Welcome to the 2009 Bucknell Engineering Student Research Symposium. At the core of its mission, the College of Engineering strives to prepare students for entry into the engineering profession, related fields and graduate programs, and for continuing development as highly competent professionals and responsible members of society. The engineering faculty are firmly dedicated to teaching excellence and actively engaged in scholarship in support of our educational mission and their disciplines. When students collaborate directly with faculty on challenging research projects, it brings together these two complementary goals and enhances our ability to fulfill our educational mission. Bucknell provides extensive opportunities for such research, and students and faculty both benefit greatly from these interactions. We are proud to showcase the research activities of our engineering students, and it is a pleasure to celebrate their achievements today.

It is fitting that this symposium is held in concert with the fourth annual College of Engineering Celebration Dinner co-hosted by the Bucknell Engineering Alumni Association, an organization committed to enriching our educational programs and enhancing a wide range of opportunities for our students. We hope that you enjoy this opportunity to interact with our engineering students and faculty, and learn about some of the impressive research they have accomplished together this year.

Sincerely,

Keith Buffinton, Ph.D.
Interim Dean, College of Engineering
Polymer nanocomposites are advanced materials that contain small amounts of nanoscale fillers in the polymer matrix. The physical property improvements in the resulting nanocomposites lead to a wide range of high-performance applications from packaging to automotive parts.

There are several widely-used techniques to fabricate polymer nanocomposites, each with distinct advantages and weaknesses. In situ polymerization and solution mixing require the use of external chemicals in batches, while the high temperature operation in melt mixing can lead to practical issues like polymer degradation and filler re-agglomeration.

Solid-state processing of polymer nanocomposites is a relatively novel method which applies high shear and compressive forces at temperatures below the melt and/or glass transition temperature of the polymer. Solid-state shear pulverization (SSSP) is an industrially-applicable, continuous solid-state process in which polymer/nanofiller blends are pulverized within a chilled twin-screw extruder.

This poster discusses the features of Bucknell’s new solid-state pulverizing system, focusing on the screw setup and feeder design. Mechanical properties of pure polymers are investigated to gain insight into the mechanochemistry occurring in SSSP. Model polypropylene-based nanocomposites made via SSSP are compared with equivalent samples made via conventional melt-mixing processes. Various physical property measurements were conducted to evaluate the processing-structure-property relationships.
Biography

Ben Aldrich is a native of Northern Virginia. He is a junior chemical engineering and economics double major. He is a member of the Bucknell student chapter of the American Institute of Chemical Engineering (AIChE), and has served as the chapter’s webmaster since the fall of 2008. Ben has had internships at ExxonMobil and the consulting firm Booz Allen Hamilton. In 2009 he was inducted to the engineering honor society Tau Beta Pi.
Faced with increased energy usage and growing concern over greenhouse gas emissions, the need for alternative and carbon-neutral fuels is becoming more evident. In order to investigate novel concepts in the utilization of alternative fuels, a complex and secure apparatus to conduct combustion research is necessary. The recently completed Bucknell Combustion Research Laboratory will allow for this cutting-edge research to take place on campus. The apparatus is designed to allow investigation of both gaseous and liquid fuels. Final tasks required to make the Combustion Research Laboratory operational included completion of the atmospheric burner, implementation of a data acquisition system, and the creation of a standard operation procedure. Building off of a previously designed lab layout, the final assembly of the atmospheric burner involved installing and leak-testing piping necessary for the operation of the test section, as well as modifying and fabricating parts for the fuel and air delivery systems. A complex data acquisition system was designed to quickly and accurately collect and record various parameters throughout the testing environment. This involved installing electrical connections for pressure transducers, thermocouples, and flow controllers and creating a LabVIEW program to collect incoming data. After these objectives were met, a standard operating procedure was created to ensure safe initialization of control systems, operation during combustion tests, and shut-down of the apparatus after test completion. This work culminated in several successful test firings with great potential for future work.
Biographies

Michelle Beck is a junior mechanical engineering major from Columbus, Ohio. She is an elected representative of Bucknell Student Government where she serves as 2011 Class Representative, Student Affairs Committee member, and Committee on Complimentary Activities member. She is also a member of Bucknell’s chapters of Society of Women Engineers and American Society of Mechanical Engineers. Michelle spent the summer of 2009 working in Bucknell’s Combustion Research Lab with Professor Christopher Mordaunt and John Stevenson.

John Stevenson is a junior mechanical engineering major from Dallas, Texas. He is an elected member of the executive board of the Bucknell student chapter of the American Society of Mechanical Engineers. John worked this summer in the Combustion Research Laboratory as part of the Bucknell Program for Undergraduate Research. He is a NASA High School Aerospace Scholar, an accomplished photographer, an Eagle Scout, and was inducted into the Alpha Lambda Delta freshman honor society.
The C programming language is a standard, widely used language that has been around for many years. It is well established as one of the main languages to write Operating systems and drivers for the hardware that connects to the computer and needs to communicate with the OS. However, C is a fairly primitive language and lacks the built in safety structure to keep potentially harmful code actions from executing. In this way, the C language is type-unsafe. CLAY, on the other hand, is type-safe, meaning it has built in rules that keep harmful and unsafe code from executing. Instead, CLAY tracks the harmful code at compile time and alerts the programmer of any safety problems with the code. Since drivers communicate with the OS and are vitally important for hardware to properly function, it is very important to make sure the code they contain is safe and will work properly with the OS. Professor Wittie’s goal is to create a complete automatic code translator that takes a given driver written in C and translates it to the type safe language CLAY, thereby creating type-safe drivers. This project started the translation procedures from C to CLAY for all selection statements and functions and many of the repetition statements and functions found in C code.
Biography

Chris Bassett is a Computer Science major at Bucknell University. He first discovered that he enjoyed working with computers back in middle school when he used to play computer games with his friends. In High School, he took his first few classes in computer programming where he learned the basics of computer code and programming languages. He came to Bucknell as an undecided major, but he knew that he would most likely become a computer science major and planned his schedule as if he came in as one. Over the summers after his freshmen and sophomore years, he interned at Raytheon Company in the software engineering department. Over the summer after his junior year he joined Professor Wittie on working on her project to translate software drivers written in the C programming language to the CLAY language. he is now a senior at Bucknell and plan to graduate with a Bachelor of science in computer science and a minor in philosophy.
The goal of this project is to build a software platform for experimental networking research. Recently, there has been a lack of experimental research in certain areas of network communication. One major reason for this is the difficulty of building, testing, and validating solutions in these areas versus the relative ease of simulation. The experimental work that has been done is confined to large mobile platforms, such as notebook computers. The goal of our work is to create an easy-to-use platform that allows researchers to redesign parts of the networking functionality in mobile devices, such as smartphones. These devices are ideal for experimental work because of their small size, light-weight, and low cost. This project is an NSF funded collaborative effort with faculty and students at Virginia Tech.
Biography

Ross is from Murrysville, Pennsylvania. He is a sophomore and part of the first class of computer engineering majors at Bucknell. He is a member of the Bucknell Mobile Autonomous Robotics Club (M.A.R.C) which is designing and building two robots for a national robotics competition next year.
Coatings currently utilized to protect structural aluminum from corrosive environments are harmful and can have detrimental effects on the environment. In an effort to resolve these problems, various hard aluminum coatings applied by the Cold Spray process have been proposed. The Cold Spray process is an emerging technology used mostly in the defense industry. Unlike thermal spray processes such as flame, arc, and plasma where a high energy source is used to heat metal powders to a molten or semi-molten state for deposition, the Cold Spray process uses pressurized gas and unique nozzle designs to accelerate the particles to a critical velocity to achieve a solid state deposition. In this study, the Cold Spray process was used to apply corrosion resistant coatings to aluminum alloys used in the aerospace industry. The corrosion resistance of these coatings was evaluated and compared to the corrosion resistance of the bare and chromate coated AA2024 substrate material. In order to evaluate the corrosion resistance of these coatings, five direct current electrochemical tests were performed. These tests include: open circuit potential, polarization resistance, potentiodynamic polarization, cyclic polarization, and galvanic testing. A rubric is presently being developed to rank each proposed coating based on overall corrosion resistance. Current work entails refining the proposed rubric and ranking each coating versus bare substrate. Results to date indicate that both surface preparation of the substrate and the carrier gas have a significant effect on the corrosion behavior of the hard coatings.
Biography

