WILLAMETTE UNIVERSITY

Science Collaborative Research Program Symposium

Student Presentations
Friday, September 13, 2013
Ford 102 & 122

Willamette University
SCIENCE COLLABORATIVE RESEARCH PROGRAM
Symposium
September 13, 2013
Ford 102 Schedule

3:15 - Alexandria Parsagian - A Permanent Magnet Zeeman Slower for Calcium - Improving Ultracold Calcium Trapping Efficiency for Creation of RbCa Molecules

3:29 - Chris Luetjen - Using a Diode Laser System to Measure the Index of Refraction of Thin Layers, and Creating Blue Laser Light

3:43 - Kendra Schmal & Annika Hagelin - Data Assimilation Techniques

4:03 - Brendan Dwyer - Modifying an NtRac1-Containing Construct to Determine Whether Heat Interferes with Auxin-regulated NtRac1 Localization

4:17 - Megan Nanry - Regional Personality Differences in the United States: A Comparison of Three Competing Paradigms

4:31-4:57 BREAK & GROUP PHOTO

4:57 - Rhys Ormond - Geometric Morphometric Analysis of Symmetry in *Camassia* in Hybrids

5:11 - Kaliko Gadson & Natalie Amo - Vespertine Flowering in *Camassia*

5:31 - Taylor Gee - The Synthesis of a Sugar Derived (bis)Oxazoline Ligand for the Asymmetric Catalysis of Henry Reactions

5:45 - Alexander Klementiev - Smoking Out Genes from Tobacco Plants: Isolation, Cloning, and Sequence of Partial cDNAs for Auxin-related and Potential qPCR Reference Genes from *Nicotiana glauca*

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Ford 122 Schedule

3:15 - Megan Newcomb - Purification and Characterization of Isoprene Synthase from the Moss *Campylopus introflexus*

3:29 - Anna Freitas & Madeline McClelland - The Role of Soil Nutrients and Moisture in Determining the Success of Prairie Restoration at Zena

3:49 - Theo Kataras - Harmonic Analysis of Treadmill Walking for Fall Risk Assessment in Older Adults

4:03 - Christina Johnson - Playing with *Caulobacter* Mucus: Determining the Genetic Basis of Bacteriophage Resistance

4:17 - Emily Harvey - Sugarcoated Bacteria: An Investigation of Exopolysaccharide in *Caulobacter crescentus*

4:31-4:57 BREAK & GROUP PHOTO

4:57 - Rebekah Daniel - Elucidating the Role of Myosin VI in Retinal Pigment Epithelium Cell Phagocytosis

5:11 - Margaret Ruwitch - Rapid Stepping Tests Challenging Medial-Lateral and Anterior Control of the Trunk as an Assessment of Stepping Performance in Older Adults

5:25 - Rebecca Josephson - NAMI-A Binding Interactions with $tRNA^{Phe}$

5:39 - Colin Stewart - Do Hybrids Collapse? Using Microsatellite Genotyping to Study the Viability of Hybrid Joshua Trees

Abstracts
Alphabetical by last name

Rebekah Daniel
Co-Author: Bianca Nagata

Elucidating the Role of Myosin VI in Retinal Pigment Epithelium Cell Phagocytosis

Mentor: David Altman
Department of Physics

The goal of this research is to determine the role of myosin VI in human retinal pigment epithelium (RPE) cell phagocytosis, a process vital for proper eye function. To do this, cultured RPE cells were made to over-express engineered myosin constructs with perturbed motor function. Polystyrene beads were then introduced to the extracellular environment and were phagocytosed by the RPE cells. We observed that, when the RPE cells were transfected with the perturbed myosin constructs, the rate of trafficking was significantly reduced compared to control cells. Thus, we demonstrated that myosin VI plays a role either directly or indirectly in RPE phagocytosis. We are now repeating these experiments while using an optical trap to apply a perturbing force to the internalized beads to test whether myosin VI specifically plays a role in generation of forces during this process. By observing the trafficking rates of the beads in the presence of external forces, we hope to gain a clearer picture of the possible forces myosin VI produces during the phagocytic process.

