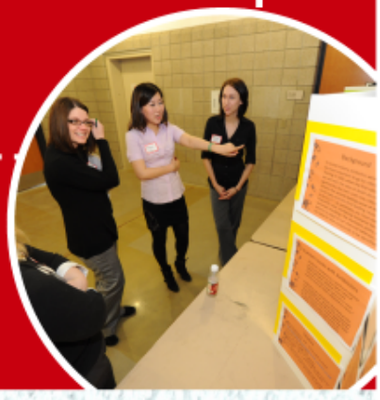

SVSU

SCIENCE & ENGINEERING SYMPOSIUM

Pioneer Hall, Friday April 20, 2012 8:30 a.m. - 4:30 p.m.

SVSU Science and Engineering Symposium

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SVSU Science and Engineering Symposium

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9:05 a.m.	**Keynote Lecture** Dr. Thomas H. Lane Vice President and Chief Academic Officer at Delta College	Pioneer-240
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Keynote Lecture

Being successful in the real world; a few things to think about

Thomas H. Lane, Ph.D.
Vice President and Chief Academic Officer at Delta College

Thomas H. Lane, Ph.D., D.Univ. (h.c) CChem, CSci, FRSC, ACSF

Tom received his undergraduate education, in chemistry, at Purdue University, a master's degree from Central Michigan University and his Ph.D. in physical organic chemistry from the Open University in England. He has been recognized by both Purdue and CMU with their Distinguished Alumni Award. Tom received the highest level of recognition from the Open University for his contributions to the sciences and education with an honorary doctorate degree that was presented at a special ceremony in the Palais des Congres, Versailles, France (September 2011).

He worked at the Dow Corning Corporation for 35 years where he achieved the highest scientific rank within the Corporation for his technical contributions in the areas of interfacial science, scientific computing, and in the biology and biotechnology of silicon. These accomplishments have been internationally recognized and summarized in over 15 US and 85 International patents, 400 technical presentations, 170 scholarly reports or publications, 5 book chapters and an encyclopedia chapter on silicon chemistry.

Among Tom's many awards is the 2007 Jerome L. Yantz, Partner in Education Award which is sponsored by the Bay Area Chamber. In addition, he holds academic positions in both the US and the UK. He is President Emeritus of the American Chemical Society (the world's largest scientific society), a Fellow of the Royal Society of Chemistry, an American Chemical Society Fellow, a Sequoyah Fellow of the American Indian Science and Engineering Society, a Fellow of the Society for the Advancement of Hispanic/Chicanos & Native Americans in Science and a number of other professional organizations. Today, Tom's primary focus is education and student success.

For fun, Tom enjoys photography. He specializes in black & white, film photography using large wooden field cameras (8x10 inch negatives). He maintains a professional level darkroom in his home to develop and print his images using techniques and formulas that date back to the mid-1800.

Independent Research Posters

P01. Elastic Properties from Sound Velocity Measurements: A Review
C. Schilling, K. Kotsidou, and R. Warzel

Sound velocity measurements in solid materials are conveniently substituted into equations of elasticity to predict Young's Modulus, shear modulus, bulk modulus, and Poisson's ratio. This method has been used over the past several decades to evaluate many different materials; most notably in studies of soil dynamics, medical imaging, and ceramic materials science. In 1970, Timoshenko and Goodier published a complete and rigorous proof of these equations, the central basis of which is a dynamic balance of elastic and inertial forces. We review that proof using a simpler mathematical format that can be more readily understood by non-mathematicians. The result is a lesson that significant errors in elastic property predictions can be avoided if the engineer understands the role of Poisson triaxial stresses on measurements of sound wave velocity. We review two algebraic expressions showing that these errors are exacerbated as Poisson's ratio increases.

P02. Design of an Apparatus to Measure the Unsteady Temperature Distribution around a Single- and a U-Tube Buried Vertically in an Infinite Medium (Application to Ground Source Heat Pumps)
D. Novak, M. Jabbari, and Dr. Chris Schilling

A major task of designing a ground source heat pump system (GSHP) is sizing of its ground heat exchanger (GHE). The sizing of GHE (usually a run of straight or coiled or U-shaped pipe buried in ground vertically or horizontally), and prediction of its performance, is complicated by many factors. Some of the factors are; the periodic, and irregular, nature of the heat exchange; the accumulative effect and the history of heat exchange; the depth dependency of the ground's undisturbed temperature and thermal properties, and the presence of ground water. This paper presents design of an experimental set up that enables introduction of GHE to under graduate students as well as providing a medium for measuring relevant GHE responses under controlled and specified conditions.

P03. Effects of Composition and Sintering Parameters on Ultrasonic Velocities and Elastic Properties of Iron and Bronze Powder Metal Alloys
Dr. K. Kotsidou and Dr. Chris Schilling

Velocities of ultrasonic tension-compression (P) and shear (S) waves were measured in three sets of alloys to calculate Young's Modulus, Shear Modulus, and Poisson Ratio according to elasticity theory. Effects of sintering time were investigated in two iron alloys: (*i*) FN-0208 containing 2.0 Ni and 0.8 C; and (*ii*) FC-0208 containing 2.0 Cu and 0.8 C. These samples were sintered at 5, 10, 20, 30, and 40 minutes in dissociated ammonia atmosphere, spanning a range of properties from under-sintered to normal sintered to better-than-normal sintered. Effects of graphite concentration and sinter density were investigated in three bronze-graphite alloys: (*i*) CT-1000 containing 90.5 Cu and 9.5 Sn; (*ii*) CTG-1001 containing 90 Cu, 9.5 Sn and 0.5 graphite; and (*iii*) CTG-1004 containing 88.3 Cu, 9.2 Sn and 2.5 graphite. Effects of the concentration of infiltrated copper were investigated in iron alloy FX-1008 containing 8 to 14.9 % Cu and 0.6 to 0.9% C. Empirical relationships between bulk density, composition, acoustic wave velocity, and the aforementioned elastic properties are presented.

P04. 21st Century Renewable Fuels, Energy, and Materials Initiative
J. Berry et. al., with C. Schilling

In 2011, Kettering University was awarded a US Department of Energy grant to develop a new class of polymer-electrolyte-membrane (PEM) fuel cells that can be fueled with the biofuels, ethanol and biomethane. SVSU and the Michigan Molecular Institute (MMI) were invited to collaborate; with MMI focused on development of electrolyte materials and SVSU focused on engineering economic analysis of producing ethanol from the energy crops, Miscanthus x Giganteous and Panicum Virgatum (switchgrass). This poster provides an overview of the entire project.

P05. Effects of Sintered Density on Elastic Properties of Iron Powder Alloys
K. Kotsidou, C. Schilling, B. Hart, and K. Lavigne

We used the pulse-echo method to measure acoustic-wave velocities in the longitudinal and transverse directions of un-notched Izod bars made of two sets of powder metallurgical alloys at varying sintered density: *i*) Astaloy CrA, containing 1.8 Cr and 0.1 Mn; and (*ii*) D.AQ, containing 0.50 Ni and 0.50 Mo. Minimal variations in sound velocity were observed as a function of direction. Young's Modulus, Shear Modulus, and Poisson Ratio were calculated according to elasticity theory: For both alloys, linear relationships between bulk density and either the Young's Modulus or Shear Modulus were observed.