Ben is a first year graduate student in the Mechanical Engineering program at Bucknell University. Originally from Newport, Vermont, Ben also attended Bucknell for his undergraduate degree where he graduated cum laude in 2009. As an undergraduate, Ben was a member of the varsity football team, the Bucknell Investment Club, and ASME. He started working on the current research project in the summer of 2008. This work to date has resulted in two conference proceedings and a peer review journal publication from phase 1 of this research. Ben is currently working on phase 2 which is focused on the evaluation of sealed coatings.
When working on a project, time and resource management must be accomplished with utmost precision, but the skills needed to do this are often acquired through trial and error. The Project Management Flight Simulator, or PMFS, is a model based in iThink software, and aims to teach students about project management while doing so in a user friendly and economical fashion. In the simulation, users take the role of a PM and are in control of a construction project to build a small four-floor office building. With the help of a computer simulation such as the PMFS, students and project managers alike can run through a scenario with emphasis on factors of their choosing and observe outcomes without any negative repercussions. Each user is tasked with managing the 33 tasks involved in completing the building, picking APMs, allocating time and emphasis on different criteria such as communication with the client, boss, or APMs and project deadlines versus project quality. Through a user’s careful choices and strategies, the project’s completion will most likely come before the deadline and under budget. However, should a user be careless, DEP and OSHA shutdowns, fluctuating client, boss, and APM goodwill, and tens of other potential problems arise that a user must deal with efficiently. Using unique algorithms, many of which utilize randomization, each experience with the PMFS will be different in some way, allowing for repetition without replication.
Biography

Dave Brown is a sophomore from Westborough, Massachusetts and majoring in Civil Engineering. He has been a member of the student chapter of the American Society of Civil Engineers since 2008 and has worked within the Bucknell Civil Engineering Department in the summer of 2009 for research purposes. He is also a member of the varsity Cross Country and Track and Field programs at Bucknell since 2008.
Computational fluid dynamics modeling (CFD) reduces significantly the cost of research/design and provides a large degree of control over experimental parameters. It can be used to develop an accurate model of the effects of scouring around an upright shaft that supports a marine hydrokinetic (MHK) device. Such devices extract kinetic energy from ocean currents with large blades and convert it to electricity, and knowledge of the effects of scouring is important in determining the stresses on their supports.

Constant velocity fluid flow with particles and a free surface is modeled using OpenFOAM, an open source CFD package. The model is comprised of a horizontal cylinder with water running around it in an open channel with several particles initialized downstream of the cylinder. This two-dimensional simulation could serve as a simple model for an undersea pipeline or communications cable resting on a seabed. Simulation parameters were extracted from The Interaction Between a Pipeline and an Erodible Bed, a notable thesis by Ye Mao written in 1986. Results from the simulation are to be compared to this thesis as a means of verification in future work.

Research this past summer involved learning how to utilize and modify OpenFOAM. The structures of several CFD approach methodologies were examined and grid mesh, boundary conditions, and a solver for the cylinder case were extracted. Only a few particles are present in the simulation, but it is hoped that future research will yield a full sediment bed that allows for particle-particle and particle-fluid interaction so the effects of scouring can be observed.
Biography

Brian is a junior mechanical engineering major from New York and Singapore. He has been a member of the Bucknell student chapter of the American Society of Mechanical Engineers (ASME) since 2008. He was a Solar Scholar at Bucknell’s Environmental Center from 2008 to 2009, presenting a workshop to educate members of the public on factors and issues in solar panel selection and installation. In 2007, Brian had industry experience at HDLC Architectural Lighting Design, where he constructed light box models to simulate the distribution of light in a space. He worked on projects such as the Bank of America building and Legg Mason headquarters renovation in New York City. Brian is also an Eagle Scout and assistant scoutmaster in Boy Scout Troop 150 and helps out whenever he is home.
My primary interest in this research project stems from a curiosity of how theoretical relationships are put together and tested in a physical experiment to prove or disprove a theory. This gives us the opportunity to view something in a way that it has never been perceived before. It is known that if you place translucent glass marbles in a column of a clear liquid, (both with the same index of refraction), when the mixture is held up to a light source you will not be able to distinguish between the marbles and the liquid it will appear as only liquid. My main interest is to see if this is possible and if it can be applied to the study of flow through a porous material. Initially there were three objectives in the Matched Index of Refraction (MIR) research. 1) Beads and fluids that have the same index of refraction needed to be found. 2) A test section within a larger test loop had to be developed, and 3) Published research on past experiments had to be reviewed in order to help establish the appropriate sizes for the test section as well as the size of the beads. Borosilicate glass beads will be used due to their index of refraction as well as their ability to be manufactured with high precision. The index of refraction on these beads matched that of Glycerol.

MIR is necessary when measuring the fluid slip velocity at the boundary layer between a free flowing fluid and a porous material. The research is currently a work in progress; the next step in this research would be to build a recirculating flow loop. There are still several parameters that need to be identified to complete the design of the test facility. They include the size of the beads, dimensions of the test section, and power of the pump to keep the loop running efficiently. Once the test facility is constructed, the beads and fluid that have a matching refractive index can be added and can be characterized. The majority of the research this summer was spent analyzing past experiments and experimental facilities, both theory and actual tests, to understand how to best recreate a real life example of a porous material inside of our test section. These past discoveries helped to determine what the next step is for our MIR experiment to make a solid contribution.
Biography

David is a junior Civil and Environmental Engineering major from Darnestown, Maryland. He is a member of the American Society for Civil Engineers. He spent three summers interning in multiple construction management capacities for HESS Construction & Engineering Services and Whiting-Turner Contracting Company in the Washington, DC area. This summer he wanted to explore the research side of Civil Engineering. David is a member of the Varsity Cross Country and Track & Field teams at Bucknell. David enjoyed his summer and the valuable experience of seeing the research side of engineering.
In the brain, glial cells have typically been assigned an auxiliary role. However, recent experiments have indicated that glial cells might directly affect the electric behavior of neurons through bidirectional gap junctions. To examine the mechanism of this influence, we simulated a Hindmarsh-Rose oscillating neuron coupled to a quiescent glial cell through a gap junction. For low coupling strengths (<0.7 pS), both cells exhibited their independent, natural behavior. At intermediate coupling (0.7–11.6 pS), both cells oscillated, synchronizing as coupling strength increased. For high coupling (>11.6 pS), a transition occurred from continuous oscillations, to periods of oscillations followed by periods of quiescence, a behavior termed bursting. In phase space, this transition was modulated by an unstable limit cycle which alternately revealed a stable limit cycle and a stable equilibrium. This type of intermittent bursting behavior has been identified in individual neurons of the hippocampus and cortex and in a network plays an important functional role in central pattern generation and information gating. This study is the first to demonstrate that a neuron-glial system may also burst, which could enable similar computational capabilities in the brain. Future experiments to validate these theoretical findings are needed.
Biography

Eileen is from Chantilly, Virginia. She is a junior biomedical engineering major. She is a member of the Bucknell student chapter of the Biomedical Engineering Society. During the summer of 2009, she learned about the research and design process while gaining valuable experience researching at Bucknell University. She is a member of the cross country, indoor and outdoor track teams at Bucknell.
Ambient atmospheric aerosols are extremely small particles suspended in the air that makes up Earth's atmosphere. Specifically, ambient aerosols are those in the lowest layer of the atmosphere that is populated by people. The sources of ambient aerosols are many, but two of the main ones are cars and other vehicles and cooking (of meats in particular). There are several methods that can be used to collect aerosols, specifically the nature of the substrate's interaction with water can be easily controlled (hydrophobic or hydrophilic), as well as several ways of imaging the aerosols when they have been collected. The two imaging processes used were Scanning Electron Microscopy (SEM) and Atomic Force Microscopy (AFM). SEM shoots a beam of electrons at the surface being imaged, and creates an image based on what is reflected back from the surface. AFM uses a tip that physically touches the surface that is being imaged, so it is able to provide information on the three dimensions of a particle rather than just a two-dimensional image. AFM is also able to provide images at much higher magnification levels with greater clarity than SEM. The substrates imaged were a mix of copper and aluminum (hydrophilic and hydrophobic, respectively) substrates used for collection in several areas in the southwestern United States, and gold-coated mica and octadecanethiol coated gold-coated mica (hydrophilic and hydrophobic, respectively). The gold and octadecanethiol coated substrates were created in the laboratory just before their use for collection to prevent contamination, and the aluminum and copper were sealed in airtight bags for the same reason (they were used for collection in 2006).
Biography

Ethan is a junior chemical engineering major from New Hampshire. He is a member of the Bucknell University student chapter of the American Institute of Chemical Engineers (AIChE) since 2008. This research was his first experience in the field.