This work was completed as part of the Willamette University Science Collaborative Research Program and supported with generous funding from the Mary Stuart Rogers Foundation.

Brendan Dwyer

Modifying an NtRac1-containing Construct to Determine Whether Heat Interferes with Auxin-regulated NtRac1 Localization

Mentors: Gary Tallman & Colin Wilson
Department of Biology

The plant hormone auxin controls many developmental processes in plants including cell wall formation, cell expansion, and cell division. Prolonged heat blocks auxin-signaled responses in cultured guard cell protoplasts of *Nicotiana glauca* (tree tobacco), but the point at which signaling is blocked is not known. Rac GTPases such as NtRac1 mediate auxin-responsive gene expression and are thought to localize proximal to membrane receptors for various extracellular signals. Before testing the hypothesis that heat reduces the capacity of auxin-activated Rac GTPase localization, NtRac1 plasmid reporter constructs required remodeling. A wild-type construct containing an auxin-activated Rac GTPase (NtRac1) isoform and a green fluorescent protein (GFP) gene, which yields a thermolabile GFP, was remodeled to produce a constitutively active form of NtRac1 and mGFP5, which produces a thermostable GFP. This NtRac1-CA construct was created by single base pair site-directed mutagenesis; mGFP5 was inserted in place of GFP by restriction digestion and fragment insertion and ligation. Experiments to remove a constitutively active CaMV35S promoter and replace it with a dexamethasone-inducible (Dex) promoter are in progress so that the timing of NtRac1-CA production can be controlled in target cells.

This work was completed as part of the Willamette University Science Collaborative Research Program and supported with generous funding from the National Science Foundation.

Anna Freitas & Madeline McClelland

The Role of Soil Nutrients and Moisture in Determining the Success of Prairie Restoration at Zena

Mentors: Karen Arabas & Briana Lindh
Department of Earth & Environmental Science

Restoration of Willamette Valley upland prairies often fails in valleys and in the shade of trees, suggesting that restoration outcomes are influenced by soil moisture, depth and/or nutrient levels. To understand this pattern, we recorded abundance of all plant species and tested soil moisture, nitrate and phosphorus levels at 100 plots within Zena's restoration sites. We found a significant positive relationship between soil moisture and abundance of *Holcus lanatus*, but significant negative relationships between soil moisture and abundance of *Plantago lanceolata* and *Agrostis*, all of which are exotic species. This finding may allow us to predict which sites will be dominated by the exotic grass *Holcus lanatus*, and thus to develop specific management plans for these wetter microsites. In preliminary results, abundances of the exotic grasses *Agrostis* and *Cynosurus echinatus* were positively correlated with soil nitrate, while abundances of two native plants, *Eriophyllum lanatum* and *Sidalcea malviflora* were negatively correlated with soil phosphorus. Based on sizes of transplanted natives in herbicided and non-herbicided plots, competition from exotic grasses appeared to have a more negative effect on the natives *Eriophyllum lanatum* and *Potentilla gracilis* where nitrate levels were higher. These correlations suggest that high levels of soil nutrients may allow exotic species to out compete natives, but further research is necessary to rule out confounding variables. Nitrate is positively correlated with both soil moisture and depth, for example, so these correlations may not be due to the nitrate levels *per se*.

This work was completed as part of the Willamette University Science Collaborative Research Program and supported with generous funding from the Mary Stuart Rogers Foundation.

Kaliko Gadson & Natalie Amo

Vespertine Flowering in *Camassia*

Mentors: Susan Kephart & Kathryn Theiss
Department of Biology

Botanists studying the genus *Camassia* have focused primarily on its morphology and phylogenetic relationships. In terms of flowering, its species are traditionally considered to be diurnal (day-blooming), but it is now known that various species of *Camassia* are, in fact, vespertine (evening-blooming). The goal of this study was to create a baseline of information describing vespertine populations of *Camassia*. Our data focused on exploration of how they compare to diurnal populations with regards to anther and stigma receptivity, flowering cycles, pollinator visitation, and reproductive fitness. For both diurnal and vespertine populations, we examined the timing of anther and pollen presentation throughout the day; observed pollinators, recording visitation frequency, duration, and visitor species; and evaluated fruit and seed production. We found statistically significant variation in pollinator visitation between diurnal and vespertine populations. Comparisons between plants in one unusual vespertine population showed variation in seed production, with plants which developed fruit later in the season producing significantly more viable seeds. This research will provide valuable insight on these unique vespertine populations, and lay the groundwork for future studies on the specific variation between vespertine and diurnal *Camassia*.

