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NASA - MISSOURI SPACE GRANT CONSORTIUM
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MISSOURI SPACE GRANT CONSORTIUM

Preface

This 27th volume of our annual conference proceedings contains the abstracts of technical research reports that were written and presented by graduate, undergraduate, and high school students supported by the NASA-Missouri Space Grant Consortium. The complete reports can be found on the enclosed CD and on-line at http://web.mst.edu/~spaceg/publications.html. The primary purpose of our program is to prepare students to contribute to nation's workforce in areas related to the design and development of complex aeronautical and aerospace related systems along with the in-depth study of terrestrial, planetary, astronomical, and cosmological sciences. This objective is being achieved by mentoring and training students to perform independent research, as well as supporting student-led hands-on engineering design team and scientific research group activities. This year's meeting was held at the Missouri University of Science & Technology on April 20-21, 2018.

The Missouri Consortium of the National Space Grant College and Fellowship Program is sponsored by the National Aeronautics and Astronautics Administration and is under the direction of Ms. Joeletta Patrick, National Program Manager. It is my pleasure to thank the Affiliate Directors of the Consortium: Dr. Dan McIntosh, University of Missouri-Kansas City; Dr. Bruce Wilking, University of Missouri-St. Louis; Dr. Ramesh Agarwal, Washington University in St. Louis; Dr. Majed Dweik, Lincoln University of Missouri; Dr. Mike Reed, Missouri State University; and Dr. Frank Feng, University of Missouri-Columbia, for their outstanding merit in directing and coordinating Space Grant activities at their respective institutions during this year. I would also like to thank our Associate Directors: Drs. Mike Swartwout and Vasit Sagan, Saint Louis University; Dr. Vayujeet Gokhale, Truman State University; Mr. David Caples, Moberly Area Community College; Dr. Dan Justice, Metropolitan Community College of Kansas City; and Ms. Tasmyn Front, Challenger Learning Center of St. Louis, for their contributions in coordinating, advising, and mentoring student activities at their institutions as well. Furthermore, I would like to express my deep appreciation for MOSGC Program Manager, Dr. Stephen Haug, for his efforts in not only producing this proceedings abstract book and CD, but also for organizing the annual conference in a way that encourages a lot of meaningful interactions. Most of all, the student authors are to be commended for preparing and presenting their research reports with a high degree of quality and making this year's meeting an outstanding success.

I hope that will you find the wide variety of student research presented herein interesting and informative.

Sincerely,

S. Balakrishnan

Dr. S. N. Balakrishnan, Director
NASA-Missouri Space Grant Consortium
NASA-EPSCoR Missouri

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A Highly Specific Method for Rapid Capture and Detection of Escherichia coli O157:H7 from Ground Beef Samples

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Department of Life and Physical Sciences
Lincoln University of Missouri

Advisor: Dr. Majed El-Dweik

Abstract

Background: E. *coli O157:H7* bacteria can cause human diseases following ingestion of contaminated food and water. Testing for potential contamination is becoming a standard procedure in many food industries. However, conventional detection methods require relatively long sample-enrichment, painstaking testing and sophisticated equipment. The purpose of the study: The current study attempts to combine specific bacterial-capture with rapid colorimetric-detection without elution using sandwich ELISA. Approach: protein A-coated magnetic beads are incubated with anti *E. coli O157:H7* capture-antibody. The resulting complexes are subsequently incubated with blocking buffers followed by the test samples to capture target bacteria. Then the complexes are incubated with HRP-linked anti *E. coli O157:H7* detection-antibody. After washing, the complexes are incubated with chromogenic enzyme substrate for colorimetric results. The main findings: This proposed detection method demonstrated good response to low bacterial concentrations allowing for shorter sample enrichment and total actual testing time less than one hour. However, weak direct binding of the detection antibody to the magnetic beads could not be completely excluded, which imposes a challenge of false positive results to be addressed by further research for the optimization of detection. Interpretation of their significance: The relatively low bacterial cell count detected by this method; the short testing time and the colorimetric results make this method suitable for pathogen detection in the field, which could pave the road for pathogen detection methods with minimal technical and expertise requirements.

Link to Full Paper

Mohamed Alalem, MD, MSc, PhD, is Post-Doc Research Associate, Cooperative Research Programs/ Department of Life and Physical Sciences/ Lincoln University.

Majed Dweik, PhD is Associate Professor, Biological and Biomedical Engineering and the Director of Center of Nanotechnology / Cooperative Research Programs/ Department of Life and Physical Sciences/ Lincoln University.

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Metformin Treatment Represses Vascular Endothelial Growth Factor Gene Transcription in MCF-7 Breast Cancer Cells

Mohamed Alalem, MD, PhD.[1,2], Bimal K. Ray, Ph.D.[2]
1. Cooperative Research Programs/ Department of Life and Physical Sciences
Lincoln University of Missouri
2. Department of Veterinary Pathobiology and Genetics Area Program
University of Missouri-Columbia

Abstract

Background/Aim: Targeting angiogenesis preferentially in cancer is a promising approach to improve treatment efficacy and safety. The aim of this study is to investigate potential upregulation of Krüppel like factor-4(KLF-4) by inhibition of mammalian target of rapamycin (mTOR) to repress vascular endothelial growth factor (VEGF) expression in breast cancer cells. Materials and Methods: Using Western blot; band shift assay; and Chloramphenicol acetyltransferase assay, we assessed the effect of different mTOR inhibitors on the level of mTOR pathway proteins and on KLF-4/ serum amyloid activating factor (SAF-1) SAF-1 DNA binding and consequently VEGF gene expression in MCF-7breast cancer cells. Results: mTOR inhibition increased KLF-4 level in breast cancer cells, but this inhibition, except for metformin, elicited rebound upregulation of mTOR signaling proteins. Thus, metformin produced a sustained increase in KLF-4 level and concomitant disruption of SAF-1 binding to VEGF promoter with consequent inhibition of VEGF expression. Conclusion: Repurposing metformin as a potential neoadjuvant and antiangiogenic treatment could provide the basis for more effective and safer antiangiogenic treatment.

Link to Full Paper

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Comparative Efficiency of Colorimetry and Ion Chromatography in Detection and Determination of Orthophosphate in Runoff Water

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Lincoln University of Missouri

Advisor: Dr. Majed El-Dweik

Abstract

Sensors for detection of the presence of chemical or biological agents in water are vital within the domain of environmental monitoring and remediation. Nutrient pollutants (NPs), mainly nitrites, nitrates and phosphates are often found in surface water in the American Midwest due to the abundant use of inorganic fertilizers throughout agricultural regions. These NPs have added to challenges of eutrophication in bodies of water which has been well established by many researchers. In this work, a portable colorimetric and ion chromatographic instruments are used for the detection and determining the presence of orthophosphate from Grays Creek in Jefferson City, Missouri, and try to introduce a sensitive and less expensive method. The absorbance was taken at 610 nm, the concentration ranged from 0.3-13.93ppm and the electric conductivity (EC) ranged from 256-437 µS/cm. The ion chromatographic data subjected to All Pairwise Multiple Comparison Procedures (Tukey Test) indicated that only sites 2 and 3 has no significance but the difference in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (p = <0.001). For the Hach handheld optical sensor the normality test (Kolmogorov-Smirnov) revealed Passed (p = 0.301). The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (p = 0.080).

Link to Full Paper

Nasruddeen Al-awwal was born in Columbia Missouri and raised in Nigeria. He graduated from Usmanu Danfodiyo University Sokoto, Nigeria where he obtained his B.S. in Applied Chemistry. He taught A-level Chemistry at College of Arts, Science and Remedial Studies Kano, Nigeria. He got his first M.S. in Organic Chemistry from SRM University Kattankulathur, India. He got his second M.S. in environmental science from Lincoln University, Missouri with emphasis on water quality. He started his PhD. in Natural Resources at the University of Missouri Columbia with emphasis in Soils, Environmental and atmospheric Sciences in Fall of 2017. Nasruddeen wants to stay in the field of research and academia and continue to impact to the community.

Ayriana Taylor was born and raised in St Louis Missouri. She is a senior majoring in Agriculture and Animal science. Her ambition is to do large animal research in the future. Ayrianais currently studying pathology and other biological technical studies as a NASA research intern at Lincoln University Missouri.

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Molecular Dynamic Simulations of Layered Metallic Systems

Austin Bollinger
Department of Physics, Astronomy, and Materials Science
Missouri State University

Advisor: Dr. Ridwan Sakidja

Abstract

The study of lead deformation mechanics taken place for example in the battery applications or other rolling processes is important in optimizing the materials strength. This study performs molecular dynamics simulations involving compression to replicate the rolling process for lead as a model system. In studying differing strain rates for the compression, the highest strain rate gives us the highest stress level within the material before the plastic deformation and failure to occur. In the temperature effect analysis, yield strength of lead increases with a corresponding decrease in in temperature. Future work will implement a polycrystal structure into the system to simulate a realistic view of deformation along the grain boundaries.

Link to Full Paper

Austin Bollinger is a undergraduate student at Missouri State University with a major in physics from St. Louis, Missouri. His hope is to get a doctorate degree in nuclear physics and advance research on fusion reactors as a source of renewable energy. Although the topic is not heavily studied at this time, hopefully it will be soon with the completion of the ITER project. In addition to working on the NASA Space Grant Consortium project, there has been work done on a similar topic for the Department of Energy in conjunction with Missouri State University.

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Visualizing the Critical Dynamic Events of Carbon Nanocomposites using Low Cost Wearable Virtual Reality Tools

Chad Brewer, Taylor Kuttenkuler, Brittany Porter, and Chris Klenke
Department of Physics, Astronomy, and Materials Science
Missouri State University

Advisors: Dr. Razib Iqbal and Dr. Ridwan Sakidja

Abstract

Purpose of the study is to construct Virtual Reality tools that can be used for materials science education to educate topics related to the dynamics in nanomaterials. Researchers used the Unity Game Engine to visualize the reactions between Carbon Nanocomposites and Oxygen molecules. After the development of the atomistic models and the initial development in Unity, the application is able to be installed on mobile devices that meet the API level for Google Daydream.

Link to Full Paper

Chad Brewer is originally from Charleston, Arkansas. He is a Senior Computer Science major at Missouri State University and also holds a BA in Sociology and an AA in Criminal Justice. Chad is currently involved with one independent research project: Visualizing the Critical Dynamic Events of Carbon Nanocomposites Using Low Cost Wearable Virtual Reality Tools. This project will end with an IEEE published paper that will hopefully land him a career either involving Virtual Reality applications or software development.

Taylor Kuttenkuler is originally from California, Missouri. He is currently a Junior Computer Science major at Missouri State University and may possibly pursue a minor in Cybersecurity. Taylor is currently involved with one independent research project: Visualizing the Critical Dynamic Events of Carbon Nanocomposites Using Low Cost Wearable Virtual Reality Tools. While not attending school, Taylor works as intern in the Information Technology Department of the the Missouri Department of Employment Security. He is hoping to use the experience gained from this project to further widen his knowledge of software development and his future career.

Chris Klenke is from Pacific, Missouri. He is a senior majoring in both Physics and General Mathematics and minoring in both astronomy and computer science. Chris researches the stability of carbon nanomaterials against aggressive environments with Dr. Ridwan Sakidja and theoretical exoplanet atmosphere components with Dr. David Cornelison, both in the Physics, Astronomy, and Materials Science Department at Missouri State University. Chris hopes to carry his research forward into a doctoral program researching astrophysics after his undergraduate studies are over.

Brittany Porter is from Kansas City, Missouri. She is a senior Sociology major with a Mathematics minor at Missouri State University. Brittany's current research projects include working with Dr. Ridwan Sakidja studying the stability of carbon nanomaterials. She also studies the intersection of Catholicism and politics with Dr. Catherine Hoegeman. Brittany is hoping to continue her education in the social sciences in the future.

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Active Cooling Using Waste Heat

Ethan Bruzzese and Patrick Kinsella
Department of Mechanical & Aerospace Engineering
University of Missouri-Columbia

Advisor: Matt Maschmann

Abstract

Using external energy to actively cool a system can decrease a system's efficiency. This project uses waste heat from a heat-generating system to drive active convective cooling. Nitinol (Nickel Titanium Alloy) is a shape-memory alloy material that changes material phase when heated or cooled past a critical temperature. The net result of the phase change is a change of material properties that can be used to induce mechanical force. Using this principle a nitinol coil was submerged equally into two baths either above or below the phase change temperature. This coil is pre-stretched and wrapped around a device with pulleys and mating gears. A force imbalance and resultant rotation occurs about the pulleys when the nitinol coil on one side of the pulley is above the transition temperature and the other is below the transition temperature. As the coil processes through the device, water is entrained in the coil, pumping cool water to the hot reservoir and vice versa. Active mechanical pumping is achieved without electrical energy, and the system self-regulates its temperature.

Link to Full Paper

Ethan Bruzzese is from Columbia, MO and pursuing his bachelors of science in mechanical and aerospace engineering, with a minor in Energy. After his graduation in May 2019, he hopes to pursue a career in the energy sector.

Patrick Kinsella is from St. Louis, MO and is pursuing his bachelors of science in mechanical and aerospace engineering. After his graduation in May 2018, he will begin his career in the United States Air Force as a Special Tactics Officer. He also plans on pursuing a master's degree in biomedical engineering.

