

# Undergraduate Research Highlights

**Morrical N, Edwards J.** Parallel Quadtree Construction on Collections of Objects. *Computers & Graphics*. 2017; 66: 162–168. doi: 10.1016/j.cag.2017.05.024. (Idaho State University)

Quadtrees are typically used to decompose objects. The authors' work is in quadtree decomposition to separate objects for later construction of the Generalized Voronoi Diagram, a geometric construct useful in robot path planning, intersection-free motion, collision detection, visualization, and analysis. John Edwards is an assistant professor of computer science at Idaho State University. Nathan Morrival performed the research during his third and fourth years (2015–2017) at Idaho State University. He is currently a PhD student at the University of Utah.

**Kotapati HK, Robinson JD, Lawrence DR, Fortner KR, Stanford CW, Powell DR, Wardenga R, Bornscheuer UT, Masterson DS.** Diastereoselective Hydrolysis of Branched Malonate Diesters by Porcine Liver Esterase: Synthesis of 5-Benzyl-Substituted C<sup>α</sup>-Methyl-β-proline and Catalytic Evaluation. *European Journal of Organic Chemistry*. 2017; 20: 3009–3016. 10.1002/ejoc.201700605. (University of Southern Mississippi)

The project utilizes the readily available enzyme, pig liver esterase, to perform a hydrolysis of an ester into a carboxylic acid. The resulting product is enriched in one enantiomer and can be used to prepare optically pure organic molecules that can be used as environmentally friendly catalysts in a variety of reactions. We have demonstrated that this environmentally friendly approach is feasible and results in the synthesis of novel heterocyclic compounds that may also find significant use in the pharmaceutical industry. Hari Kiran Kotapati is a postdoctoral research associate and Douglas S. Masterson is a professor of chemistry at the University of Southern Mississippi. Douglas R. Powell is manager of the Chemical Crystallography Laboratory at the University of Oklahoma. Rainer Wardenga is chief scientific officer of Enzymicals AG. Uwe Bornscheuer is deputy director of the Institute for Biochemistry at the University of Greifswald in Greifswald, Germany. Daniel Lawrence was a capstone student and is now in medical school. Kimberly Fortner was a capstone student and is now in dental school at Marquette University. Jamarii Robinson was a high school student and is now studying chemical engineering at Mississippi State University. Caleb Stanford was a high school student and is now studying engineering at Mississippi State University. This research was supported by an NSF-Career

Award, American Chemical Society, McNair Scholars Program, and the University of Southern Mississippi's Office of the Vice-President for Research.

**DeLuca M, King R, Morsy M.** Bioprospecting Saline Gradient of a Wildlife Sanctuary for Bacterial Diversity and Antimicrobial Activities. *BMC Research Notes*. 2017; 10: 397. doi: 10.1186/s13104-017-2711-9. (University of West Alabama)

Antibiotic-resistant bacteria are becoming a global crisis, causing death of thousands of people and significant economic impact. The discovery of novel antibiotics is crucial to saving lives and reducing health-care costs. To address the antibiotic-resistant crisis, in collaboration the Small World Initiative, which aims to crowdsource novel antibiotic discovery, this study aimed to identify antimicrobial producing bacteria and bacterial diversity in the soil of the Stimpson Wildlife Sanctuary, an inland area with a soil salt gradient. Mustafa Morsy is associate professor of biology at University of West Alabama. The research was conducted as part of the honors theses of Mara DeLuca and Riley King. DeLuca is currently a graduate student at Brunel University. King graduated in spring 2018.

**Blay ES, Schwabedissen SG, Magnuson TS, Aho K, Sheridan PP, Lohse, KA.** Variation in Biological Soil Crust Bacterial Abundance and Diversity as a Function of Climate in Cold Steppe Ecosystems in the Intermountain West, USA. *Microbial Ecology*. 2017; 74: 691–700. doi: 10.1007/s00248-017-0981-3. (Idaho State University)

This study assessed how climate and grazing disturbance may affect the abundance and diversity of bacteria in biocrusts in cold steppe ecosystems located in southwestern Idaho. We found Actinobacteria as the major bacterial component within study site biocrusts (relative abundance 36–51%) using analyses based on 16S small subunit ribosomal RNA gene sequences. Phyla Actinobacteria and Firmicutes were higher at elevations experiencing cooler, wetter climates whereas the abundance of Cyanobacteria, Proteobacteria, and Chloroflexi decreased. Erika Blay and graduate student Stacy Schwabedissen analyzed and wrote the first draft of the manuscript as a senior thesis under supervision of Kathleen Lohse and Timothy Magnuson in the Department of Biological Sciences at Idaho State University. Blay is currently in biomedical graduate school in Texas. Peter Sheridan and Ken Aho assisted with molecular and statistical analyses. Lohse and Magnuson revised the manuscript for submission. The research was supported by

National Science Foundation for Reynolds Creek Critical Zone Observatory #NSF EAR 1331872 awarded to Lohse.