This work was completed as part of the Willamette University Science Collaborative Research Program (KG) and supported with generous funding from the National Science Foundation (NA).

Taylor Gee
Co-Author: Brendan Zhang
THE SYNTHESIS OF A SUGAR DERIVED (BIS)OXAZOLINE LIGAND FOR THE ASYMMETRIC CATALYSIS OF HENRY REACTIONS
Mentor: Andrew Duncan
Department of Chemistry

Asymmetric catalysis offers an efficient synthesis of chiral organic compounds with complex chemical structures. Sugars work well as starting materials for chiral ligands used in asymmetric catalysis because they themselves are chiral and occur in nature as single enantiomers. They are also are inexpensive and are readily available. Our ligand of choice is a bis(oxazoline) (box) ligand. Box ligands have been used successfully in a wide variety of asymmetric reactions. *N*-Acetyl-D-Glucosamine (GlcNAc) was used as the starting material in the synthesis of this chiral ligand. Copper (II) salts were reacted with our ligand, resulting in the formation of a chiral metal complex. This complex could be used for catalysis of the Henry reaction between benzaldehyde and nitromethane.

This work was completed as part of the Willamette University Science Collaborative Research Program and supported with generous funding by the American Chemical Society Petroleum Research Fund.

Emily Harvey

Sugarcoated Bacteria: An investigation of Exopolysaccharide in *Caulobacter crescentus*

Mentor: Melissa Marks
Department of Biology

Exopolysaccharide (EPS) is a carbohydrate layer present on the cell surface of some types of bacteria that performs a wide range of biological functions. We predict that the biochemical pathway by which EPS is produced is disrupted by the deletion of a 21-gene mobile element in one strain of *Caulobacter crescentus*. This deletion results in the loss of a mucoid phenotype in the mutant NA1000$\Delta\Phi$ strain compared to the wild-type NA1000 strain. Confocal microscopy has allowed us to visualize the EPS layer of each cell type using fluorescently conjugated lectin proteins that specifically bind carbohydrates. Preliminary data of this sort has supported the hypothesis that the EPS layers of the two strains are different. Further studies involving the isolation of EPS by biochemical separation techniques should allow us to quantify and further characterize the EPS composition of each strain.

This work was completed as part of the Willamette University Science Collaborative Research Program and supported with generous funding from the Mary Stuart Rogers Foundation.

Christina Johnson

PLAYING WITH *CAULOBACTER* MUCUS: DETERMINING THE GENETIC BASIS OF BACTERIOPHAGE RESISTANCE

Mentor: Melissa Marks
Department of Biology

Caulobacter crescentus is a fresh water bacterium that has undergone adaptations to life in laboratory over the past 50 years. One of these adaptations was the loss of an exopolysaccharide layer that, when present, gives the bacteria a mucoidy appearance. Interestingly, the presence of this outermost layer correlates with higher resistance to bacteriophage infection. The purpose of this study was to determine what genes are involved in bacteriophage resistance. We are systematically deleting genes in a mobile element that encodes an EPS production pathway layer and testing the mutants for bacteriophage susceptibility. To date, three mutants have been identified with intermediate mucoidy, two of which are very susceptible to bacteriophage. Our results, in combination with the predicted functions of these genes, suggest that these three genes are involved in the EPS production pathway and that EPS is required for CR30 bacteriophage resistance. Future work may identify additional genes within the mobile element that play a role in EPS production in *Caulobacter*.

This work was completed as part of the Willamette University Science Collaborative Research Program and supported with generous funding from the Mary Stuart Rogers Foundation.