P06. Engineering Economic Analysis of Cultivating Miscanthus and Switchgrass for Production of Ethanol and Methane: Application to Central Michigan
G. Roekle and A. Bond (Advisor: Dr. Chris Schilling)

We reviewed cost-benefit studies on cultivating perennial grasses to supply future markets for ethanol and methane. We present capital-cost analysis that compares production of Panicum virgatum (switchgrass) with Miscanthus x giganteous using central Michigan agronomic conditions in the year 2011. Our simulation software is useful because it helps assess production management trade-offs; most importantly land rental vs. land ownership, the use of contracted services, the timing of crop planting and harvest, and differing transportation-logistics scenarios. Our key conclusion is that biomethane production is more cost effective than production of ethanol ; primarily because the latter has excessive transportation costs and excessive loss of dry matter from harvest operations. Ethanol production is not cost effective on the scale of single farm; and instead entails long-distance trucking of dried harvest to massive, centralized ethanol production facilities. In contrast, biomethane production is feasible with short-distance hauling of wet, ensiled harvest to small-scale anaerobic digesters, sited either on-farm, or amongst a cluster of adjoining farms.

P07. Characterization of novel polysaccharide and protein composites
Steven Mankoci, Fredy Pratama, Dr. David Karpovich, and Dr. Tami Sivy

Recent research at SVSU by Schilling, Karpovich, and Tomasik has resulted in an innovative biodegradable plastic created from soy protein isolate and polysaccharide-rich corn cob powder. It has been hypothesized that electrostatic interactions or an amide bond forms between positively charged amines of the protein and carboxylates of the oxidized polysaccharides. The purpose of this study is to further investigate this hypothesis using recently acquired analytical equipment, including Raman spectroscopy and differential scanning calorimetry. A major focus of this study so far has been on the building blocks of these intriguing bioplastics. Cellulose, carboxylated cellulose, soy protein isolate, soy meal, and soy beans themselves were thoroughly analyzed. From these components, conformational changes were observed in Raman spectra that may be contributing to the overall strength of the bioplastic. To further explore the molecular interactions that may be contributing to the strength of the bioplastic, thermal analysis of these building blocks, as well as the bioplastics themselves, was performed.

P08. Hand-made neem oil for sustainable agriculture in developing countries
James Polega, Amanda Foote, Elizabeth Thom, Dr. Lanny Robbins, and Dr. David Karpovich

Developing countries in sub Saharan Africa, such as Ghana, posses an important yet relatively underutilized resource with neem trees. Traditionally, oil from the seeds of neem trees has been used for small-scale insect control and personal care products. Widespread usage of this potential resource is not seen due to lack of equipment for extraction and techniques for application. Our current research focuses on the process of extracting neem oil by hand-kneading of crushed neem seeds. Since hand-made neem oil requires no special equipment to extract, it is a culturally appropriate method for individuals in developing countries to obtain this high value natural resource. Furthermore, our results show this process yields oil at amounts comparable to other common extraction methods and with a higher concentration of limonoids, the bioactive ingredients. Many fundamental chemical principles govern the process. This presentation will discuss the chemistry, characterization, and agricultural uses of hand-made neem oil.

P09. Emulsion Technology For No. 6 Fuel Oil/Glycerin Emulsions
Hannah E. Mize, Anthony J. Lucio, Dr. Lanny Robbins, and Dr. David Karpovich

No. 6 fuel is a heavy fuel oil (HFO) that has a relatively high viscosity. It needs to be pre-heated prior to pumping otherwise it will congeal and clog fuel lines. Its undesirable characteristics result in lower demand thus making it an inexpensive fuel for power-plants and ocean-going vessels. We have experience in producing stable emulsions of No. 2 fuel in crude glycerin obtained from biodiesel processing in order to find value added applications of the glycerin. By increasing the surfactant amount in our formulations, we produced a similar emulsion with HFO. This formulation could lead to a lower viscosity fuel compared to No. 6 fuel oil alone and expand the utility of the low cost fuel. Crude glycerin analysis and characterization remains an essential part of the project, since contaminants in the glycerin vary from source to source and have an effect on emulsion formulations. This poster will present our results on the formulations and resulting properties of emulsions of No. 6 fuel oil in crude glycerin.

P10. Contamination source and wetland habitat combine to produce anoxic conditions on the North Branch of the Kawkawlin River

Hannah M. Voss, Meaghan VanWert, Robin Messing, Jacob VanHouten, and David Karpovich

Saginaw Valley State University (SVSU) and Delta College conducted research on the Kawkawlin River Watershed during the summer of 2011. The group performed weekly sampling and monitoring of 22 river sites for nutrients, D.O., bacteria, and other biotic and abiotic parameters. The Kawkawlin River, as part of the Saginaw Bay Watershed, is included in the EPA (Environmental Protection Agency) Saginaw *Bay and River Area of Concern* due to sedimentation, eutrophication, bacterial contamination, impaired fisheries, as well as riparian and in-stream impediments to navigation and stream flow. The overall goal of this project is to determine river water quality and to identify specific river impairments in order to implement possible restoration initiatives in the future. Of particular concern, is a specific riparian wetland reach on the North Branch that is frequently in a state of non-attainment of the Michigan standard for dissolved oxygen. This area exhibits characteristics of wetland habitats including slow flow and the lack of a defined channel. Analysis of the data collected suggests that anoxic conditions on the North Branch are a result of fecal contamination upstream of the reach in question. D.O. levels show a negative correlation with indicator bacteria (*E. coli).* The D.O. profile shows a typical oxygen sag curve just prior to the riparian section. We conclude that the placement of the wetland habitat inhibits the recovery of anoxic conditions caused by the input of a contaminant upstream.

P11. Saginaw Bay Watershed GLISTEN Cluster: Kawkawlin River Watershed Assessment

Collaboration among students and faculty at Saginaw Valley State University and Delta College

GLISTEN (*Great Lakes Innovative Stewardship through Education Network*) is a three-year service-learning project funded by the "Learn and Serve America" Higher Education program of the Corporation for National Community Service. GLISTEN harnesses the expertise and innovation of college faculty and students in 8 states and 2 Canadian provinces to promote stewardship of the Great Lakes. Sub-awards designed to support consortia in 8 Great Lakes states were awarded to lead institutional partners. As part of this effort, the Saginaw Bay Watershed Cluster (SBWC) comprised of Saginaw Valley State University (SVSU) and Delta College developed Great-Lakes-stewardship-focused courses and conducted research on the Kawkawlin River Watershed. This group also included community-based organizations, local governments and others interested in improving water quality in the region. During the summer of 2011, the group performed weekly sampling and monitoring of 22 river sites for nutrients, D.O., bacteria, and other biotic and abiotic parameters. The data was compiled and summarized by SVSU and Delta students and will be delivered to the Kawkawlin River Watershed Property Owners Association (KRWPOA), Bay Area Storm Water Authority (BASWA) and the MDEQ (Michigan Department of Environmental Quality. The Kawkawlin River, as part of the Saginaw Bay Watershed, is included in the EPA (Environmental Protection Agency) Saginaw *Bay and River Area of Concern* due to sedimentation, eutrophication, bacterial contamination, impaired fisheries, as well as riparian and in-stream impediments to navigation and stream flow. This project seeks to address some of the impacts to the system through on-going assessment.

Computer Science Posters

CS01. Securing Future Space Missions: Modeling and Analysis of NASA's Mission Software Infrastructure Using Petri-Nets
Amanda Pavlicek (Advisor: Dr. Tai-Chi Lee)

The purpose of this research is to improve the validation and performance of mission safety software within the mission control room, as well as achieving financial objectives and fulfilling governmental regulation while utilizing the best software engineering and project management practices. The implementation of this project will be represented in an analysis paper that utilizes Petri-Nets to portray the enhanced relationships within the mission control software infrastructure. The results of this research will contribute to our understanding of designing a more efficient software infrastructure. With this newly acquired knowledge, NASA organization, once the organization is given the opportunity to restart manned space missions, can push the barriers of space exploration and aeronautical science within the current market's reinforced limitations in future NASA space missions.