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Software Defined Radio Methodologies for CubeSat Reliability

Anna Case
Department of Mechanical and Aerospace Engineering
Missouri University of Science and Technology

Advisor: Dr. Henry Pernicka

Abstract

Software-defined radio (SDR) technology is critical to space-based communication, especially as spectral congestion in VHF/UHF bands worsens. While SDR implementations are increasingly commonplace, there remain a number of challenges due to the space environment and limitations within the space radio industry. Namely, the lack of an accepted SDR standard has led to many sub-optimal implementations. A look at NASA's Space Telecommunications Radio System (STRS) architecture presents the precedence to move from software controlled radios to a more cognizant level, which is particularly lacking in the CubeSat industry.

There also arises need for SDR standardization to promote responsible spectrum usage. Too often are Amateur standards used for sake of familiarity over efficiency. STRS reflects the overall goals of SDR technology: a decreased development time and cost, increased radio reliability, adaptable and evolvable software, and vendor independence. Implementing logic such as congestion control can help provide a more reliable link and higher overall throughput. Yet, SDRs must find a balance between automating radio functions and retaining flexibility.

This report details work on the communication system for the Nanosat-8 project at Missouri S&T Satellite Research Team. The SDR in question is an Ettus B200 which runs custom C++ code, largely reliant on GNU Radio Companion backbone. Much effort went into maximizing the efficiency at other layers in the link by using optimal coding schemes. The protocols in use and reasoning behind them are described with some comments on standardization efforts.

Link to Full Paper

Anna Case, originally from Kansas City, is currently a sophomore attending Missouri University of Science and Technology. She is currently working towards two Bachelor's degrees in computer and electrical engineering, working as the RF communications lead for the Nanosat-8 project on the M-SAT Team and as an undergraduate research assistant at the Applied Microwave Non-Destructive Testing Lab.

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Incidence of Tidal Features Hosted by Massive CANDELS Galaxies from 1<z<3

Cody Ciaschi
In Collaboration with Kameswara Mantha. Luther Landry,
Rubyet Evan, Logan Fries, and Courtney Hines
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University of Missouri-Kansas City

Research Supervisor: Prof. Daniel McIntosh

Abstract

The importance of major merging at $z > 1$ is still to be determined. It has been shown that star formation in galaxies was highest at $z\sim2$ in an era some call "Cosmic High Noon". Since then, star formation has been highly quenched, and the number of disk-dominated galaxies has significantly decreased. Models and observations have shown that major mergers can quench star formation and produce massive spherical bulges but might not be the sole contributor. Theories and observations have also suggested that non-major merging hierarchical processes, such as clump migration, may be more important in the growth of spherical bulges and assembly of massive galaxies than previously thought. By determining the fraction of mergers within the sample, it can be shown how important mergers were in the creation of spherical bulges. Using better constraints of massive $1 < z < 3$ galaxies hosting hallmark tidal features, a signature created by gravitational tidal forces during galaxy mergers, important calibrations for converting tidal detections into merger fractions can be found and a neural network that will robustly identify transient and faint tidal signatures can be created. To identify tidal features, a Graphical User Interface(GUI) was designed to visually classify ~10000 galaxies from all 5 CANDELS fields. Current observations show 0.15-0.2% of galaxies in the sample host tidal features depending on specific metrics. In the future, the detected tidal features in the H-Band residual images can be compared to H-band galaxy classifications to look at the fraction of mergers hosting tidal features.

Link to Full Paper

Cody Ciaschi has been doing research with Dr. Daniel McIntosh and the Galaxy Evolution Group at the University of Missouri-Kansas City since the beginning of summer in 2017. He is currently a second year master's student and hopes to finish his Master's degree by the end of the summer 2018.

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Seismic Analysis of the Pulsating Subdwarf B Star EPIC 212508753 Using Data from NASA's Kepler Space Telescope

John Crooke
Department of Physics, Astronomy, and Material Science
Missouri State University

Advisor: Dr. Michael Reed

Abstract

EPIC 212508753 is a subdwarf B (hot horizontal branch, sdB) star which has been observed by the Kepler Space Telescope during its extended mission, K2, in short cadence mode where a new image is obtained roughly every minute for about 80 days. Using time series analysis of the data we have found the star to be a rare hybrid pulsator with both g- and p-mode pulsations where most of the pulsations are p modes. These pulsators are extremely important as p modes sample near the surface and g modes can sample deeper, near to the core. This means that hybrid pulsators allow us to characterize the entire star. As a hotter, predominantly p-mode pulsator, EPIC 212508753 is particularly interesting for seismic study. We have discovered frequency multiplets in both the p- and g-mode regions which we use to identify pulsation modes and determine that EPIC 212508753 rotates like a solid body, in contrast to some other sdB stars.

Link to Full Paper

John Crooke is a graduating senior at Missouri State University in the Physics, Astronomy, and Materials Science Department. He is from Springfield, MO and is majoring in physics with the astronomy and astrophysics track and minors in mathematics and philosophy. After graduation he plans to enter a PhD program in the astronomy field.

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Mining CANDELS Data to Identify Massive Compact Targets from the Early Universe for JWST

Rubyet Evan
In Collaboration with Logan Fries, Kameswara Mantha, Cody Ciaschi, and Luke Landry
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University of Missouri-Kansas City

Research Supervisor: Prof. Daniel H. McIntosh

Abstract

This report summarizes the UMKC target selection of massive galaxies from Hubble Space Telescope (HST) data for observations with the James Webb Space Telescope (JWST). Recent findings by Barro et al. and Kocevski et al. based on HST data from the Cosmic Assembly Near-IR Deep Extragalactic Legacy Survey (CANDELS) suggest that the most-dense ("compact") examples of massive (>1e10Msun) galaxies at redshifts z>1.5 (look-back times >9 billion years ago) likely represent a critical evolutionary step in the early development of massive elliptical galaxies that exist in the present-day universe. Deep JWST imaging and spectroscopy hold promise for gaining new insights into why these important galaxies appear to go through brief phases of active star formation and black hole growth. Using physical parameters available in the CANDELS database for galaxies in the Extended Groth Strip (EGS) field, 126 massive z>1.5 galaxies meeting specific compact density criteria defined in Kocevski et al. were selected for JWST observations. These targets were included in a JWST proposal (Cosmic Evolution Early Release Science Survey; PI Steve Finkelstein), which was one of 13 international teams to be awarded observation time with the next-generation space observatory starting in summer 2019. CANDELS visual classifications, optical and near-IR colors, and available X-ray data allow this sample to be subdivided into subsamples to prioritize the planned JWST observations from rare (10%), high-priority targets with active black-hole growth to low-priority (60%) inactive and non-star-forming systems.

Link to Full Paper

Rubyet Evan grew up and lived in Kansas City for most of his life after moving from Bangladesh. This is now his second year as an undergraduate student majoring in physics with an astronomy emphasis and mechanical engineering. He's been doing research with Dr. Daniel McIntosh and the Galaxy Evolution Group at the University of Missouri-Kansas City since the summer of 2017. He's also a mentor and previous scholar of the 'A Bridge to the Stars' program also under the supervision of Dr. Daniel H. McIntosh. Outside of university work, his biggest activity is mentoring the FIRST Robotics Team from Lincoln College Preparatory Academy (of which he is a former member). For the future, he plans on undertaking engineering research and continuing astronomy research to eventually work on research that encompasses both fields.

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Using Tidal Features in the Nearby Universe to Determine Dynamical History and Incidence of Gas-Rich and Gas-Poor Mergers

Logan Fries
In Collaboration with Kameswara Mantha, Cody Ciaschi, Rubyet Evan, and Luke Landry
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University of Missouri-Kansas City

Research Supervisor: Prof. Daniel McIntosh

Abstract

This report summarizes contributions by Logan Fries to the UMKC target selection of massive galaxies from Hubble Space Telescope data for observations with the James Webb Space Telescope. Building from these efforts, a new pilot study is presented to analyze the optical color of tidal features from a select sample of visually-identified SDSS galaxy interactions and mergers from Weston et al. 2017 (Mstar>1e10Msun, z<0.08) to gain new insights into the nature of these dynamical encounters. Gravitational interactions between massive galaxies are predicted to produce tidal features during the first close pericentric passage and the final merging phases. Hallmark tidal features are used by many studies to quantify the rate of major galaxy-galaxy merging. A In this trial, two interactions were selected – a spiral-spiral (gas-rich) and an elliptical-elliptical (gas-poor) – plus one gas-rich, plausible post-major-merger train wreck. A new tidal extraction and quantification method by Mantha et al. was employed to SDSS g and r-band images that are first analyzed using GALFIT to remove a symmetric galaxy radial light profile. The color was used to estimate the stellar mass of each tidal feature. The color of the galaxy and of the tidal features was used to learn whether the interactions are quiescent or star-forming according to the urz color-color plane. The tidal feature mass will be compared with predictions from merger simulations to constrain the mass ratio of the progenitors. Ultimately, a new tidal feature metric will be employed to the analysis of larger samples.

Link to Full Paper

Logan Fries is a junior studying astrophysics at the University of Missouri-Kansas City. He is from Lee's Summit, Missouri and wishes to eventually get a Ph.D. in astrophysics and continue doing research.

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Smoothing for Nonlinear Gaussian Mixture Probability Hypothesis Density Filters

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Missouri University of Science and Technology

Adviser: Dr. Kyle J. DeMars

Abstract

This paper investigates a smoothing method using the nonlinear Gaussian mixture probability hypothesis density (GMPHD) filter for use in multi-target tracking. This specific smoother is developed using backwards recursion operations in order to improve upon the preexisting forward filtering solution. The observational and dynamical models considered are nonlinear in nature, creating complexities not present in previous works that developed multi-target smoothers for linear dynamics and measurements.

Link to Full Paper

Gunner Fritsch is a student attending the Missouri University of Science and Technology in Rolla, MO, and is pursuing a PhD in Aerospace Engineering. His research interests include multi-target filtering and estimation theory.

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Brain Activity During Sleep: Developing a Functional Model

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Adviser: Sonya Bahar, PhD.

Abstract

Many models have been developed over the past few decades to simulate sleep cycles in a variety of creatures, including rats, Cetaceans, and humans. A few have more depth, including separate, interacting hemispheres and multiple drives. The model presented here will include more detail and complexity, providing a detailed tool that can be adapted for use in computational experiments. This model will be comprised of individual Huber-Braun neurons, sorted into regions of the brain essential to the maintenance and switching of sleep states, which includes waking, rapid-eye-movement (REM) sleep and non-REM (NREM) sleep. Each region will inhibit or excite others, and input from the circadian and homeostatic drives will be incorporated. The regions will be divided into separate but interacting left and right hemispheres. Current, basic versions of the model include a region of sleep neurons, a region of wake neurons, and the circadian drive. Each region inhibits the other, with wake neuron activity correlated with the circadian drive and sleep neuron activity inversely correlated. Sleep is suppressed during the day, while wake is suppressed at night. The high activity periods of each region partially overlap, which may be mediated by adapting parameters and coupling. This overlap may also be due to lack of other mediating inputs, which will be added one at a time as the model grows in complexity.

Link to Full Paper

Tera Glaze is from Joliet, Illinois. She is working on her PhD in the Department of Physics and Astronomy at the University of Missouri – St. Louis. Her research centers around studying neurons and their behavior via computational models. She presented her research on Neural Chimeras at the Experimental Chaos and Complexity Conference in Banff, Canada in May of 2016, and published said research in *Chaos* the same year. Her goal is to finish her dissertation in the next year.

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Thermal Conductivities of Two-dimensional Graphitic Carbon Nitrides by Molecule Dynamics Simulation

Yuan Dong, Melinda M. Groves, Min Meng, and Chi Zhang
Department of Mechanical & Aerospace Engineering
University of Missouri, Columbia

Adviser: Dr. Jian Lin

Abstract

Two-dimensional (2D) graphitic carbon nitrides (2D GCNs) are a rising class of 2D polymeric materials. Compared with graphene, they have many attractive merits, such as their great semi-conductivity and photo-catalyticity. Despite much progress in studying their various properties, their thermal properties have been given little attention. In this work, thermal conductivities of three kinds of 2D GCNs, heptazine-based g-C_3N_4 (HEP), triazine-based g-C_3N_4 (TRI), and 2D polyaniline g-C_3N (PANI), were computationally investigated by non-equilibrium molecule dynamics (NEMD) simulations based on both Tersoff and ReaxFF potentials, which offer comprehensive understanding of their thermal properties. It was found that the PANI was predicted to show extrapolated bulk thermal conductivities of 810 W/(m·K) and 461.9 W/(m·K) by the Tersoff and ReaxFF potentials, respectively. The HEP and TRI have much lower bulk thermal conductivities, ranging from 14.1 to 119 W/(m·K). Nevertheless, they are still much higher than those of traditional polymers. The ReaxFF potential also shows that carbon-nitrogen bonds are stiffer than those modeled by the Tersoff potential, resulting in higher phonon harmonicity and longer phonon mean free paths.

Link to Full Paper

Melinda Groves is a Junior in the Department of Mechanical and Aerospace Engineering at the University of Missouri-Columbia.