Rebecca Josephson

NAMI-A Binding Interactions with $tRNA^{Phe}$

Mentors: Karen Holman & Sarah Kirk
Department of Chemistry

NAMI-A, a ruthenium-based chemotherapeutic drug, shows promise in Phase 2 clinical trials at treating cancer with reduced side effects as compared to platinum-based drugs. It is pharmaceutically attractive because of its observed affinity for cancerous cells and low toxicity in healthy cells. The reason for different NAMI-A interactions is likely due to disparate cellular environments, namely pH and reducing conditions. However, the mechanism of action of the drug is not well understood, nor is its primary target known. A goal of this study is to understand the binding interactions of NAMI-A with one potential cellular target, $tRNA^{Phe}$. Two methods used to analyze binding interactions were polyacrylamide gel electrophoresis and Y-base fluorescence studies at different conditions to model "normal" and cancerous cell conditions. Results show that there is a difference in binding at pH 7.4 ("normal") and pH 6.0 (cancerous). Native PAGE gels indicate that an NAMI-A adduct forms at much lower concentrations in pH 6.0, or cancerous cell environments, giving insight to the drugs' greater effectiveness in cancerous cells over healthy cells. Preliminary fluorescence studies at pH 7.4 may indicate the presence of multiple NAMI-A binding sites.

This work was completed as part of the Willamette University Science Collaborative Research Program and supported with generous funding by the Willamette University Presidential Scholarship and the Willamette University Atkinson Grant.

Theo Kataras
Co-Author: Margaret Ruwitch

Harmonic Analysis of Treadmill Walking for Fall Risk Assessment in Older Adults

Mentor: Brandi Row Lazzarini
Department of Exercise Science

Falls become increasingly prevalent and damaging as we age, posing a significant threat to health and quality of life. Trunk acceleration measures during gait are used to predict fall risk because irregular enter of mass movement indicates challenges to control that often precede falls. The method of gait regularity assessment used was the harmonic ratio, which takes into account the 'cycles' within accelerations in a single direction during walking and whether these cycles are constructive or destructive with respect to the primary stepping harmonic of forward walking. This measure represents the ability to keep stride smooth and regular, but requires straight, uninterrupted walking trials with many steps which can be difficult to obtain overland in an indoor environment. The treadmill can be used because it allows measurement of a large set of such data in a small space. This study examined the symmetry of gait in participants over 70 years of age during treadmill and overland walking. Treadmill walking was performed at a speed separate from overland speed, determined by averaging upper and lower bounds of comfortable treadmill walking. Preliminary analysis suggests that the treadmill is not a suitable replacement for overland walking for fall risk assessment via harmonic ratio.

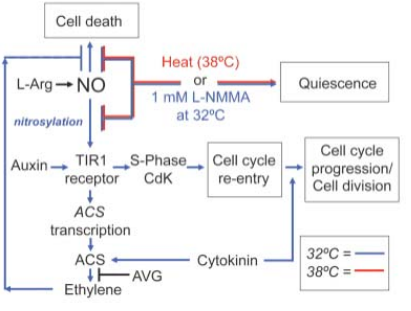
This work was completed as part of the Willamette University Science Collaborative Research Program and the *i*Human Sciences Initiative Grant Program.

Alexander Klementiev

Smoking Out Genes from Tobacco Plants: Isolation, Cloning, and Sequence of Partial cDNAs for Auxin-related and Potential qPCR Reference Genes from *Nicotiana glauca*

