INSTITUTE OF NORTHERN ENGINEERING

2013 Annual Report

ENGINEERING SOLUTIONS FOR THE WORLD'S COLD REGIONS AND BEYOND

INSTITUTE OF NORTHERN ENGINEERING

Faculty conduct research in all areas of engineering including but not limited to civil, computer, electrical, energy, environmental, geological, materials, mechanical, mining, and petroleum engineering.

INE focuses on basic and applied research and development as well as research outreach.

INE promotes interdisciplinary and collaborative research and development.

INE seeks to increase student involvement in research and development so as to produce graduates at the cutting edge of engineering and technology.

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Front/back cover photo: Under the midnight sun, Dr. Matt Nolan's team extracts ice cores on McCall Glacier, Arctic National Wildlife Refuge, to understand climate change over the past 400 years. (Photo: M. Nolan, INE)

Inside cover photo: At the peak of fall colors a bush plane leaves Dr. Matt Nolan's team at the Hula Hula River, Arctic National Wildlife Refuge, to study the linkages between glaciers, climate, and ecology. (Photo: M. Nolan, INE)

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IN 2013, THE INSTITUTE OF NORTHERN ENGINEERING ADDED A SUITE OF TALENTED NEW FACULTY TO AN ALREADY ROBUST GROUP OF RESEARCHERS.

The Institute of Northern Engineering (INE) continues its robust trajectory with research expenditures in FY13 being the 3rd highest in INE's history. INE remains a world leader in cold climate science and engineering with competitive growth in a number of research areas, including energy production, modeling and testing of mechanical systems, environmental engineering and hydrology, mining, and petroleum development. We will continue to strategically invest in these areas and others that advance INE's mission to engineer solutions for the world's cold regions and beyond. By investing strategically, we have continued the successful recruitment of world-leading researchers in these areas.

Faculty are the backbone INE. Because our faculty undertake the rigorous challenges of conducting research, now is the time to consider our role in mentoring. To ensure INE's continued success, we want those both inside and outside the institute to be involved in its future through mentoring. Whether mentoring new generations of eager students, our staff members, or faculty, it is our responsibility to ask, "Who am I mentoring?" and "Who is mentoring me?" This goes for mentors and protégés alike. Be active in the shaping of your future and the future of someone else. If you believe as I do that a rising tide floats all ships your mentoring contributions benefit us all.

Thank you for your interest, support and dedication to INE.

If you have questions or would like more information on the goals for INE in the upcoming year, please contact me.

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Dr. Daniel White serves as INE Director and Associate Vice Chancellor for Research at UAF. Above: Dr. White in front of the new engineering facility at UAF. (Photo Courtesy: UAF)

INE's center directors have developed the following thoughts on mentoring.

1. Your "mentor" is not one person. You should have a suite of mentors to advise you on different career aspects. As a mentor, be open to mentoring people in all areas, including faculty, staff and students.
2. Your mentors should be vertically integrated. It is helpful to have a mentor above or below your current status. A staff member or junior faculty, for example, could serve as a research mentor to a full professor.
3. Mentorship is dynamic and the mentors you need in your first year as a faculty member may be different than the second. As a mentor, focus on "graduating" protégés from your mentorship.
4. Your mentors should change with your mentoring needs and career advancement.
5. Be active in choosing your own mentors; choose people that add value to your career.
6. Mentorship requires homework and follow-up on behalf of both the mentor and the protégé.
7. The mentor and the protégé need to be committed to the mentoring relationship.
8. Mentoring is a wide range of advice derived from a wide range of venues. An open forum, lunch, cookout, or picnic could all serve as venues for mentoring.

COLLEGE OF ENGINEERING & MINES

INSTITUTE OF NORTHERN ENGINEERING

INE General Research (IGR)
Some faculty conduct research directly through INE in areas such as vehicle development, robotics, sensor networks, nanotechnology, and mechanical and materials research. To learn more, contact Director Daniel White at dmwhite @alaska.edu, 907-474-5457.

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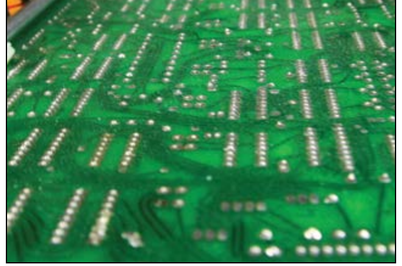
The **Alaska Center for Energy and Power** is an applied energy research program. ACEP excels at being responsive to immediate and long term needs of residents, industries and agencies and focuses on research related to community and industry-scale power generation, transmission, heating, and transportation fuels. ACEP projects span a variety of fossil and renewable energy technologies. Diesel engine efficiency, renewable-diesel hybrid systems, grid integration and energy storage, hydrokinetic research, geothermal resource assessments, and biomass for heating and power are a few ongoing ACEP projects.



Mission: DEVELOP AND DISSEMINATE PRACTICAL, COST-EFFECTIVE, AND INNOVATIVE ENERGY SOLUTIONS FOR ALASKA AND BEYOND.

Vision: ALASKA LEADING THE WAY IN INNOVATIVE PRODUCTION, DISTRIBUTION, AND MANAGEMENT OF ENERGY.

ACEP's goal is to find energy solutions that make both technical and economic sense for Alaska and beyond. ACEP was formed in January 2008 with the goal of addressing energy issues important to Alaska and its residents, businesses, and industries. While ACEP prioritizes its work where Alaska has specific needs, our solutions can also apply to a broader market including the circumpolar Arctic, developing nations as they become more energy-intensive, and to addressing the resilience of the U.S. electric grid as the nation moves toward greater reliance on distributed generation sources.

ACEP infrastructure includes two new testing facilities available for use by clients and research collaborators. The Power Systems Integration (PSI) Laboratory at UAF mimics a village grid and is capable of testing a wide range of generation scenarios and components for the islanded micro-grids found in Alaska, lowering costs to industry and reducing the risk to utilities. Second, the Tanana River Hydrokinetic Test Site (TRHTS) is located in the rural community of Nenana, and is used to test hydrokinetic power-generating devices, related technologies, and to characterize the river environment under realistic Alaska river conditions.

ACEP has an eye toward the future. ACEP educates the workforce of tomorrow by involving graduate and undergraduate students from diverse backgrounds in almost all of our research projects. Funding for student research is a critical need. Recent donations from BP and Siemens Building Technologies have allowed us to involve students in our projects. Through this funding we have also developed the ACEP Summer Internship Program, which includes seminars, field trips and student presentations to complement project work. In addition, ACEP reaches hundreds of Alaska's K–12 youth each year through a variety of popular and growing programs.