CS02. FPGA-Based Computing – Tutorial Approach
Mark White, Michael Gubody, Allison Nicol, Christopher G. Plachta, Jeremy Strawn, and Cori Thompson (Advisor: Dr. Tai-Chi Lee)

This work involves a student research team that engages in activities to explore the use of FPGA's for computationally intensive applications. To learn the basics concepts and the fundamental logic design of a processor, a research team led by two seniors is formed. In order to fully understand how the FPGA works, a series of tutorials were targeted at analysis and synthesis of the functionalities for various components in a processor. For example, the construction of clocks, registers, adders, multiplexors, and bus connections etc… are implemented and tested. Both Altera and Xilinx tool kits with FPGA boards are used in the design. Once students have gained enough experiences with constructions and designs of the basic components, they move on to build a computing platform, which may consists of special processor and custom instructions on FPGA's that will be called by the main process from the application source codes. Because the low cost and less energy consumption of FPGA it makes an attractive efficient processing element. In addition, the FPGA offers the flexibility of reconfiguring the hardware for various applications. Thereby the advantages of using hardware/software co-design can be realized. Furthermore, this project provides students with research experiences that are needed for their graduate study or design skills required at workplace.

CS03. The Automation of the Taymouth Township Public Library
CIS 424 Class (Advisor: Dr. Scott James)

The 2011-2012 CIS 424 capstone project involved designing the workflows, hardware and software systems necessary to move a paper card catalog based library to a new computerized system created specifically to the library's needs. Barcode technology was employed to handle patron and media management. In addition, connections to external systems such as the Library of Congress and the Michigan Electronic Library Catalog (MELCAT) are integrated into the system, allowing records and data pertaining to the library's collection to be shared.

CS04. Rippl automatic peer to peer file syncing

Gregory McNish, Jesse Grekowicz, Joseph Chrysler, and Erik Butterworth
(Advisor: Dr. Farid Hallouche)

Peer to peer networking eliminates many of the legal tensions of file synchronization by cutting out the server. Peer to peer protocols like Bit Torrent, though often used for questionably legal activities, are enormously powerful, but many still require some form of server interaction to be effective. Before a peer to peer connection is established between two torrent clients, for example, both must first connect to a tracking server to learn of the other's existence. This slim server dependency introduces a glaring point of failure into the network mesh.

Ripple aims to solve both the legal woes of client-server architecture and the pinch-points of peer to peer by building a self-managing, self-directing clustered node architecture that uses peer to peer connections maintained by the network itself. Unlike a dedicated tracking server, nodes in a rippl mesh each contain an internal map of the entire network that constantly updates to the changing environment. For this reason, nodes need not connect to a central tracking server, but to any node on the existing network, to learn about their peers.

CS05. Secure Client-Server Business Conferencing

Michael Fitzpatrick, Austin Kimmel, and Hector Zimmermann-Ayala
(Advisor: Dr. Farid Hallouche)

Multimedia business conferencing is a growing field. Co-workers have a need to share vital and sensitive business documents. In addition, co-workers should be able to partake in live chat and video conferencing for matters where documents are not involved and face to face time is needed. A program of this magnitude will help save companies' time and money normally allocated to travel and its expenditures. Communication and data transfer will be quick, simple and can occur at any time of the day regardless of the participant's schedule.

Our project is devised of two key software components: the client and the server. Since this is a private project and not a funded business operation, our server is not consistent; it must be run when we wish to use any number of clients. After our server is up and successfully running, we can then connect any number of clients. These clients can be run on one machine (through multiple windows) or on connected computers.

Up to this point we have successfully created a server that can connect to multiple clients. These clients are then aware of other clients connected to the server, and can communicate with one-another via chat. Thus far, our application is reliable and efficient; the software does not crash or drop connections. Also, as far as efficiency goes, the program runs smoothly on all tested computers. Security has yet to be touched upon.

CS06. Node.js HTTP Socket Server: ***A New Kind of Real-time Chat Experience***

Michael Louks, Dylan Swartz, Jessica Legner, and Sebastien Pic
(Advisor: Dr. Farid Hallouche)

There are many examples of chat servers on the web today, and from the beginning, we wanted our chat to stand out from the rest. As we began to design our project, we wanted to solve a common problem with current online chats. Our goal was to create a "stream of consciousness" style of chat, in which, as a user types, each character is immediately displayed in the chatting area. This would allow for more fluid and natural conversations in an online chat environment.

Although the chat server was our main goal, we also decided to implement an email server to give users an alternative to chat in our project. This would allow the user to communicate with someone who is not present in the chat. We used a custom jQuery plug-in to have an email dialog appear. This saves the user from opening another tab or browser window, logging in to their email client, and drafting the message; the user can do it all in one browser window.

We decided to use HTTP sockets and Node.js for our project. This allows us to write both the client side and server side code in a single language – JavaScript. The Node.js HTTP module allows the client and server to maintain a persistent connection. The logic we mapped out involves two separate JavaScript files, client.js and server.js – the flowchart is shown in the diagram below.

CS07. Demon File Sharing

Scott Patke, Roger Ryder, and Chris Schneider (Advisor: Dr. Farid Hallouche)

For our project we put together a peer-to-peer program that is used to store files into one server. The main use of this program is to allow users to be able to access their files no matter what computer they are working on. The user will need to use our Peer-To-Peer- Agent in order for them to be able to access their files. From this peer-to-peer connection multiple users will be able to connect to the same account in order to download and upload files along with being able to do such things as modifying these files and adding new ones. The server is responsible for storing all the files that the peer(s) will be connected to. In order for a user to be connected the connection in which they are connecting to must also be connected.

Some different components that we had considered adding to our project were a chat part where the different users that were logged on could chat amongst each other. Also we had a password component that would be added to the connect component that we currently had but that was also removed. Given more time we would like to add that to our project. Something else we would like to add that we had talked about in about in our proposal is having it so it would automatically sync as the opened documents were being used.

CS08. Chat Server Application

Lucas McClain, Nicole Urbain, and Michael Sander (Advisor: Dr. Farid Hallouche)

Chat is referred to as a casual conversation between two or more individuals. Online chat occurs via the Internet and utilizes a display-based communication system. It is a way of communicating by sending text messages to people in real-time. This communication occurs between different users connected to a remote and a host system. A formal term for online chat is synchronous conferencing. Online chat takes many forms such as a chat room or through instant messaging.

For this project, we have created a chat server application. We have followed the traditional application-layer client-server paradigm. The client-server paradigm is made up of two main parts. One part is the server. This is an application that runs all the time, usually on a remote machine. The other part is the client. The client application only runs when a user wishes to use the chat service. There can be multiple copies of the client application running. Basically, each user that wishes to use the chat service will be running a client application. There is always only one server application running. In the pages to follow, we will be examining both the server and client application developed in this project. All of the sample code provided in this project was written in the .NET programming language using Visual Basic Studio 2010.

Chemistry Research Posters

C01. Tubular Precipitation Structures

Amber D. Berkobien (Advisor: Dr. Jason Pagano)

Silica gardens are a reaction-precipitation system in which hollow metal-silica tubes form upon seeding a metal crystal in a solution. We investigate the following eight metals as seed crystals: nickel(II) nitrate, calcium nitrate, manganese(II) sulfate, copper(II) nitrate, cupric sulfate, magnesium chloride, ferric(III) chloride, and cobalt(II) chloride. The mass values for the seed crystals are all within 20%. The induction time varied from 9-900 s depending on the choice of seed crystal. We report data on tube height, radii, and growth observations for the particular metal salt seed employed. We also present results of tubular precipitation structures created from a flow injection technique.