A method to characterize local mechanical behavior in small diameter fibers was developed to aid in both improving understanding of structure-property relationships in natural fibers and providing a method for comparing mechanical behavior in natural and biomimetic fibers. The fibers used in this experiment are silkworm and spider silks, as well as mussel byssus threads. These techniques can also be applied to other small scale fibers.

The strain mapping technique being developed in our lab uses a piezoelectric micromanipulator with pulled glass tips, a dye that will bind to the fiber of interest, an inverted microscope with camera, and a custom image processing Matlab program. To begin an experiment, both ends of a small piece of silk fiber are glued to a glass slide. A pulled glass needle (with nominal diameter of 0.1 µm), surface-treated to make the surface hydrophobic (for oil-based dyes) or hydrophilic (for water-based dyes), is then used to apply dye at discrete locations on the fiber. These spots will be tracked during fiber stretching to observe local strains in the fiber. The dyed fiber is placed on an inverted microscope and a glass micromanipulator tip is used to displace the middle of the fiber, straining the fiber in a v-shape. The fibers are also strained in a more linear direction to better analyze the forces applied. As the fiber is strained, a sequence of images is captured using the camera attached to the inverted microscope. The images are then analyzed using a custom image processing program modified from an already developed Matlab program. This software program tracks the dye particles attached to the fiber, computes local strains, and outputs maps of local strains in the fiber. These strain maps can then be used to quantitatively evaluate and compare deformation mechanisms in small-scale fibers. (Note: the Matlab program is still under development at this time).
Biography

Christina is from Rochester, NY. She is a junior Computer Science and Engineering and Mathematics double major with a minor in physics. She is a member of the Bucknell student chapter of both the Association for Computing Machinery (ACM) and Society of Women Engineers (SWE) since 2007. She is a Presidential Fellow at Bucknell, and through this program does research work in both the Biomedical Engineering and Mathematics departments. She was inducted into Alpha Lambda Delta freshman honor society in 2008, and earned a Presidential Award for Distinguished Academic Achievement and Patriot League Scholar Athlete recognition in 2009.
The Small Business Development Center (SBDC) of Bucknell University offers free engineering consultation to businesses all across Pennsylvania. It is the only SBDC office in the state to provide solutions for technical engineering problems. While advised by faculty and staff, undergraduate engineering students work with local businesses to resolve a wide variety of problems that fall within the different fields of engineering. This provides a mutual benefit for the business owner and student—It is an inexpensive alternative to hiring a professional engineering consultation company and it is a valuable learning experience for the student.

A cabinet manufacturing company located in central Pennsylvania was interested in offering additional sizes for their furniture but was unable to test the strength of the proposed sizes until after construction. As an alternative to this build-and-break way of producing a new line of cabinets, the new proposed designs were able to be modeled using Finite Element Analysis (FEA) on computers in Dana Engineering at Bucknell University. FEA method of modeling consists of generating a 3D Computer Aided Drawing (CAD) of the different furniture models and performing a finite number of calculations on these models to determine the position and degree of the deflection under different sets of loading conditions. In addition, the areas of the cabinets containing the maximum stress were able to located and analyzed. From these results, improvements to current design and future guidelines for new construction were determined for the manufacturer.
Biography

Mike is from Northumberland, PA. He is a senior mechanical engineering and Spanish major. During his time at Bucknell, he has been the community service chair of Phi Kappa Psi and an executive officer for Habitat for Humanity during which time he has attended mission trips during spring and winter breaks. He has studied in Madrid, Spain. He is a recipient of the John A. Walls Academic Scholarship and Phi Kappa Psi Scholarship awards.
DEVELOPING AN XML LANGUAGE
FOR CREDIBLE WIRELESS NETWORK SIMULATION

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Ad-hoc network simulation can benefit greatly from the creation of standardized tools and the automatic application of best practices within those tools. Without such standardization and automation, research groups cannot easily reproduce each others’ results when they use different technologies and methods. This project exists in the larger context of the creation of a framework for automating network simulation experiments and focuses specifically on the need for developing formalisms for model description that can be translated for arbitrary underlying simulators.

In our research, we have begun developing an XML-based language with which to describe these models, independently of any simulator program. XML is well-suited to our needs because it is a W3C-endorsed description language, an open and widely-used standard, and accessible through a suite of related technologies – XPath, XSLT, XML Schema, etc. – which are used for querying, validating, and transforming XML data.

We have aimed to implement our model description transformation pipeline in successive layers so that even a novice user is able to quickly produce meaningful research. These novice users can describe a simulation model in the first, most abstract stage, and let the tools in place automatically render simulator-specific script code. At the same time, expert users can choose to edit their model description at stages closer to the final simulator-specific script generation, thereby giving them more control over specific model details hidden from the novice. We incorporate this kind of layering in order to make a multi-user scenario possible. In addition, the overall framework becomes more robust, since input validation is implemented at each layer individually.
Biography

Andrew is from Newark, NY. He is a junior computer science and engineering major with a minor in mathematics. Andrew is a member of the Bucknell student chapter of the Association for Computing Machinery, as well as the Alpha Lambda Delta freshman honor society. Andrew works on campus as a peer writing consultant for the Bucknell University Writing Center. He will be continuing his work with Dr. Felipe Perrone this Fall before leaving to study at King’s College, London, for the Spring 2010 semester.
Blending of two or more plastics can allow for tailored materials with highly tunable and customizable attributes, and are of interest in both industry and research. However, most plastic (polymer) combinations are thermodynamically immiscible and current methods of polymer blend production have significant limitations. In immiscible blends, reactive extrusion or introducing a third “compatibilizer” species can “compatibilize” the resulting systems, but are only applicable to specific polymer families or chemically-modified polymers.

Studies have been conducted using mechanochemical reactions to prompt polymer chain scission, which can generate compatibilizing block copolymers from the component species in situ via free radical formation and recombination. Two techniques which utilize such mechanochemical principles are cryogenic milling and solid-state shear pulverization (SSSP). Cryogenic milling is a batch-scale process in which polymer pellets are contained within a processing vial and ground via a magnetically-driven tungsten carbide impactor. SSSP utilizes a continuous twin-screw extruder operating at below ambient temperatures.