Advanced Security System Education, Research, and Training Center

ASSERT is a multidisciplinary center devoted to Advanced System Security Education, Research, and Training. The center provides curriculum and program development, workshops, research opportunities, K – 12 outreach, and access to Information Assurance research resources. The ASSERT Lab, located in the Computer Science department, provides an isolated networked computer environment suitable for information assurance and computer security education, research, and training.

ASSERT provides educational opportunities in Information Assurance and Computer Security; an Information Assurance and Computer Security research environment for faculty, staff, and students; and outreach to law enforcement, government, business, and the public at the local, statewide, and national levels.

ASSERT infrastructure includes several components, including a lab that offers isolated virtual machines and remote access, a physical SCADA (supervisory control and data acquisition) lab, and a digital forensic laboratory. The ASSERT Lab infrastructure has been funded through grants from the University of Alaska Fairbanks, the UAF College of Natural Sciences and Mathematics, the State of Alaska, the UAF Technology Advisory Board, the National Science Foundation, and NASA.

ASSERT outreach efforts include testimony and assistance to federal agencies, attorneys, and investigators in digital forensics cases; membership in and leadership of the Honeynet Project; presentations to local, statewide and national groups such as Infragard, the Colloquium for Information Systems Security Education, and the Collegiate Cyber Defense Competition Working Group; and organization of CCD competitions for teams around the nation.

Mission: PROMOTE A CULTURE OF AWARENESS AND ADVANCEMENT OF THE CURRENT STATE OF KNOWLEDGE IN THE FIELD OF INFORMATION ASSURANCE IN ALASKA AND BEYOND THROUGH DEDICATED RESEARCH, EDUCATION, TRAINING, AND OUTREACH.

ASSERT faculty lead an NSF-funded project to design, deploy, and manage a national computer security infrastructure for institutions and students throughout the USA.

As a result of efforts at ASSERT, UAF has been designated as an NSA/DHS Center of Academic Excellence in Information Assurance Education.

UAF INE AUTC

The **Alaska University Transportation Center** draws on expertise throughout the state, building strong partnerships among research organizations, industry, and state agencies. AUTC is uniquely able to address transportation issues common to cold regions. Alaska is both its market and its research laboratory. The AUTC theme, "transportation safety, security, and innovation in cold regions," was selected to complement the mission and direction of the University of Alaska — to inspire learning and to advance and disseminate knowledge through teaching, research, and public service, emphasizing the North and its diverse peoples.

The Alaska University Transportation Center SEEKS TO IMPROVE TRANSPORTATION IN COLD REGIONS THROUGH RESEARCH, EDUCATION, AND OUTREACH.

AUTC works to meet the needs of Alaska stakeholders such as the Alaska Department of Transportation & Public Facilities, the Alaska Railroad Commission, the oil and gas industry, and the broader transportation community across the nation. As the only center with a specific primary focus on cold region transportation issues, AUTC's work at the University of Alaska fills a national need.

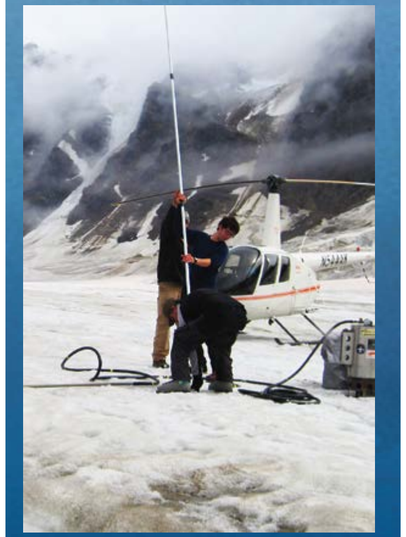
AUTC directs its efforts to all modes of transportation. Like many northern regions, Alaska depends on multimodal transportation for part of its economic growth. A mix of highway, air, marine, rail, and pipeline infrastructure makes it possible to meet the need for goods and transportation for its people. Northern geographies face special challenges, including a population density that varies across the region, long distances between communities (often with no interconnecting roads), and high dependence on aviation and marine transportation. Diverse geographic features, along with complicating factors such as unstable soils, permafrost, and extremely cold temperatures lead to high transportation costs.

Pipelines for oil and other fuels dramatically impact the economic well-being and security of the nation. When such infrastructure traverses arctic and subarctic terrains, the challenges of planning, designing, constructing, and maintaining pipelines are best met by Arctic experts. In addition, AUTC has addressed unresolved infrastructure challenges associated with increased Arctic sea lane traffic and Alaska's need for Arctic marine infrastructure.

Improvements in cold regions transportation engineering and dissemination of innovative research to the national forum are AUTC's primary goals. The center addresses issues related to those identified in the FHWA Research and Technology report as key research and technology themes. Among these are the impact of climate change on permafrost, reduction of construction and maintenance costs for transportation infrastructure, improved air quality during the winter months, and other measures that address multimodal concerns facing Alaska and the nation's transportation community.

werc Water and Environmental Research Center

Established in 1965, the **Water and Environmental Research Center** has long been a world leader in addressing research questions involving the Arctic's water and environmental assets.



Mission: PERFORM BASIC AND APPLIED RESEARCH RELATED TO WATER AND ENVIRONMENTAL RESOURCES, TRAIN GRADUATE STUDENTS AT MASTERS AND PHD LEVELS, AND DISSEMINATE PERTINENT RESEARCH INFORMATION TO THE PUBLIC.

WERC faculty and staff conduct research to solve problems associated with cold regions and to provide reliable, current information to decision-makers dedicated to planning Alaska's future. Hydrologic research is vital for designing and maintaining infrastructure in remote and often understudied regions.

WERC serves the scientific community by analyzing, archiving, and disseminating diverse sets of hydrologic, meteorologic, and environmental data, as well as modeling present and future trends via computational methods.

WERC graduate and undergraduate students participate extensively in research. Many become licensed professional engineers or professional hydrologists, and are heavily recruited to fill technical and management positions.

WERC partners with other organizations to contribute to climate, energy, and transportation studies. The International Arctic Research Center, Alaska Center for Energy and Power, Scenarios Network for Alaska Planning, and Alaska University Transportation Center are frequent collaborators.

WERC's multiple lab facilities include cold rooms for controlled-temperature experiments, analytical chemistry instrumentation, and material properties equipment for measuring physical, thermal, and hydrologic soil properties.

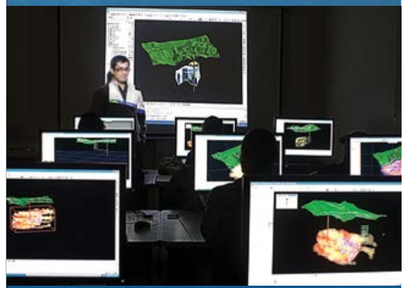
WERC field researchers conduct logistically-complex, physically demanding research expeditions in America's arctic and subarctic regions.