C02. Hierarchically structured semiconductor tubes

Eric J. Nelson (Advisor: Dr. Jason Pagano)

Silica gardens, or chemical gardens, grow when a solid of a metal-ion salt is placed into a sodium silicate solution. The final result of this process is a landscape of hollow tubes of different sizes and shapes, resembling a tree or garden. We discuss synthetic strategies via the silicate garden route toward the production of metal oxide and/or metal chalcogenide semiconductor tubes. Tube formation is monitored using digital photography. We examine the structural features and chemical composition of post-synthesized semiconductor tubes using SEM-EDS. The results from UV-vis, FT-IR and thermal analyses are presented.

C03. Effect of Deposition Rate on the Stability of Hole Transport Layer Glasses Prepared by Physical Vapor Deposition

Paige M. Krzyskowski (Advisor: Dr. Kenneth Kearns)

Physical vapor deposition was used to prepare amorphous solids of *N,N'*-bis(3-methylphenyl)-*N,N'*-diphenylbenzidine (TPD), a hole-transport material relevant for use in organic light emitting diodes and photovoltaic applications. While holding the substrate temperature constant at 283 K, which is 0.85 T_g of TPD (333 K), deposition rates were varied from 0.45 to 55 nm/s, creating glasses with low fictive temperatures (T_f) and high kinetic stability as determined by differential scanning calorimetry. All fictive temperatures of deposited TPD were found to be lower than the glass transition of the ordinary supercooled liquid glass, with the lowest being 28.4 K below T_g. The lowering of T_f illustrates increased thermodynamic stability of the vapor-deposited glass with the slowest deposition being the most stable. Depositions at the lowest rates were also found to be the most kinetically stable as determined by higher onset temperatures (T_{onset}). When ordinary glasses are aged over 2000 hours, the same effects on the thermodynamic and kinetic stability of the glass are observed. The lowest T_f obtained from vapor-deposited glass was still 18.6 K *below* the T_f of the 2000 hour aged glass. The highest T_{onset} obtained was 12.1 K higher than that of the 2000 hour aged glass. It would take significantly more aging for the aged glass to reach the stability obtained by vapor-deposition. Vapor-deposition is a more time efficient process than aging to produce stable glasses.

C04. Effects of nanoscale confinement of the hole-transport material TPD in controlled pore glasses

Steven M. Hurney (Advisor: Dr. Kenneth Kearns)

Organic molecules are being investigated for use in a number of electronics applications. For instance, dye-sensitized solar cells rely on the confinement of organic molecules within a porous TiO_2 matrix. An undesirable property of these organic materials is their instability at elevated temperatures. Using differential scanning calorimetry, the thermal properties of the hole-transport material *N,N'*-Bis(3-methylphenyl)-*n,n'*-diphenylbenzidine (TPD) was examined at varying levels of confinement in controlled pore glasses (CPGs) with pore diameters ranging from 7.5 to 102.6 nm. The confinement of hole-transport materials in CPGs made of silica can be used to simulate the geometric conditions of dye-sensitized solar cells. We observed two glass transitions, T_g, of the TPD. The first was at a lower temperature near the unconfined bulk T_g, while the second was at a temperature nearly 35 °C greater. For samples with the greatest confinement (7.5 nm pores), the first T_g was observed below the normal bulk transition. The existence of two T_g's in a single component system can be described by a core-shell model where the material at the center of the pore exists as a "core" liquid surrounded by a "shell" that is stabilized by interactions with the pore wall.

C05. Thermal Transitions of α-NPD and TPB Confined within 7.5 nm to 102.6 nm Pores

Aaron Bond (Advisor: Dr. Kenneth Kearns)

Dye sensitized solar cells (DSSC's) are very promising candidates as sources of alternative energy. Of particular interest are solid state DSSC's, which use glass forming molecules as the hole transport material (HTM). Solid state devices circumvent the leakage and corrosion problems faced by similar liquid electrolyte DSSC's, and offer a potential route to higher efficiency devices. We used differential scanning calorimetry to measure the thermal transitions of two glass forming HTMs, α-NPD and TPB, confined within silica glass pores of diameters 7.5-102.6 nm. It was found that confinement of these molecules resulted in a depression of the melting temperature with increased confinement. This melting temperature depression is similar to previous reports on canonical glasses, and could be qualitatively described by the Gibbs-Thomson equation. For TPB systems, this depression ranged from 14□K for 102.6 nm pores, to 45□K for 7.5 nm pores. Similar results were seen in α-NPD. The melting temperature depression could limit the operating temperature of the device considerably, as most devices utilize pores ranging from 15-30 nm.

C06. Enhancing the properties of amorphous OLED materials via physical vapor deposition

Zachary Devereaux (Advisor: Dr. Kenneth Kearns)

Physical vapor deposition was used to prepare amorphous samples of the hole transport layer N,N'-di-[(1-naphthyl)-N,N'-diphenyl]-1,1'-biphenyl-4,4'-diamine (α-NPD). Deposition rates ranging from 0.3 nm s^{-1} to 30 nm s^{-1} were utilized to deposit the α-NPD onto a substrate held at 293K, which is 81% of the glass transition temperature, T_g. The deposition process allowed for the formation of organic glasses with unusually low fictive temperatures, T_f, and high kinetic stability in comparison to glasses formed by controlled cooling of the liquid and subsequent aging for two months. These experimental results corroborate the existence of enhanced surface mobility at the glass-vacuum interface. The enhanced surface mobility allows for the amorphous glass molecules to rearrange forming a stable glass. The formation of stable glasses for OLED devices may aid in the range of molecules that could be used; these stable glasses will remain solid at higher temperatures due to the high T_f. Previous physical vapor deposition work on α-NPD by Yokoyama has shown that depositing near $0.8T_g$ results in enhanced electrical properties as well.

C07. Development of a Colorimetric Method for Determination of Bacterial Concentration
Alaina Nunn (Advisor: Dr. Stephanie Brouet)

The synthesis of a cephalosporin, which may react with the cell walls of bacteria or β-lactamase to release a sulfur containing compound (2-mercaptopyridine-N-oxide), is described. The importance of the release of 2-mercaptopyridine-N-oxide is that when in the presence of Fe a complexation will occur, creating a violet color. This color change may allow a correlation to be made between the intensity of the color and the concentration of bacteria present. Success of this project would represent the development of a new colorimetric test for bacterial concentration.

C08. Substitution of Thymol on Cefotaxime
Dana Stolicker (Advisor: Dr. Stephanie Brouet)

Cefotaxime is a member of the 3rd generation cephalosporin family of β-lactam antibiotics. Cefotaxime is given to patients to fight bacterial infections, in particular gram positive and gram negative bacteria. Over time, antibiotics become increasingly less effective in treating bacterial infections due to emerging resistance in bacteria. Cephalosporin molecules, upon their reaction with bacterial components, undergo a mechanism that results in the release of a small molecule from the C-3 position. The design and development of dual-action antibiotics, in which the released small molecules have antibiotic properties of their own, is a possible pathway to more effective drugs. This strategy has been employed previously with other antiseptic molecules and has been shown to increase the efficacy of antibiotics. When thymol, a component of thyme, was mixed with β-lactam antibiotics, it was reported to enhance bacterial inhibition. The goal of this research is to replace an acetate, located at the C-3 position of Cefotaxime, with thymol so that the molecule is embedded into the structure of the cephalosporin. Other essential oils components found to have antiseptic properties shall be explored as well.