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Stationary Beacons Employed for Lunar Landing Navigation

J. Cameron Helmuth
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Missouri University of Science and Technology

Advisor: Dr. Kyle J. DeMars

Abstract

A lunar descent and landing navigation scenario is presented in which measurements are available from an inertial measurement unit, a star camera, and a transmitting beacon on the surface. These data are processed within a Cholesky square-root formulation of the multiplicative extended Kalman filter. Results indicate that more data are required to accurately estimate the states but the beacon concept may be promising as cooperating vehicles near the moon become more common.

Link to Full Paper

Cameron Helmuth is a student at the Missouri University of Science and Technology in his second year of graduate studies. He is pursuing a doctorate in Aerospace Engineering, and will be interning at the Air Force Research Laboratory in Albuquerque, New Mexico this summer. His research centers on estimation theory, particularly, space vehicle navigation. Cameron grew up in Kansas City, Missouri, and received his bachelor's degree in Mechanical Engineering from the University Missouri – Columbia.

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From PID to Plot: A Map to RS-25 Data Assessment

Aaron Hensley[1], Jennifer Adams[2], Michael Dai, Delphine[3] Le Brun Colon[4], and Sean Neal[5]

Research Advisors: Timothy Duquette and Gustavo Martinez
NASA-Marshall Space Flight Center

Abstract

The RS-25 engine is the main propulsion system on the Space Launch System. Its complexities require an organized and comprehensive data assessment method. After each hot-fire test, raw data must be visualized in plots to provide a meaningful picture of the engine's health and performance. The Liquid Engine Systems branch (ER21) provides systems engineering support for the RS-25 and is responsible for this effort. While most aspects of the engine are properly monitored, there are four data assessment issues which needed to be addressed: insufficient coverage, redundant analysis, lack of rationale behind assessment methods, and lack of knowledge needed to interpret the underlying meaning of the data. In addition, the knowledge needed for data assessment in general is not fully documented, making it difficult to carry over to the incoming workforce. The aim of this project was to extend the scope of our current data assessment while standardizing the process. The team redeveloped a portion of the data assessment plots, documented the rationale behind them, and created a template to guide future development on this project. Along with this, a comprehensive tool tracking the statistics of what data are taken into account was made to quantify the coverage of our assessment plots.

Link to Full Paper

Aaron Hensley is from Warrensburg, MO, and is currently a 2nd-year M.S. Aerospace Engineering candidate in the Department of Mechanical and Aerospace Engineering at the Missouri University of Science and Technology in Rolla, MO. Aaron will begin his career in the field of space exploration in May of 2018, working for the National Aeronautics and Space Administration at Glenn Research Center in Cleveland, Ohio. His work will consist of integration and systems development of the propulsion system that will be used on the European Service Module for the Orion spacecraft. He believes that the development and innovation of space exploration technologies not only benefits the expansion and advancement of humanity in space, but also for the Earth and its residents. He believes that deep-space missions will help to discover new and exciting things about the universe that humans had not known before and he wants to be a part of the generation that pushes the boundaries of what is known. Aaron is greatly looking forward to beginning work for NASA and contributing to their dedication to space science and exploration for the benefit of all mankind.

1. Missouri University of Science and Technology
2. UNC Charlotte
3. Purdue University
4. Oregon State University
5. Indiana University-Purdue University Indianapolis

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Computational Fluid Dynamics Analysis and Optimization of a Blalock-Taussig Shunt

Thomas Hess
Department of Mechanical Engineering and Material Science
Washington University in St. Louis

Advisor: Dr. Ramesh Agarwal

Abstract

Blalock-Taussig or BT shunts are a surgical procedure performed on infants suffering from cyanosis or "Blue Baby Syndrome." Cyanosis refers the purple or blue color of the skin resulting from low blood oxygen saturation. A BT shunt is an artificial vessel placed between the right subclavian or carotid and the pulmonary artery to increase lung blood flow and blood oxygen saturation levels. During this independent study, the flow of blood through several different BT shunt configurations was analyzed using ANSYS Fluent, a Computational Fluid Dynamics (CFD) software analysis tool. Data from each shunt analysis was compared to help determine the shunt parameters and design with optimal flow dynamics for use in infants suffering pulmonary vascular blockage. It was found that the entrance boundary of current BT shunts causes many problems due to the abrupt change in flow direction. A newly designed shunt partially resolves this problem, however, additional work is required to fully optimize the design.

Link to Full Paper

Thomas Hess is a 1st year graduate student at Washington University in St. Louis pursuing a master's degree in Mechanical Engineering Design. He has two undergraduate Bachelor's degrees including: a Physics degree from Loyola University in Chicago and a Mechanical Engineering degree from WashU. Originally from Cincinnati Ohio, Thomas has lived all over the Midwest and hopes to expand his experiences by working on engineering design problems on the west coast. He is currently intern for General Motors in their hybrid/electric motor department and has previously worked with their manufacturing engineering team. While he has a great interest in cars, Thomas also has a strong enthusiasm for space related engineering and plans to work in that field after graduation.

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Aerothermal Analysis of Deployable Reentry Technology with Simulation Tools of Different Fidelity

Andrew Hinkle
Department of Mechanical & Aerospace Engineering
Missouri University of Science and Technology

Advisor: Dr. Serhat Hosder

Abstract

Convective heat transfer distributions over spherically blunted cone geometries representing the aero-shell shapes of deployable re-entry technologies predicted with simulation tools of different fidelity are analyzed and compared quantitatively. The highest fidelity solution is obtained with the LAURA CFD code by modeling the chemically reacting non-equilibrium flow field with a 10 species, 2 temperature gas model of Mars atmosphere. The three lower fidelity tools investigated include: (1) an engineering correlation based prediction method, (2) CBAero code of NASA and, (3) LAURA code with perfect gas assumption. For each tool, the simulation errors are obtained by comparing the predictions to the highest fidelity solution. The errors are presented at selected surface points of interest and for the entire surface by the integrating the error distributions for the design space defined by the velocity, density, and nose radius. CBAero is shown to have lower error in all measures than the correlation based model, as well as CPG LAURA in some measures. Example heat flux distributions are compared qualitatively and the results are discussed in the context of creating multi-fidelity modeling approaches for efficient and effective analysis and design of re-entry vehicles.

Link to Full Paper

Andrew Hinkle, of Jackson, Missouri, is currently an undergraduate senior in Aerospace Engineering, in the Department of Mechanical and Aerospace Engineering at Missouri University of Science and Technology. After graduation, he will begin a direct Ph.D. program under the advising of Dr. Serhat Hosder, in the area of computational aerothermodynamics. Andrew hopes to eventually be a researcher at NASA Langley in Hampton, Virginia.

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Multi-Mode ThrusterDevelopment for CubeSat Flight Demonstration

Barry Holland
Department of Mechanical & Aerospace Engineering
Missouri University of Science & Technology

Advisor: Dr. Henry Pernicka

Abstract

Small Satellites (or SmallSats), are becoming prevalent as vessels for scientific payloads in Low Earth Orbit (LEO) due to their low cost and rapid turnaround. As SmallSats increase in ubiquity, SmallSat propulsion remains an underdeveloped concept. Propulsion subsystems are difficult to integrate in a SmallSat due to high constraints on mass, volume, and power density. A novel solution to this problem is the multi-mode thruster system. Such a thruster is capable of operating in both a high thrust, low specific impulse chemical mode and a high specific impulse, low thrust electrospray mode. Demonstrating the capabilities of such a thruster is the objective of the Missouri S&T Satellite Research Team's APEX (Advanced Propulsion EXperiment) and M³ (Multi-Mode Mission) projects. The Missouri S&T Satellite Research Team has been tasked with the design, development, and testing of the propellant feed system, including all actuators, inhibits, sensors, and control mechanisms. Design of the propulsion system included means of propellant management, storage, and pressurization, and creating a system that includes inhibits and checks required by the Air Force Research Laboratory's University Nanosatellite Program (UNP) and prescribed by detailed risk analysis. Thruster development and testing was, and remains, an iterative and difficult process, given the lack of previous work done in SmallSat propulsion systems. This included testing a demonstration unit with various representative fluids and pressure environments. Further testing will include testing within a pressure vacuum environment and subjecting the unit to a vibration environment to demonstrate survivability during launch and leak-proof testing to quantify and mitigate system leakage.

Link to Full Paper

Barry Holland is a Junior in an undergraduate course of study in Aerospace Engineering at the Missouri University of Science & Technology. He is from Rolla, having moved there in 2011, only to attend university there four years later as a first-generation college student. His father was an avionics technician in the United States Navy in the early 90's, and his maternal grandfather was an aircraft engine technician for the United States Air Force. While the author has personally chosen to pursue efforts in the realm of space systems technologies, it can be said that the desire to create things meant to leave the ground was genetically bestowed. Along with his work on this project, he also works with the Missouri S&T Satellite Research Team as the MR & MRS SAT Thermal subsystem lead. He is involved with and has held leadership positions with the Missouri S&T Rocket Design Team, an on-campus design team that builds rockets to compete on an international collegiate level; which includes student designed and built solid rocket motors. Upon completion of his undergraduate program, Barry hopes to pursue graduate studies with the objective of obtaining a Ph.D. in Aerospace Engineering. His graduate studies as well as his career after graduation will likely be focused on research and development of innovative propulsion systems for the next generation of spacecraft.

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Molecular Production Rates and Abundances in ER61

Melissa Huber
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University of Missouri – St. Louis

Advisor: Dr. Erika Gibb

Abstract

C/2015 ER61 is a relatively recently discovered Oort Cloud comet. We observed four parent volatile compounds using the ISHELL at IRTF on Mauna Kea. We report the volatile compound abundances of C_2H_6, CH_3OH, and OH on April 16 and April 17 relative to water in the comet. Relative to other comets, ER61 appears to be "organically enriched" with respect to its abundances. This classification system helps us determine the role that comets played in shaping life on Earth, as these comets may have brought water and other molecules to Earth that helped develop the evolution of organic matter.

Link to Full Paper

Melissa A. Huber is an undergraduate student pursuing a Bachelor's Degree in Physics along with a minor degree in Mathematics at the University of Missouri – Saint Louis. After completing her degrees she intends to go to graduate school for Astrophysics to do further research in this field.

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Stellar Carbon Onion Condensation Simulation

Tristan Hundley
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University of Missouri – Saint Louis

Advisor: Dr. Philip Fraundorf

Abstract

Presolar graphite droplets that have unlayered spherical graphene cores and concentric graphite shells surrounding them, are referred to as carbon onions. They are extracted from meteorites and are isotopically shown to have formed in asymptotic giant branch star photospheres. These particles likely nucleated homogeneously from carbon vapor into supercooled droplets of carbon liquid, which solidified slowly enough for the growth of unlayered graphene sheets. To examine the conditions that the unlayered graphene forms, evaporating graphite ovens are manufactured to control the settling and cooling times for the condensing carbon. The particles produced include core-rim onions, rim-only graphite onions and carbon nanotubes. Using diffraction analysis, data is compared from the synthesized onions to presolar onion data to verify similarities and help understand the particle formation in red giant atmospheres.

Link to Full Paper

Tristan Hundley is an Engineering Physics senior at the University of Missouri-Saint Louis. He is from Saint Louis, Missouri and in addition to working on research projects he is a flight crew scheduler at GoJet Airlines. After graduation he hopes to attain a position working in the space industry and beyond that to obtain graduate degrees in Aerospace/Astronautical Engineering and Planetary Science. He hopes to work as an astronaut and develop next generation scientific instruments used in space exploration.

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Using CANDELS Visual Classification to Identify Massive Peculiar and Irregular Galaxy Targets for JWST

Luther Landry
In collaboration with Kameswara Mantha, Cody Ciaschi, Logan Fries, Rubyet Evan, and Scott Thompson
Department of Physics and Astronomy
University of Missouri - Kansas City

Research Supervisor: Prof. Daniel McIntosh

Abstract

This report summarizes contributions by Luther Landry to the UMKC target selection of massive galaxies from Hubble Space Telescope (HST) data for observations with the James Webb Space Telescope (JWST). Measuring the frequency of major galaxy-galaxy interactions over cosmic timescales is a key step toward quantifying the rate of galaxy merging and constraining its role in galaxy evolution. Distinguishing major mergers from other mass-assembly processes is exceptionally difficult, yet, quite important as merging is predicted to affect a wide range of galaxy properties. To improve on plausible identifications based on HST data from the Cosmic Assembly Near-IR Deep Extragalactic Legacy Survey (CANDELS), 900 irregular and peculiar massive galaxies from the Extended Groth Strip (EGS) field were identified using CANDELS visual classifications. JWST targets were defined by consensus (>65%) peculiar/irregular flag agreement among at least 3 human classifiers. This sample contains consensus subtype mergers (9%), interactions (22%), and irregular disks (28%). These targets were included in a JWST proposal (Cosmic Evolution Early Release Science Survey; PI Steve Finkelstein), which was one of 13 international teams to be awarded observation time with the next-generation space observatory starting in summer 2019. Deep JWST imaging holds promise to better identify a variety of predicted physical processes that may be responsible for disturbing the morphologies of these massive galaxies including major/minor merging, disk instabilities, and non-merging hierarchical compaction. Mining the premiere CANDELS data for targets was only possible after most of the EGS classifications were completed by UMKC.