**Donahue MG, Jentsch NG, Realini EC.** An Intramolecular para-Phenolic Allylation Free Radical Cyclization Strategy for the Synthesis of Alkaloids and Terpenes with Spiro[4.5]decane Architectures. *Tetrahedron Letters*. 2017; 58: 3219–3222. doi: 10.1016/j.tetlet.2017.07.003 (University of Southern Mississippi)

The synthesis of small molecules isolated from plants, called natural products, is a vital area of research for the development of new chemical reactions. In this project, commercially available aromatic phenols were transformed into spirocyclic compounds that map onto complex natural products called alkaloids and terpenes. These classes of molecules are often the inspiration for the development of new prescription drug leads. The strategy developed in this research has the potential to create new molecular scaffolds previously inaccessible by other reactions. Matthew G. Donahue is an assistant professor of chemistry and Nicholas Jentsch is a graduate research assistant at the University of Southern Mississippi. Erin C. Realini, a junior-senior in 2014–2015, conducted an independent study and capstone research project. She is currently enrolled at South College School of Pharmacy in Knoxville, planning to graduate in 2020 with a PharmD degree. Funding was provided by a grant from the USM Drapeau Center for Undergraduate Research.

**Oprisan A, Rice A, Oprisan SA, Giraudet C, and Crococo F.** Non-Equilibrium Concentration Fluctuations in Superparamagnetic Nanocolloids. *The European Physical Journal E*. 2017; 58: 3219–3222. 2017; 40: ar 14. doi: 10.1140/ejpe/i2017-11503-y. (College of Charleston)

Paramagnetic nanoparticles have a wide range of biomedical applications that allows them to be functionalized and guided to the desired location inside the body using an external magnetic field. Transport properties of nanocolloids are influenced by the particle sizes and their magnetic susceptibility. We used a shadowgraph light scattering method to experimentally measure the amplitude of non-equilibrium fluctuations that take place at the interface between a nanocolloid and water. The dynamic light scattering method also allowed the direct measurement of the correlation time of fluctuations and the numerical estimation of the diffusion coefficient. Ana Oprisan is an associate professor and Sorinel Oprisan is a professor in the Department of Physics and Astronomy at the College of Charleston. Cédric Giraudet is a research fellow with University of Erlangen-Nuremberg in Erlangen, Germany. Fabrizio Crococo is a professor at the Université de Pau et des Pays de l'Adour in Anglet, France. Ashley Rice graduated from the College of Charleston in

May 2017 and is currently a graduate student in mechanical, aerospace, and biomedical engineering at the University of Tennessee. As an undergraduate, Rice contributed to experimental studies in non-equilibrium fluctuations of nanocolloids and presented research results at more than 30 professional meetings. The research was supported by a R&D grant from the College of Charleston.

**Oprisan SA, Austin D.** Phase-Locked Mode Prediction with Generalized Phase Response Curve. *BMC Neuroscience*. 2017; 18(Suppl1): P9. (College of Charleston)

Most neurons receive hundreds of inputs during every single firing cycle that continuously reset their phase. We successfully generalized the current theories of phased resetting to accommodate more than one input per firing cycle. We tested numerically the mathematical predictions and found that they also match existing experimental data available for small neural networks. Sorinel Oprisan is a professor in the Department of Physics and Astronomy at the College of Charleston. Physics undergraduate Dave Austin carried out two years of research in the computational neuroscience lab; he graduated in spring 2018. Austin's research was supported by NSF CAREER IOS-1054914 grant to Oprisan and a grant from the Howard Hughes Medical Institute to the College of Charleston as part of the 2012 Undergraduate Science Education Competition.

**Brower AP.** Gender Roles and Gender Stereotypes in Four Newbery Award-Winning Books. *SLIS Connecting*. 2017; 6:1: ar 6. doi: 10.18785/slis.0601.06. (University of Southern Mississippi)

As gender equality has become a more prominent issue and men and women have become more equal, one would expect this change to be reflected in children's literature. This study examines four Newbery Award-winning books to determine if this change is apparent. Alex Paige Brower's honors thesis, on which the publication was based, won the Committee on Services and Resources for Women (CSRW) Kathanne W. Green Award for outstanding student paper focused on a gender topic. Brower is currently a master's student and graduate assistant in the USM School of Library and Information Science.