C09. Exploring the role of prenyl alcohols in isoprene biosynthesis and isoprenoid pathway-related cytotoxicity in *Bacillus subtilis*
Juliette Brown (Advisor: Dr. Tami Sivy)

Isoprenoids are formed through two biochemical pathways in the cell: the mevalonic acid (MVA) pathway and the methylerythritol (MEP) pathway. Cytotoxicity related to flux through each of the pathways has been described and attributed to a buildup of the prenyl diphosphates isopentenyl diphosphate (IPP) and dimethylallyl diphosphate (DMAPP), the precursors for all isoprenoids. DMAPP is also the substrate for the biosynthesis of the volatile isoprene, which we hypothesize is produced as a safety valve metabolite to rid the cells of toxic prenyl diphosphates. We are exploring the cytotoxicity in *B. subtilis*, which produces isoprene enzymatically from MEP pathway carbon, in two ways. First, we created a null mutant of *nudF*, the enzyme product of which consumes DMAPP as a substrate and produces prenyl alcohol. We are characterizing this knockout for cell viability and for isoprene production. Second, we are feeding cells permeable prenyl alcohols. We have developed a novel GC-MS method in order to measure the uptake of the alcohols and to determine whether they are converted to diphosphates, and are characterizing viability and isoprene production. These two approaches allow us to investigate MEP pathway-related cytotoxicity and the potential role of isoprene in relieving this toxicity in *B. subtilis*.

Chemistry Class Project Posters

C10. Organometallic Catalysis: Brief Overview of History and Application

Jesse Place, Tyler Beyett, and Samuel Langhorne (Advisor: Dr. Arpita Saha)

Organometallic catalysts have often been employed for industrial synthesis of compounds, especially in the synthesis of polymers. Two notable examples of these polymers are polyethylene and polypropylene, which are often synthesized using the organometallic catalyst called the Ziegler-Natta catalyst. Organometallic catalysts are used because they allow simple manipulation of organic compounds and reduce activation energy of many organic reactions. Organometallic catalysts have several modes of action, most prominently being bond activation. C-H bond activation has been achieved via coordination to iridium and rhodium complexes. The first described asymmetric Diels-Alder reaction was performed using a niobium catalyst which activates the diene as well as imparting chirality on the product. Other uses of organometallic catalysts include Friedel-Crafts alkylation/acylation where metal-halide catalysts are required for bond polarization and the Simmons-Smith reaction which features a Zn(Cu) coordination complex that facilitates cyclopropanation. These organometallic catalysts are vital to several commercial and industrial applications. Several bulk chemicals such as ammonia are produced using an organometallic catalysts and nitrogen. Likewise, the Ziegler-Natta catalyst provides the world's polyethylene and polypropylene by using triethylaluminium as a catalyst to produce long polymers of 1-alkenes. Without these catalysts, these processes would be impossible.

C11. Donor-Acceptor Complexes of Borazines

Zac Dewald, Rui Wang, and Liang Ge (Advisor: Dr. Arpita Saha)

Boron-nitrogen based chemicals have been gaining notoriety as useful hydrogen-storage vessels. But complexes created when these chemicals have been dehydrated also have interesting and unique characteristics. A particular form of these chemicals, known as borazine ($[HBNH]_3$), a six membered cyclic compound where the ring is composed of alternating boron and nitrogen atoms, has recently been studied in depth, and found to have some very unique characteristics. By both theoretical and experimental study, borazine has been found to have a relatively low reactivity and other characteristics reminiscent of carbon based aromatic rings. As a result, borazine has become known as the "inorganic benzene". This project will take a look at the similarities and differences between borazine and benzene, as well as some other unique properties of borazine, such as its ability to use the vacant orbitals found on the boron atoms in the rings to form donor-acceptor sigma bonds in the presence of various Lewis acids and bases. Specifically, the possibility of neutral Lewis acids and bases combining with borazine to form donor-acceptor complexes will be analyzed to see if these complexes can be used as a less endothermic process for hydrogenating borazine and polyborazine complexes.

C12. The Frist Artificially Created Element Technetium (Tc)

Nathan Cormier, Michael Morrow, and Michelle Rivard (Advisor: Dr. Arpita Saha)

Our poster will give a general overview of the first man-made element Technetium (Tc) including practical uses, history, and general information. Tc, element 43, was predicted to exist based on the periodic table and was erroneously reported as having been discovered in 1925, at which time it was named masuriurm. It was not until 1937 when Carlo Perrier and Emilio Segre artificially produced element 43 by bombarding molybdenum-98 with neutrons, hence its name meaning "artificial" derived from the Greek word technetos. There are twenty-two reported isotopes of technetium with masses ranging from 90-111. It is unique in that all isotopes are radioactive. Currently the most useful isotope is technetium-99. It has a short half-life and can bind chemically to many biologically active molecules, producing properties suitable for many medical radioactive isotope tests. Technetium-99 has also been proposed for use in optolectric nuclear batteries and small amounts of technetium have been successfully used to retard the corrosion of steel in closed systems. This element is rarely encountered outside nuclear facilities or research laboratories and is produced in large scale since it is extracted from spent nuclear fuel rods. However, at this time only small amounts of this have any commercial use.

C13. Graphene: The Miracle Material

Dana Stolicker, Jennifer Ott, and Eric Nelson (Advisor: Dr. Arpita Saha)

Graphene's interesting structure has been creatively synthesized in numerous ways, and offers various beneficial applications. Graphene is an allotrope of carbon. The structure comprises of a planar sheet of one atom thick sp2-hybridized carbon bonds. These atoms are densely packed together to form a honeycomb lattice. Dating back to 1948 the first TEM images of multiple layers of graphene were studied. More recently in 2004 physicists at the University of Manchester isolated the first individual planes of graphene using adhesive tape. Modern synthetic methods involve micro-mechanical alleviation of grapite, epitaxial growth, chemical vapor deposition, graphite oxide reduction, and even sugar. Some of the most important applications of graphene include electronics, anti-corrosion, gas detection, distillation, and anti-bacterial. Graphene is quickly becoming a hot topic in the scientific world. Every day new functions for this compound are being developed. The Nobel Prize in Physics for 2010 was awarded to Konstantin Novoselov and Andre Geim for their research involving graphene.

C14. Indication of Carcinogens in Household Air-spray and Cleaning Products by Ames Test Analysis

James Polega and Devin Simon (Advisor: Dr. Tami Sivy)

The purpose of this experiment was to utilize a modified Ames Test in order to analyze carcinogenic effects of disinfecting and odor eliminating spray products on a strain of *E. coli DJ702,* which expresses the human P 450 cytochromes, the enzymes which handle the breakdown of organic chemicals in the body. Antibacterial and deodorizing sprays were applied to *E. coli DJ702*. The bacteria will be treated with the products and the presence of mutagens will be identified via growth on plates containing lactose. The presence of the chemical mutagens will alter the function of the lacZ109 gene in the strain to create viable proteins that allow for growth on lactose sugars. If no mutagenic compounds are present bacterial growth will not occur. This will allow for an easy method to screen bacteria for the presence or absence of mutations.

C15. Effectiveness of Carb Intercept in Inhibiting Hydrolysis of Starch

Madison Bangert and Sarah Morelli (Advisor: Dr. Tami Sivy)

Carb Intercept is marketed as a dietary supplement that will reduce the body's intake and absorption of high starch carbohydrates by inhibiting natural starch hydrolysis. Carb Intercept has not been tested by the FDA, and therefore there is no way to know its. With this in mind, we designed an experiment that will test the activity/reaction rate of amylase, an enzyme that breaks down starch, with and without the presence of Carb Intercept. It will be interesting to see if Carb Intercept really can inhibit carbohydrate breakdown and, if so, to what degree.

