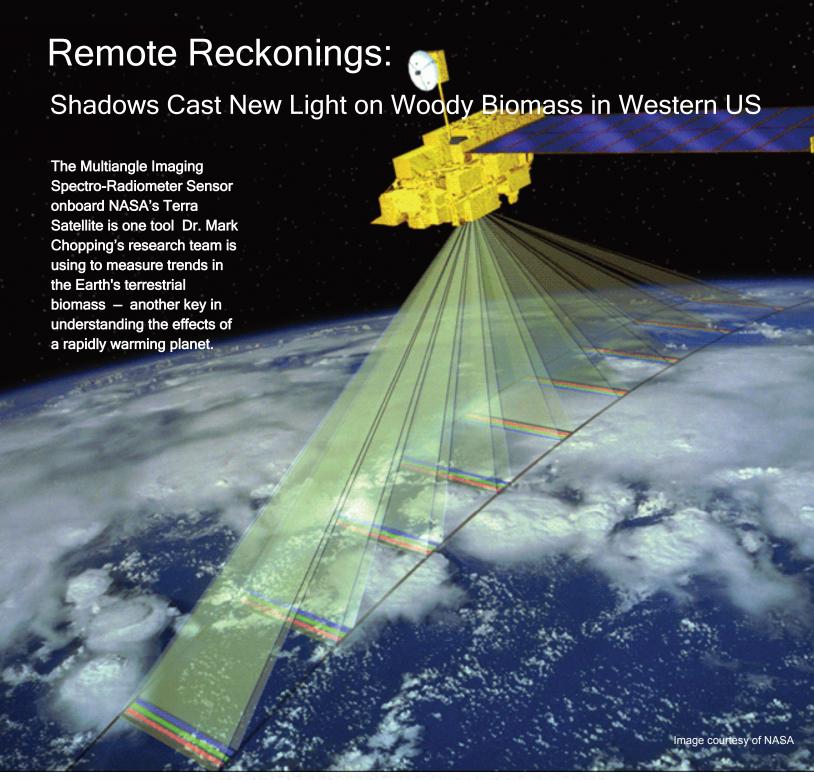
Volume 1, Number 1 Fall 2012

# csam insights

The Research Chronicle of the College of Science and Mathematics

Where Discovery and Innovation Meet



## The Nexialist Frontier

#### Sustainability: the most important emerging discipline of our time

Dr. Elliott Grosvenor spent years on an interplanetary voyage doing battle with vicious feline-like carnivores that bore deadly tentacles, mischievous telepathic avian aliens, deep space beings that implant parasitic eggs in human stomachs, and expansive beings capable of destroying all intelligent life. His success in these epic ventures was a direct result of his exceptional nexialist talent. Author A. E. Van Vogt's imagined adventure in his "Voyage of the Space Beagle" (1950, Simon and Schuster)

highlights Dr. Grosvenor as a scientist with expertise that is the progenitor to what we believe is a modern approach to science - interdisciplinarity or, actually of greater parallel, transdisciplinarity. Van Vogt defined nexialism as a merger of various disciplines in an organized manner with one discipline informing the other.

"As the only Nexalist aboard the Space Beagle, (Dr. Grosvenor) had been ignored for months by specialists who clearly did not understand what a Nexalist was, and who cared very little anyway".

The focus for this first Dean's Perspective in the founding edition of the College of Science and Mathematics (CSAM) Insights research chronicle emerged from my thoughts about the

"Voyage of the Space Beagle" while listening to presentations at an International Conference on Sustainable Development recently held on our Montclair State University campus. Over 30 countries were represented at the conference with a focus on what I consider the most important emerging discipline of our time, sustainability.

By nature and need, sustainability is transdisciplinary, stocked with individuals who are, or should be, nexialists. Sustainability represents converged disciplines with the lofty goal, no less, of saving our living planet through a balance of environment,

economics, and societal democracy. The real focus is resiliency, that is the ability for society to functionally sustain through or quickly recover from major environmental disruptions. Think here about our global ability to sustain an accepted "norm" (or recover to that "norm") from pandemics, major crop failures, drought, climate change, major earthquakes and storms, or wars.