This study focuses on comparing polymer blends made via common melt-state processing techniques to those fabricated through both batch cryogenic milling and continuous SSSP. Current results indicate phase stabilization and compatibilization via both methods.
Biography

Marc is a Chemical Engineer (German minor) from York, Pennsylvania currently involved in the fifth year of an accelerated BS/MS program. When not wooing prospective students on guided engineering facilities tours with his mellow baritone voice, he busies himself by being a teaching assistant for multiple ChemE and German courses, developing new crafting projects for the Craft Center, playing the euphonium in Bucknell’s Symphonic Band, and getting the new Polymer Hybrid Nanocomposites Lab up and running. In the summer of 2007, Marc participated in the Institute for Leadership in Technology and Management, and performed an environmental audit of Playworld Systems, Inc. He returned the next summer to help streamline the instruction of the program, and to start his research into polymer nanocomposites and blends. He is an avid skier and unwinds on long bike rides through the Central Pennsylvanian countryside.
Previous studies have shown normalized kinetic energy \((\frac{1}{2}mv^2/\pi r^2)\) to be a significant predictor of eye injury risk from impact (Duma 2005; Kennedy 2006, 2007). Further research can be systematically conducted to determine the effect of spherical versus blunt projectiles and projectile size at fixed normalized energies, and to correlate internal eye pressure to normalized energy. To perform these tests, a pneumatic cannon with enclosure was designed to achieve a normalized kinetic range of 5-100 kJ/m², which includes energies that inflict a broad range of eye injuries up to globe rupture (Kennedy 2006). Within the enclosure, a cadaveric eye threaded with a pressure transducer is mounted in an acrylic orbit on a load cell. The cannon has been validated with \(~110\) projectile tests across a range of 3.2-17.5 mm diameters. Velocity has been calculated using high speed video analysis at 4,000-8,000 fps and adjusted within \(\pm 2\%\) to account for fisheye error. Proven to offer repeatable and consistent performance with theoretical, the cannon will be used to determine optimal parameters for predicting eye injuries, information of which can be used by the military for evaluation of protective eyewear.
Biographies

Allison Hoch is a senior biomedical engineer, currently working with the SBDC (Small Business Development Center) to assist local businesses and entrepreneurs with patent searches, engineering research, and performance testing. This past summer, she spent performing bio-injury mechanics research at Bucknell University and the summer prior performing material science research at Drexel University. In her spare time, she enjoys biking around the Lewisburg countryside.

Curtis Saunders is a senior mechanical engineer, currently working on an Honors Thesis which involves re-designing a bone quality measurement device. He is also a Thermodynamics and Fluid Mechanics Teaching Assistant. He spent this past summer performing bio-injury mechanics research at Bucknell University and the summer prior helping to design and construct Bucknell’s first Combustion Research Laboratory. He also enjoys working on and driving antique cars and has restored a 1914 Ford Model T which he regularly drives.
The stability of solid oxide fuel cell (SOFC) anodes during cycles of reducing and oxidizing environments (redox cycling) is a critical parameter of durability, particularly for portable applications. The standard Ni-YSZ anode is not stable during redox cycles because the volume of Ni substantially increases upon oxidation. This expansion ultimately results in mechanical failure of the fuel cell. To address this limitation, SrTa_{x}Ti_{1-x}O_{3} (STT) has been investigated as a potential material for redox-stable anodes. While Ni is both an e⁻ conductor and an oxidation catalyst, STT can only provide e⁻ conduction and a separate catalyst must be added. Dense STT and porous STT-YSZ composites, for x = 0.01, 0.05, and 0.10, were sintered in both air at 1873 K and hydrogen at 1773 K. X-ray diffraction (XRD) indicated a single perovskite phase for STT and that STT and YSZ are chemically compatible. Conductivities greater than 1 S·cm⁻¹ were achieved for porous STT-YSZ with x = 0.01 and 0.05 when initially reduced at 1773 K. Without this high temperature reduction, conductivity was too low for SOFC anode applications. STT with x = 0.01 demonstrated the highest redox stable conductivity with a porous conductivity of 0.9 S·cm⁻¹ after oxidation at 1273 K.
**Biography**

William is from Allentown, Pennsylvania. He is a junior chemical engineering major and economics minor. He is a member of the Bucknell student chapter of the American Institute of Chemical Engineering (AICHE) since 2008. As a sophomore, he worked at Lutron Electronics Co., Inc. where he put his engineering skills to work in testing a new product. William is a member of Delta Upsilon fraternity and holds positions as the secretary, Interfraternity Council delegate, judicial board member, and Peer Advisor.
Metal powder products are critical intermediates in many manufacturing processes, where metal powders are compacted and sintered into solid components like automotive parts, for example. Metal powder is often produced from scrap iron off other processes, which may bring with it impurities such as sulfur that build up in the powder manufacturing process. In one instance, a client of the Small Business Development Center’s Engineering Development Services received complaints from a customer of a strong, undesirable, sulfur-like odor resulting from the use of their powdered metal product. It was also observed the odor was present in the solvent used in the client’s manufacturing process. In the work described, samples were taken of the solvent and of several of the metal powder products from both product batches that caused odor complaints and those that did not. Tests were done on the headspace of the samples using flame photometric detector gas chromatography (GC FPD) instrument and methods in Bucknell’s Environmental Lab. Various sulfur compounds were found present in the samples but hydrogen sulfide (H₂S) was identified as the compound of chief odor concern and was found at greater concentrations than other sulfur-containing compounds. Further GC FPD testing was then done to determine the relative H₂S concentrations in the liquid solvent and gaseous headspace phases. After identifying H₂S as the criteria odor-causing compound and determining its relative concentrations in the phases present, experiments were conducted in order to learn how the H₂S might be formed in the system. To emulate conditions that the metal powder might experience in manufacturing and shipping to the customer, the powder products were contacted with solvent, water and strong acid. The gases evolved from these reactions were then analyzed using GC FPD. It was found that contact with the strong acid generated the most H₂S. The presence of acid in the metal powder manufacturing process suggests that this represents the primary mechanism of H₂S generation in the manufacturing process.
Biography

Jeremy is a senior Chemical Engineering major from Denver, PA. He is in his fourth year of employment as a student engineering consultant at the Bucknell Small Business Development Center. He was also able to get work experience at CET Engineering Services, an environmental engineering consulting firm, where he worked as a summer intern for the summer of 2009. On campus, Jeremy has been a member of Tau Beta Pi, an engineering honor society, since the fall of 2008 and has been a member of the Bucknell student chapter of the American Institute of Chemical Engineers since the spring of 2008. Jeremy is also actively involved in InterVarsity Christian Fellowship, where he plays the drums on the worship team.
SEEING “NANO:” THERMOGRAVIMETRY, X-RAY DIFFRACTION, AND SCANNING ELECTRON MICROSCOPY APPLIED TO POLYMER NANOCOMPOSITES

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Visualizing the separation and dispersion of nanofiller within a polymer matrix is key in determining the effectiveness of the processing methods of polymer nanocomposites.

Thermogravimetric analysis (TGA) is used to determine the composition of a polymer nanocomposite by measuring the residual weight after subjecting it to high temperatures. The most prevalent method used to determine the structure of nanofillers within a polymer composite has been X-Ray Diffraction (XRD), which reveals information about the structure by observing the scattered intensity of the x-rays. Although both of these methods provide valuable information about the polymer nanocomposites, a more concrete, direct method of imaging the polymer nanocomposite morphology would be desirable.

The scanning electron microscopy (SEM) has been a promising method of visualizing the nanofillers within the polymer matrix in the submicron level. Although the SEM allows one to observe the minute details on the surface of the polymer, it is still difficult to see the fillers, as they are buried under the base polymer. The top most layer of the polymer needs to be removed so as to expose the fillers for proper imaging.
Biography

Krishna is a fifth-year senior from Sri Lanka, majoring in chemical engineering and management and hopes to pursue a career in pharmaceuticals or the financial industry after graduation. As a member of the American Institute of Chemical Engineers, his research will be presented at the national conference later this year. He is very involved on campus in leadership roles such as serving as the VP-External in the Interfraternity Council and chairing the Committee of Complementary Activities. The leadership roles and the other opportunities that are easily accessible at Bucknell have made the last four years the most memorable in his life.
The Marcellus Shale natural gas formation beneath Pennsylvania has the potential to produce trillions of cubic feet of gas, enhancing the regional economy. Unfortunately, the Commonwealth’s natural waters may be put at risk during the exploration of this exceptionally valuable energy resource. My research has aided the broader efforts towards reducing the possibility for natural water contamination via discharge of large amounts of total dissolved solids (TDS), also known as salts. After being pumped deep into the earth’s surface to hydraulically fracture the shale formation, flowback water rise’s back to the ground surface during gas extraction from producing wells. Throughout my research, flowback water samples from a number of producing wells and a treatment facility in PA were collected and analyzed to characterize pollutants generated from the wells. TDS parameters were analyzed, along with COD, TSS, and BOD$_5$, as well as specific cations and anions using ion chromatography. After characterization, chemical precipitation testing of the flowback water was examined to reduce the TDS requiring subsequent treatment. However, it was determined that conventional chemical precipitation treatment was not effective in significantly reducing the average TDS in the samples, thus, reverse osmosis (RO) is currently being investigated. To produce a “Big Picture” of the effects of the brine water, a watershed model of the West Branch of the Susquehanna was created using GIS and a mass balance system implementing both the chemical and physical characterizations of the wastewater. This watershed analysis suggests there is a need for special facilities to handle the contaminated water from the natural gas extraction. High TDS treatment facilities are in fact being permitted currently by DEP, which is fueling components of my ongoing research this semester.
Biography