The experiment will include two separate sections. The first part of the experiment will look at the degradation of starch by amylase in starch-agar plates with and without the presence of Carb Intercept. This will be a strictly qualitative portion to the experiment and will be based on colorimetric properties of starch indicators. The second half of the experiment will utilize a standard protein assay procedure to measure rates of activity of amylase, once again with and without Carb Intercept.

Preliminary findings of the starch-agar plates indicate that Carb Intercept may slightly reduce the rate of catalysis during starch hydrolysis by amylase. Further results are to follow.

C16. Fried vs. Non-Fried: What's the Difference? An Analysis of Fast Food Value Menu Items at the Molecular Level

Jordan Killop and Steven Mankoci (Advisor: Dr. Tami Sivy)

In our fast paced society, fast food is always a convenient meal for people on the go. Some of the most popular products on fast food menus are the inexpensive "value menu" items, especially for people living on a budget. However, there is much controversy surrounding exactly how much of a "value" these products are because of the disputed cost on the consumer's health. This study is to be conducted to determine exactly how bad these inexpensive food items are to a consumer's health, with our focus on comparing fried and non-fried value menu sandwiches. The goal of this study is to determine the fat content using GC/MS FAME analysis and identification (saturated, unsaturated, trans) using RAMAN spectroscopy, protein content using BCA-Assay and UV-Vis spectrometry, and ability for each food item to induce mutation in bacteria using a modified Ames Test. The menu items we intend to test will be taken from the value menus at McDonalds, Burger King, and Arby's.

Electrical Engineering Posters

Senior Design Posters

E01. Hybrid Renewable Energy System- Utilizing Solar and Wind Energies
Kayla Scanlon, Abu Bakar Fayyaz, Chris Wheatley, Xiaoqian Meng, and Fadel Aldhaif (Advisor: Dr. Russ Clark)

The purpose of this project was to enforce the concepts that have been obtained throughout the various courses required in the Electrical Engineering Program. This project placed emphasis upon the design of a system as well as other engineering concerns such as ethics, the environment, the economy, safety, and sustainability. When initially developing the project, attention was given to the ever increasing demand for energy, the desire to reduce dependence on fossil fuels, and the environmental impact that those fossil fuels have. The project that was developed addressed these concerns as well as showcased the skills developed from the variety of classes required of the program. The result was the creation of a self-sustainable power generation system that would provide power to a residential unit that is not connected to the power grid. The project used a hybrid generation system that implemented a wind turbine and a solar panel to produce the required power needed in order to sufficiently run a small load. The system was installed on the campus of Saginaw Valley State University in the hopes that it could be used in future projects by both the university and students. The power that was generated was stored in a series of battery packs which were chosen based on the desired operating conditions.

E02. Encoder Module
Scott Kenyon (Advisor: Dr. Russ Clark)

As a co-op for Wineman Technology Inc., I was tasked with designing, building and debugging a configurable encoder board based around a microcontroller. The module accepts the quadrature pulse outputs from any standard motor encoder and processes these signals. The processor then outputs an “up/down” pulse of user-configurable resolution, as well as the encoder outputs for reference. Additionally there is a configurable option to include a position/speed signal in the form of an analog output. All configurations are through NI Labview interfaced with a 9-pin serial port.

The final project will be displayed with a hands-on prototype, connected to a pulse generator on the input side, and a PC with Labview on the output/configuration side. The user will be able to select encoder resolution, anti-dither option, and type of analog output. Once the pulse generator starts, the module will begin processing encoder signals and the results will be visible on the PC monitor.

E03. Instrumentation to Aerate and Extract Air from Liquid Lubricants
Robert Bull (Advisor: Dr. Russ Clark)

This design will be implemented in order to solve a curiosity in the lubrication industry. How much air can a liquid lubricant absorb? In order to determine this, an apparatus will be constructed that will saturate a liquid with a set volume of air over a specific time. Saturating the oil with air will hopefully provide an ideal condition where the fluid will contain the most air possible at the given environmental pressure and temperature. After oil has been aerated, then that fluid will have its air extracted. The extraction of air will take place in an environment that is ideal to allow the most amount of air to be extracted the fastest. This amount of air will be measured.

E04. Solar Panel Tracker

Mohammed Alrwaili and Mohammed Al-qarni (Advisor: Dr. Russ Clark)

This project will be concerned with the outdoor tracking of the solar energy by making use of the movement of sun. This project will address the concerns of the environmental pollution that is brought about by the use of the fossil fuels. Use of solar energy will help to conserve the fossil fuel reserves for the future generations. The main focus of the project is to enable the solar panel to track the sun by making use of a light sensor that will be controlled using a servo-motor. The solar panel will convert the solar energy into electrical energy. A sensor that is responsible for directing the panel will be mounted at 45 degrees. This sensor will enable the panel to move from east to west by a variation of 75 degrees.

This project is going to make use of software that will be responsible for controlling the movement of the solar panel by receiving 5 volts of electricity from the sensor and sending it to the controller. This will enable the sensor to receive the minimum required 5 volts of electricity from the panel. This will allow the sensor to send enough electricity to the motor in order to enable the motor to move the solar panel. The solar panels will be required to be adjusted twice a year, during the summer and winter. Making use of optimal positioning of the solar panel will enable the consumer to harness as much energy as possible from the sun.

E05. Unit Under Test Control for Nexteer Automotive Validation

Tim Klinesmith and George Kyle (Advisor: Dr. Russ Clark)

This paper presents the design considerations and implementation for "Unit Under Test Control for Nexteer Validation". The design project was prepared for Saginaw Valley State University's ECE499 (Senior Design 2) class. The project is able to activate and read diagnostics from a Nexteer Automotive Electronic Power Steering System or stand alone controller while controlling hand wheel and ignition signals. The completed project design utilized a combination of hardware and software to achieve the goal. Labview was used to create all controls and associated SW code. The Labview program controlled 2 hardware circuits. The first circuit was for a programmable ignition cycle using a combination of resistors and FETs. The second circuit was a controlled, isolated circuit that delivered valid hand wheel signals needed for the EPS systems to be functional. The ignition circuit used a combination of resistors, isolated regulators, phototransistor optocouplers, and digital potentiometers. All controller communication occurred via CAN protocol, and it was necessary to develop the proper vehicle signals and transmit them over the CAN bus using a PEAK Tool.

E06. PV Laboratory Tool

Jordan Roe and Matt Gehrcke (Advisor: Dr. Russ Clark)

Our PV lab tool will allow students as well as instructors to verify theory with application. Our solar station is a lab tool to supplement the SVSU Electrical Engineering Department and give students "hands on" experience will solar power. The school presently has no demonstrative capabilities to solar power; but gives an adequate theoretical approach to understanding and design. The goal of this project will make solar conversion less abstract and more tangible. Students will be able to compare output and efficiency of the station to the manufactures rated/expected output during varying environmental and loading conditions. The panel is adjustable using dc motors for both azimuth and zenith angles (rotation and pitch). The solar station charges the battery and produces a steady state DC voltage. The station inverts the DC voltage and creates an AC voltage output. The interface panel will display an output for DC charging voltage, DC open voltage, and current drawn by the charging circuit and short circuit current of the solar panel.