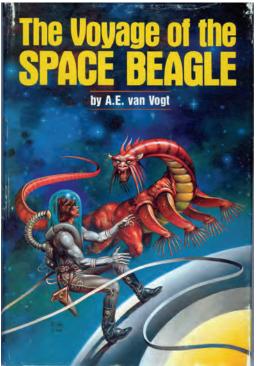
In this inaugural edition of CSAM Insights are articles on fluid

dynamics, spectral imagery, systems biology, historic environments, faunal diseases, and epidemiology. These all represent aspects of the knowledge cache we must grow in sustainability to better understand our air and water, the dangers of spreading pathogens, the distribution and use of resources, and our earlier earth's environment. These are essential components to help define resilient approaches for current and future generations and for a future that seeks to insure clean environments, healthy and sufficient food and water resources, a sound economy, and appropriate medical and

by A.E. van Vogt educational support and assets.

> The "answers" to so many of today's critical questions are found in the

blending of historic (read "silo") science and math disciplines. That's why so many of our CSAM scientists and mathematicians and their students work together in seeking answers to important questions. It's why we in the College of Science and Mathematics attend carefully to the future through a focus on shared and converging disciplines and creating future generations of nexialists.



By Dr. Robert S. Prezant Dean, College of Science and Mathematics

#### 2

#### The Nexialist Frontier

A perspective from the Dean

4

#### Remote Reckonings

Shadows cast new light on woody biomass in western U.S.

6

#### Math Goes Viral

Mathematical models make significant contributions to the field of epidemiology

7

#### **True Colors**

Spectral imaging is changing the way we look at the world

8

#### A World Without Frogs?

A species under global attack

10

### Journey to the Bottom of the Earth

Preparing the next generation of earth and environmental scientists

13

#### Range of Motion

How fluid dynamics research is uncovering novel solutions to complex problems

14

#### The Search for New Knowledge

A glimpse at CSAM's published research



contents





## csam insights

The Research Chronicle of the College of Science and Mathematics

Volume 1, Number 1 Fall 2012

csam insights is collaboratively produced by CSAM's research faculty and members of the Dean's staff in an effort to broaden awareness and understanding of the scope and relevance of CSAM's research initiatives as well as the critical role research plays in preparing the next generation of scientists.

Dean of the College Dr. Robert S. Prezant

Science Advisor: Dr. Lynn Schneemeyer

Editorial & Design Advisor: Ann P. Frechette

www.montclair.edu/csam



By Dr. Mark Chopping

An important consequence of a warming planet that NASA satellite measurements have confirmed is the ongoing loss of mass from the Greenland and Antarctic ice sheets. However, the trend in the "carbon sheet" – Earth's terrestrial biomass – is much less certain. After decades of increases, global vegetation productivity declined in the period 2000-2009, mainly as a result of drought in the southern hemisphere.

There are big changes happening in the continental United States as well: while woody biomass has been increasing in parts of the eastern United States, western forests have been suffering from climaterelated wildfire, drought, and bark beetle episodes that have recently become much more frequent, severe, and extensive. Documenting these changes is important in order to help us understand the consequences of a rapidly warming planet and to allow us to seek ways to mitigate and/or adapt to those changes, for example, by protecting and growing forests.

While earth-observing sensors on NASA orbiting satellites provide an extraordinary and unique tool for tracking changes in the Earth's vegetation — the

"One consequence of a warming planet that NASA satellites have confirmed is the net loss of mass from the Greenland and Antarctic ice sheets.

However, the trend in the 'carbon sheet' - Earth's terrestrial biomass - is much less certain."

- Dr. Mark Chopping

Image courtesy of NASA GSFC

# Reckonings

#### Shadows Cast New Light on Woody Biomass in the Western US

coarse resolution imagery they provide is available daily for the entire globe -- the 250 m spatial resolution means it is difficult to interpret. For the past six years, Professor Mark Chopping of Montclair State University's Earth and Environmental Studies Department and his students have been pursuing a new approach. Vegetation is often mapped using differences in spectral reflectance (the ratio of the amount of reflected to incoming light). This tells us about vegetation function by providing estimates of the abundance of photosynthetically-active green leaves; however, it does not provide information on canopy 3-D structure.

Professor Chopping has found a way to map canopy height by exploiting the fact that sensors such as NASA's Multiangle Imaging Spectroradiometer (MISR) and Moderate Resolution Imaging Spectroradiometer (MODIS) observe the surface in different directions. This "multi-angle" approach provides a signal that can be used to adjust a canopy reflectance model's parameters, allowing retrieval of canopy height and cover. These can, in turn, be used to estimate woody biomass and answer questions such as "how much atmospheric carbon was fixed by this forest over the last decade?"