Link to Full Paper

Luther Landry is an MS candidate in astronomy at the University of Missouri - Kansas City. Originally from Nixa, MO, he received a BA in philosophy from William Jewell College in 2007. That was not a good year to graduate with a degree in philosophy. In 2016, he decided to go back to school pursue his childhood love: physics and astronomy. He now collaborates with UMKC's Galaxy Evolution Group to help better understand the role of major mergers in galaxy evolution.

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Aerodynamics of Bio-Inspired Wings

Andrew LeBeau
Department of Mechanical & Aerospace Engineering
Missouri University of Science and Technology
Advisor: Dr. K.M. Isaac

Abstract

Computational Fluid Dynamics were used to study the NACA0009 airfoil with tubercles. One leading edge design follows previous experimental work while another provides an extreme case to gather more insight into the complex flow patterns caused by tubercles.

Link to Full Paper

Andrew LeBeau is a Doctoral candidate at the Missouri University of Science and Technology.

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Searching for Cosmic Collisions with CANDELS: Novel Tidal Debris Finder for the UMKC Galaxy Evolution Group

Kameswara Bharadwaj Mantha
In collaboration with Cody Ciaschi, Logan Fries, Rubyet Evan, Luther Landry, Scott Thompson, Courtney Hines, and the CANDELS Team
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University of Missouri – Kansas City

Research Supervisor: Dr. Daniel H. McIntosh

Abstract

Gravitational tidal forces during galaxy-galaxy merger events cause the host galaxies to exhibit transient tidal features, which are considered as hallmark identifiers of the merging process. Theoretical simulations predict that physical properties of tidal features (e.g. color, stellar mass) hold essential information (dynamics, gas content) about the merging process. To robustly detect and quantify the strength of tidal features, this study uses a large sample of visually-inspected sample of 2D light-profile fitting based model-subtracted images of 10,000 galaxies with Mstellar>109.5 M□ at 1<z<3 identified as hosting tidal features from the Cosmic Assembly Near-Infrared Deep Extragalactic Legacy Survey (CANDELS). This automated software pipeline performs smoothing and dedicated local-sky background estimation for each galaxy to select features above a signal-to-noise significance. In addition, this software includes a novel area-wise significance estimator to select statistically significant contiguous-pixel regions. In this report, we demonstrate the successful working of tidal feature extraction software on our galaxy sample to quantify their surface brightness as a means to measure their strength.

Link to Full Paper

Kameswara Bharadwaj Mantha was born in 1992 in Warangal, India. Upon graduating from high school, he completed his Bachelors in Electronics and Communications Engineering at K. L. University. To pursue his interest in Astronomy, he joined the Galaxy Evolution Group (GEG) in the Department of Physics and Astronomy at University of Missouri – Kansas City. He is a student member in the American Astronomical Society (AAS) and Astronomical Society of India (ASI), and has presented his research at 227th, 229th, 231st AAS meetings, and at the 36th ASI meeting. He is currently a Ph.D. candidate with Dr. Daniel H. McIntosh, scheduled to graduate in early 2020, after which he plans to pursue a career as a Post-Doctoral research scientist.

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Density Functional Theory Studies of the Thermodynamic and Structural Properties of Silicon-Based Borohydrides

Tianna McBroom[1], Oleksandr Dolotko[2], Shalabh Gupta[2], Vitalij Pecharsky[2], and Eric Majzoub[1]

Advisor: Dr. Eric Majzoub

Abstract

The storage of hydrogen for proton exchange membrane fuel cells for transportation applications requires the use of high pressure compressed gas, or chemical storage of hydrogen in the form of solid or liquid compounds. Light metals are desirable for solid hydrogen storage to maximize the energy content by weight. Hydrides containing anion complexes include $NaAlH_4$, and $LiBH_4$, where $[AlH_4]^-$ and $[BH_4]^-$ anions are counterbalanced by cations. Experiments suggest that silicon-based borohydrides may be a viable candidate for hydrogen storage. Utilizing first-principles density functional theory (DFT) combined with the prototype electrostatic ground state (PEGS) approach to predicting crystal structures, the authors examined over 2,500 prototype structures for one- to two-formula units in the composition space of $AlSiCl_xB_yH_z$, where x,y = {1,2,3,4} and z = {8 - 18}. The lowest energy structures were found to be unstable against decomposition to known compounds, suggesting that experimentally prepared materials using mechanical milling are metastable. Interestingly, the low energy structural landscape consists of a tendency toward Si- and Al-based polymeric units with a flat energy landscape giving rise to a multitude of low symmetry polymorphic structures. Using these metastable structures, a focus was placed on hypothetical desorption reactions that occur if elemental reaction pathways were restricted. A discussion of the thermodynamics of these reactions is also presented.

Link to Full Paper

Tianna McBroom, originally from Rolla, MO, is a senior undergraduate in the Department of Physics and Astronomy at the University of Missouri – St. Louis. She graduates in May of 2018 with honors and distinction with her B.S. in Physics and plans to pursue a PhD with an emphasis in materials physics.

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1. University of Missouri-St. Louis
2. Ames Laboratory, Ames, Iowa

Oxygen Saturation Control for Premature Infants During Feeding Using Automatic Control

Lydia Meyer
Department of Mechanical & Aerospace Engineering
University of Missouri
Advisor: Dr. Roger Fales

Abstract

For infants born prior to 32 weeks' gestation and/or weighing less than 1500 grams at birth, maintaining a safe arterial oxygen saturation level (SpO2) is critical for long-term and short-term health. The SpO2 level is regulated by adjusting supplementary oxygen (FiO2) delivered via a high-flow nasal cannula for the population of infants which are the focus for this research. The ideal SpO2 level of the infant lies within a range that depends on gestational age and other factors. As an example, 87 and 93 percent saturation may be selected as the safe range in some cases for this specific population of infants. Using current technology and practices in a neonatal intensive care unit (NICU) setting, a neonate receives supplemental oxygen through a nasal cannula attached to an oxygen blender. The blender dispenses air with supplemental oxygen ranging from 21 percent oxygen in air to 100 percent oxygen. Nurses manually adjust the oxygen blender to keep the infant's SpO2 level within the desired range. The nurse can see a display of the SpO2 on a bedside monitor which also produces alarm notifications when the patient is outside of the desired range of SpO2. The automatic oxygen control system receives information from a pulse oximeter and will adjust the FiO2 levels based on the SpO2 data. Many factors may influence the SpO2 levels of premature infants and cause a premature infant's oxygen level to desaturate. Feeding the premature infant poses challenges to maintaining safe SpO2 levels. The automatic controller has been demonstrated several times in a clinical trial in which the premature infant is fed frequently. Data from the trials, conducted in both automatic and manual modes, has been analyzed to compare the efficacy of oxygen control in automatic mode to manual mode before, during, and after feeding the premature infant.

Link to Full Paper

Lydia Meyer is a senior mechanical engineering major at the University of Missouri-Columbia. Meyer is originally from Jefferson City, Missouri. Meyer has conducted research on automatic control since May 2016 and has presented her research at the Mizzou Undergraduate Research Forum, Chancellor's Address, and Undergraduate Research Day at the Capitol. Meyer has interned at the Missouri Department of Transportation, where she developed alternative energy powering systems and a plan to implement infrastructure to support autonomous vehicles on Missouri roadways. Meyer plans to spend the summer of 2018 as an intern at the National Renewable Energy Laboratory in Golden, Colorado. In this internship, she will assist with modeling the energy usage of vehicles and using the model to determine the most efficient route of an origin-destination pair. Meyer hopes to earn a graduate degree in mechanical engineering and research the effects of automatic control on the energy efficiency and usage of electric vehicles.

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Shock Tube Experimentation Investigating the Hydrodynamics of an Impulsively Accelerated Multiphase Cylinder

John B. Middlebrooks
Department of Mechanical & Aerospace Engineering
University of Missouri - Columbia

Advisor: Jacob A. McFarland

Abstract

Shock driven multiphase instabilities (SDMI) are unique physical phenomena that have far-reaching practical applications in engineering and science. The instability is present in high energy explosions, scramjet combustors, and supernovae events. The SDMI arises when a multiphase interface is impulsively accelerated by the passage of a shockwave. It is similar in development to the Richtmyer-Meshkov (RM) instability however, particle-to-gas coupling is the driving mechanism of the SDMI. As particle effects such as lag and phase change become more prominent, the SDMI's development begins to significantly deviate from that of a traditional RM instability. A new experiment has been developed for studying the SDMI in our shock tube facility. In our experiments, a multiphase interface is created and flowed into the shock tube where it is accelerated by the passage of a planar shockwave. The interface development is captured using CCD cameras synchronized with planar laser illumination. This talk will give an overview of new experiments conducted to examine the development of a shocked cylindrical multiphase interface. The effects of Atwood number, particle size, and a secondary acceleration of the interface will be discussed.

Link to Full Paper

John B. Middlebrooks, from St. Louis MO, is currently an MS student in Mechanical and Aerospace Engineering at the University of Missouri-Columbia, as a University of Missouri Ronald E. McNair Scholar and Missouri Space Grant Fellow. John wishes to continue his education in the area of Thermal-Fluids sciences through coursework and research.

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Developing Flight Software for the Nanosat 8 Satellite Project

Jonathan Miller
Department of Mechanical & Aerospace Engineering
Missouri University of Science and Technology

Advisor: Dr. Henry Pernicka

Abstract

The intention of this project is to develop flight software for the Nanosat 8 satellite project. This software will be able to be reused in future satellites and future missions. In order for the flight code to be operational, it must be able to communicate with other systems such as the Guidance, Navigation, and Control algorithm, divide the workload of interfacing with hardware among several subthreads, log all command and sensor data to be downlinked for analysis, and automatically initialize itself on bootup as well as recover in the event of a crash or hardware reset. This research elaborates on the work required to implement the functionality of these objectives in the flight code. Once the flight code is operational, the satellite will be able to perform the Day In the Life test, where the satellite hardware is faces with real life scenarios.

Link to Full Paper

Jonathan Miller is from Poplar Bluff, MO, and is a sophomore in college. He is pursuing a double major in Computer Science and Computer Engineering at the Missouri University of Science and Technology in Rolla, MO. Jonathan has always been fascinated by computers, and once he was in high school he taught himself how to program. His first programming language was Java, but since enrolling at S&T he has also learned how to program in C/C++, Python, Lua, and Shell scripting. He is an active member of the Satellite Research Team on campus and Lead of the Command and Data Handling Subsystem. After graduating, Jonathan hopes to obtain a career in either cyber defense or software engineering.

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Fracture Toughness Testing of Additively Manufactured Ultem 1010

David Murphy
Department of Mechanical & Aerospace Engineering
Missouri University of Science & Technology

Advisor: K. Chandrashekhara

Abstract

Fracture toughness is one of the most important material properties to consider when choosing a material for design. Fracture toughness helps quantify the likeliness a material will experience brittle fracture with a crack present. The use of additive manufacturing has been continually growing in a variety of fields for some time now. As a designer, having access to accurate and necessary material properties is key in the decision-making process. Manufacturing a material to withstand its expected stresses even with an unplanned crack could create a viable and safer option than past materials.

The objective of this work is to quantify the fracture toughness of Ultem 1010. Ultem 1010 is a high temperature aerospace quality material, and Ultem 1010 can be used for both primary structure and tooling. The manufacturing of the test samples will change two design parameters: build direction, and raster angle. These parameters will allow for a full-factorial design of experiments (DOE). The resin will be manufactured at Missouri University of Science & Technology (Missouri S&T). The techniques used for manufacturing will minimize void content and increase consistency. Fracture toughness testing will be done according to ASTM standards. The tests of the parts will be conducted on an Instron Universal Testing Machine at Missouri S&T.

Link to Full Paper

David M. Murphy was born in Naperville, IL to Molly and Dave Murphy. He will be receiving his Bachelor of Science in Mechanical Engineering this upcoming May from Missouri University of Science and Technology. At the completion of this semester, he will begin his enrollment in the Ph.D. program at Missouri S&T and expects to complete his work by 2022.

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Application of the Intermittency Transition Function to the Wray-Agarwal Turbulence Model in OpenFOAM

Hakop J. Nagapetyan
Department of Mechanical Engineering and Material Science
Washington University in St. Louis

Advisor: Ramesh K. Agarwal

Abstract

This paper integrates an intermittency transport equation γ into the Wall-Distance-Free Wray-Agarwal (WA) one-equation turbulence model to create a two-equation WA-γ model for computing transitional flows. The model is validated by computing transitional flows past flat plates in zero and slowly varying pressure gradients for which experimental data and computations using other transition models are available. Computational results for benchmark ERCOFTAC flat plate transitional flow cases namely the T3A, T3B, and T3A- under zero pressure gradients as well as the T3C2-5 under slowly varying pressure gradients are obtained and compared with the experimental data and the computations from other transitional models. For all transitional flow test cases considered, good agreement between the computations and the experimental data is obtained. The WA-γ is found to be accurate and very efficient in computing transitional flows.