Chris Kulish was born and raised in the beautiful state of Pennsylvania. He grew up in a small town, Spangler of western PA, but attended the Milton Hershey School in 2001 and completed the vocational carpentry program there. Since then, he has been a hardworking Civil Engineer, as well as a carpenter for the Bucknell theater department. He spent two summers as Master Carpenter in Middlebury, Vermont, and dove deep into the world of the Marcellus Shale natural gas this past summer. Kulish is the president of the Bucknell Powerlifting club, a member of ASCE, and an avid motorcyclist while adventuring to skateboard, drum, and fly-fish. Throughout his senior year, he is working on graduate level courses in pursuit of a master’s degree here at Bucknell, focusing on designing for construction safety.
A novel microfluidic method is proposed for studying diffusion of small molecules in a hydrogel. Microfluidic devices were prepared with semi-permeable microchannels defined by cross-linked poly(ethylene glycol) (PEG). Uptake of dye molecules from aqueous solutions flowing through the microchannels was observed optically and diffusion of the dye into the hydrogel was quantified.

The microfluidic devices containing PEG microchannels are fabricated using photolithography. PEG solutions of varying water content are used to investigate the effect of hydrogel swelling ratio on small molecule diffusion. The unsteady diffusion of small molecules (dyes) within the microfluidic device is monitored and recorded using a digital microscope. The information is analyzed with techniques drawn from digital microscopy and image analysis to obtain concentration profiles with time. Using a diffusion model to fit this concentration v. position data, a diffusion coefficient is obtained. This diffusion coefficient is compared to those from complementary NMR analysis. A pulsed field gradient (PFG) method is used to investigate and quantify small molecule diffusion in hydrogels.

There is good agreement between the diffusion coefficients obtained from the microfluidic methods and those found from the NMR studies. We demonstrate that the microfluidic method can be used for a wide variety of combinations of hydrogels and small molecules, and both uptake and elution studies can easily be performed. The microfluidic approach allows study of diffusion at length scales that approach those of vasculature, facilitating models for studying drug elution from hydrogels in blood-contacting applications.
Biography

Andrew is from North Potomac, MD. He is in his final year of the combined 3-2 MS/BS Program for Chemical Engineering. Andrew also has a minor in mathematics. Andrew is a member of the American Institute for Chemical Engineers (AIChE) student chapter and has presented research at the AIChE national conference in 2008. Andrew is a certified engineer in training (EIT) and is also a founding member of Bucknell’s club rugby team.
Soil-bentonite slurry trench cutoff walls, or slurry walls for short, are often used in various engineering and environmental applications as hydraulic barriers. Bentonite clay in the slurry wall increases in volume upon hydration with water, reducing the ability of groundwater to flow through the slurry wall, thus resulting in the desired low hydraulic conductivity. However, research has shown that various factors can negatively influence the swelling capacity of bentonite, thereby increasing the hydraulic conductivity of the slurry wall. One such factor involves the chemical properties of liquids permeating through the barrier. Because of these possible negative effects, recent attention has been given to the development and potential use of modified bentonite clays that are resistant to changes in hydraulic conductivity (are compatible) upon contact with water containing high concentrations of salts. The focus of this research study was to examine the effectiveness of two of these “salt-resistant” bentonite products for providing improved compatibility in slurry walls used for geoenvironmental containment. Soil-bentonite mixtures (backfills) were prepared to meet full scale slurry wall backfill requirements using one of two “salt-resistant” bentonites or a conventional (unmodified) bentonite. The samples were then tested in flexible-wall permeameters to measure their hydraulic conductivity. Both water and CaCl$_2$ solutions of various molarities were used to permeate the samples. CaCl$_2$ is a salt that has proven aggressive in negatively altering the hydraulic conductivity of bentonite barriers. In this manner, the compatibility of various bentonites at increasing concentrations of an aggressive permeant fluid could be evaluated. It is hoped that this research will improve the usefulness of slurry walls in many engineering and environmental applications.
Biography

Matthew is a Civil and Environmental Engineering major, with a minor in Engineering Geology. Currently he is completing his fifth year at Bucknell and will graduate with a B.S. and M.S. in Civil Engineering in May 2010. Upon graduation he will be commissioned as a Second Lieutenant in the U.S. Army and will wed his fiancée Gina. While at Bucknell, he served as president of the student chapter of the American Society of Civil Engineers (ASCE) and served as a student representative to the Bucknell Engineering Alumni Association (BEAA).
Poster #22

MARINE HYDROKINETIC ENERGY: POWER EXTRACTION AND ENVIRONMENTAL IMPACTS OF UNDERWATER TURBINES

Justin O’Brien, David D’Alessio, and Laura Beninati, Ph.D

Department of Civil Engineering, Bucknell University
Department of Mechanical Engineering, Bucknell University

Marine Renewable Energy (MRE) by way of tidal turbines is an emerging technology that could help provide clean energy needs for generations. However, the energy is not entirely clean and environmental impacts do exist and must be mitigated for the energy to be truly green. The specific environmental impact that was chosen to study is the sediment transport due to the presence of these devices. The increase in moving sediment causes the turbidity in the water to increase, as well as changes to the bottom of the stream or river. By mapping the change in the river bed, turbines may be modified to be more efficient and create fewer disturbances in the river bed.

A challenge that had to be overcome pertaining to the flume facility was the water depth issue. The flume is only capable of a maximum of 3” of water. In order for the largest model turbine to effectively function, there needs to be 12 inches of water in the flume. To achieve the depth that is required, a tailgate system was designed and installed. Tailgates of different heights were installed and tested to determine the proper size needed for the testing. After a series of tests, a tailgate of 9 inches at a flow rate of between 800 and 900 gallons per minute would provide the twelve inches of water.

Another issue that had to be addressed a “vortex” that formed on one side of the flume and its affect on the velocity profile. The vortex creates a higher velocity on one side of the flume. To negate the effects, the experiment was designed to take place in the center 24” of the flume. Also, large rocks were placed at the inlet of the flume, creating a porous medium or “honeycomb” to straighten the flow.

The turbine was placed into the flume and a velocity field was measured around it.

The future portions of the project will require the turbine to be tested with the sediment in place. Using a method to determine the displacement, the sediment bed will be mapped and noted for any changes that occur due to the flow alteration.
Biography

Justin is a junior civil and environmental engineering major at Bucknell. He is originally from Orwigsburg, PA. He is a member of the local chapter of the American Society of Civil Engineering. Athletically, Justin is a member of the Bucknell cross country and indoor and outdoor track and field teams. He also worked on a project dealing with matched index of refraction during the summer of 2009. In the summer of 2008, Justin conducted research in the field of green certified buildings. After his graduation in 2011, Justin plans to enter industry as a civil engineer with a specialty in either structures or environmental engineering.
Urban modeling can be simply stated as the study of an urban area’s characteristics, in order to better understand that particular location, and how various factors affect the area. Past studies in urban modeling have been performed in wind tunnels to most closely emulate real world conditions; however these conditions operate under the oversimplification of two factors, wind direction and building heights. In this research analysis the simplified model of the drag on buildings was programmed using MATLAB, which is a computer program that allows the user to input codes to run and return appropriate output. The wind force on buildings is equally a drag force on the air, implying that the drag of buildings on the air directly affects the turbulence. This turbulence then impacts pollution transport modeling. In addition, the building heights for this study were assumed to be normally distributed. This research focused on constructing a predicting equation that would determine the occurrence of friction velocity ($U^*$ ratio) due to the surface roughness caused by variations in building heights. $U^*$ ratio represents the ratio of shear stress with varying building heights to shear stress with uniform building heights equal to the mean height of the distribution. After much experimentation the only two variables used in the predicting equation were frontal area index ($\lambda$) and the ratio of the standard deviation to mean building height ($\sigma_{ratio}$) as shown below.