Learn more about AUTC at: http://ine.uaf.edu/autc

To learn more about WERC visit http://ine.uaf.edu/werc

UAF INE MIRL

The **Mineral Industry Research Laboratory** performs basic and applied research that supports exploration, evaluation, development, production, processing, refining, transportation, permitting, and land reclamation related to using the mineral and energy resources of Alaska for the maximum benefit of all its people. Major topical areas include beneficiation, hydrometallurgy and pyrometallurgy of ores, geotechnical engineering (including frozen ground), impact of cold climate on mine ventilation, systems engineering, mineral economics, and computational intelligence for mine operations.



For more information visit: http://ine.uaf.edu/mirl

The Mineral Industry Research Laboratory CONDUCTS BASIC AND APPLIED RESEARCH TO AID IN THE DEVELOPMENT OF ALASKA'S MINERAL AND ENERGY RESOURCES.

Current projects highlight the role of MIRL faculty in supporting the mineral industry. They include exploring mineral processing options for the Bokan Mountain rare earth resource near Ketchikan, Alaska and searching for solutions to air quality problems at the Fort Knox surface gold mine outside of Fairbanks caused by air inversion. MIRL faculty sometimes lend their expertise to address problems outside the mineral industry. For example, students are involved in developing a methodology for geological characterization of mafic rock — one possible material for sequestrating carbon dioxide. Another project conducted feasibility studies on transporting mineral deposits to communities that can make use of them.

Our faculty lend their expertise to industries, companies and projects outside of Alaska as well. The American University of Mongolia (AUM) contracted with MIRL to help design the curriculum of their proposed school of engineering. A key factor behind AUM's decision to seek MIRL involvement was the technical expertise MIRL/INE could offer in mining engineering and cold climate engineering, two topics very pertinent to Mongolia. Erdenet Mining Company, in Mongolia, and Cliffs Natural Resources, a mining company with operations in the US and elsewhere, requested short courses to help them apply computational intelligence to their operations data for purposes such as mine-mill reconciliation.

Alaska's mineral wealth is well known. What is less known is the mining related expertise available in MIRL faculty, specialties in short supply worldwide. Extractive metallurgy expertise has slowly eroded worldwide over the last few years. There are not many mine ventilation experts, especially those that can go beyond basic ventilation networks. Utilization of massive amounts of mine operations data and mining it for specific purposes, such as mine-mill reconciliation, requires knowledge of both computational intelligence and mining engineering, a combination not easily found.

MIRL has hired two new faculty with expertise in the area of mineral processing / extractive metallurgy—dry processing and pyrometallurgy. New acquisitions include an atomic absorption spectrometer, zeta potential meter and a Lidar scanner.

The Petroleum Development Laboratory CONDUCTS OIL AND GAS RESEARCH WITH EMPHASIS ON CONVENTIONAL AND HEAVY OIL DEVELOPMENT, CONVENTIONAL NATURAL GAS AND METHANE-HYDRATE RESOURCE ASSESSMENT AND DEVELOPMENT, AND COAL-SEAM METHANE RESOURCE DEVELOPMENT ON ALASKA'S NORTH SLOPE.

Current study areas include coal-seam methane, methane hydrates, enhanced viscous/heavy oil recovery, carbon dioxide capture and sequestration, Arctic oil well and geothermal well cementing, gas-to-liquid transportation through the Trans-Alaska Pipeline System, and enhanced oil recovery through microbial and wettability alteration processes.

PDL works in partnership with the private sector; federal, state and local governments, and nongovernment organizations to conduct research and extend technologies for assessing, characterizing, quantifying, and developing Alaska's oil and gas resources. One such partnership is with Kitami, Japan to conduct joint research in the area of methane hydrates. Similar agreements are in progress with Russia and China.

PDL attracts funding from sources such as the U.S. Department of Energy, the U.S. Department of the Interior, and private oil companies.

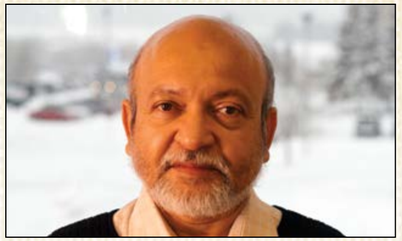
PDL maintains specialized laboratories, including the Pressure-Volume-Temperature Fluid Properties Lab, Petrophysics Lab, Miscible Displacement Lab, Gas Hydrate Lab, GC/MS Analytical Lab, and the Ceramic Membrane Testing Lab.

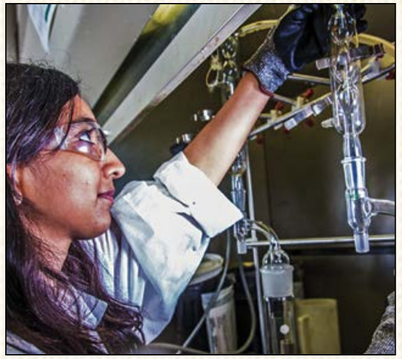
PDL faculty members are recognized nationally and internationally by such groups as the Society of Petroleum Engineers, American Association of Drilling Engineers, and National Academy of Sciences.

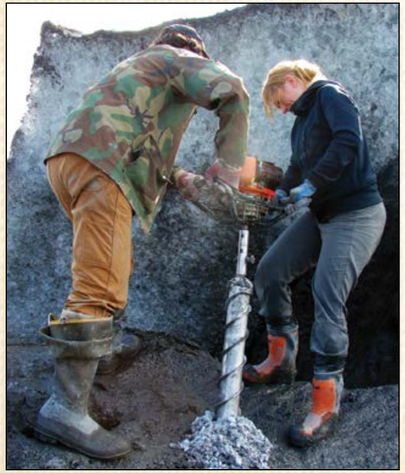
PDL

Faculty in the **Petroleum Development Laboratory** conduct basic and applied research in areas such as reservoir characterization, modeling, and simulation, enhanced oil recovery, and fluid characterization, drilling, and production. They assist the Alaska petroleum industry, state agencies, and federal agencies in efforts to make better use of these resources under stable and healthy environmental conditions. PDL serves rural communities by exploring ways to keep fuel production and transport as economical and safe as possible. Extensive graduate research opportunities are offered to students from Alaska and all over the world. PDL focuses on North Slope conventional and heavy oil development, North Slope conventional natural gas and methane-hydrate resource assessment and development, geothermal resource development, and coal-seam methane resource development in Alaska.

Learn more about PDL at: http://ine.uaf.edu/pdl







RESEARCH *Profiles*

Nicole Misarti

Those who have visited Italy know of its vast archaeological wonders—megalithic monuments, Pompeii, Rome; the list can be as long as your vacation. For Dr. Nicole Misarti, research assistant professor in INE's Water and Environmental Research Center, Italy was her childhood home and the place that gave rise to her interest in how humans are integral parts of the landscape.