**Loxtercamp M, Moore M, Kelleher L, Scibora LM.** Influence of Experience and Attentional Focus in a Single Arm Iso-kinetic Elbow Flexion. *Medicine & Science in Sports & Exercise*. 2017; 49: 481. (University of St. Thomas)

The present study aimed to better understand how attentional focus instructions influence motor skill learning and performance. Novice and experienced performers

were asked to perform an isokinetic elbow flexion using a Biodex dynamometer under a no-instruction control condition, followed by counterbalanced conditions in which performers were instructed to focus attention on squeezing the bicep muscle (i.e., internal focus) and moving the Biodex resistance arm (i.e., external focus). Consistent with the hypothesis, experienced performers demonstrated significantly greater force output under the external, but no effect of condition was observed among the novice performers. Lucy Kelleher is an adjunct faculty member at University of St. Thomas Lesley. Scibora is an assistant professor of exercise science at the University of St. Thomas and the faculty mentor for the research. Junior exercise science majors Blake Loxtercamp and Marcus Moore carried out the research during fall 2016 as part of an independent mentored research program. Both Loxtercamp and Moore are applying to chiropractic graduate programs.

**Hart LB, Wischusen KW, Wells RS.** Rapid Assessment of Bottlenose Dolphin (*Tursiops truncatus*) Body Condition: There's an App for That. *Aquatic Mammals*. 2017; 43: 635–644. doi: 10.1578/AM.43.6.2017.635 (College of Charleston)

The objective of this study was to develop a mobile application that allowed instantaneous comparison of bottlenose dolphin morphometrics to previously published body condition reference intervals in situ, allowing for further analysis to be done on animals that fall outside the healthy range. The app was developed using MIT App Inventor 2 software and its functions were validated using historical and simulated data. The app was field tested during a bottlenose dolphin capture-release health assessment in Sarasota, Florida. Leslie Hart is an assistant professor of public health at the College of Charleston. Randall Wells is director of the Sarasota Dolphin Research Program at Mote Marine Laboratory. Kerry Wischusen is an undergraduate student at the College of Charleston studying biochemistry. She was the programmer of the mobile application during this project. The research was funded by the Undergraduate Research and Creative Activities (URCA) Program at the College of Charleston.

**Artim JM, Hook A, Grippo RS, Sikkel PC.** Predation on Parasitic Gnathiid Isopods on Coral Reefs: A Comparison of Caribbean Cleaning Gobies with Non-Cleaning Microcarnivores.

*Coral Reefs*. 2017; 36: 1213–1223. doi: 10.1007/s00338-017-1613-6. (Arkansas State University)

This study examined the difference in consumption rates of dedicated cleaning fish and of opportunistic nocturnal fishes on parasitic gnathiid isopods. We also estimated site level predation on these gnathiids by combining observations of local fish abundance and of gnathiid consumption. We concluded that dedicated cleaning fish do consume large quantities of gnathiid parasites. Our results also suggest that collectively, other gnathiid predators may have an equal or greater impact on gnathiid populations. Paul C. Sikkel is an associate professor of biology, Richard S. Grippo is a professor emeritus of biology, and John Artim is a visiting assistant professor of biology at Arkansas State University. Alexandra Hook is an undergraduate who collaborated on this study from 2014 through 2016. She is now a senior majoring in biology with an emphasis in environmental studies and a minor in marine biology at Arkansas State University. The research was supported by grants from the National Science Foundation (OCE-121615 and OCE-1536794, Sikkel, principal investigator).

**Anders KR, Berekzi N, Best AA, Frederick GD, Mavrodi DV, Vazquez E, SEAPHAGES, et al.** Genome Sequences of Mycobacteriophages Amgine, Amohnition, Bella96, Cain, DarthP, Hammy, Krueger, LastHope, Peanam, Phelps ODU, Phrank, SirPhilip, Slimphazie, and Unicorn. *Genome Announcements*. 2017; 5:49:e01202-17. doi: 10.1128/genomeA.01202-17 (University of Southern Mississippi)

This study analyzed genome sequences of 14 bacterial viruses (bacteriophages) isolated using *Mycobacterium smegmatis* as host. This host is a close relative of *Mycobacterium tuberculosis*, a bacterium that causes tuberculosis and kills more people than any other infectious agent. Results of this work will help to better understand the contribution of bacteriophages to the evolution of mycateria and develop novel genetic and molecular tools that can be used to study this important group of microorganisms. Dmitri Mavrodi is an assistant professor of biological sciences at University of Southern Mississippi. Sarah-Elizabeth Polley and Gabriella Rayes are Honors College students at USM who isolated the genus Hammy. Amber Coats, Matthew Guillot, and Kassye Howe are Honors College students who contributed to genome annotation and are listed as members of the SEA-PHAGES group. This research was supported by the USM Department of Biological Sciences in collaboration with the Howard Hughes Medical Institute.