Link to Full Paper

Hakop J. Nagapetyan is a doctoral candidate in the Department of Mechanical Engineering and Material Science at Washington University in St. Louis.

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Design and Testing of the Flight Computer for a SmallSat Propulsion System Testbed

Daniel Newberry
Department of Mechanical & Aerospace Engineering
Missouri University of Science and Technology

Advisor: Dr. Henry Pernicka

Abstract

The APEX spacecraft is a 6U CubeSat being developed by the M-SAT research team on the Missouri S&T campus. The purpose of the APEX spacecraft is to demonstrate a multi-mode propulsion system by performing a series of orbital maneuvers. In support of the APEX spacecraft, a low-cost, high-performance flight computer is required. To this end, a flight computer interface board was designed. This purpose of this board is to support the primary flight computer of APEX, a Raspberry Pi Computer Module 3 Lite, and to interface the various components and subsystems of APEX with the flight computer. While accomplishing this, the flight computer interface board will be constrained by the limitations on physical dimensions and mass, along with power consumption of the supporting circuitry. Fulfilling these constraints is crucial for a successful small satellite mission. The first revision of the flight computer interface board was fabricated in December of 2017. This revision was tested and is currently in use in the APEX flatsat setup. As of writing this report, development of the second revision is ongoing. The second revision will implement changes recommended from testing and required from design alterations.

Link to Full Paper

Daniel Newberry is from a small town called Jerseyville, Illinois, and is currently in his first year of the direct-to-Ph.D. program in Aerospace Engineering in the Mechanical and Aerospace Engineering Department at the Missouri University of Science and Technology. His research interest is primarily in the application of Guidance, Navigational, and Control systems to small satellites. Part of the application of GNC systems to small satellites is the challenge of working with the limited computational hardware inherent with these systems.

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Computational Investigations of Andalusite

Weston R. Renfrow
Department of Physics, Astronomy, and Materials Science
Missouri State University

Advisor: Prof. Robert Mayanovic

Abstract

Water directly affects the way magma flows beneath the earth's crust. By studying how water acts when mixed with a silicate melt, we can gain a better understanding of Earth's volcanos and its mass distribution. This will, in turn, allow us to study the habitable zone of rocky exoplanets and help us on our search for life on other planets. Currently there are no studies about hydrous (i.e., with soluble water) silicate melt with sufficient data on the structure of the systems. With this research we hope to gain a better understanding of the structure of these systems by the use of molecular dynamics simulations of the andalusite-water system.

Link to Full Paper

Weston Renfrow is from Overland Park, KS and is currently perusing a BS degree in Physics/Material Science at Missouri State University. He hopes to either continue his education and pursue an advanced degree or find a career in the field of science.

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Water Assisted Liquefaction of Lignocellulose Biomass by ReaxFF Based Molecular Dynamic Simulations

Sean C. Rismiller, Melinda Groves, Ming Meng
Department of Mechanical & Aerospace Engineering
University of Missouri-Columbia

Advisors: Yuan Dong and Jian Lin

Abstract

ReaxFF based molecular dynamics (MD) simulation provides opportunities for fundamentally understanding pyrolysis of lignocellulosic biomass through precisely controlled reaction conditions and monitoring of reaction evolution processes. Despite demonstration of simulating the pyrolysis process of dry lignocellulose, MD investigation of this process assisted by water is yet to be performed. This is important considering that most pyrolysis experiments are performed under wet conditions. In this paper, roles of water on the pyrolysis process of the lignocellulose were investigated by ReaxFF MD simulation. In the simulation, both dry cellulose and lignin systems as well as their systems containing 33% and 66% water by weight were studied at a temperature range of 1250 K-2000 K at a time scale of 5 ns. Products were characterized by studying their phases, H/C, O/C ratios, and their higher heating values (HHV) to evaluate their value as fuels. Time evolutions of chemical products were investigated to determine the role of water in the reactions. Compared with dry systems, pyrolysis of the cellulose in presence of water shows enhanced breakdown of the cellulose polymer, increased oxygenation of the products, and shift of the final products from char to oil. In contrast, lignin remains largely unaffected by water, and simulation has reproduced experimental results of lignin char formation at elevated temperature in liquefaction. Additionally, as temperature increases the water's oxygenating effects in cellulose is decreased. These theoretical results provide solid evidence for unveiling the reaction mechanism of biomass pyrolysis, offering useful guidance for processing wet biomass to liquid fuels.

Link to Full Paper

Sean C. Rismiller is a Senior in the Department of Mechanical & Aerospace Engineering at the University of Missouri-Columbia.

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Molecular Dynamics Simulations of Anorthite-Melt-Water Interactions

Devon T. Romine
Department of Physics, Astronomy, and Materials Science
Missouri State University

Advisor: Prof. Robert Mayanovic

Abstract

This study is a continuation of ongoing research into hydrous albite melts, which was the first attempt at creating structural data of hydrous silicate melts. Anorthite is an aluminosilicate with Ca incorporated into it ($CaAl_2Si_2O_8$). Water dissolution into silicate melts like anorthite plays an important role in modifying the physical properties of the silicate melt. These modification to the physical properties can directly impact many fields of interest, such as the eruptive power of magmas and the transfer of mass in these magmatic processes. This will also lead to a better understanding of the water cycle regarding the plate tectonics of the Earth. Using this data, we could also determine more about the tectonics of exoplanets, and even constrain habitable zones of these exoplanets. There are also potential uses for this information in the field of construction, as a lot of concrete and window mixtures use silicates in their compounds. To this extent, large simulation-cell molecular dynamic calculations are being processed to try and make a detailed quantitative structure of hydrous anorthite melt systems.

Link to Full Paper

Devon Romine is from Sikeston, Missouri, and is currently pursuing a BS degree in Physics at Missouri State University. Devon hopes to pursue an advanced degree in physics in the near future.

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Conceptual and Numerical Analysis of Active Wingtip Vortex Cancellation in Propeller-Driven Electric Aircraft

Peter Sharpe
Department of Mechanical Engineering and Material Science
Washington University in St. Louis

Advisor: Dr. Ramesh K. Agarwal

Abstract

As battery and electric motor technology continues to advance rapidly, propeller-driven electric aircraft are likely to become a significant part of the aviation market in the near future. One proposed design configuration for electric aircraft involves using large, wingtipmounted propellers to actively cancel wingtip vortices, a method called active wingtip vortex cancellation (AWVC). By reclaiming part of the kinetic energy that would otherwise be lost to tip vortex formation, drag is decreased. In addition, the induced spanwise flow and upwash from the propeller causes the spanwise lift distribution to remain more uniform at the wingtips, increasing lift. Previous wind tunnel testing of this configuration characterized a significant increase in lift and decrease in drag, particularly in low-aspect-ratio configurations. This paper builds on that research by examining several test cases with a 3D, transient, viscous, sliding mesh CFD analysis in an effort to validate numerical methods for future conceptual design studies. In addition, many practical considerations regarding the implementation of this design are analyzed. Geometry from the aforementioned wind tunnel literature was reconstructed and analyzed. CFD indicated an 18.1% increase in lift and 5.1% increase in net thrust was possible solely through the phenomenon of AWVC. Furthermore, this CFD analysis matched wind tunnel data to within approximately 1%, validating the CFD approach for the analysis of more exotic configurations involving active wingtip vortex cancellation.

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Peter Sharpe is a Senior in the Department of Mechanical Engineering and Material Science at Washington University in St. Louis.

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Analysis of pulsating Subdwarf B Stars from NASA's K2 Campaign 7

Alyssa Slayton
Department of Physics, Astronomy, and Materials Science
Missouri State University

Advisor: Dr. Mike Reed

Abstract

Asteroseismology is the study of stars using vibrations (pulsations). There are two types of pulsations: pressure modes (p-modes) and gravity modes (g-modes). P-modes have a much higher frequency and come from the outer regions of the star. G-modes have a lower frequency and come from the star's core. All of the data used was collected using the seventh field of the extended mission of NASA's Kepler Space Telescope (K2), of which we observed 9 subdwarf B (sdB) stars of which four were discovered to be pulsators.

Link to Full Paper

Alyssa Slayton is a freshman attending Missouri State University pursuing physics and computer science. She began working with Dr. Reed during fall of 2016 when she was a senior attending Republic High School. She plans to continue this work next year as a sophomore at Missouri State University. She intends to graduate and continue with her master's degree.

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The Dynamical State of a Young Stellar Cluster

Timothy Sullivan
Department of Physics and Astronomy
University of Missouri-St. Louis

Advisor: Dr. Bruce A. Wilking

Abstract

The velocity dispersion of a young embedded cluster should reflect the initial conditions of star formation and the subsequent role of stellar interactions. Recent studies of prestellar cores indicate that stars should form in subvirial conditions, yet radial velocity dispersions of young, optically visible clusters already show significantly higher dispersions than the prestellar cores. The timing of stellar encounters in the early phases of formation is critical as it can affect the structure of circumstellar disks and the formation of planetary systems. We have been granted telescope time on NASA's Infrared Telescope Facility (IRTF) in Hawaii and used an echelle spectrograph to obtain spectra for a number of deeply embedded young stellar objects (YSOs) in the summer of 2016 and recently in the spring of 2017. These sources, along with already published results for more developed YSOs, should give us a larger sample size to work with. We are using Markov-Chain Monte-Carlo simulations to analyze our data to find the most accurate values for these objects radial velocity, veiling, and vsini. Our goal is to investigate whether the most deeply embedded objects have lower velocity dispersions more comparable to prestellar cores.

Link to Full Paper

Timothy Sullivan was born in Kansas City, Missouri and lived there before attending Truman State University for his undergraduate degree. Timothy is currently in his sixth year in the graduate program at the University Missouri St. Louis and hopes to earn a PhD in physics this year while doing astronomy and astrophysics research.

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Evaluation of Aerospace Quality Fiber-Reinforced Transparent Composites

Gregory Taylor
Department of Mechanical & Aerospace Engineering
Missouri University of Science & Technology

Advisor: Dr. K. Chandrashekhara

Abstract

This study investigates the manufacture and evaluation of transparent composite panels composed of an S-glass fabric and epoxy resin. All materials are commercially available to reduce cost. While S-glass fibers are more expensive than the traditional E-glass fibers used in fiberglass composites today, S-glass fibers will provide a higher stiffness and optical clarity due to the higher quality glass used in the fibers. The epoxy resin is synthesized at Missouri University of Science & Technology from two common epoxies and a cure hardener. To improve optical clarity, the fibers and resin are first manufactured in small samples to incrementally narrow the refractive index of the resin until matching the fiber refractive index. Upon successful matching of refractive indices, a large batch of resin is synthesized to manufacture the transparent composite panels. Composite panels are first manufactured with the more cost-effective vacuum assisted resin transfer molding followed by a traditional aerospace quality autoclave manufacturing to reduce voids. Currently, performance evaluation of the composite panels will involve transparency, tensile, flexure, and low-velocity impact tests. Results of this study can be later utilized for numerous aerospace applications including ground and air vehicle windows and facial visors.

Link to Full Paper

Gregory A. Taylor was born in Belleville, IL to Mark Taylor and Sharen Taylor. He received his Bachelor of Science degree in Aerospace Engineering in May of 2012 from Missouri University of Science and Technology and joined the M.S. degree program in Aerospace Engineering the following semester. He completed his M.S. degree in December 2014. He is currently enrolled in the Ph.D. program at Missouri S&T and expects to complete his work in Fall 2018.

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Computational Simulations of an Albite Melt Reacting with Water Molecules

Jesse A. Underwood,
Department of Physics, Astronomy, and Materials Science
Missouri State University

Advisor: Prof. Robert Mayanovic

Abstract

Water dissolution acts as an important component in modifying physical properties of aluminosilicate melts which directly impact the eruptive power of magmas in volcanos. Studies of water-melt interactions on the atomic scale can shed light on the understanding of the water cycle and plate tectonics on Earth and can then be applied to habitable zones of rocky exoplanets. Currently, there are no detailed structural data of hydrous aluminosilicate melts. For the first time we have successfully carried out Molecular Dynamics (MD) simulations, using ReaxFF potentials, of hydrous albite ($NaAlSi_3O_8$) at high temperatures. Structural data was obtained by calculation of the atomic Structure Factor, S(Q), and exploring the simulation for hydroxyl and water units dissociating the bridging oxygens of the albite network structure.

Link to Full Paper

Jesse Underwood is from Rogersville, Missouri, and is currently pursuing a BS degree in Physics at Missouri State University. Jesse hopes to pursue an advanced degree in physics in the near future.

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Spectral Energy Distribution Analysis of Nearby Major Mergers from the SDSS

Madalyn E. Weston
University of Missouri – Kansas City

Advisor: Daniel H. McIntosh

Abstract

The connection between merging galaxies and active galactic nuclei (AGNs) is widely debated in the literature. Central to this debate is the simultaneous presence of star formation (SF) and AGNs, which emit light at similar wavelengths. Dust produced during SF can also obscure an AGN. Therefore, disentangling SF and AGN activity in these systems is key to understanding the major merger-induced growth of stellar mass and central supermassive black holes. In this ongoing research, spectral energy distribution (SED) analysis is used to quantify the amount of SF and AGN activity in a sample of merging galaxies and a sample of statistically-matched control galaxies, presented in Weston et al. (2017)1. The results of SED analysis will be used to answer the following research questions: (1) Do all merging galaxies host an AGN that contributes significantly to the IR energy output (20% of the total IR light or more), regardless of optical emission type? (2) Do mergers identified as Seyfert or dusty AGNs by Weston et al. (2017)1 host more SF or AGN activity than those classified as non-AGNs? (3) Are previously selected AGNs in mergers different than those in non-merging galaxies? (4) Does the amount of AGN activity found through SED analysis scale with the [OIII] luminosity (a proxy for AGN power) of the host galaxy?