"We were not initially trying to map forest canopy height. In one of the first shrub maps we produced, we thought that the high cover estimates were simply errors resulting from the large slope. But I quickly realized that this was because we were looking at trees rather than shrubs and we had used a fixed canopy height in our model. When we allowed a model parameter related to height to vary, we could see that we had a method for mapping canopy height at large scales" Chopping said.

Professor Chopping's research is supported by NASA and has been published in a series of papers in Remote Sensing of

Environment, Geophysical Research Letters, International Journal of Remote Sensing, Remote Sensing Letters, and IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing.

Chopping is a member of the NASA MISR Science Team, the NASA Terrestrial Ecology Science Team, and the NASA Carbon Cycle & Ecosystems Vegetation Structure Working Group. He also serves as principal investigator in NASA's Earth Observing System (EOS) program, and on the editorial board of *Remote Sensing of Environment*.



# Math Goes Viral



Researchers using mathematical models have made significant contributions to the field of epidemiology in recent years. These models have both explanatory and predicative power to describe disease dynamics that will lead to the design of more effective control methods to limit epidemics.

By Dr. Lora Billings

Diseases that sweep through cities and towns, with names like Swine flu and Ebola that kill indiscriminately by the hundreds and thousands, are the stuff of nightmares and horror movies. Unfortunately, such diseases – epidemics – are also real threats today. Both new (emerging) diseases and older diseases that re-emerge can devastate populations and cost the world's economy millions of dollars.

While diseases like the H1N1 strain of the flu virus capture the headlines and ignite our fears, most people are unaware about how vaccine-preventable

Lora Billings

diseases continue to thrive in many parts of the world. For example, most people in the US think that the childhood disease, measles, poses little threat to human health. However, the World Health Organization, WHO, estimates that in 2007 there were 197,000 measles deaths worldwide despite the 82% overall vaccination coverage. In countries where measles has been largely eliminated, cases brought in from other countries by travelers remain important sources of infection.

Dr. Lora Billings, of the Department of Mathematical Sciences, and her students, have been using a dynamical systems approach to analyze models that predict disease outbreaks to provide new insights into travel-related disease spread.

She is part of a team of applied mathematicians and epidemiologists who are working to develop new models that are motivated by real epidemiological threats, derived from data collected from around the world, and focused on answering questions that could save lives.

The impact of interdisciplinary research efforts combining mathematical fields, such as nonlinear analysis, stochastic dynamics, and network theory, with systems biology approaches such as population dynamics, epidemiology, and immunology is creating real excitement in the field of research.

In a recent project, the team considered the interplay of vaccination rates and migration rates on disease spread in networks of populations. Former mathegraduate student, Jackson Burton, proved that neglecting migration effects overestimates the vaccination levels necessary for disease eradication. The results suggest more efficient vaccination strategies may be identified for groups of countries with significant migration between them. In addition, former graduate student, Jonathan Hayes, designed computer simulations of migration on these networks to help verify theoretical results.

The disease-spread models that are being created include real-world variables such as immunization rates and treatment effects. They are more intuitive to design and conceptually easier to describe and analyze. Ultimately, the greater understanding of disease spread will aid public health workers in the design of more effective control methods to limit epidemics.



By Dr. Stefan Robila

Spectral imaging is a technology that is impacting more and more of our lives. In life sciences, spectral imaging processing can be applied in microscopy to detect cancer associated tissue and are now standard in techniques such as endoscopy and virtual surgery. In food production, it is used as a way to detect contaminants. In homeland security, it is used to detect camouflaged vehicles or the presence of other human-made structures. In the arts, it is used to analyze the artist's composition approaches for paintings or to detect fakes or alterations.

The human eye sees the world only in red, green and blue. However, large regions of the electromagnetic spectrum, including the infrared and ultraviolet portions of the spectrum, are invisible to the unaided eye. Spectral imaging can capture light from frequencies beyond the visible range, and allow the additional information that the human eye cannot see to be analyzed. Moreover, the reflectance of light can be sampled into tens of hundreds of narrow electromagnetic spectrum intervals for much more detailed measurements.

Pictured above is a color image of a flower arrangement. To the right is a hyperspectral image of the same arrangement after additional processing shows the difference between fake vegetation (blue - bottom of pot) and real vegetation (green - top of the arrangement)

Spectral imaging is a technology originally developed by NASA and the Department of Defense for air and space-based exploration. Beginning as a natural progression of photography to remotely observe our planet and other cosmic bodies, the initial goal was to employ spectral imagers in analysis of geological structures and detection of minerals or oil or mapping of hydrological systems. Soon though, it expanded into environmental mapping and agriculture where differences in spectral information among vegetation and non-vegetation (as well as between different vegetation types) allow highly accurate vegetation classification and assessment of crop yields and health.