Mechanical Engineering Posters

Senior Design I

M01. Bernier Cast Metals - Foundry Swing Boom

Heather Courneya, Jeremiah Winkel, and Randy Allen (Advisor: Dr. Brooks Byam)

Bernier Cast Metals Inc. (BCM) is a foundry located in Saginaw, Michigan, and is in need of a portable lifting device, capable of being transported by a fork truck and as a stand-alone crane for use outdoors. This lifting device is to be made from slightly used materials at BCM, along with some additional purchased materials. This lifting device is being designed to help workers at BCM to pick up and place 100 to 500 pound casts onto a pallet after the shakeout and cleaning processes. Currently, BCM workers do this manually. This lifting device will improve ergonomics for operators, reduce potential disability (injury) claims, improve production and save material handling time. The impact of this lifting device is unique because it's a portable crane that can be moved with a fork truck, as well as sit as a stand-alone unit. The device will be similar to a Jib Crane but offer a portable solution for manual lifting, resulting in improvement of production, workflow, safety and ultimately making BCM more money.

M02. Early Development Mobility Device: Wheelchair-Accessible Swing

Ashley Wondergem, Piotr Kazmierczak, and Adam Lucio (Advisor: Dr. Brooks Byam)

In order to push towards a more integrated society which aids those with disabilities, our team has chosen a project to be carried out with the Melvin G. Millet Learning Center of Saginaw Michigan. The project involves the design and construction of a wheelchair-accessible swing set to give the children at this institution a brand new experience. The swing will feature an easily accessible ramp with secure, retractable straps and a braking system to allow for a safe ride. Keeping the other features consistent, three different braking systems were considered for the swing. After careful consideration, an underground, friction-based braking system was chosen for the design. Since this piece of equipment will be new to the Millet Learning Center, it should have a positive impact on the lives of the students and hopefully show them that their disabilities do not have to completely limit them. The design of the swing will be finalized by April and the desired completion of installation of the swing is July.

M03. BEL Pure shear experiment grips

Justin Rhody, Josh McCurley, and Matt Messing (Advisor: Dr. Brooks Byam)

The pure shear experiment is a very useful experiment when studying the physical characteristics of "soft solids" such as rubbers, elastomers and biological tissues. A pure shear experiment is basically a very wide extension test performed in a uniaxial test system. Pure shear, however, is different than simple extension tests in several ways. First, the sample width to height ratio in pure shear experiments is quite large, on the order of 7 to 1 and greater. Secondly, in a pure shear experiment the sample must be kinematically constrained in the lateral direction. That is, while the sample extends it must not be allowed to contract side to side. This is going to cause the sample's thickness to shrink by the same factor as the extension. This means that if the sample is pulled to 3 times its original height, it will subsequently contract to a third of its original thickness. The grips used to hold the sample need to be able to adjust to the decreasing thickness accordingly, ensuring that the sample does not slip during the test. As such, pure shear grips are being designed to allow for pure shear testing of rubbers, elastomers and other soft solids.

M04. Vermicompost Drying System

Todd Andrzejewski, Dustin Finn, and Josh Hand (Advisor: Dr. Thomas Mahank)

A vermicompost dryer unit is to be designed and developed for the Saginaw Valley State University greenhouse. The greenhouse takes in the used coffee grounds as well as most of the discarded food and other refuse from the campus and places it in a series of worm beds to begin the decomposition process. The worms consume most of the organic material, these results in a large bed of nutritious soil. The soil needs to be dried to a useable moisture level of about 30 weight percent moisture in order to be run through a screener that separates the fine particles from the larger particles. Currently the drying process takes anywhere from a couple weeks to a month to dry the soil form approximately 70 weight percent to 30 weight percent moisture. The dryer designed in this project is required to dry 100lb of moist soil to 30 weight percent moisture in 24 hours or less. Once the soil is dried to the appropriate moisture content it can be ran through a screen in order to separate the particle size. After the screening process the product is then used in the SVSU greenhouse or is sold to the public.

M05. Bay City State Recreational Area Beach Cleanup

Adam Ross, Devin Pashak, and Dave Clark (Advisor: Dr. Brooks Byam)

The beach at the Bay City State Recreation area once was an area that tourists and locals visited to relax and enjoy the water. Now, due to the smell and the feel of the muck beneath your feet, the beach has lost its appeal. Saginaw Valley State University and Duperon Corporation have taken the initiative to design and build a machine that removes the muck in order to restore the beach to a tourist attraction and a place for family fun.

The prototype will consist of a rolling cage that houses the inlet nozzle to an 8 horse power pump. Muck and sand are vacuumed up and pumped tangentially into a hydrocyclone (cylindrical tank) for cyclonic separation. The sand, which has a higher density than the muck, is forced to the inner wall of the hydrocyclone and is washed out the bottom outlet and returned to the bay. The muck is swept out the top of the hydrocyclone through a tube positioned at the center of the cyclone, and is poured onto a filtering conveyor. The conveyor dewaters the muck and dumps it into a holding tank so it can be removed from the water and compacted for disposal.

Mechanical Engineering Posters

Senior Design II

M06. Silverware Sorter for Bavarian Inn of Frankenmuth

Matthew Barrette, Hussain Al Zawad, and Luke Meador (Advisor: Dr. Brooks Byam)

Sorting silverware in a restaurant can be a very time consuming and costly task. The Bavarian Inn Restaurant of Frankenmuth, MI, is a large and very busy restaurant. Sorting silverware by hand is the current method used at Bavarian Inn, and virtually every restaurant. Our task is to design a process or product for Bavarian Inn that can reduce the amount of time needed to sort silverware. This will enable Bavarian Inn to reduce labor costs, better utilize their staff, improve restaurant flow, and provide a better quality of service to their customers.

M07. Huhtamaki Plastics Counting System for High Speed Production

Paul Doherty, Shane Dhooghe, and Bryce Funchion (Advisor: Dr. Thomas Kullgren)

Huhtamaki Inc. is a global producer of paper, plastic, and molded fiber packaging. Huhtamaki's production plant in Coleman, Michigan produces various disposable and reusable plastic products such as cups, bowls, plates, and lids. This facility produces billions of parts annually which must be counted and packaged for sales. For many of its products, Huhtamaki uses a "skip-trim" for its counting and packaging system. A skip-trim part is a part that is purposely miss-trimmed leaving a noticeable flange on the edge of the part. The skip-trim specifies to the packing employee the correct number of parts package. The skip-trim part cannot be sold to customers, so it must be scrapped and recycled back into the production process. The amount of excess scrap produced by the skip-trim process is substantial. These extra scrap pieces require more energy to reprocess and be formed into usable products. Huhtamaki is in search of a new process or product that can count and separate parts for packaging while reducing the amount of scrap produced.

M08. Ceramic Mold Handling System for Acra Cast

David Novak, Mike Fox, and Nate Villaire (Advisor: Dr. Brooks Byam)

Acra Cast, an investment casting foundry in Bay City, demonstrated a need for a new system to handle hot ceramic molds. To accomplish this, a prototype carrier rack was constructed that is adjustable and can hold two to three molds depending on their size. A manipulator was then constructed and suspended below a jib crane to pick up the carrier racks and transport them around the working floor.

M09. Improving a FSAE Racecar Chassis

David Bell, Matthew Griffin, and Devin Heck (Advisor: Dr. Brooks Byam)

SVSU Cardinal Formula Racing (CFR) has a need for an improved FSAE racecar chassis. CFR is a student organization at Saginaw Valley State University. They annually design, build, test, and compete with a racecar in a FSAE competition. In 2012, CFR is competing in a FSAE competition at Lincoln, Nebraska on June 20-23. In addition to chassis design, CFR has never had a method of analytically modeling its chassis. This project lays out the steps in order to design, build, and test a FSAE racecar chassis. The focus of this project will be documenting the design, build, and validation of the chassis to support the team at the FSAE design event. This focus is necessary in order to make the design event semi-finals. This will result in more points that are needed to win. This system is a redesign of the 2011 CFR chassis. A redesign is necessary in order to accommodate the system changes. In addition, analytically modeling the chassis will allow us to strengthen the weak portions of the chassis. This system is the foundation of the car. It has to accommodate all other systems and be torsionally stiff. The chassis must be torsionally stiff so the chassis does not deflect under suspension roll.