This finding greatly contributed to the study of urban modeling because such analyses could be utilized in policy making to mitigate pollution due to vehicle emissions, minimize potential hazard from both accidental and non-accidental release of toxic gasses traveling by wind, urban planning regulations, green space allocation and even meteorological research. Urban areas easily serve as places with greater employment opportunities for its inhabitants, in effect metropolitan areas tend to attract an influx of people. As a result, urban areas tend to have increased pollution levels due to higher usage of motorized vehicles, whereby the need for accurate modeling of pollutant transport was birthed. Urban modeling research such as this could aid in understanding the extent of pollution, and thereby pass regulations that can help mitigate these pollution levels.
Biography

Winnie Okello is a senior civil and environmental engineering student here at the school of engineering. She was born and raised in Kenya, east Africa until high school, where she attended Whitehall high school in Whitehall, PA. After graduating high school, she studied in Lehigh carbon Community College (LCCC), in Schnecksville, PA, where she earned her Associates degree in liberal Arts through LCCC’s honor’s scholars program. Post graduation she transferred to Bucknell University through the Jack Kent Cooke Scholarship Program partnership with LCCC. Winnie has been a member of ASCE, SWE and NSBE for the last two years and as graduation approaches, she looks forward to working in the water resources or environmental arenas of Civil and environmental engineering. She would eventually like to become involved in environmental policy making in a global context.
Nowadays, countless 3D animated movies are created and released to theaters for public viewing on a now regular basis. As the software that is used to create these 3D tales continues to make advances so does the quality and spectacle of the newer animated films. While considerable time needs to be spent on the story construction, there is a complex and difficult process that goes into developing the digital assets and animation required for a 3D movie. I chose, using Blender 3D as my software of choice, to study the complete process, going through the entire production pipeline process that goes into making 3D worlds and character by making a 5 minute animated short, titled “Creative Chaos.” This included the necessary storyboarding, vertex modeling, texturing and shading, rigging and skinning (the process of attaching an armature to a 3D model), animation, particle effects, lighting, rendering, sound creation, compositing, post production, and exporting to the movie to a viewable medium (DVD). My vision for “Creative Chaos” was that it would present an interesting short story set in creative and imaginative environments. The artistic concept and design of the project were enhanced with the use of carefully placed lights and the addition of ambient occlusion, shadow generation, detailed environmental textures, sound effects, advanced particle simulations, and non-linear armature animation.

I have continued my research past the completion of this animated short, going on to study the program’s physics simulation capabilities, game logic, and capabilities to create much more advanced and detailed 3D models and animation. This further research will culminate in another animated short called “The Pit and the Pendulum” based on Edgar Allan Poe’s original short story.

The software applications that were used during the research were Blender 2.45, Gimp Portable, Gimp 2.2, Audacity Portable, and Windows sound recorder (all open source programs, except Windows sound recorder, freely available for download). Digital cameras and scanners were also used to import my sketches into the program for use in vertex modeling (and to import images into the program for certain textures).
Biography

Alex is from Silver Springs, Maryland. He is a freshman Computer Science and Engineering major. He is a member of the technology support for Bucknell’s Issues of the 21st Century program. He has worked with 3D modeling for four years, starting with basic animation and dynamic simulation in AutoDesk Inventor. For the past two years, he has worked with 3D animation using programs such as Blender, AutoDesk Viz, and AutoDesk 3Ds Max. Alex also practices 2D art, both in traditional and digital forms, using Gimp Portable as his tool of choice for digital photo manipulation.
Microfluidic devices can be used for many applications, including the formation of well-controlled emulsions. In this study, the capability to continuously create mono-disperse droplets in a microfluidic device is used to form calcium-alginate capsules through a suspension polymerization in an oil solution from aqueous droplets of calcium chloride and sodium alginate. Calcium-alginate capsules have many potential uses, such as immunoisolation of cells, microencapsulation of active drug ingredients, and encapsulation of bitter agents in food or beverage products. Capsule formation is accomplished through fusion of a sodium alginate droplet and a calcium chloride droplet. The high surface tension between the droplet of calcium chloride and sodium alginate necessitates the use of the surfactant sodium dodecyl sulfate (SDS) and a soft lithography device with a judiciously designed geometry. After creating the capsules, it is necessary to separate them out of the oil solution and into an aqueous solution. A common method of separation is centrifugation, which can damage both the capsules and the cells inside. The use of a microfluidic device with channel walls of disparate hydrophobicity is used to stabilize co-laminar flow of an oil phase and an aqueous phase. The disparity of hydrophobicity is accomplished by defining one side of the microfluidic device with the hydrogel poly (ethyl-glycine) (PEG), which adheres to the glass surface through the use of 3-(trichlorosilyl)-propyl methacrylate (TPM). Due to the difference in surface energy within the channel, the aqueous stream is stabilized near PEG-DA and the oil stream is stabilized near a hydrophobic resin (optical adhesive). The technique of passive separation using co-laminar flow has shown promising results in separating the calcium-alginate capsules from the oil phase and into the aqueous phase. The separation device has also shown potential for applications in extraction, specifically extracting a dye from a hydrophobic fluid into a hydrophilic fluid during co-laminar flow within the channel.
Biography

Renee is a fifth year combined Bachelors/Masters Chemical Engineering major with a minor in Biomedical Engineering. She has been a member of Bucknell’s chapter of American Institute of Chemical Engineers (AICHE) and Society of Women Engineers (SWE) since 2006. She presented her research at the AIChe National Conference in November 2008 and the AIChe regional conference in April 2009. During the summer of 2007, she interned at Frito Lay, Inc. under the direction of a processing engineer at a manufacturing plant in York, PA. During the summer of 2008, she gained research experience through NASA’s Summer Internship program at the Glenn Research Center located in Cleveland, Ohio. She has also been a teaching assistant for Bucknell’s Chemical Engineering and Chemistry departments since 2007.
Printed Circuit boards (PCB’s) play an important role in many of today’s technologies because they are the foundation for complex electronic circuits. The focus of this research project was to build a cost-effective circuit board for use in small mobile robots. A small mobile robot needs different sensors to orient itself to its surroundings, a computer to process the information received from the sensors and motors to take appropriate action based on the information processed. It also needs a simple interface so that software programmers can write and download programs to the robot easily. Different hardware platforms and robotic starter kits are currently available for purchase. However, these platforms are often too expensive and have numerous restrictions that make the use of a wide range of sensors and motors nearly impossible. The Handy Board is one of the most popular and powerful robotic controllers available in the marketplace. This device is very powerful and has many advantages, but it is also very expensive with a selling price around $300. The board also has a built in power supply, which limits the amount of current available to drive different commercially available motors. Another equally popular circuit board is the one used for Lego Mindstorms. This circuit board is half the price of the Handy Board, but it has a lot of restrictions. It can only support up to three sensors and can only power small Lego motors. The end result of this research was a very general processor board with a raw cost of about $50.
Biography

Billy Raska is from Bridgewater, New Jersey. He is a sophomore electrical engineering major and legal studies minor. He is a member of the Bucknell student chapter of the Institute of Electrical and Electronics Engineers (IEEE) since 2008. He is a member of Alpha Lambda Delta freshman honor society, inducted in 2009. He is also the president and cofounder of the Mobile Autonomous Robotics Club (MARC). He recently received the Jeffrey James Harold Prize for being the first year electrical engineering student with the highest cumulative grade point average. Outside of engineering his greatest interest is Frisbee. Currently, he is the captain of the Discbusters intramural Frisbee team. Recently, he also just organized a dodgeball intramural team.
Transporting information using light signals guided using total internal reflection forms the backbone of modern telecommunications. As devices that process optical signals get smaller the polarization of light becomes increasingly important. Polarization Splitters are often used to deal with this problem. Unpolarized light is inputted into the device. There are two outputs, one containing only Transverse Electric (TE) polarized light and the other containing only Transverse Magnetic (TM) polarized light. A silicon material based polarization splitter on Split Ridge Waveguide (SRW) has been designed. A directional coupler is used for splitting. TE and TM polarizations have a large difference in coupling length due to the SRW structure. The proposed splitter demonstrated extinction ratio above 20 dB for both TE and TM polarizations, excess loss below .04 dB, at a length of 390 m.
Biography