"Almost every city had been inhabited for thousands of years," she says, recalling Italy's impact on her intellectual curiosity. As an adult, living for a brief period in the Aleutian Islands solidified her interest in the history and future of marine ecosystems. "I became concerned with how climate change has impacted ecosystems—including humans, over time," she adds, "and if we could use the past to better understand what changes we may be facing in the future."

Misarti uses shell and bone samples from archaeological sites as well as lake core and local soil sediments to examine how marine ecosystems have changed over thousands of years. She utilizes stable isotope analysis, trace element analysis, and archaeological data for comparisons with similar data from the present. Working in Alaska has given her access to a vast and valuable array of data.

"In Alaska, many of today's coastal communities are still located in the same place as prehistoric villages were, and often rely on many of the same resources," Misarti says, explaining the field work that takes her from Barrow to Kodiak and down the Aleutian Island chain. "I feel my work is particularly applicable to everyday life around the state."

This year, she and a cross-disciplinary team of researchers announced a new study into declining Pacific walrus populations that is unprecedented in scope. Sponsored by the National Science Foundation, the highly collaborative project will use UAF's Ancient Genetics Lab, chemical tracers in modern and ancient walrus samples, and compilations of indigenous history housed at the Rasmuson Library to trace and analyze Pacific walrus population trends of the past. Vital to Alaska's Northwestern coastal subsistence hunters and the sustainability of many remote villages, declining walrus populations are a critical concern. Ultimately, she says her team hopes the information their research produces will help Alaska plan for a sustainable future.

Orion Lawlor

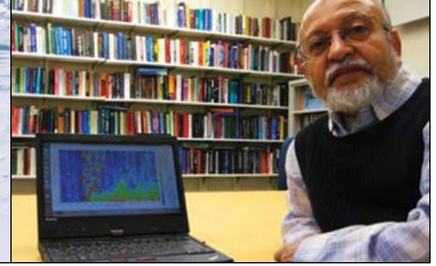
Many remember Short Circuit's "Number Johnny Five," the Transformers cartoon series, or the popular Robotix toys. These inspirational springboards wowed a generation of robotics enthusiasts in the 1980s as basic computers proliferated across the American market. Among that generation was Dr. Orion Lawlor, assistant professor of Computer Science at UAF, who is now helping move the next generation forward at INE.

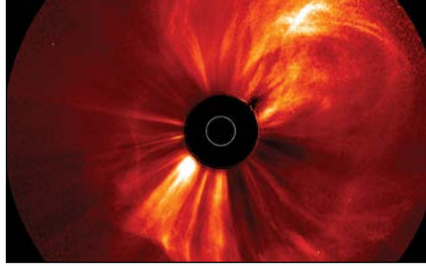
"I've been interested in robots since I was a little kid," Lawlor says. However, the real spark struck in 1988 when he saw a friend use MacPaint on a Mac Plus computer. He saw his friend drawing, making a mistake, and then hitting the Edit and Undo commands to fix the mistake instantly. "That was something I wanted to learn more about," Lawlor recalls. By 1991 he was writing BASIC programs and fighting the kinds of syntax errors he watched his brother spend hours struggling with just a decade before. Today he's doing much more.

His research at INE includes work on aurora borealis visualization and measurement as well as unmanned vehicle (UV) robotics and local school outreach. Last May Lawlor served as co-host for the National Science Foundation's Cyber Alaska Cyber-physical System Search and Rescue Robotic Challenge at UAF. It pitted teams of Alaska high school students against one another in a race to remotely command an unmanned ground vehicle (UGV) in a live scaled-down search and rescue exercise. Students navigated the UGV over and around obstacles in search of a simulated lost hiker—a plastic figurine.

Ironically, Lawlor finds the discouraging challenges of software and hardware innovation to be the most exciting part of his work. "I love the delayed gratification of building things," he explains. "Sometimes the gap between inspiration and reality is hours and sometimes it's decades, but the final payoff has always been worth it for me."

In his latest project Dr. Lawlor is helping a group of engineering students build an autonomous robot for the NASA Robotic Mining Competition.





Bob Perkins

"As oil fields are developed in the Alaska offshore the possibility of a marine oil spill increases," says Dr. Bob Perkins, professor of civil and environmental engineering, explaining the motivation behind his research into toxicology. "Knowledge of the relative harm of the response options is vital to responsible decision-making in the event of an oil spill in offshore arctic Alaska." Oil dispersants are a very useful and popular tool in industry dividing the oil slick into micro-particles where naturally occurring bacteria can metabolize the oil. However, Perkins wants to know "as a large man-made spill will require a massive response... are dispersants and the inducted micro-particles more harmful than leaving the oil slick on the surface?"

These questions drive Perkins' research—how chemicals impact humans and the environment. His work takes him all over Alaska to Barrow and across the North Slope and all the way down to Juneau and the Southeast. He typically examines chemicals applied either as part of a project such as creosote from marine piles or natural materials generated by the project like naturally occurring asbestos. Partners from state agencies, the oil and gas sector, as well as the National Fisheries Service, U.S. Environmental Protection Agency, U.S. Coast Guard, and others have sought his insight in this area.

Through a recent project Perkins' work helped the State of Alaska continue using creosote-treated harbor wood by demonstrating that creosote leachate is below levels that harm marine life like herring eggs. "As a result," Perkins says, "the State does not need to remove creosoted wood from our harbors, nor use less efficient means of preserving wood."

To each big research question Perkins brings a storied and diverse civil engineering career that began with pipelines and industrial facilities on land and offshore. He moved on to designing civil and environmental projects and managed them for project owners. Perkins eventually ran a private firm involved with hazardous and toxic waste management, remediation, and worker health and safety. In this sense, he says his engineering career has taken on three dimensions: civil and environmental project design and management; chemical impacts on human and environmental health; and project interaction with the public.

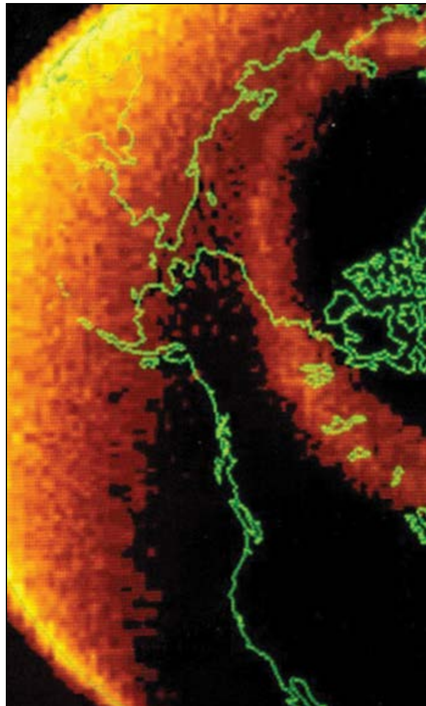
"I also teach and lead our department," Perkins adds when asked about his biggest challenge. In addition to research he has both instructional and administrative duties in UAF's College of Engineering and Mines. "So my issue is to find enough time."

