These applications vary from urban/social interaction sensing to terrestrial ecological observing. Each node collects information and performs processing but due to the limited power, efficient algorithms are needed to gather the distributed information across the sensor network. Moreover, frequent faults in radio links or nodes within the network make more structured, tree based communication systems susceptible to losing large amounts of data. This problem of efficiently distributing information with relatively simple computational demands, and also a certain degree of fault tolerance was the focus of this research project. I specifically focused on using more probabilistic approaches to distribute and query information. To explore different algorithms I used a set of Mica2 motes programmed using nesc and an embedded operating system called Tinyos. Additionally, I used a simulator to complete initial algorithm research. A multi-path application to gather the number of active motes in a region was developed and implemented on set of motes. Some communication improvements were identified and used in this simple aggregate data

collection program. Future research may include exploring gossip based approaches to other types of data queries, utilizing a variety of collected sensor data.

Digital Art on Campus Project – A Virtual Art Tour

Grant Thompson (Session II.E.3)

The Digital Art on Campus Project is a study of how the web-based media content can enhance the physical landscape. Conventional signage is often inadequate to deliver the intensions, ideas, or research represented in the built environment. Additionally, there are places where significant signage is inappropriate, such as urban plazas or parks. In the context of a museum, signage is a main way in which information is communicated about the collection. Working in conjunction with the University Museums, the project is an experiment in using the Internet to deliver a web-based tour of fifteen pieces of the Art on Campus Collection. The project combines streaming video and downloadable audio files to showcase the Art on Campus collection. Wireless Internet, or Wi-Fi, is becoming more prevalent and more devices are able to take advantage of wireless technology to access the Internet. By creating content that can be viewed over the Internet, more information can be made available to the site user about the space. The Digital Art on Campus Project is one example of how the digital landscape can enhance the physical landscape by allowing site users to engage the site through web-based programming and content.

American Midwifery: A Study of Two Iowa Midwives

Dawniece Trumbo (Session I.A.3)

A recent study published in the June 2003 edition of *American Journal of Public Health* found that low-risk patients who received collaborative midwifery care had birth success rates comparable to those who saw only physicians, with fewer interventions, more options, and lower cost to the health care system. I also found that the percentage of births attended by midwives in the United States had increased steadily between 1975 and 2002, with a total of 7.9% in 2004, but the percentage in Iowa was significantly behind with only 5.6% of total births. The purpose of this study is to identify some of the critical challenges and barriers, as well as the benefits and opportunities, to the profession of midwifery in Iowa. This study explores the practice of midwifery, the challenges of the profession, and relationships with organizational entities such as hospitals, insurance companies, and managed care organizations.

Urban Overflow: The Gentrification of a Prominent Denver Neighborhood

Lisa Willman (Session II.E.4)

Just north of downtown Denver, Colorado, lies a neighborhood going through some major changes. Highlands Neighborhood has been host to a series of ethnic dominances throughout the years, and the impact of these populations can be seen in the varied architectural vernacular. Now building efforts in the LoDo (LowerDowntown) area of Denver have extended their new high-rise loft apartment buildings into Highlands, taking advantage of the low-priced real estate primarily owned or rented by the Hispanic population. Based on Hispanic housing trends, it was hypothesized that the Hispanic members of the community would show more opposition to the new building efforts than their Anglo neighbors. However, through interviews with community members both within and outside of Highlands Neighborhood, the response appears to be exactly the opposite. This multidisciplinary study concludes with simple efforts that can be made by the community members to clean up the neighborhood without city government intervention, as well as how developers can preserve the rich architectural makeup of the neighborhood by paying homage to the diverse ethnic past in their designs. Highlands Neighborhood offers a unique opportunity for designers to take a closer look at the impact that urban planning initiatives can have on the human level.

Art Smarts: Invigorating Education through the Integration of the Arts

Maria Witte (Session I.A.4)

This project proposes a methodology for changing education to integrate art for children kindergarten through middle school via two key additions. The first addition introduces the use of a sketch or reflection book for pupils, tailored to their maturity level. Deviations of the sketchbook/journal are perfectly acceptable if they engage the student more proficiently, such as collage or video. The second addition proposes a set of goals for teachers to successfully connect to students through the journals/sketchbooks. Time for free thinking in education is vastly ignored, but as little as 15 minutes each school day could vastly improve a student's wellbeing. The benefits of practicing the arts consist of self-expression, relationship building, understanding, and creativity, as well as a teaching tool for other subjects. It provides a more holistic method of learning. The arts engage all the learning styles: visual/spatial, verbal/linguistic, logical/mathematical, bodily/kinesthetic, music/rhythm, interpersonal, intra-personal, existential, and naturalistic as described by Howard Gardner. Through the sketchbook/journal teachers will be more aware of the student's learning type. Also, teachers will be able to look for potential problems in the child's life, including abuse or psychological problems, which may be expressed in their sketching/journaling and would have otherwise gone unnoticed.