Jonathan Salmans is a senior at Bucknell University pursuing a dual degree in electrical engineering and economics. Past research projects have included work on designing a polarization splitter with Prof. Lin (Summer 2009) and designing the electronics for a swimming robotic fish (Summer 2008). On campus he currently serves as a TA for Physics 211 and is active in Intervarsity Christian Fellowship.
Aggradation, or sediment deposition, is a very common problem at many bridges crossing small streams in the Susquehanna River watershed. Modifications to the channel near a bridge crossing can lead to the extensive deposition of sediment in the bridge waterway. This partial blockage of the bridge waterway poses serious safety problems to the overall bridge structure. The most common solution for aggradation in Pennsylvania is to dredge the stream channel frequently. While this mitigation procedure is successful in clearing some of the sediment that is blocking the waterway, it also creates conditions that promote further sediment deposition at the bridge. Sediment transport and bridge hydraulics need to be investigated to determine a more sustainable solution to aggradation at bridge crossings. The main goal of the presented research was to initiate monitoring sites to measure changes in stream bed elevation. This data will then be used to develop mathematical models of the sediment transport processes at these bridge crossings. The current bridge design guidelines focus on the transport of just the water through the bridge waterway. The monitoring and mathematical modeling of sediment transport at bridges will help inform bridge design guidelines that account for the transport of sediment through the bridge waterway in addition to the water.
Biography

Brian Schultz was born on August 15, 1988, in Lewisburg, PA. He grew up five miles outside of town on Shamokin Mountain. Brian graduated from Lewisburg Area High School in 2006 and attended The Pennsylvania State University, University Park campus the following year. There he was given early acceptance into the Civil Engineering Major. After one year, he transferred to Bucknell University in 2007 as a sophomore in Civil & Environmental Engineering. Over the summer of 2009, Brian participated in a research program at Bucknell University sponsored by the Michael Baker Corporation. He plans on continuing his education after graduation and attending Bucknell for his Masters in Engineering. Afterwards, Brian would like to find a job around the Lewisburg area, and settle down.
Misconceptions exist in all fields of learning and develop through a person’s preconception of how the world works. An example of a misconception is to believe a floor tile is at a lower temperature than a carpet when they are both in the same room. The two are actually at the same temperature, but the tile absorbs heat from the body more quickly giving the impression that it is colder. The purpose of this research was to repair misconceptions in thermodynamics by using inquiry-based activities. Inquiry-based learning is a method of teaching that involves hands-on learning and self-discovery. Previous work has shown inquiry-based methods result in better conceptual learning by students relative to traditional lectures. The thermodynamics activities were designed to guide students towards the correct conceptual understanding through observing a preconception fail to hold up through an experiment or simulation. The developed activities focus on the following topics in thermodynamics: Internal Energy versus Enthalpy, Equilibrium versus Steady State, and Entropy. For each topic, two activities were designed to clarify the concept and assure it is properly grasped. Each activity is described in a packet containing experimental instructions as well as pre- and post-analysis questions. All activities and packets were designed to be performed as a hands-on experiment or simulation in a small group, requires students to write down a prediction before performing the experiment, requires students to explain their observations and compare them to their prediction, and draws the students’ interest. Preliminary data were collected this summer and showed an improvement in conceptual understanding for students with misconceptions. Currently, the activities are being tested on a large scale at a number of universities.
Biography

From Mahwah, NJ, Jeffrey Stein is in his fifth year at Bucknell and will receiving both a bachelor’s and master’s degrees in chemical engineering. He gained work experience in the summers of 2006 and 2007 while working in quality control for a skin care and cosmetics company. Through his junior and senior years, he performed research in hydrogels for Professor Vogel and Professor Maneval. In addition to his academics, Jeffrey also plays French horn in both the band and orchestra as well as play sports. He is currently on the club baseball and roller hockey teams.
Poster #30

THE EFFECTIVENESS OF BENDWAY WEIR STREAM RESTORATION STRUCTURES AT BRIDGE CROSSINGS

Ben Stodart, Advisor: Jessica Newlin

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Many of the bridges in the Northern Tier region of Pennsylvania have partially-blocked bridge waterways due to the deposition of gravel to cobble-sized sediment. Channel modifications that were made near the bridge crossings create flow conditions that cause the stream sediment load to be deposited in this reach. Previous means of addressing this process were primarily limited to dredging the stream channel to improve flow, but a new approach to redirecting the flow through bridge openings involving in-stream restoration structures has been researched. The overall purpose of this study was to analyze the hydraulic performance of bendway weirs in a natural river at various flow stages. Our proposed research would yield a three-dimensional data set for evaluating fluid flow dynamics for several flow rates. The first phase of this research was to scale available data from Mitchell Creek and Morgan Creek, located in the Northern Tier Region of Pennsylvania. Once scaled to fit the available facilities, a physical model was constructed along with different weir configurations to measure a range of velocity fields. The three-dimensional velocity measurements were obtained using an Acoustic Doppler Velocimeter (ADV). After the data was collected at various locations throughout the weir configurations, the velocities were compared to determine if the weirs had influenced the velocity field. The results show that the weirs were effective at increasing the flow velocity in the center of the channel in some cases. This implies that bendway weirs installed on river banks could create higher velocities that can transport sediment through the bridge waterway. The natural transport of sediment through the bridge opening would eliminate the need for dredging of the channel. Further data analysis is ongoing, as we are investigating the effects of the increased flow velocity on the shear stress being applied to the channel bottom.
Biography

Ben Stodart is from Houtzdale, Pennsylvania. He is a senior enrolled in the Civil and Environmental Engineering Program at Bucknell University. On campus he has been involved with American Society of Civil Engineers (ASCE), Bucknell Rifle Association, and the Bucknell Powerlifting Team. In the summer of 2007 and 2008, he interned as a bridge inspector with the Pennsylvania Department of Transportation, gaining valuable insight into the many issues threatening the safety of country’s bridges including pier and abutment scour. Upon graduation he hopes to attend graduate school in the Northeast. Eventually he would like to work for either the federal government or a private firm design stormwater management systems or flood control systems.
Simulation has been an important resource for functional and performance analyses of computer networks. Although the number of widely adopted network simulators is small, new ones continue to be created to address gaps in the functionality of existing tools. It can be argued, however, that the greatest need of the scientific community is to raise the credibility of published simulation studies. Our research demonstrates that this need can be addressed by enabling network simulators to provide fool-proof automation of the experimental process. Ideally, the simulator’s interface would provide users with an environment to minimize set up time for experiments and to guarantee their reproducibility, and to safeguard the statistical rigor of data analysis. In our work we derive a set of requirements for automation tools from recent literature and from our own experience in tool construction. Once these requirements are fulfilled, network simulation tools can have a stronger impact in education, in carrying out large simulation studies, and in enhancing the credibility of simulation results.
Biography

Bryan is a Junior from Springfield, Virginia. He is a 2007 graduate from Thomas Jefferson High School for Science and Technology in Fairfax Virginia. He is now simultaneously pursuing a BS in computer science and engineering and a BA in mathematics. Bryan was inducted into the Alpha Lambda Delta national freshman honor society and is the co-Secretary and Treasurer for the Pi Mu Epsilon national honorary mathematics society. He has conducted research in collaboration with Professor Felipe Perrone at Bucknell since the fall of 2007, including the summer of 2008 under the Bucknell Program for Undergraduate Research. He was sponsored by the university to travel with Dr. Perrone to Avignon, France in the fall of 2008 to present their work at the IEEE International Workshop on Selected Topics in Mobile and Wireless Computing (STWiMob 2008). Bryan is also a 2009 recipient of the prestigious Barry M. Goldwater Scholarship.
Poster #32