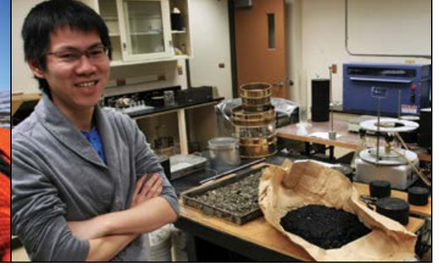
Vikas Sonwalkar

Changes in solar activity lead to adverse conditions within the upper atmosphere including enhanced electrical currents and charged particles which may cause disruption of satellite operations, communications, navigation, and electric power grids. The term "space weather" refers to changes in the Earth's space environment. Vikas Sonwalkar's research on space plasma waves has led to new methods to measure space weather conditions in the upper atmosphere as a function of solar activity and has provided a deeper understanding of space weather phenomenon. The high latitude location of Fairbanks, Alaska and the complementary research activities of other space scientists at UAF provide an ideal environment for Dr. Sonwalkar's research.

Dr. Sonwalkar came to UAF in 1995 after a 17-year stretch at Stanford where he received his PhD and later taught and researched in the department of electrical engineering. He is currently a professor in the Department of Electrical and Computer Engineering in CEM and has served as department chair in 2003-05 and 2008-09. At UAF Dr. Sonwalkar has worked on research projects sponsored by NASA, NSF, Los Alamos National Laboratory, Alaska Science and Technology Foundation, Alaska Space Grant Program, and the U.S. Navy. Using data from the IMAGE satellite he is currently working on whistler- and Z-mode radio sounding of the Earth's magnetosphere a topic he pioneered since the early 2000s. In the past he has investigated the generation mechanisms and propagation of electromagnetic waves of natural and/or man-made origins in the terrestrial, Venusian, and Neptunian magnetospheres. Dr. Sonwalkar has widely published on diverse topics including plasma wave generation and propagation, remote sensing of radiation belts, antennas in space plasmas, digital and analog electronics, fisheries acoustics, and ultra wideband communication.

Well recognized for research and teaching alike Dr. Sonwalkar takes particular interest and pleasure in teaching and mentoring graduate students. He has supervised the research of 7 PhD, 17 MS, and 10 undergraduate students. Dr. Sonwalkar also enjoys reading, walking, and table tennis having won medals in many tournaments including a recent gold and silver in the 2013 Alaska Senior International Games.





Erica Betts

Each spring as many doctoral students are grinding away in labs and libraries Erica Betts is likely just stepping off of a snow-machine near a thawing Arctic river. Wearing hip-waders and a flotation device she'll soon climb into the water dodging icebergs and slush flows to collect hydrology measurements.

"To understand the impact of climate change on fish and wildlife species in the Arctic we need to understand broader scale linkages," says Betts, explaining the applications of her work which links fish movement to regional hydrology and climate. With dual master's degrees from Georgia Tech in city planning and in civil engineering she is interested in interdisciplinary hydrology questions at the intersection of hydrology, biology, and engineering. She currently works as a graduate research assistant in INE's Water and Environmental Research Center supporting North Slope hydrology research led by Professor Douglas Kane. If successful she hopes to help Alaska and sponsors at the U.S. Fish and Wildlife Services determine the possible impacts of a changing climate on Arctic grayling populations in the Kuparuk River.

Betts did not plan on coming to UAF. Having begun a PhD program at Georgia Tech she was approached by a colleague who suggested a more exciting location for her hydrology research. "They thought I would be perfectly suited for this project," she recalls. "My research was in a big city and I liked the idea of getting out of the office! It provided the opportunity to gain field experience and pursue an interesting research topic."

She was right. Now her typical research day depends largely on the season. "Field work begins just before break up in the spring so we can capture the beginning of the open water season," she explains. "All my data is collected during this period up until things begin to freeze back up in the fall. Then, the winter is largely spent in front of the computer analyzing data and planning the next field season."

She says the most challenging aspect of this work comes from working in such remote locations which constrains logistics and drives up operation costs. Despite the challenges, she still finds working in these places exciting and hasn't tired of the amusement that comes from riding a snow-machine or helicopter into places where few humans may have ventured beyond the pages of *National Geographic*.

Chuang Lin

Like much of China's northern regions, Chuang Lin's hometown faces permafrost issues similar to Alaska's. Having seen those infrastructure and engineering challenges he says, "I am eager to open my mind to see the different resolutions at the Institute of Northern Engineering." Lin is earning his master's degree in civil engineering while working as a research assistant on permafrost studies in the Cold Regions Research and Engineering Laboratory's permafrost tunnel.

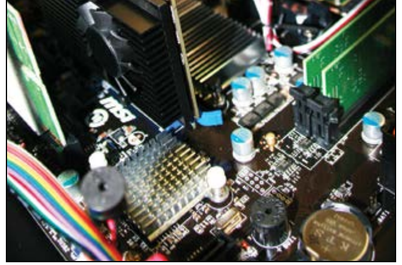
Lin is working as a graduate teaching assistant for Dr. Xiong Zhang on studies that may lead to more solid and economic foundations for cold-region housing. "I really enjoy the process of field test design, preparation, and conduction," Lin explains. "I learned not only the knowledge, but also communicating and cooperating skills that could not be learned from textbooks."

The rigors of graduate study keep Lin at a computer for much of his time so he prefers his field work as it lets him apply knowledge to real projects. He says the most challenging aspect of his research is the volume of data he analyzes and the harsh environment—staying in the field for 3-4 hours at -40 °F. Lin travels to the permafrost tunnel every three days or so then returning to the lab to analyze data.

He says he stays excited about the work by solving the kinds of unexpected problems that frequently arise with cold region research. "There are so many challenges," he says, "having a problem solved will always make me excited for even a whole week."

Permafrost remains an important area of research for Alaska with implications for structures as well as roads, runways, railways, and pipelines. Because permafrost is sensitive to temperature and water content changes, state engineers are eager to better understand the creep behavior of ice-rich permafrost–a type common to Alaska. With so much interest in this topic it seems this research is likely to continue, which is fine with Lin, who doesn't seem to mind his work in the permafrost tunnel.

"It really helps you to calm down because it is so cold," Lin says of the tunnel. "There are a lot of fossils and live fungi in the tunnel. It leads you on a tour of the ancient ice age."