Dr. Stefan Robila, Professor in Computer Science, is involved in many novel applications of spectral image processing, a uniquely interdisciplinary field combining environmental and life sciences with a strong computational component. With the support of the NSF, Robila and his undergraduate MSU students have built a database of hyperspectral faces, extracted spectral

and faces images and have devised methods to improve face recognition. Also, using one of the few hyperspectral cameras available in the New Jersey, Robila and his students are studying real time detection of vegetation, and techniques to detect vegetable freshness. Theoretical advances, including new algorithms for data compression for classification and detection, have been developed by the Robila group and have general applicability to many types of data ranging from Earth observations to cellular investigations.

With funding from Sun Microsystems and the NSF, multiprocessor servers and clusters are being used by Robila and his graduate students to produce spectral imaging results in close to real time and will enable other new applications of this technology.

# A World Without Frogs?

By Dr. Lisa Hazard and Dr. Kirsten Monsen-Collar

Try to imagine a world without frogs. No peepers would announce the arrival of spring and the mosquito and fly populations would soar. Amphibians, including frogs, are suffering population declines worldwide as a result of habitat loss, pollution, and disease. CSAM Professors Lisa Hazard and



Drs. Lisa Hazard (I) and Kirsten Monsen-Collar (r) collect samples from adult green frogs (*Lithobates clamitans*) in Ocean County, NJ for Ranavirus testing.

Kirsten Monsen-Collar, and PhD student **Paola Dolcemascolo** recently documented the first known New Jersey cases of two lethal amphibian diseases, Ranavirus and the fungus *Batrachochytrium dendrobatidis* (Bd). In 2009, this team discovered asymptomatic animals with Bd in Sussex County, and in 2011 they documented a severe Ranavirus outbreak in Ocean County.

Ranavirus has been implicated in amphibian mass mortality events worldwide and may be contributing to significant declines in the populations of some species. In 2011, the MSU amphibian disease team was called to Ocean County to investigate a mass die-off of tadpoles at a wildlife management site. At the site, they discovered sick and dead green frogs, and Fowler's toad tadpoles were displaying the typical signs of Ranavirus, including lethargy, swelling and red skin lesions. Both living and dead tadpoles were screened for the presence of Ranavirus DNA using traditional and Real-Time PCR (polymerase chain reaction), which confirmed that the animals were infected with Ranavirus. The following summer, animals at the site and other nearby ponds in the Pinelands again showed signs of Ranavirus disease. The team is continuing to track the progress of this outbreak.

Because of the potential threat these pathogens pose for amphibian populations in New Jersey, Ms. Dolcemascolo and Drs. Hazard and Monsen-Collar plan to investigate these diseases in multiple species statewide over the next several years. Working with the NJ Department of Environmental Protection, over 1000 samples have been collected from amphibians throughout the state. These samples will allow mapping of the distribution of these pathogens across New Jersey. The team hopes their work will contribute to the survival of New Jersey amphibians and to the overall health of the New Jersey environment.

#### For the expertise and solutions to manage New Jersey's environmental future

## Think Montclair State.

Montclair State plays a pivotal role in environmental science education and research to mitigate historic damage to New Jersey's ecosystems; examine/address future economic and ecologic impacts associated with land-use decisions, use of natural resources and global climate change; and prepare the next generation of environmental scientists and professionals.

#### **Education Innovation**

- PhD in Environmental Management
- Masters Degrees in Environmental Management, Environmental Science, Geoscience, Aquatic and Coastal Science
- Certificate Programs in: Water Resource Management, Geographic Information Science and Environmental Forensics
- Customized Training Programs for New Jersey's environmental sector

#### **Institutes and Centers**

- PSEG Institute for Sustainability Studies
- Passaic River Institute
- Battelle Memorial Institute
- Center for Environmental Management and Analysis
- New Jersey School of Conservation

#### Laboratories

- Microscopy and Microanalysis Research Lab
- Remote Sensing Lab
- GIS Lab

#### **Consulting Expertise**

- Water/sediment sampling and analysis
- Geochemical contamination investigation
- Hydrologic / hydro geologic monitoring & modeling
- Benthic biodiversity studies
- Wetlands assessment
- Vegetation and wildlife studies
- Landscape characterization
- Environmental data management
- Computerized mapping
- Air quality and climate modeling
- Site investigations

#### **Graduate Internships**

As a leading educator of New Jersey's next generation of environmental scientists and professionals, Montclair State's Master's and PhD students work with numerous state and national environmental firms and agencies as field or laboratory research intems in areas such as: environmental quality assessment, natural resource conservation, biodiversity, contaminant remediation, groundwater contamination, soil science, waste management, sustainable development, remote sensing, and spatial analysis.