Mentors: Gary Tallman & Colin Wilson
Department of Biology

Nicotiana glauca is unique among plants because of its high basal thermotolerance. Although it is expected to survive in an increasingly warmer global climate, studies suggest that under heat stress this plant may stop growth in order to survive. Auxin is a major plant growth hormone. Auxin-induced transgene expression is suppressed when *N. glauca* is exposed to heat, and inhibitors of nitric oxide (NO) synthesis mimic the effects of heat stress. Whether heat and NO biosynthesis inhibitors suppress expression of native (endogenous) auxin-regulated genes in this plant is unknown. A challenge in measuring native gene expression in *N. glauca* is the lack of DNA sequence information for auxin-related genes and potential reference genes for reverse transcription-quantitative polymerase chain reaction (RT-qPCR) studies. I isolated partial cDNAs for auxin related genes and for potential RT-qPCR reference genes; cloned them in bacterial plasmids; and determined their DNA sequences. Genes successfully sequenced included: L25 and NT103-1. Because nitrate reductases can catalyze NO production, partial cDNAs for this enzyme were sequenced as well. Ultimately this DNA sequence information will be used to understand how heat regulates hormone-mediated gene expression related to plant survival under heat stress.



This work was completed as part of the Willamette University Science Collaborative Research Program and supported with generous funding from the Mary Stuart Rogers Foundation.

Chris Luetjen
Co-Author: Jonathan Hallsted

Using a Diode Laser System to Measure the Index of Refraction of Thin Layers, and Creating Blue Laser Light

Mentor: Michaela Kleinert
Department of Physics

The index of refraction of a material is the ratio of the speed of light in a vacuum, compared to the speed at which light travels though the material. This index is very useful for determining the optical properties of materials, and there are various ways to measure it. In this talk I will discuss an inexpensive and novel method to determine refractive indices of thin layers by using a simple laser configuration called an extended cavity diode laser (ECDL) that is commonly used in many optics and atomic physics labs. With this novel approach, we have accurately determined the refractive indices of water, vegetable oil, and air. Our work is currently in the final stages of preparation for publication in the American Journal of Physics. Future uses of this method include index matching of biological cells with the media surrounding the cells, and measuring the index of refraction of thin optical coatings. I will also briefly discuss my current research in producing blue laser light to cool and trap calcium atoms.

This work has been supported by the Willamette University Science Collaborative Research Program with generous funding by the National Science Foundation and the M.J. Murdock Charitable Trust.

Megan Nanry
Co-Authors: Samuel D. Gosling, University of Texas at Austin; Jeff Potter, Atof Inc., Cambridge, MA

Regional Personality Differences in the United States: A Comparison of Three Competing Paradigms

Mentor: Erik Noftle
Department of Psychology

Research on regional personality differences in the U.S. has been limited in conceptualizing regions along politically defined boundaries (i.e., states) and in only assessing broad personality traits. The current study employs two recently developed paradigms for conceptualizing and mapping U.S. regional differences, which are based alternatively on historical, social, and economic divisions. We contrast them against a politically defined paradigm--the nine state-based divisions developed by the U.S. Census Bureau. Over one million participants from outofservice.com were clustered into groups based on the three paradigms. Personality was assessed using ten-facet scales derived from the Big Five Inventory. Robust regional personality differences were identified for all three regional paradigms. Interestingly, patterns of findings were sometimes different across the pairs of facets. Ultimately, the study suggested that the conceptualizations of regional differences based on historical, social, and economic divisions yielded stronger and more interpretable findings than the conceptualization based on political boundaries.

This work has been supported by The Character Project (Erik E. Noftle, PI), with generous funding by the John Templeton Foundation.

Megan Newcomb

Purification and Characterization of Isoprene Synthase from the Moss *Campylopus introflexus*

Mentor: Alison Fisher
Department of Chemistry

Isoprene is a volatile organic compound emitted by plants. In the atmosphere, isoprene reacts with nitrogen oxides and hydroxyl radicals, causing the formation of ozone and an increase in the lifetime of atmospheric methane. Isoprene is also the monomer of the molecular family isoprenoids, which can extend in length from two to thousands of combined isoprene molecules. Isoprenoids serve a variety of biological roles and can also be used industrially to make rubber, perfumes, and fragrances. The protein isoprene synthase makes isoprene from its precursor, dimethylallyl pyrophosphate (DMAPP). Isoprene synthase has been found and studied in many angiosperm species, but no isoprene synthase has been purified or thoroughly characterized in a moss. The moss *Campylopus introflexus* has large local populations and grows in thermal vents, indicating increased durability that may be beneficial to its potential use in industry. This summer of research was focused on improving the purification processes for isolating isoprene synthase from *Campylopus introflexus*, as well as using column chromatography to determine the protein's molecular weight.