Sandra Boatwright

INE is an inherently interdisciplinary organization in which staff and researchers alike work at the intersection of multiple specialized fields. Sandra Boatwright, proposals and publications manager at INE, runs an office that helps more than 60 faculty and engineers from numerous fields write proposals and papers to fund and share their work. Doing this requires a combination of writing and editing, scientific and technical knowledge, and administrative aptitude within a deadline-intensive environment.

While Boatwright says short deadlines are a constant challenge with her work, she finds the excitement and variety rewarding. “It’s one of the things that keeps me interested in this job,” she says, “there’s a competitive element in helping researchers produce and submit the best proposals they can.”

Boatwright also enjoys the subject matter. “Not many jobs would allow me to spend most of my day reading about phenomena such as permafrost and marine animal life cycles or about new technology in energy production,” she explains. “The other day I read a proposal about developing a way to ‘lasso’ asteroids in space; how cool is that?”

Boatwright taught writing courses during graduate school and worked as a technical editor after earning a double major in Microbiology and English as an undergrad. This background prepared her to take on the varied responsibilities central to her work.

“Working with budgets requires a different kind of thinking, as does the interpretation of federal guidelines,” she says. “In my office, our job is to help you do the research you want to do by helping you present it to federal agencies and other organizations in the best way possible and by making the submission process as efficient as we can. Knowing ‘the rules’ is just a starting point; figuring out how to help a researcher navigate different agency policies and how to look ahead to how these might impact a project is the important part.”

Like many good managers, she credits her team. “The success of our office is due to the other staff,” she says, “they make it possible for us to offer such a wide range of research services to CEM.”

Peter Prokein

Since joining INE as a student assistant in 1999, IT manager Peter Prokein continues a career that has kept pace with rapid advances in technology to improve the effectiveness and efficiency of INE’s research and operations.

Today, Prokein’s responsibilities cross technologies that were barely in existence when he started. In fact, by the mid-2000s, he helped INE become the first campus research unit to deploy server virtualization technology, realizing significant capital savings. “Server virtualization made good sense,” says Prokein. “It’s our professional and ethical responsibility to be frugal with the funds granted to us and there is no better way to save money in IT than to virtualize servers.”

In addition to server infrastructure he manages enterprise storage, backup and disaster recovery, as well as implementing INE’s Internet-based outreach. From a technical point of view, these are the behind-the-scenes functions that enhance the everyday work of INE researchers.

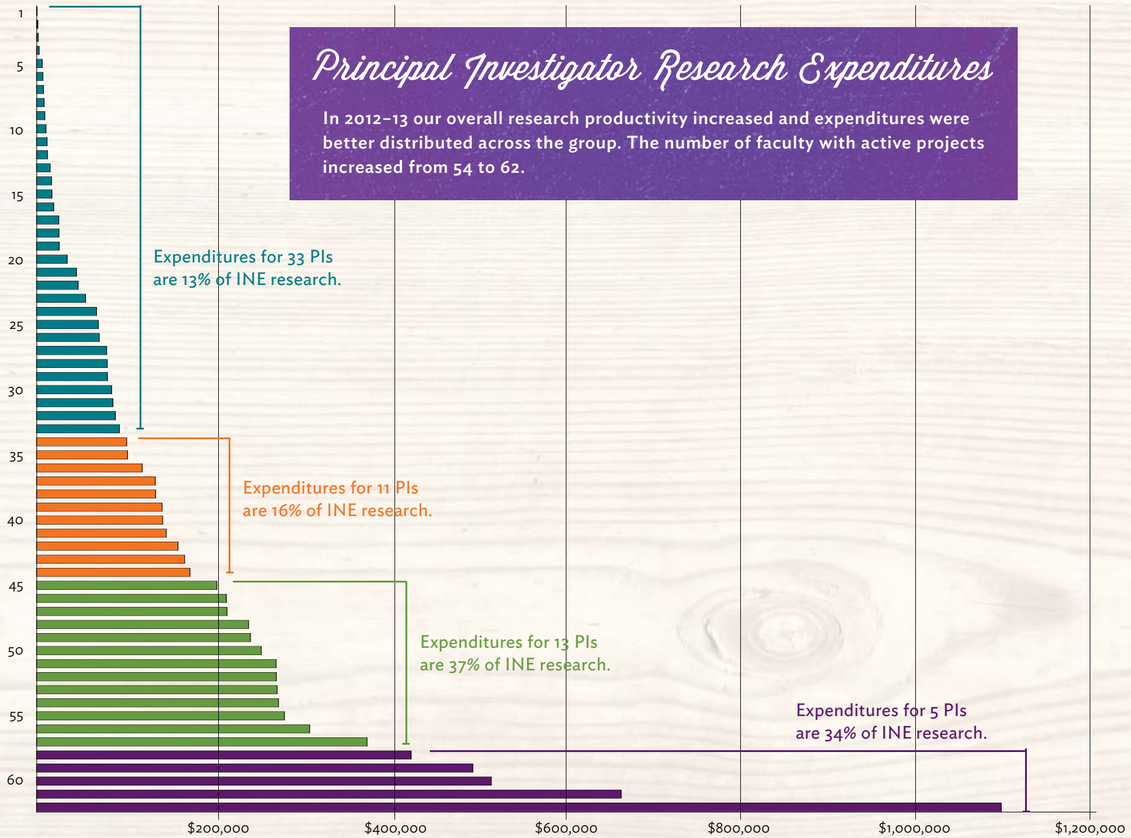
“To me working at INE is about asking myself what I can do today to make the life of INE researchers easier or add value to their research projects,” Prokein explains. “Sometimes that means providing a new database server to a project and sometimes it’s something small like switching a user to an ergonomic vertical mouse to improve productivity.”

And this work isn’t just in the office. Prokein is frequently sent to remote and inhospitable locations to support the institute’s researchers. “We were recently working on a project collaborating with a federal agency and we were able to deploy a remote weather station far above the Arctic Circle and deliver a live data stream from that station to the Internet in less than 12 hours from initial deployment,” Prokein recalls. “We are able to perform with such agility because our staff works as a team of dedicated professionals from purchasing, to logistics, to field deployment, to telemetry programming, to web delivery.”