EFFECT OF CRACK OPENING
ON PENETRANT CRACK DETECTABILITY

Devn Weaver, Mentor: Willard L. Castner

Structural Engineering Division
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Johnson Space Center (JSC) has several sets of Probability of Detection (POD) specimens. These sets consist of titanium plates with fatigue cracks of known length and location. The sets are used to find a quantitative measure of the efficiency of a non-destructive evaluation procedure. The usual metric is that for a specified crack length there is 90% chance of detection with a 95% confidence. The goal of this project was to investigate some of the questions regarding the JSC POD specimens that resulted from their recent use to certify inspectors of NASA contractors. In order to evaluate the titanium POD specimens, a procedure for conducting fluorescent penetrant tests in the lab and documenting the indications was developed through several iterations. The main concern about the JSC POD specimens was their rather large “V” shaped crack-opening from the etching procedure that was used to remove smeared metal. This “V” shaped opening exists for several thousandths of an inch deep and could significantly affect the detectability of the cracks. By incrementally sanding off one-thousandths of an inch from the surface of a POD specimen, a better understanding was gained of how the “V” shaped crack opening affects fluorescent penetrant testing. Scanning electron microscope photographs and fluorescent-dye penetrant tests with high-magnification images were used to document the crack at each level until five-thousandths of an inch was removed. This investigation revealed only a slight decrease in the effectiveness of fluorescent penetrant testing with a smaller crack width.
Biography

Devin is a senior mechanical engineering major and physics minor. He has been a member of the Bucknell student chapter of the American Society of Mechanical Engineering (ASME) since 2006. In the summer of 2009, he was able to get some work experience in the aerospace industry as he interned at Johnson Space Center in Houston, TX through the Pennsylvania Space Grant Consortium. He is vice-president of the Bucknell Outing Club. He was also involved with the development of Bucknell’s first combustion laboratory and is planning on using the laboratory to conduct an Honors Thesis in conjunction with Christopher Mordaunt, Ph.D.
Poster #33

BRIDGE DESIGN AND CONSTRUCTION.

Grant Weekes

Princeton Jct., NJ 08550

The bridge I built was for a small nature preserve near my school. The creek I was to span at the time had only a few 4X12 boards with 2X4 planks nailed to the bottom for a bridge. This low board-walk barely cleared the marshy ground, and was often flooded during rain. Ken Carlson and Kevin Appelget are both involved with the state department and the upkeep of preserves; they told a classmate of mine that a new bridge needed to be built. Soon after my classmate, Jenny Yu, announced to the A.P. Physics classes in my school that those interested in making a bridge had an opportunity to do so. A few other students and I showed interest. Months later summer was nearing and nothing had been presented to Ken and Kevin. My patience with the immobility of the process stopped one night and I drew up some designs. After a few revisions I sent them in. I based the designs on a bridge in a large park behind my house. The designs were approved and I got the go ahead to build as long as I used galvanized hardware and pressure treated wood. I did not do too many stress calculations in my design, but I did make sure to build a bridge which I knew would withstand many times what could be expected. There was some vacillation in what type of girders I would use, but nothing which further delayed the construction. A couple days after buying the wood and hardware the bridge was completed to design.
Biography

Grant is from Princeton Junction New Jersey. He is a Freshman Mechanical Engineer. His experience with Engineering is limited to construction done for recreation and what he has learned at Bucknell. Grant plans on joining American Society of Mechanical Engineers. Grant hopes to become very involved outside of the classroom in Mechanical Engineering. Outside of class Grant spends his time working stage crew, playing club Frisbee, and dancing with Jelani. Grant also ran long distance throughout high school. His hobbies include Nerf gun Modification, wood working and BMX riding.
Quantum dots (QD) are semiconductor nanocrystals that have size-dependent absorption and fluorescence emission properties. The color emission is dependent on the band gap of the material, which is related to the electromagnetic energy released. Depending on the size of the band gap, the fluorescence can range from ultraviolet to infrared. Currently, most quantum dots are made of cadmium selenide (CdSe) cores and a zinc sulfide (ZnS) shell. The zinc sulfide shell is added to enhance the fluorescence, protect the cadmium selenide and allow ligands to be added that can make the quantum dots water soluble and able to be functionalized with other molecules. Microwave synthesis is used, decreasing the energy required to drive the reaction and creating a narrow size distribution of nanocrystals. The reaction time and temperature determines the size of the nanoparticles, and thus the color emitted. A new method for synthesizing the nanoparticles was developed, which involves injecting the selenium precursor at the reaction temperature. This new method gives greater control over the reaction temperature and time and allows for the production of smaller CdSe quantum dots (more blue), which was not possible before. The use of oleylamine in dissolving the cadmium precursor was eliminated, replacing it with a small amount of octadecene and oleic acid. Using this procedure, samples of CdSe nanoparticles at reaction temperatures ranging from 130°C to 170°C were synthesized. After measuring the fluorescence of each sample, it was found that the CdSe quantum dots made at a temperature of 150°C had the highest fluorescence peak. It was also found that as the reaction temperature increased wavelength at the maximum increases and full width at half the maximum (FWHM) decreases, indicating that the quantum dots become larger and the size distribution becomes narrower as reaction temperature increases. This new method for producing CdSe nanoparticles can be applied to nanoparticles made with other metal precursors. Zinc selenide (ZnSe) quantum dots were successfully produced using this same method.
Biography

Sarah is a junior in Chemical Engineering with an intended minor of Biomedical Engineering. She began research during the summer of 2009. She is a member of the Bucknell student chapter of the American Institute of Chemical Engineering (AIChE) since 2007. She is also a member of the Alpha Lambda Delta honor society, inducted in 2008.
Field-Programmable Gate Array (FPGA) is an integrated circuit designed to be configured by the customer or designer after manufacturing — hence “field-programmable.” FPGAs can be used to implement any logical function that an application-specific integrated circuit (ASIC) could perform. FPGA offers the flexibility of a general-purpose processor and the performance of an ASIC at a relatively low cost. Therefore, FPGA is very useful in research to execute high-performance computation. The goal of this project is to implement a Boolean function classification algorithm on an FPGA board. The algorithm chosen is spectral classification. It takes the $2^N$ bits truth table from an $N$-input Boolean function and multiply it with an $N \times N$ matrix to get the function’s spectrum. Then a combination of five types of operations is executed on the spectrum to convert the spectrum into a canonic form. All $N$-input Boolean functions can be classified into different classes that each has a unique canonic spectrum. Due to the fact that the magnitude of the classification problem increases double exponentially, it becomes impossible for general-purpose processor to handle the task when $N$ increases. It is possible for FPGA to handle this task because of its parallel nature and speed that is comparable with ASIC. To illustrate the advantage of FPGA, same algorithm is implemented in Java on a modern PC and in C on a PowerPC processor. The performances of three platforms is measured and compared.
Biography

Hao is from Changzhou, China. He is a sophomore computer engineering major. Academically, he is a hard-working student with very good grades. Although he is not affiliated with any professional society or honor society, he actively seeks research and work opportunities related to his study. He did undergraduate research with Professor Nepal during the past summer and is continuing to do research with Professor Nepal this semester. He is also an Alumni of Society and Technology Residential College. Outside classroom, he is the treasurer of Chinese Cultural Association and active member of Students for Asian Awareness at Bucknell and Shotokan Karate Club.
The Engineering Student Research Symposium was born out of the desire to replicate, for students, the national-level conference experience without leaving campus. Originally funded through the General Electric Faculty For the Future program, all engineering students who have conducted research with a Bucknell faculty member or at an off-campus program were invited to submit abstracts for publication. Students then prepare their work in the form of a poster to be shared an educated national audience (you!). This allows students to exercise their presentation and networking skills in a manner similar to that found at larger conferences without ever leaving campus. Audience members will also benefit, by having a chance to learn more about the exciting work pursued by Bucknell engineering students.

We hope that you enjoy this sixth Bucknell Engineering Undergraduate Research Symposium, and we welcome your comments and suggestions on how this activity might improve for the future.

We wish to thank Dean Buffinton, Stephanie McKinney, and General Electric for their help bringing this symposium to reality.

Dr. Margot A. S. Vigeant, Associate Professor, Chemical Engineering and Associate Dean of Engineering
Dr. Karen T. Marosi, Associate Dean of Engineering
Lois A. Engle, Assistant to the Dean
Poster session organizers