For more information, contact us at 973.655.4225 or go to montclair.edu/csam



College of Science and Mathematics



One of the skills imparted by a strong science education is critical thinking. By taking multiple sources or types of data and synthesizing them into a complete picture, critical thinking lets us form a new and realistic view of complicated issues, move the body of scientific knowledge another small step forward, and frame the next question that needs to examined.

The complex environmental challenges of today are creating a growing need for scientists with rigorous research training and in-depth knowledge in earth and environmental sciences. CSAM's research-active faculty provide countless opportunities for undergraduate and graduate students to participate in relevant, real world scientific research including Drs. Sandra Passchier and Stefanie Brachfeld, geoscientists in the Department of Earth and Environmental Studies.

The coastal regions of the earth's continents, including the 127 miles of New Jersey shoreline, are threatened by global climate change. Even a 10% loss of the Antarctic Ice Sheet could raise global sea level by many feet, inundating coastal areas worldwide and displacing millions of residents. A broad scientific consensus concludes that environmental changes caused by human habitation of the earth, especially the burning of fossil fuels, is driving significant changes in the climate. The changes are happening most rapidly at the Earth's poles and therefore, much scientific study is being focused on the climate history of those regions, especially Antarctica. Professors Brachfeld and Passchier use sediments as recorders of Earth's climate history, with a focus on the origin and evolution of the Antarctic Ice Sheet and its dynamics.

While ice cores give climate clues back about one million years, sediment cores can reach back in time much further, into a realm known as 'deep time.' "Deep sea cores are important to give us clues of past climate shifts as the deposits are protected from ice-sheet advances," said Dr. Brachfeld.

Drs. Passchier and Brachfeld have a combined total of 11 expeditions to Antarctica funded by the National Science Foundation, Antarctic Drilling Program, and Integrated Ocean Drilling Program. Seven Montclair State University students have participated in these expeditions, while dozens of others have worked in the professors' research laboratories analyzing sediment core samples.

Dr. Passchier, working with MSU students Daniel Hauptvogel, Candice Falk, Melissa Hansen, Nadine Orejola, Sarah Busch, Jason Darley, Ian Johnson, Audrey Burns, Linda Martin, and Dan Ciarletta, has



#### **Brendan Reilly**

M.S. Geoscience (in progress)

Thesis topic: Magnetic and sedimentologic analysis of a Late Holocene sediment core, Barilari Bay,

Antarctica

#### **Nadine Orejola**

B.S. Geoscience (in progress)

Honors research topic: Pliocene ice dynamics IODP Site U1358, Wilkes Land Margin, Antarctica



#### Melissa Hansen

Ph.D. Environmental Management
(in progress)

M.S. Geoscience completed 2011

Now working on Pliocene ice dynamics, IODP Site U1359, Antarctica

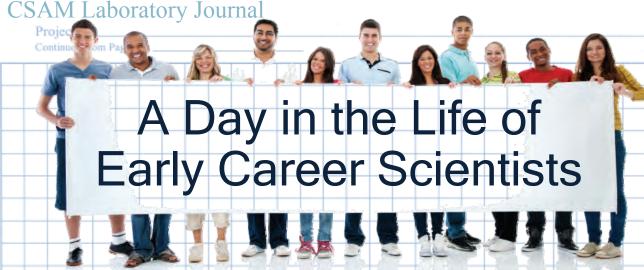
examined marine sediments collected by international sea-floor drilling programs to explore the earliest formation of the Antarctic ice Sheet and the role of the Earth's cryosphere in long-term global climate change. The Passchier group has been able to reconstruct ancient environments and past ice sheet extent, and to examine the response of the Antarctic Ice Sheet to ancient warm periods in order to understand how the ice sheet might respond to the modern warming trend.