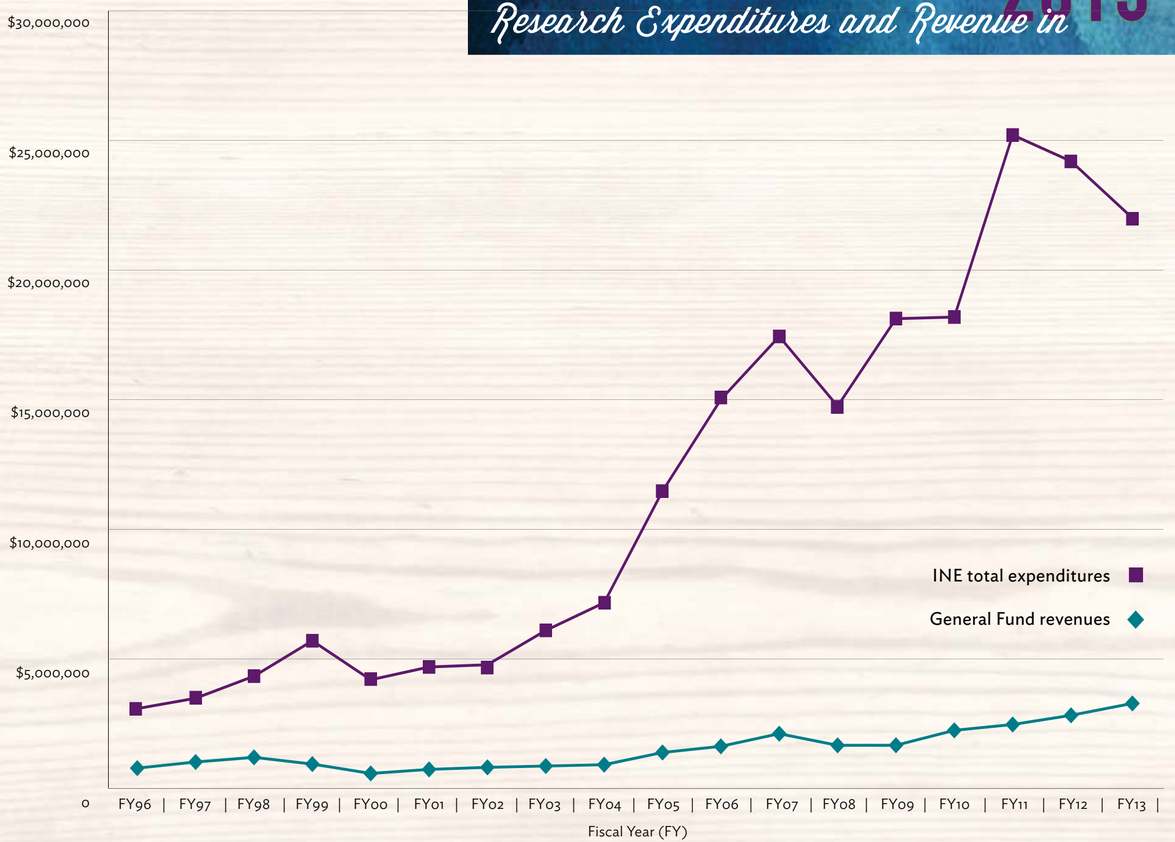
Delivering this kind of performance is among the challenges Prokein finds rewarding about his work. “We do what it takes to get the job done,” he says, “that’s why I love working at INE.”

Principal Investigator Research Expenditures

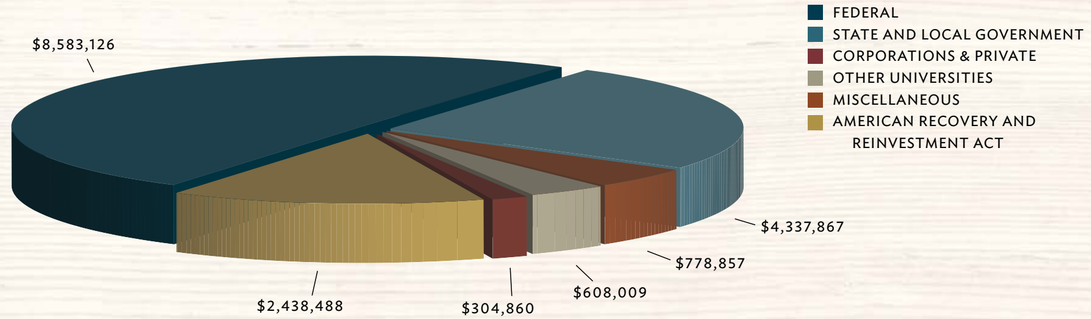
In 2012–13 our overall research productivity increased and expenditures were better distributed across the group. The number of faculty with active projects increased from 54 to 62.



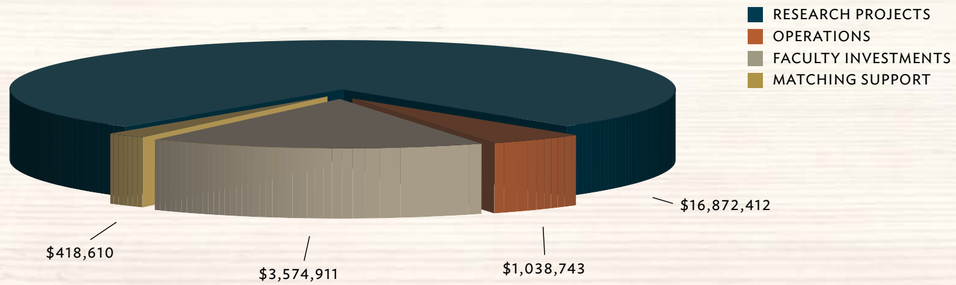
Research Expenditures and Revenue in 2013



FY13 RESEARCH REVENUE SOURCES



FY13 INE RESEARCH AND GENERAL FUND



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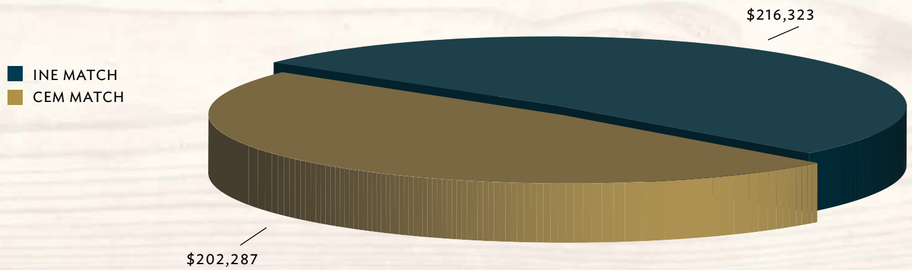

INE faculty investment expenditures consist of all the research centers (ACEP, AUTC, MIRL, PDL & WERC), PI overhead accounts, equipment, travel and student tuition awards. INE operation expenditures consist of administrative, information technology and proposal office support, which includes salary and benefits.