B01. Molecular Markers in Hybridization of American Black Ducks and Mallards
Anh Tran (Advisors: Dr. Gail Kantak and Dr. David J. Stanton)

The American Black Duck was once the most abundant duck in North America and a species greatly prized by hunters. However, the geographic range of the American Black Duck currently is shrinking due to habitat loss and possible hybridization with the more abundant and widespread Mallard. Identification of hybrids is difficult, making population monitoring and assessment of the hybridization issue problematic. Using feather specimens from American Black Ducks, Mallards, and hybrids which had been collected from 26 states in the eastern United States, we used DNA fingerprinting to characterize these three populations in terms of several parameters, including allele frequencies, level of heterozygosity, Hardy Weinberg equilibrium and genetic distance. The eventual goal is to be able to identify a suite of molecular markers capable of distinguishing hybrids from the parental species.

B02. New Insect Species Discovered in Michigan
Dr. Stephen W. Taber

Several previously unknown insect species were recently discovered in the swamps, marshes, and forests of Michigan. Illustrations and discussions of examples are provided in addition to the materials and methods of research in the field and in the laboratory.

B03. Molecular Identification of Mycetophilid Species Based on the Mitochondrial COI Gene
Oliver Keller (Advisors: Dr. David J. Stanton and Dr. Stephen W. Taber)

In this study we sequenced and analyzed the mitochondrial partial cytochrome oxidase subunit 1 (COI) gene for two new species of fungus gnats (Diptera: Mycetophilidae) to confirm the validity of *Boletina michigana* Taber and *Docosia walpurga* Taber as new species. Both species were originally described by Taber based on non-genitalic and mainly genitalic morphology. Total genomic DNA was extracted from whole specimens using a DNeasy kit. The appropriate region was amplified by PCR using primers to conserved sequences. Cycle sequencing was performed and sequences were determined in both directions using capillary electrophoresis on the CEQ 8000 (Beckman Coulter). The sequences were used to perform a BLAST search and aligned with known sequences from other insects. The sequences were not found to match any previously known species of mycetophilids in the BLAST database suggesting that these are in fact two new species. Phylogenetic analysis using previously submitted sequences of specimens from the same genera will be used to test these results. The sequences will also be sent to the Barcode of Life project (a DNA barcode reference library) to establish new species records.

B04. DNA Fingerprinting of Lake Michigan Zebra Mussels (*Dreissena polymorpha*)

Benjamin Belkholm* and Aminah Wells (Advisor: Dr. David J. Stanton)

Zebra mussels are an invasive species introduced into the Great Lakes from Europe in 1986. Since then, they have spread aggressively throughout the United States and they have had a dramatic effect on water quality and biodiversity. Genetic studies of invasive species are critical in determining the viability and potential ecological impact of these populations. In order to assess genetic variation, population substructure and patterns of gene flow, samples of zebra mussels were collected from four sites in Lake Michigan and compared to four samples from Lake Huron. DNA was extracted from frozen samples and PCR was performed in order to amplify polymorphic fingerprint loci. The PCR products were checked on agarose gels and analyzed using the CEQ 8000 automated DNA analysis system from Beckman-Coulter. Fragments sizes were determined and genotypes were identified using internal reference standards. The parameters investigated included: number of alleles; observed and expected heterozygosity; population substructure (F_{ST}); and genetic distance (D). The results reveal a great amount of genetic variation and allow for the evaluation of patterns of gene flow in zebra mussel populations in the Great Lakes. The potential for determining the origin of populations in inland lakes and rivers is also examined.

Oral Session B: Electrical Engineering **Room: Pioneer-242**

--From EE Senior Design (See Pages 18-19 for abstracts)

E01. Hybrid Renewable Energy System- Utilizing Solar and Wind Energies
Kayla Scanlon, Abu Bakar Fayyaz, Chris Wheatley, Xiaoqian Meng, and Fadel Aldhaif (Advisor: Dr. Russ Clark)

E02. Encoder Module
Scott Kenyon (Advisor: Dr. Russ Clark)

E03. Instrumentation to Aerate and Extract Air from Liquid Lubricants
Robert Bull (Advisor: Dr. Russ Clark)

E04. Solar Panel Tracker
Mohammed Alrwaili and Mohammed Al-qarni (Advisor: Dr. Russ Clark)

E05. Unit Under Test Control for Nexteer Automotive Validation
Tim Klinesmith and George Kyle (Advisor: Dr. Russ Clark)

E06. PV Laboratory Tool
Jordan Roe and Matt Gehrcke (Advisor: Dr. Russ Clark)

Oral Session C: Mechanical Engineering – I

Room: Pioneer-243

--From ME Senior Design I (See Page 20-21 for abstracts)

M01. Bernier Cast Metals - Foundry Swing Boom
Heather Courneya, Jeremiah Winkel, and Randy Allen (Advisor: Dr. Brooks Byam)

M02. Early Development Mobility Device: Wheelchair-Accessible Swing
Ashley Wondergem, Piotr Kazmierczak, and Adam Lucio (Advisor: Dr. Brooks Byam)

M03. BEL Pure shear experiment grips
Justin Rhody, Josh McCurley, and Matt Messing (Advisor: Dr. Brooks Byam)

M04. Vermicompost Drying System
Todd Andrzejewski, Dustin Finn, and Josh Hand (Advisor: Dr. Thomas Mahank)

M05. Bay City State Recreational Area Beach Cleanup
Adam Ross, Devin Pashak, and Dave Clark (Advisor: Dr. Brooks Byam)

Oral Session D: Mechanical Engineering – II

Room: Pioneer-245

--From ME Senior Design II (See Pages 21-22 for abstracts)

M06. Silverware Sorter for Bavarian Inn of Frankenmuth
Matthew Barrette, Hussain Al Zawad, and Luke Meador (Advisor: Dr. Brooks Byam)

M07. Huhtamaki Plastics Counting System for High Speed Production
Paul Doherty, Shane Dhooghe, and Bryce Funchion (Advisor: Dr. Thomas Kullgren)

M08. Ceramic Mold Handling System for Acra Cast
David Novak, Mike Fox, and Nate Villaire (Advisor: Dr. Brooks Byam)

M09. Improving a FSAE Racecar Chassis
David Bell, Matthew Griffin, and Devin Heck (Advisor: Dr. Brooks Byam)

Oral Session E: Computer Science **Room: Pioneer-240**

CS01. Securing Future Space Missions: Modeling and Analysis of NASA's Mission Software Infrastructure Using Petri-Nets
Amanda Pavlicek (Advisor: Dr. Tai-Chi Lee)

The purpose of this research is to improve the validation and performance of mission safety software within the mission control room, as well as achieving financial objectives and fulfilling governmental regulation while utilizing the best software engineering and project management practices. The implementation of this project will be represented in an analysis paper that utilizes Petri-Nets to portray the enhanced relationships within the mission control software infrastructure. The results of this research will contribute to our understanding of designing a more efficient software infrastructure. With this newly acquired knowledge, NASA organization, once the organization is given the opportunity to restart manned space missions, can push the barriers of space exploration and aeronautical science within the current market's reinforced limitations in future NASA space missions.