Dr. Brachfeld and MSU students Michael Cacciapouti, Gina Quiñones, Rachel Darley, Molly Rosig, Cathleen Dale, David Cuomo, Kenneth Kacperowski Jr., Carl Natter, Jason Darley, Deepa Shah, Brendan Reilly, Tommy Clayton and Natalie Romanoff focus on the past 10,000 years as the baseline against which modern warming trends are evaluated. They use geochemical and magnetic tracers within glacial-marine sediment to investigate the behavior and stability of the ice shelves on the fringe of the Antarctic Ice Sheet, many of which have collapsed catastrophically over the past 60 years. The removal of buttressing ice shelves leads to the acceleration of ice flow from glaciers directly into the ocean, contributing to sea level rise. The seafloor and its resident animal and plant communities that spent the past 10,000 years in darkness are now experiencing a sunlit water column, causing changes in these communities. Studies of these ice shelves, which represent the evolving Antarctic system in miniature, provides insights at a scale that allows geological, biological, glaciological and oceanographic processes and interconnections to be observed.

The scientific findings of Brachfeld and Passchier have been published in journals including Nature, Geology, Geological Society of America Bulletin, Paleoceanography, Earth and Planetary Science Letters, and Global and Planetary Change.

Pictured above left and to the right is the RVIB Nathaniel B. Palmer, one of the icebreaking research vessels that has been home to MSU research faculty and students in Antarctica. The ship serves as a platform for global changes studies including biological, oceanographic, geological and geophysical research.





#### **Physics**

Ferrofluids are remarkable magnetic liquids made of iron nanoparticles suspended in a liquid. Alex Cali (pictured below) is an-NSF funded GK-12 MS



student in the Department of Mathematical Sciences who is working with Drs. Phil Yecko and David Trubatch on the properties of ferrofluids.

Ferrofluids have many industrial applications including forming the seal around the spinning shaft in a hard drive. Emerging applications such as drug delivery and "lab on a chip" require a better understanding the properties of these liquids on small length scales.

Alex's research includes experimental, theoretical and computational approaches to the study of ferrofluids. Alex has been involved in theoretical calculations that connect an MSU mathematical model describing ferrofluids to new data obtained at the Advanced Photon Source at the Argonne National Laboratory.

#### Molecular Biology

It is said that we know more about the surface of the moon than we do about the soils under our feet. Cherrelle McGlone (pictured below), a student in the MS in Molecular Biology program, is working with Profs. Jennifer Adams Krumins, Department of Biology and Molecular Biology, and Nina Goodey, Department of Chemistry and Biochemistry, to gain new insights into the communities of microbes, fungi and bacteria in soils



and their responses to environmental stresses, especially the presence of heavy metals in contaminated soils. The team is currently examining soils collected at Liberty State Park, where the soil is highly polluted with heavy metals including chromium and lead.

By working jointly with both ecologist Krumins and biochemist Goodey, Cherrelle is gaining a transdisciplinary perspective on the nature of contaminated soils including the impacts of heavy metals on the microbial community ecology and specific enzyme functions.

Life Sciences

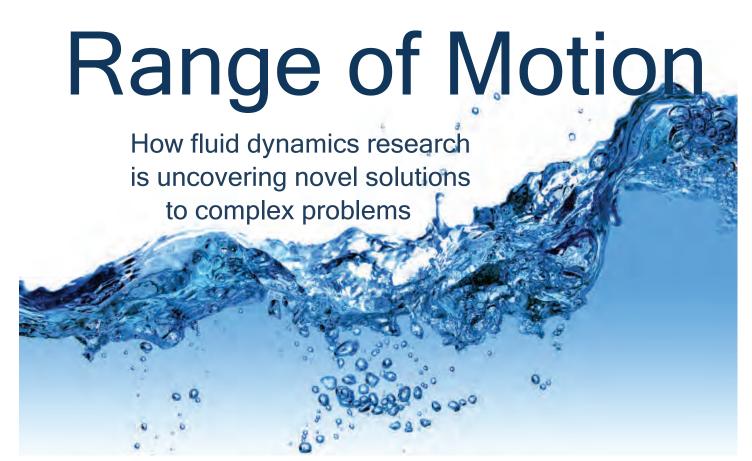
Millions of individuals throughout the tropics are affected by filarial diseases, such as river blindness and elephantiasis, caused by thread-like nematode worms. A team of graduate research students including Akruti Patel, Agnieszka Nawrocka Chojnowski (pictured below), Katie Gaskill and William De Martini, working with Dr. John Siekierka, Director of the Sokol Institute of Pharmaceutical Life Sciences, uncovered an enzymatic pathway critical for filarial parasites to resist attack by the host innate immune system. The pathway involves protein kinase which they have targeted with synthetic inhibitors that ultimately lead to the death of the parasites. This work has captured the attention of



Celgene Corporation's Global Health Division which is funding a program in Dr. Siekierka's laboratory to develop selective inhibitors which have the potential of becoming a drug to treat filariasis.