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Madalyn E. Weston is from Independence, Missouri. Upon graduation from high school, she completed her Bachelor of Science degree in Physics at the Missouri University of Science & Technology in 2012, and her Master's degree in Physics from the University of Missouri – Kansas City in 2015. She has represented UMKC at many conferences, including the WISE@5 Conference at Caltech in Pasadena, CA, and the "Galaxy interactions and mergers across cosmic time" conference in Sexten, Italy. She is currently a Ph.D. candidate in Physics and Education at UMKC.

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Meteorite Impact Structures as Outcrop-Scale Analogues for Mountain Building Events: Decaturville, MO

Simin Wu
Department of Physics, Astronomy, and Materials Science
Missouri State University

Advisor: Dr. Matthew McKay

Abstract

Understanding the architecture of mountain belts is limited because studies are typically confined to surficial exposures with lesser amounts of subsurface data and active margins are prone to successive tectonism that obscures the rock record. In west-central Missouri, a Paleozoic meteorite impact is exposed that contains a range of outcrop-scale structures. High-detail mapping and structural analyses of road cut exposures near Decaturville, MO reveals thrust fault sequences contain 1-2 m thick mixed carbonate and clastic sheets that include rollover anticlines, structural orphans, and lateral ramp features. While the strain rate in a meteorite impact is orders of magnitude greater than that in orogeny-scale structures, the morphology and spatial relationships in these impact structures may provide insight into larger tectonic features. Deformation, heat, and stress diffuse outwardly from the central peak of the crater. Therefore, the crater rim was chosen as a sample site as it has undergone the right amount of deformation to have recognizable, exposed structures.

U-Pb and (U-Th)/He radiometric dating of zircon grains from sandstones was conducted to investigate the age of the impact structure. Results, however, reveal that the sample sites did not reach temperatures in excess of ~200°C, and the impact was not recorded in our samples. This indicates that deformation occurred at lower temperatures than estimated. The geochronology data, however, provide evidence of 300 million year old sediment transport from the south. Zircon grains in ~315 million years old sediment are ~800-550 million years old, which requires sediment pathways from areas of Texas and Louisiana that have been buried since the opening of the Gulf of Mexico in Jurassic time (~180 million years ago). This study yielded evidence for low temperature, high strain deformation during bolide impacts and also provided insight into 300 million year old sedimentary drainages.

Link to Full Paper

Simin Wu is a senior undergraduate student at Missouri State University studying geology. In 2013, she won first place in the Mars Exploration Student Data Teams. In the future, she hopes to attend graduate school to receive her Master of Science in geology. She aspires to work in a petroleum company or as a field mapper for a state survey.

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Asteroseismic Analysis of NASA's *Kepler Space Telescope*
K2 Mission Data of Compact Stars

Matt Yeager
Department of Physics, Astronomy, and Materials Science
Missouri State University

Advisor: Dr. Mike Reed

Abstract

NASA's K2 mission has provided, and continues to provide, a wealth of data on numerous subdwarf B (sdB) pulsators for asteroseismology. However, the data is not as clean as the original Kepler mission and requires significant processing before useful analysis can be performed. After a clean light curve is extracted from the data, we use various tools, including Fourier transforms, the Kolmogorov–Smirnov test, and Echelle diagrams for seismic studies. Asteroseismology is the study of stars' pulsations to probe their inner structure which we cannot directly observe. Comparing the observed pulsations of a star with models can lead to new discoveries about sdB stars, including additional physics to be incorporated into models. The goal of this report is to provide an overview of what asteroseismology is and the methods and tools used to apply it to sdB stars.

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Matt Yeager is a junior at Missouri State University studying in the Physics, Astronomy, and Materials Science Department. His major is Physics with an emphasis in Astronomy/Astrophysics. After graduation he hopes to pursue a PhD in physics.

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The Design of Experimental Apparatus for Diagnosing an Atmospheric Pressure Plasma Torch

Calvin Young
Fluid Mixing and Shock Tube Laboratory
University of Missouri-Columbia

Advisor: Dr. Jacob McFarland

Abstract

The Fluid Mixing and Shock Tube Lab at the University of Missouri is currently working under a Department of Energy grant to generate and study an atmospheric plasma. The goal of the study is to develop and diagnose an atmospheric pressure plasma torch, and create a mathematical model that accurately describes the behavior of the plasma created. Generation of a long, laminar atmospheric plasma requires the design, creation, and development of an atmospheric plasma torch. Diagnosing the state of a plasma requires the implementation proper experimental measurement methods and as such requires the design of experimental apparatus. As an undergraduate researcher, the Author has designed and fabricated equipment to create plasma and measure certain designated intensive properties.

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Calvin J. Young is a junior at the University of Missouri – Columbia studying Mechanical Engineering and works at the Fluids Mixing and Shock Tube Lab under Professor Jacob McFarland as a senior undergraduate researcher. In his studies he particularly enjoy courses in thermal fluid sciences, and hopes to further his education by attending graduate school. He takes a particular interest in jet turbines used for propulsion, and hopes to someday work in that field. Born and bred a Missourian, Calvin hails from Kansas City.

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Solar Eclipse 2017: Engaging the Kirksville Community

Patrick Morgan, Rebecca Niemeie
Truman State University

Advisors: David Caples, Moberly, Area Community College
and Dr. Vayujeet Gokhale' Truman State University

Abstract

The lead up to the solar eclipse on the 21st of August, 2017 presented an opportunity to engage the community in astronomy and the physics of the Earth-Moon-Sun system. We accomplished this by hosting public, safe Sun viewing events at area public schools, the Adair County public library (ACPL), Truman State University (TSU), and Moberly Area Community College (MACC). Participants viewed the sun through various filtered telescopes, observed sun spots, and learned interesting facts about the Earth-Sun-Moon system. TSU hosted an Eclipse workshop to area educators and business. ACPL, MACC, TSU, and the Kirksville School District sponsored safe eclipse viewing areas with a focus on outreach to public school and university students, as well as the Kirksville community. Volunteer faculty and students hosted each location to monitor the telescopes, facilitate discussion and answer questions. Partly due to our efforts, we were able to create enough awareness and excitement to be able to give away or sell ($1.50 each) close to 7000 solar eclipse glasses in the Kirksville community. Because of unfortunate weather conditions, the turn-out on the day of the eclipse was subdued. At the time of the eclipse, most of Northern Missouri experienced thunderstorms. Moving forward, two solar telescopes and two solar binoculars will be shared with the Adair County Public Library. The library will make the telescopes available to the public in a "Library Telescope Program". Two Truman students are developing documentation and instructions for setting up the solar scopes and their safe usage. Our endeavors brought attention to STEM fields through the viewing events, talks, presentations and programs, and through the continued availability of solar scopes at the library, and the resulting area media coverage throughout Northern Missouri, and Southern Iowa.

Link to Full Paper

Patrick Morgan is a computer Science undergraduate student at Truman State University. He is involved in the astronomy, Italian, and ceramics clubs on campus. He was also involved in the Solar Eclipse committee during the 2016-2017 school year and following summer. Patrick hopes to eventually use his Computer Science degree in the astronomy field.

Rebecca Niemeier is a junior Linguistics major at Truman State University. She has interests in computational linguistics and astronomy and dreams of visiting all 50 states.

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David Caples is an Assistant Professor of Mathematics at Moberly Area Community College. He has a masters degree in mathematics from the University of South Dakota with an emphasis in computational mathematics. When away from the classroom, he enjoys backpacking, camping and reading.

Vayujeet Gokhale is an assistant professor of physics at Truman State University. He earned his BSc. in physics ('96) and MSc. in nuclear physics ('98) from the University of Bombay, followed by a PhD in astronomy from Louisiana State University. Dr. Gokhale loves the night sky and National Parks, and dreams of becoming an astronomy park ranger at the Arches National Park in Utah.

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Inspiring and Educating Students at the High School and College Level Through Participation in Robotics Competitions

Malia Waddell, Simeon Bauer, Dominic Torre, and Sacdiya Sayid
Metropolitan Community College of Kansas City

Advisor: Dr. John Daniel Justice

Abstract

This report contains research, introductions, and personal statements about FIRST Robotics, diversity, and the relationship between college and high schoolers conducted by the Metropolitan Community College and Penn Valley campus early college academy high schoolers. Starting in the spring of 2017 they formed a team of six students in their second year of college and under the guidance of Professor Dan Justice they began to experiment with the FIRST robotics starter kits. This continued into the summer as they worked on creating and programing a robot that could compete in the previous season FIRST Tech Challenge (FTC) - Velocity Vortex. At the start of the fall semester of 2017 the students formed a partnership with the Early College Academy (ECA). College students began to mentor and learn alongside the high school students as they prepared for the new season of FTC. Everything from setting up the workspace, designing, programing, building and competing were shared learning experiences.

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Malia Waddell was adopted from Hefei, China in the Anhui Province and has lived in Platte City Missouri for the majority of her life. Currently a sophomore attending Metropolitan Community College of Kansas City and seeking a degree for an Associate of Engineering. She is a member of Phi Theta Kappa, Upsilon Xi chapter, part of the Maple Woods Honor Society, enrolled in the Collaborative Engineering Program (CEP) with the University of Missouri-Kansas City and seeking a Bachelor's of Science in Mechanical Engineering. Malia hopes to pursue a career involved with working, designing, and improving high-speed transportation like the Hyperloop or the Shinkansen of Japan.

Simeon Bauer was born in Merriam, Kansas and attended multiple Catholic schools while growing up in Kansas City, Kansas including Bishop Ward High School. He then moved to Riverside, Missouri and graduated from Park Hill South High School. He plans to complete an associate degree in engineering at Metropolitan Community College in May 2018 and then transfer to Missouri University of Science of Technology to major in Chemical Engineering in the summer of 2018. After earning a bachelor's degree, he plans is to attend graduate school for a Master's in Material Science and Engineering or apply for an officer commission with the United States Marine Corp.

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Dominic Torre is a freshman college student at Metropolitan Community College – Penn Valley. He is studying engineering, and is quite open as to which discipline. At the moment, he plans to major in engineering and minor in German Literature and Linguistics. He tutors chemistry in the science tutoring lab, and works at the front desk at the math tutoring lab.

Dominic has spent his entire life doing lots of volunteer work. As long as he can remember, it has been a part of his life. He still volunteers twice a month or more, and has attained over 100 hours of service every year for five years and counting. Robotics has been an interest of his for quite some time now, especially since many of his friends have been doing it for a long time, and when the opportunity to participate in a team presented itself, he could not refuse.

Sacdiya Sayid is a full-time student at Penn Valley Community College. She is a part of the Early College Academy which enables her to be a college student her last two years of high school. Sacdiya attended Lincoln College Preparatory Academy since 6th grade and has demonstrated academic excellence. She has maintained 4.0 all through her academic career. Sacdiya has always excelled at math, taking advanced coursework at a young age. She currently is learning and thriving in her STEM classes. She joined the Robotics team in hopes of understanding engineering processes. Sacdiya is trying to obtain her General Associate's of Arts degree and will plan on transferring for a Bachelor's in Computer Engineering. The FTC robotics team has allowed her to flourish in a team environment with other high school students trying to work on a common goal as well as mentors to help achieve that goal. Sacdiya is also very involved in the community. She has acquired 80 hours of community service through tutoring and mentoring others in the community.

Dan Justice joined MCC in 1995 as a district-wide engineering instructor, a position he still holds. As engineering coordinator, he schedules engineering classes across the MCC district, designs curriculum and works with area universities maintaining articulation agreements. He holds a Bachelor's degree in Aerospace Engineering from Missouri S&T, and a Master's and Ph.D. in Aerospace Engineering from the University of Texas at Austin.

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Missouri University of Science and Technology Satellite Team

Taylor Eschbacher, Kyle Jernigan
Department of Mechanical & Aerospace Engineering
Missouri University of Science and Technology

Advisors: Dr. Henry Pernicka and Dr. Jonathan W. Kimball

Abstract

The Missouri University of Science and Technology Satellite Research Team (M-SAT) was first founded in the summer of 2002 as the UMR SAT team as part of the Distributed Space Systems effort implemented by NASA. The goal of this team was to create innovative and new concepts in the space industry while providing students ranging from undergraduates to graduates experience with design and manufacture of space systems. Beginning with the Air Force Research Laboratory's University Nanosat Program 4 competition with a design concept of a tethered pair of satellites performing close proximity operations, M-SAT refined that idea (e.g., using thrusters instead of a tether) in subsequent competitions until placing first in the Nanosat-8 competition in January 2015 with the MR & MRS SAT microsat pair. The mission uses stereoscopic imaging to perform close proximity operations, and is currently in the final phase of prototype testing and review by the AFRL UNP program. In addition, the team is also developing two other CubeSats: the Advanced Propulsion Experiment (APEX), anticipated for the Nanosat-10 competition, and the Multi-Mode Mission (M^3) for the NASA Undergraduate Student Instrument Project. Both of these missions utilize an innovative propulsion technology developed at the Missouri University of Science and Technology's Aerospace Plasma Laboratory. The mission of the team is to prepare students for a career in the space industry with the necessary skills and in depth knowledge of the design and fabrication of satellites as well as to develop enabling technologies for use with smallsats.