This work has been supported by the Willamette University Science Collaborative Research Program with generous funding by the M.J. Murdock Charitable Trust.

Rhys Ormond

Geometric Morphometric Analysis of Symmetry in *Camassia* Hybrids

Mentors: Susan Kephart & Kathryn Theiss
Department of Biology

Hybrid individuals often show phenotypes intermediate to their parents, making hybrid zones ideal for experiments on speciation. Species in the genus *Camassia* often co-occur in the same habitats. Previously presumed to not hybridize with each other, the radially symmetrical *C. leichtlinii* ssp. *suksdorfii* and the bilaterally symmetric *C. quamash* ssp. *maxima* sometimes form evident hybrid zones that gradate from one species to the other. I used geometric morphometric analysis, a technique only relatively recently applied to botany, to quantify differences in shape and symmetry between populations of these two camas species and their putative hybrids. Results from geometric morphometric analysis of 220 floral images from two sympatric sites and two allopatric sites agreed with the categorization of these same plants based on traditional morphological characters. Principal component analysis revealed distinct species separation between parental types in all populations, but also evidence of hybridity. Sympatric populations were closer to each one another along the first principal component than allopatric populations, suggesting gene flow may be influencing evolutionary patterns in this genus.

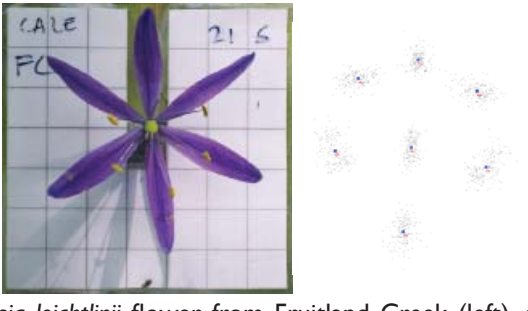


Fig. A *Camassia leichtlinii* flower from Fruitland Creek (left), one of the images contributing to a consensus diagram (right) of the seven landmark points with all recorded deviations. The consensus points depict the average morphology across all individuals, while the cloud of points surrounding them show each individual's deviation around that average.

This work has been supported by the National Science Foundation - Research Experiences for Undergraduates.

Alexandria Parsagian

A Permanent Magnet Zeeman Slower for Calcium - Improving Ultracold Calcium Trapping Efficiency for Creation of RbCa Molecules

Mentor: Michaela Kleinert
Department of Physics

Ultracold heteronuclear molecules are of great interest for their applications in ultracold chemistry, precision spectroscopy, tests of fundamental symmetries, and quantum computation. Alkaline-earth/Alkali-metal dimers in particular possess both a permanent electric and magnetic dipole moment, making them ideal for the study of strong long-range dipole-dipole interactions in combined electric and magnetic fields. We are working toward the creation of ultracold RbCa, which will be formed from its ultracold constituent atoms rubidium and calcium. The high melting point of calcium necessitates a Zeeman slower to slow the atoms from about 1000 m/s to below 100 m/s before they enter the trapping region. Our slower uses neodymium magnet pairs at varying distances from the calcium beam to closely match the ideal slowing field. The addition of a Zeeman slower will allow us to increase the number of trapped calcium atoms, and thus increase the number of RbCa molecules created each second. In this talk, we will present preliminary data of the magnetic field achieved by this permanent magnet slower design.

This work has been supported by the Willamette University Presidential Scholarship with generous funding by the M.J. Murdock Charitable Trust.