Read and Understood By

Signed Date Signed Date



The doors to the laboratory of Professor Ashuwin Vaidya are almost always open. Revolving groups of students stand together deep in discussions or gather around the equipment in the lab. The Vaidya Complex Fluids Laboratory (CFL) studies the motion of fluids to gain new insights into diverse and complex phenomena ranging from the large scale global weather patterns and oceanic currents to the much smaller scale flow of blood in the micro-vessels of the human body and modern microfluidic devices.

The flutter of falling leaves, the periodic sway of a flag or the rotations of a windmill moving in the wind are some common examples of a phenomenon known as vortex-induced oscillations (VIO). Vortex-induced oscillations have important consequences in the design of large scale structures as oil rigs, sky-scrapers and suspension bridges. All of these can experience

wind effects, which are actually examples of high speed flows. In this research, Michael Cohrs and Wayne Ernst from MSU, physics majors and honors students in the SHIP program, recently collaborated with faculty from the University of Pittsburgh. In this work, Prof. Vaidya and his students are trying to understand the nature of complex oscillations

resulting from the encounter between a flowing liquid and on an immersed obstacle. In particular, they examine the wake that results from the interaction between the fluid and the object. The ultimate goal of this research is to find new approaches for harnessing energy from nature.

Over 10% of the American population between 30 and 60 years of age suffer from problems with their eyes such as dry eye syndrome. Another project in the Vaidya lab aims at elucidating the mechanical function of the multiple fluid layers that compose the tear film of the human eye. Prof. Vaidya has worked with former mathematics graduate student Douglass Platt and physics undergraduate students **Paul McLaughlin** and **John Park** to investigate the fluid mechanics of the human eye. Hopefully, a more detailed functional understanding of

the tear film in the human eye can help in determining and treating a number of significant eye disorders.

Going forward, Dr. Vaidya and his students hope to explore other examples of the physics and mathematics of fluid flows in geophysical and biophysical contexts.



Dr. Ashuwin Vaidya (r) and CSAM student Andrew Mauro (I) at work in the Complex Fluids Lab



#### A Glimpse at CSAM's Published Research

## The Search

Each year, faculty and student research papers in the College of Science and Mathematics publish in well over 100 competitive peer reviewed papers in important venues. These research papers represent continuing steps in advancing the search for new knowledge. Below are brief summaries of a very few of these articles.

Professor Yang Deng, of the Department of Earth and Environmental Studies

and his student describe a novel approach that results in the simultaneous removal of soluble organic contaminants and ammonia from wastewater including water that leaches from landfills.

Deng, Y. and C. Ezyske (2011). "Sulfate radicaladvanced oxidation process (SR-AOP) for simultaneous removal of refractory organic contaminants and ammonia in landfill leachate." Water Research, 45, pp. 6189-6194.

**Professor David Konas,** of the Department of Chemistry and Biochemistry, and his students describe the efficient synthesis of a novel fluorine-containing analog of the essential amino acid tryptophan. Fluorescence is a property of the natural

Konas, D.W., D. Seci and S. Tamimi (2012).
"Synthesis of (L)-4-fluorotryptophan," Synthetic Communications, 42, pp. 144-152.

amino acid tryptophan that can be utilized to study protein structure and dynamics. In cases where fluorescence from multiple tryptophans disrupts the signal from the molecule of interest, replacement of the interfering molecules with the non-

fluorescent 4-fluorotryptophan removes that interference.

**Professor Erin Krupa**, of the Department of Mathematics and her colleague Dr. Confrey, investigate the use of a specific set of curricular materials in high needs schools in North Carolina in order to understand influences on teachers' instruc-

tional practices and, ultimately, student success in mathematics.

Krupa, E., and J. Confrey (2012). "Using instructional coaching to customize professional development in an integrated high school mathematics program." In J. M. Bay-Williams (Ed.), Professional Collaborations in Mathematics Teaching and Learning: Seeking Success for All, pp. 161-174.