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Kyle Jernigan is from Rolla Missouri and is currently dual enrolled at the Missouri University of Science and Technology as both an undergraduate and a masters student in the Aerospace Department with an emphasis on space propulsion systems. Upon graduation he hopes to continue his masters degree while seeking full time employment in the space industry and helping propel mankind into the future. When not found in the lab he can often be found watching movies or attempting to coach his U15 soccer team on the field.

Taylor Eschbacher is from Saint Louis, Missouri and is currently in his fourth year of pursuing bachelor's degrees in aerospace and mechanical engineering. His academic interests include atmospheric and space propulsion system design and hypersonics. Upon graduation he hopes to join the workforce as a propulsion systems engineer and then begin graduate studies.

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SLUAV AUVSI Competition Team

Mathew Dreyer, Andrew Hoelscher, Holden Duncan
Saint Louis University

Advisor: Srikanth Gururajan

Abstract

A group of undergraduates at St. Louis University work throughout the year to develop an airplane to compete in the AUVSI SUAS competition. The team must equip the platform with the necessary instruments to accurately complete the specified tasks (autonomous flight, air delivery system, obstacle avoidance, and object detection, localization, and classification). The purpose of the team is to engage learning outside the classroom and develop skills within the engineering tool-kit in undergraduate students. With this in mind, the team has further improved the platform from the 2016-17 competition year by changing the flight controller, improving communications, and implementing computer vison techniques. The team has added new members from various majors and is working for a top 15th finish at the competition in June.

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Andrew Hoelscher is Team Captain and is a Senior in Mechanical Engineering. He is originally from O'Fallon, IL, and is a member of O'Fallon's Men's Slow-Pitch Softball Team (back to back champions)

Matt Dreyer is the Flight Controls Lead and is a Junior in Aerospace Engineering. He is originally from Kirkwood, MO, and plays 3rd base on St. Louis University's Club Baseball Team (2nd in nation in 2016).

Holden Duncan is the Software Lead and is a Sophomore in Computer Science. He is originally from Kettering, OH, and is an internationally ranked League of Legends player

Srikanth Gururajan, originally from Wildwood, MO, is the team's advisor and owned a pet elephant as a child

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Enhancing Remote Sensing Research and Education in Missouri through Workshops and Augmented Reality Developments

Kevin Eblimit, Sean Hartling, Stephen Leard, Matthew Maimaitiyiming
Department of Earth and Atmospheric Sciences
Saint Louis University

Advisor: Dr. Vasit Sagan

Abstract

Remote sensing has major advantages as a mechanism for learning. Across Missouri, educational institutions, from K-12 to the collegiate level, engage in the scientific process to investigate environmental issues, such as water quality monitoring, invasive species, biodiversity conservation and other important environmental issues. Given the importance of remote sensing for natural resource assessment and environmental monitoring as well as economic decision making, attention should be given to strengthen those institutions in academic and technical assistance. This project aims to enhance school and student learning, including the public, through hands-on learning in their community. The main topics presented in this project are: 1) the integration of UAS and relevant sensors as a highly autonomous environmental survey tool and 2) augmented reality applications that interpret multi-sensor imagery derived from UAS platforms. These topics have been presented to a diverse audience of organizations, educators, students, and general public through multi-institutional research collaborations, technical workshops, and hands-on learning displays. The work ties to several NASA areas of emphasis: 1) authentic, hands-on student experiences in science and engineering, 2) environmental science and global climate change, 3) diversity of institutions, faculty, and students, and 4) the capacity of institutions to support innovative research infrastructure activities to enable early career faculty to focus their research toward NASA priorities. The main objective of this initiative is to promote a remote sensing community committed to creating, establishing and assessing innovative education research and theory and incorporating it into effective practice.

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Kevin Eblimit is a M.S. student in Geographic Information Science program. He earned his B.S. in Geographic Information Systems and Technology from Texas A&M University, College Station, Texas (2017). He joined the Remote Sensing Lab in Fall 2017. His research focuses on remote sensing applications in engineering and oil exploration.

Sean Hartling is a PhD student in the Integrated and Applied Science (IAS) program with emphasis on remote sensing and GIS. He received his B.A. from Washington University in 2006 in St. Louis and a Graduate Certificate in Advanced Remote Sensing and GIS from Saint Louis University. His research focuses on storm damage forecasting for regional utility network using UAS/satellite remote sensing and GIS.

Stephen Leard is a M.S. student in the Geographic Information Science program and joined the SLU Remote Sensing Lab in the fall of 2017. His research focuses on immersive interfaces for remote sensing data visualization and human factors affecting zoonotic spillover risk.

Matthew Maimaitiyiming was admitted to the PhD in Integrated and Applied Science (IAS) program concentrating on environmental science and GIS at Saint Louis University in January of 2013. His research focuses on water and food nexus for safeguarding food security using multiscale hyperspectral remote sensing data. Matthew expects to receive his PhD degree from Saint Louis University in 2018.

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Capability Driven CubeSats

Connor L. Morris and Jeffrey Kelley
Space Systems Research Laboratory
Saint Louis University

Advisors: Dr. Michael Swartwout, Mr. Keith Bennett, and Dr. Kyle Mitchell

Abstract

The Space Systems Research Laboratory's (SSRL) current project is identifying and mitigating CubeSat system failures stemming from turnover of laboratory volunteers. Previously, SSRL spacecraft missions and SSRL management teams have been requirements-driven. However, each graduating class results in a loss of collective laboratory knowledge and experience in space systems engineering. The Minimum Viable Product (MVP) series is a project in both CubeSat design and laboratory management that seeks to identify risks to the spacecraft and to develop mitigation strategies for future SSRL generations. The MVP series of spacecraft consists of five separate milestones of spacecraft configuration. Furthermore, for each MVP spacecraft iteration, multiple flight units will be reproduced to increase available spacecraft stock so that capability can be added in incremental stages without having to redesign a BUS.

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Connor L. Morris is a junior Aerospace Engineering B.S. student at Parks College at Saint Louis University. Connor grew up in Omaha, NE and graduated from Creighton Preparatory High School in 2015. He begins his first NASA Pathways Co-op Tour for Aerospace/Mechanical Engineering in the fall of 2018 at Johnson Space Center in Houston, TX. He expects to graduate in 2020.

Jeffrey Kelley is a sophomore undergraduate student studying Aerospace Engineering in the Parks College of Aviation, Engineering and Technology at Saint Louis University. He grew up in Prairieville, Louisiana, and graduated from Catholic High School of Baton Rouge before coming to Saint Louis. He is currently serving as program manager for the Space Systems Research Lab, and hopes to eventually find employment at NASA.

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Saint Louis University Rocket Propulsion Laboratory

J.T. Cook, David Philiphose, and Henry Wright
Saint Louis University

Advisor: Dr. Michael Swartwout

Abstract

Saint Louis University Rocket Propulsion Laboratory (SLURPL) is a student organization that seeks to design, construct, and successfully launch high power rockets with the goal of forming its members into future leaders within the Aerospace Industry. The team consists of student members from three separate colleges within Saint Louis University, as well as faculty mentors and mentors within the greater engineering industry. SLURPL plans to compete in the Spaceport America Cup, held from June 19th to June 23rd, 2018. It's entry, entitled Project Wayfinder, will be entered into the "10,000 feet AGL apogee with Student Researched and Designed (SRAD) solid rocket propulsion system" category. In house filament winding technology will be used for airframe fabrication, while other components are also constructed entirely by students. While the motor casing used is a commercial purchase, motor testing the solid rocket motor mixing is performed entirely by the SLURPL Propulsion Team. The rocket will also carry with it an avionics package capable of transmitting live flight data and a live video feed through the flight. The final component of the launch system is a payload that will be entered into the SDL Payload Challenge. The payload consists of a deployable dual-copter to be released during the rockets descent, capable of transmitting live video and being piloted from the ground. The 2017-2018 academic year has seen the design and construction of most of the launch system. The future holds the completion of construction, system integration and testing, and finally a launch at Spaceport America.

Link to Full Paper

James (J.T.) Cook is currently a junior Aerospace Engineering student at Parks College of Engineering, Aviation and Technology. He is originally from Placentia, California. J.T. prides himself on his academic and leadership abilities. He has maintained a spot on the Parks College Dean's List for all 5 semesters at Saint Louis University. J.T. has used his leadership skills and the experience he has gained during his time at SLURPL to find ways to help the organization function more efficiently, as well as prepare its members for careers in the wider aerospace industry. His goals for SLURPL this year include well detailed design reviews, proper testing/quality assurance, and holding the SLURPL organization to tighter financial planning practice. After completing his undergraduate degree at SLU, J.T. hopes to begin a career within the aerospace industry designing and testing liquid rocket engines.

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Enhancing the Multidisciplinary Astrobiology Research Community at Truman State University

Truman State University Astrobiology Research Group

Advisors: Dr. Carolina Sempertegui-Sosa and Dr. Vayujeet Gokhale.

Abstract

Faculty and undergraduate students at Truman State University continued the activities of the Multidisciplinary Astrobiology Research Community and introduced new interdisciplinary educational opportunities for Truman students. A total of four students (two supported directly) and two faculty members from the Biology and Physics departments participated in research activities sponsored by this project. In addition, the 'Astrobiology Seminar class' continues to gain popularity and is currently offered with 10 students from a variety of science and non-science disciplines. We discuss astrobiology themed review papers during the seminar class, and devote a significant amount of time discussing short 'review projects' each student is involved in. These projects support the activities of the astrobiology research program at Truman, strengthen the Center for Astrobiology, and inspire students from a range of science and non-science disciplines to consider research opportunities and careers in science and astrobiology. One student from this group will be selected based on interest, aptitude, availability and performance to participate in astrobiology research in summer 2018.

Link to Full Paper

Jordan Goins is a third year Biology major with minors in Environmental Studies and Astronomy at Truman State University. She is passionate about life sciences and hopes to pursue a career in environmental research.

Ashley Herdman is a sophomore biology student at Truman State University. She has an interest in soil microbiology and is pursuing a career in research. Ashley is very passionate about environmental health and would like to work to reduce pollution and contamination throughout her education and professional career.

Carolina Sempertegui is an Assistant Professor of Microbiology at Truman State University. She earned her Master's in Public Health at Ohio University and Ph.D in Molecular and Cell Biology in 2011 and 2012 respectively. Dr. Sempertegui's laboratory has been focused on the study of cellular responses to UV radiation, using *Saccharomyces cerevisiae* as microbial model.

Vayujeet Gokhale is an assistant professor of physics at Truman State University. He earned his BSc. in physics ('96) and MSc. in nuclear physics ('98) from the University of Bombay, followed by a PhD in astronomy from Louisiana State University. The Gokhale group is interested in identifying and observing exoplanets in transiting systems, and studying habitable zones around low mass stars.

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Light Pollution in Kirksville

Jordan Goins, Ashley Herdman, Steven Pankey, and Emily Wren
Truman State University

Advisors: Dr. Vayujeet Gokhale, Truman State University
Mr. David Caples, Moberly Area Community College

Abstract

Faculty and undergraduate students at Truman State University and the Moberly Area Community College (MACC) participated in activities related to quantifying the light pollution in and around the Kirksville area in northeast Missouri, and near Anderson Mesa in Flagstaff, Arizona. Students used light sensors to track the amount of light projected towards the sky at various locations on campus, the University farm, at Thousand Hills State Park (about 5 miles W/NW of Kirksville), and at Anderson Mesa (about 15 miles S/SE of Flagstaff, Az). In addition, students used DSLR cameras to qualitatively capture the amount of light pollution by capturing long exposure tracked and untracked images of the night sky. Students have reached out to school administrators, the Truman State Physical Plant, and the local power company (*Ameren*) to understand the process of outdoor light and light fixture selection. Students successfully obtained internal funding through the 'Funds Allotment Council' and the 'Environmental Sustainability Fee Committee' ($3000 + $2500) to installed 'warmer' lights and light shields on outdoor lights across the Truman State campus. Additionally, students continue to increase awareness about light pollution as part of the outreach program during the weekend shows at the *Del and Norma Robison Planetarium* at Truman State University. This includes handing out light pollution related brochures, a 6-minute '*Losing the Dark*' planetarium documentary produced by the *International Dark Skies Association*, and Q&A sessions with the audience.

Link to Full Paper

Jordan Goins is a third year Biology major with minors in Environmental Studies and Astronomy at Truman State University. She is passionate about life sciences and hopes to pursue a career in environmental research.

Ashley Herdman is a sophomore biology student at Truman State University. She has an interest in soil microbiology and is pursuing a career in research. Ashley is very passionate about environmental health and would like to work to reduce pollution and contamination throughout her education and professional career.