Margaret Ruwitch
Co-Author: Theo Kataras

Rapid Stepping Tests Challenging Medial-Lateral and Anterior-Posterior Control of the Trunk as an Assessment of Stepping Performance in Older Adults

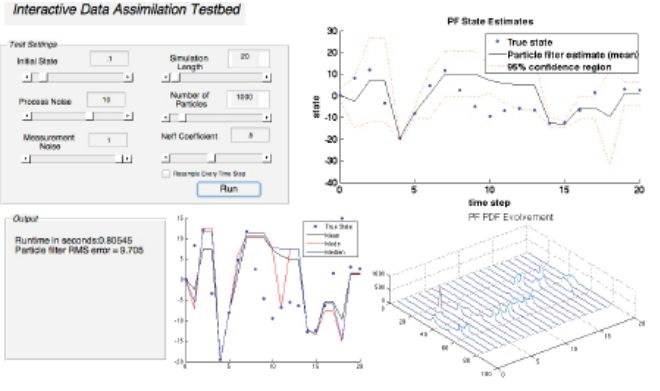
Mentor: Brandi Row Lazzarini
Department of Exercise Science

Increased fall risk in older adults has been associated with decreased control of trunk movement in the medial-lateral and anterior-posterior directions during stepping. The purpose of this study was to develop simple tests involving rapid stepping motions that challenge medial-lateral and anterior-posterior control, with the potential to be used as screening tools for fall risk. Forty cognitively intact adults aged 70 and older participated in the study. Participants were asked to complete three stepping tests involving medial-lateral shifts in the center of mass while wearing an accelerometer. Medial-lateral, vertical, and anterior-posterior acceleration measurements, the number of steps completed, and the time were recorded. Preliminary data analysis for one of the step tests showed a mild positive correlation between the number of steps completed and medial-lateral acceleration magnitude and variability.

This work was has been supported by the Willamette University Science Collaborative Research Program and the iHuman Sciences Initiative Grant Program.

Kendra Schmal & Annika Hagelin
DATA ASSIMILATION TECHNIQUES
Mentor: Haiyan Cheng
Department of Computer Science

Data assimilation is a process by which observational data are optimally incorporated into a computational model of a real system. Such techniques are often applied to forecast modeling and localization problems, including weather prediction, image tracking and financial forecasting. While data assimilation techniques have been successfully applied to smaller real-world problems, it remains challenging for larger-scale problems in terms of algorithm efficiency, result accuracy, and ability to deal with high-dimensionality. The particle filter method has attracted much attention in recent years as a data assimilation algorithm used for solving nonlinear forecasting problems with non-Gaussian errors. The goal of our research is to gain a better understanding of the limitations of the particle filter method, and to develop new algorithms to overcome these limitations. We implemented and performed comprehensive tests on the classic particle filter using a chaotic, 3-dimensional model. We also implemented a hybrid version of particle filter with the particle swarm optimization (PSO) algorithm. To expedite runtime analysis and data collection, we developed an Interactive Data Assimilation Testbed (IDAT), which can be easily adapted for testing different data assimilation algorithms. IDAT enables us to design new test schemes and further analyze simulation results.



This work has been supported by the Willamette University Presidential Scholarship with generous funding by the National Science Foundation.

Colin Stewart

Do Hybrids Collapse? Using Microsatellite Genotyping to Study the Viability of Hybrid Joshua Trees

Mentors: Christopher Smith & Ramona Flatz
Department of Biology

Joshua trees (*Yucca* spp.) are woody monocots endemic to the Mojave Desert. Like all yuccas, Joshua trees are pollinated exclusively by yucca moths, in a specialized, obligation pollination mutualism. Recent work suggests that there may be two distinct species of Joshua tree, *Y. brevifolia* and *Y. jaegeriana*, and that these tree types hybridize. These hybrid trees appear in high density in a section of Tikaboo Valley, Nevada. While surveying the zone with a high-density of hybrids, many trees were found with collapsed branches, suggesting that hybrid trees may have unstable branching architecture and lower survival. We tested this hypothesis by genotyping nearly two hundred trees from the hybrid zone, and analyzing these data to identify pure and hybrid individuals. We then determined whether collapsed trees are more likely to be of hybrid origin, and thus whether hybrids have lower fitness than the parental species. Our results may help to determine whether barriers to gene flow, or selection against intermediate phenotypes, are more important in maintaining species boundaries.

This work was completed as part of the Willamette University Science Collaborative Research Program and supported with generous funding from the Mary Stuart Rogers Foundation.