CSAM Insights | Page 14

# for New Knowledge

Professor Emily Hill, of the Department of Computer

Sciences, seeks to reduce soft-ware maintenance costs by building intuitive software and program comprehension tools. In

Hill, E., L. Pollock, and K. Vijay-Shanker (2011). Improving source code search with natural language phrasal representations of method signatures." Proceedings of the 26th IEEE International Conference on Automated Software Engineering (ASE'11), November 2011. [preprint]

this research, combining aspects of software engineering, program analysis, natural language processing, computational linguistics, information retrieval, text mining, and machine learning, Dr. Hill and collaborators present new ways to utilize textual and structural information to improve software search and program exploration tools.

**Professor Nina Goodey**, of the Department of Chemistry and Biochemistry, is developing a detailed understanding of the relationship between structure and function of enzymes, focusing on how the flexibility inherent in protein structures

is related to their catalytic power. In this paper, she and her students examine an important new model system, dihydrofolate

Goodey, N. M., M.T. Alapa, D.F. Hagmann, S.G. Korunow, A.K. Mauro, K.S. Kwon, S.M. Hall (2011). "Development of a fluorescently labeled thermostable DHFR for studying conformational changes associated with inhibitor binding". Biochemical and Biophysical Research Communications, 413, pp. 442–447.

reductase from *Geobacillus stearothermophilus* (DHFR), a novel organism isolated from volcanic hot springs.

Professor John Smallwood, of the Department of Biology

Lesko, M. J., J. A. Smallwood (2012).
"Ectoparasites of American Kestrels in
northwestern New Jersey and their relationship to nestling growth and survival."
Journal of Raptor Research, 46, pp. 304-313.

and Molecular Biology, and his students are seeking to understand declines in Kestrel numbers in New Jersey. They measured the ectoparasites, including

fleas, lice, mites, and flies, of Kestrel broods in a set of nesting boxes but found no evidence that ectoparasite removal would be an effective strategy in increasing the nesting success of American Kestrels in Northwestern New Jersey.

**Professor Diana Thomas**, of the Department of Mathematics, and her students and collaborators examine why weight loss resulting from increased exercise intervention

tends to be lower than predicted. A systematic examination of studies that monitored compliance to exercise pre-

Thomas D.M., C. Bouchard, T. Church, C. Slentz, et. al (2012). "Why do individuals not lose more weight from an aerobic exercise intervention at a defined dose? An energy balance analysis."

Obesity Review doi: 10.1111/j.1467-89X:2012.01012.x.

scriptions and measured exercise-induced change in body composition suggest that the small amount of weight loss observed results from low actual exercise energy expenditures together with an increase in caloric intake in many individuals.

#### Professor Lora Billings, of the Department of Mathemati-

cal Sciences, and

her students and collaborators, analyze how the eradication of a disease depends explicitly on the interplay



between vaccine distribution and population migration. Her analysis suggests potentially novel vaccination policies in the optimal deployment of finite public health resources.



# THE COLLEGE OF SCIENCE AND MATHEMATICS

## Where Discovery and Innovation Meet

#### **Education Excellence**

For over a century, the College of Science and Mathematics (CSAM) has built distinguished academic programs that encompass the natural and physical sciences, mathematics, computer science, information technology, and K-12 science and math education.

The college's five disciplinary departments offer 30 bachelor degree programs, 15 masters and 2 doctoral programs with emphasis on discovery-based research and career preparedness for our majors.

#### **Transdisciplinary Discovery**

In the face of the enormously complex challenges our global society faces in the 21<sup>st</sup> century – from sustainable use of natural resources to improved human health -- CSAM's research faculty is actively engaged in combining strengths across disciplines and building research programs of exceptional power and relevance.

#### **Innovative Approaches**

Ten institutes and centers focus on informing, designing and implementing new approaches and solutions in areas such as improving K-12 science and math education; mitigating historic damage to surrounding ecosystems; and advancing cutting edge research in pharmaceutical life sciences and sustainability.

#### **Collaborative Culture**

CSAM is committed to the ongoing formation of academic/industry collaborations and partnerships, both on and off campus, to speed the development and commercialization of new technology and provide long-term economic benefits to New Jersey and beyond.



"Our growth and success is based on a simple educational philosophy: outstanding and dedicated faculty, energized students and a relentless commitment to academic and research excellence."

Dean Robert Prezant
 College of Science
 and Mathematics



Learn how you can become a part of New Jersey's future research center designed to meet the challenges of the 21st century. Contact Peggy Harris at harrisp@montclair.edu