Emily Wren is a sophomore at Truman State University. She studies biology and is on the pre-physician assistant track. Emily loves stargazing, coffee shops, and anything outdoors. In the future, after pursuing a career as a PA, she would love to become a nature photographer and travel the world.

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Steven Pankey is a senior undergraduate student of Mathematics and Physics at Truman State University. He joined the light pollution group led by Professor Vayujeet Gokale, which aims to increase public awareness and quantify light pollution. Steven's activities in this group are focused around quantifying the effects light pollution on data collected using DSLR Photometry.

David Caples is an Assistant Professor of Mathematics at Moberly Area Community College. He has a Masters-degree in mathematics from the University of South Dakota with an emphasis in computational mathematics. Prior to his seven years of teaching, he worked as a computer consultant in St. Louis for ten years completing projects at AT&T, Union Pacific, and Monsanto. When away from the classroom, he enjoys backpacking, camping and reading.

Vayujeet Gokhale is an assistant professor of physics at Truman State University. He earned his BSc. in physics ('96) and MSc. in nuclear physics ('98) from the University of Bombay, followed by a PhD in astronomy from Louisiana State University (2007). Dr. Gokhale loves the night sky and National Parks, and dreams of becoming an astronomy park ranger at the Arches National Park in Utah.

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Mizzou SURF's *Tigris Maris*

Trent Toliver, Sean Murray, Megan Ellis, and Brendan Cassell
Department of Mechanical & Aerospace Engineering
University of Missouri – Columbia

Advisor: Dr. Josiah A. Bryan

Abstract

Mizzou Students' Underwater Robotics Foundation (SURF) has designed and built an autonomous underwater vehicle (AUV) capable of performing a variety of underwater tasks. AUV's have many real-life applications from marine biology studies to oceanography to space exploration. Mizzou SURF's AUV, named *Tigris Maris*, has been designed and built in less than a years' time. This technical report discusses the initial concepts, final design, and manufacturing of the submarine as well as electronics/software, testing, and optimization of the AUV. The Mizzou SURF team has spent hundreds of hours working on the design and manufacturing of the AUV. Some fluid dynamic analysis has been conducted. The results of these studies have been used to make the AUV as hydrodynamic as possible. Various forms of testing have been done to optimize the design as well. With all of these studies, Mizzou SURF has built a highly-efficient and well-performing AUV.

Link to Full Paper

Trent Toliver grew up in Marshall, Missouri. He is now a senior at the University of Missouri in Mechanical and Aerospace Engineering with a minor in Astrophysics. He is the co-President of SURF, served as Secretary of SEDS, and has also been an active member of ASME. Trent does undergraduate research for Dr. Angela Speck, studying interstellar dust grain size distribution. He hopes to work in the space exploration industry after graduation and one day receive his Masters and Doctorate degrees.

Sean Murray is a senior in Mechanical and Aerospace engineering as well as Astrophysics at the University of Missouri. He grew up in St. Charles, MO, just outside of St. Louis, and is currently serving as Co-President of SURF. Sean is the former President and active member of ASME, as well as a founding member and Treasurer of SEDS. Alongside these extracurricular activities, he does undergraduate research for Dr. Angela Speck, studying radiative transfer effects on interstellar medium, and dust grain size distribution from late age variable stars. Sean has interned at Stealth Space Company in San Francisco, CA, as a Propulsion Design Engineer for low-cost, purpose built rockets, and will return to intern again this summer. He hopes to continue working in the space exploration industry upon graduation and receive his Masters and Doctorate degrees in aerospace and astrophysics respectively.

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Megan Ellis is a senior in Mechanical and Aerospace Engineering at the University of Missouri. She grew up in Jamesport, MO, a rural farm area north of Kansas City. She currently serves as the treasurer of SURF and does honors research under Professor Dr. Ma in heat transfer and phase change materials. Megan has interned at Textron Aviation as a Pneumatic Systems Engineer and will intern at Lawrence Livermore National Lab this summer as a Materials Engineering intern in the SULI program. During her college career, she also has served as an Engineering Ambassador, a member and leader in Alpha Chi Omega sorority, as well as a member of ASME and Pi Tau Sigma. She hopes to one day receive her Masters and Doctorate degrees.

Brendan Cassell is a senior at the University of Missouri studying Mechanical and Aerospace Engineering. He grew up in Wildwood, MO, a suburb of St. Louis. He is currently Webmaster of Mizzou SURF and President of the student chapter of ASME. Brendan has interned as a Mechanical Design Engineer at Silgan Plastic Food Containers and as a Tooling Engineer at Textron Aviation. He hopes to work in the aerospace industry after graduation and wants to one day receive a Master's degree in Aerospace Engineering.

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Increasing Popularity and Success of A Bridge to the Stars, a High School to College Pipeline Program

Derrick Jennings (Spring 2018 Development Intern/Bridge Mentor)
Spring 2018 Bridge Mentors:
Jaime Arnold, Rubyet Evan, Sammie Hays, Lauren Higgins, and Courtney Hines
Department of Physics & Astronomy
University of Missouri – Kansas City

Supervisor: Prof. Daniel McIntosh

Abstract

This report covers the process of the Spring 2018 semester (FY2017) and the overall progress of A Bridge to the Stars scholarship and mentoring program set up by Prof. Daniel McIntosh at the University of Missouri – Kansas City. Results from Spring 2017 (FY2016) semester will be discussed and compared to all semesters of the Bridge program. The goal is to aid underrepresented inner city high school students to see the possibilities of themselves in a STEM career. This is achieved by offering them a unique opportunity to attend and succeed in a college level astronomy course, where they gain an understanding of basic physics/astronomy principles in the process of gaining confidence for their future undergraduate careers. All 10 scholars from Spring 2017 passed the Astronomy 155 course at UMKC and had an average grade being equal to that of their collegiate peers. Spring 2018 semester (FY2017) is proceeding nicely with the largest class of seventeen scholars. The demographics of the sixteen students reflect the inclusive goals of A Bridge to the Stars. This year has come with a record number of eight different high schools with participating scholars. This increase in success was in large part due to this year being the second time the program had a development intern and many parts of the program were as a result, updated. Since this was the largest semester, Prof. McIntosh hired six undergraduate interns for the 2018 Spring (FY2017) semester, Derrick Jennings, Jaime Arnold, Rubyet Evan, Sammie Hays, Lauren Higgins, and Courtney Hines to peer mentor the scholars. The interns were to attend class with the students, as well as meet outside for a one-hour study session each week.

Link to Full Paper

Derrick H. Jennings II grew up in the suburbs of Kansas City. He is a Sophomore in Physics at UMKC and Senior in French at UMKC. Derrick plans to move to France and study particle physics upon graduation.

Rubyet Anzum Evan grew up and lived in Kansas City for most of his life after moving from Bangladesh. This is now his second year as an undergraduate student majoring in physics with an astronomy emphasis and mechanical engineering. He's been doing research with Dr. Daniel McIntosh and the Galaxy Evolution Group at the University of Missouri-Kansas City since the summer of 2017. He's also a mentor and previous scholar of the 'A Bridge to the Stars' program also under the supervision of Dr. Daniel H. McIntosh. Outside of university work, his biggest activity is mentoring the FIRST Robotics Team from Lincoln

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College Preparatory Academy (of which he is a former member). For the future, he plans on undertaking engineering research and continuing astronomy research to eventually work on research that encompasses both fields.

Courtney Hines grew up in the Shawnee Mission School District. After graduating high school he enlisted into the United States Air Force where he served six years at Offutt Air Force Base as an Aerospace Ground Equipment specialist for the E4-B Presidential Support Mission. He completed his Bachelors of Science in Music Production from Full Sail University before beginning his undergraduate studies in physics with an emphasis in astronomy. He is currently in his second year of study at the University of Missouri-Kansas City. He along with two other mentors are leading a project to build a display particle accelerator to increase interest in science. He plans to partake in research with the Physics and Astronomy department during his remaining time at UMKC and after graduation aims to join a graduate program fosters his interest cosmology, theoretical physics, and/or high energy physics.

Jaime S. Arnold grew up in Weatherby Lake, Missouri and went to the Park Hill School District. Now she is continuing her education at the University of Missouri - Kansas City where she is in the process of getting two degrees and one minor: Bachelor of Science in Physics with an Emphasis in Astronomy, Bachelor of Science in Biology and a minor in Chemistry. Along with two other mentors, she is working to build a display particle accelerator; the group hopes this project is the first of many. Jaime's aspirations include research in both the Biology department and the Physics and Astronomy department as well as advancing her education after she completes her undergraduate degrees. Her ideal career would utilize the breadth of her eclectic educational background, making Astrobiology an exemplary fit.

Lauren Higgins grew up in Kansas City, Missouri and is a non-traditional college student who began her 14+ year college journey as a Music Education Major. Now, she is majoring in Physics with an emphasis in Astronomy and minoring in Mathematics. She is the Vice President of the Society of Physics Students and a founding member of the UMKC student organization Women in Science. She wants to pursue a PhD. in either Particle Physics or Astrophysics and she wants to become a professor.

Samantha Hays grew up in Monroe City, Missouri and moved to Kansas City, Missouri to attend the University of Missouri - Kansas City upon graduating from high school in 2016. She is in the process of obtaining two degrees and one minor, including a Bachelor of Science in Biology, a Bachelor of Arts in Chemistry, and a minor in Astronomy. She is currently the Academic Assistant for the Honors College and President of Pride Alliance. She previously worked three semesters at the UMKC School of Law. After completing her undergraduate degrees, she will work towards a Masters in Molecular Biology and apply to medical school. Her career aspiration is to work as a pediatric neurologist.

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How to Build an Effective High School-to-College STEM Bridge

Derrick Jennings (Spring 2018 Development Intern/Bridge Mentor)
Spring 2018 Bridge Mentors:
Jaime Arnold, Rubyet Evan, Sammie Hays, Lauren Higgins, and Courtney Hines
Department of Physics & Astronomy
University of Missouri – Kansas City

Supervisor: Prof. Daniel McIntosh

Abstract

A Bridge to the Stars (ABttS) is an innovative high school to college pipeline that actively engages students from all backgrounds in enriching and impactful experiences related to STEM. Over the last 2 years, a number of innovations have been implemented to the program that have significantly increased the number of applicants and improved outcomes. ABttS is dedicated to building a blueprint for similar bridges to help traditionally underrepresented cohorts move from pre-college interest in STEM, to college enrollment in these degree programs, and eventually a career in a corresponding field. To this end, interested parties are offered the novel and successful methods utilized by ABttS to help others develop new programs or include added benefits in pre-existing programs. This poster summarizes the innovations that impact high-school ABttS participants (Scholars) and UMKC student interns (Mentors) including online applications, online teacher recommendations, scholar orientation and ice breakers, mentor orientation, long-term tracking surveys, and mandatory weekly mentoring meetings in which near-peer mentors help scholars succeed in their first on-campus university experience at remarkable rates (see the ABttS talk). The confidence boost provided to students through participation in this program is crucial in improving the diversity of the STEM workforce nationally.

Link to Full Paper

Derrick H. Jennings II grew up in the suburbs of Kansas City. He is a Sophomore in Physics at UMKC and Senior in French at UMKC. Derrick plans to move to France and study particle physics upon graduation.

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So We Decided to Build a Satellite… Who Knew How Much Fun This Would Be?!

Professor Hank Pernicka
Department of Mechanical & Aerospace Engineering
Missouri University of Science and Technology

Abstract:

Upon his arrival to Missouri S&T in 2001, Dr. Pernicka established the Space Systems Engineering (SSE) lab. Developed for both research and teaching purposes, the intended use of the SSE lab is for students and faculty to conceive of, design, fabricate, integrate, testing, and eventually fly small satellites ("smallsats") in Earth orbit. This endeavor takes advantage of the relatively recent smallsat "revolution" that has been characterized by some as a disruptive technology with the potential to make space exploration accessible to a much larger group than previously possible. The Missouri S&T Satellite Research Team (M-SAT) was established for the purpose of developing enabling technologies for smallsats. The team is composed of freshman through Ph. D. students and faculty from across campus. Three smallsat projects are currently in various stages of development: the MR & MRS SAT microsatellite pair, the APEX CubeSat, and the M3 CubeSat. The seminar will discuss the team's history and these projects, as well as some of the successes and lessons learned over the years.

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Hank Pernicka graduated from Purdue University in 1990 with his Ph.D. in Aeronautical and Astronautical Engineering. He then joined the Aerospace Engineering faculty at San José State University for eleven years. During this time, he spent two summers at NASA's Jet Propulsion Lab working on the Mars Observer spacecraft and other missions. He also enjoyed multiple collaborations with Lockheed Martin and Space Systems/Loral. But in 2001 when he and his wife got tired of all the good California weather, they headed back to the Midwest and joined Missouri S&T. Since then he has focused his research on astrodynamics and small satellite design, fabrication, and testing.

In his imagined spare time, Dr. Pernicka enjoys bicycling, downhill skiing, mountaineering, coaching youth soccer, and playing basketball (despite his slightly height-challenged affliction and being blind in one eye). Amazingly, his wife has put up with all these shenanigans now for 34 years!

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