FY13 FUND 1 EXPENDITURES

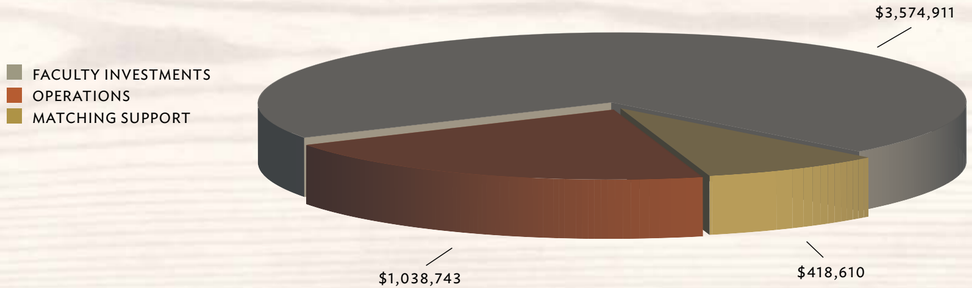

Photo Credits

Cover: Under the midnight sun, Dr. Nolan's team extracts ice cores on McCall Glacier, Arctic National Wildlife Refuge, to understand climate change over the past 400 years (INE photo by Matt Nolan). Inset photos, from left to right: WERC assistant research professor Nicole Misarti conducts fieldwork near Kodiak, Alaska (INE photo Courtesy of Nicole Misarti). Graduate student Shruti Oza adjusting testing equipment in the Petroleum Development Laboratory (UAF photo by Todd Paris). Former student researcher Patrick Brandon and doctoral student Feng Xiao confer during an install of a seismic bridge monitoring system on Alaska's Chulitna River bridge as part of an AUTC study (INE photo by Mike Fisher).

Inside cover: At the peak of fall colors, a bush plane leaves Dr. Nolan's team at the Hula Hula River, Arctic National Wildlife Refuge, to study the linkages between glaciers, climate, and ecology (INE photo by Matt Nolan).

Page 2: Dr. Daniel M. White, INE Director and Associate Vice Chancellor for Research in front of the new engineering facility site at the UAF College of Engineering and Mines (CEM Photo Courtesy of INE).

Page 3: Center and director organizational chart (Holdmann, Genetti and Patil photos by Todd Paris; All other photos courtesy of INE).

Page 4: Bottom Left: ACEP Director Gwen Holdmann presents at the 2013 Rural Energy Conference (ACEP photo by Todd Paris). Top Center: ACEP's Power Systems Integration (PSI) Lab at UAF (ACEP photo by Todd Paris). Top Right: ACEP research engineer Jack Schmid and graduate student researcher Paul Duvoy work on an ACEP hydroelectric project (ACEP photo by Todd Paris).

Page 5: Top Left: Research assistant John Quan assists student programmers in an ASSERT laboratory (INE computer lab photo by Todd Paris; INE technology photos by Rob Harper).

Page 6: Bottom Left: Students, Alaska DOT & PF staff, contractors, and researchers install a fiber-optic remote structural health monitoring system on Alaska's Chulitna River Bridge (INE photo by Mike Fisher). Top Center: Crews apply test sections of experimental soil stabilizers in rural Alaska (AUTC photo by Billy Connor). INE researcher and associate professor of geological engineering Margaret Darrow leads a tour of local school kids at the U.S. Army Cold Regions Research and Engineering Laboratory Permafrost Tunnel (INE photo by Rob Harper).

Page 7: Top Left: WERC researcher and PhD student Sean Brennan examines a lab sample (INE photo courtesy of WERC). Top Center: WERC research technician Emily Youcha and Director Bill Schnabel collect stream data on the Koyukuk River near Bettles, Alaska (WERC photo by Rob Harper). Right: WERC research team conducting field work during a study on the Jarvis Glacier, Alaska (INE photo courtesy of Anna Liljedahl).

Page 8: Bottom Left: Rajive Ganguli, director of the Mineral Industry Research Laboratory (MIRL) and professor and chair of the Mining and Geological Engineering Department at the UAF College of Engineering and Mines (INE photo courtesy of CEM). Top Center: CEM Dean, Doug Goering with mining equipment near Fairbanks, Alaska (INE photo courtesy of CEM). Top Right: UAF Alumnus Dominic Orr in the Silver Fox Mine (UAF photo by Todd Paris).

Page 9: Top Left: Working up close with lab instruments—graduate students gain both analytical and hands-on experience (UAF photo by Todd Paris). Top Center: Processing equipment in the petroleum research lab. A graduate student researcher prepares a sample in the petroleum lab (UAF photo by Todd Paris).

Page 10: Column 1: Top: Research assistant professor Anna Liljedahl sets up a weather station near the Jarvis Glacier, about 35 miles south of Delta Junction, Alaska (UAF photo by Todd Paris). Bottom: INE researchers, including former AUTC student of the year Eva Stephani, drilling sample cores in permafrost (CEM photo courtesy of INE). Column 2: Top: Pictured: Dr. Vikas Sonwalkar, professor of electrical and computer engineering in the College of Engineering and Mines. (INE photo by Kala Hansen). Center: Pictured: Graduate student Shruti Oza adjusting testing equipment in the Petroleum Development Laboratory (UAF photo by Todd Paris). Bottom: A petroleum lab sample (UAF photo by Todd Paris). Column 3: Top: Research professional Matt Bray studies pressurized petroleum samples in a Duckering Building rock mechanics laboratory. (UAF photo by Todd Paris). Bottom: A WERC researcher measures Arctic stream flow levels on Alaska's North Slope (INE photo courtesy of WERC).

Page 11: INE research technician Kevin Irving and graduate research assistant Joel Homan work on a remote mountaintop weather station deep in the Brooks Range (INE photo courtesy of WERC).

Page 12: Photos: Left and Top Center: Nicole Misarti conducts fieldwork near Kodiak, Alaska (INE photo courtesy of Nicole Misarti). Top Right: Nicole Misarti uses shell and bone samples from archaeological sites, as well as lake core and local soil sediments to examine how marine ecosystems have changed over thousands of years (INE photo courtesy of Nicole Misarti).

Page 13: Inset: Professor Orion Lawlor (INE photo courtesy of Orion Lawlor). Photos: Top Left: Pictured: Remote-controlled UAV navigates toward a simulated lost hiker during the 2013 CyberAlaska Cyber-physical System Search and Rescue Robotics Challenge (CEM photo courtesy of INE). Top Center: UAVs, cars, helicopters, and more—unmanned robotics is one of many areas in information technology in which students are interested. Pictured: A robot car from the 2013 CyberAlaska Cyber-physical System Search and Rescue Robotics Challenge (CEM photo courtesy of INE). Right: Dr. Lawlor (background center) confers with colleagues during the 2013 CyberAlaska Cyber-physical System Search and Rescue Robotics Challenge (CEM photo courtesy of INE).

Page 14: Left: Doctoral student Kelly McFarlin (pictured) collecting sea samples (INE photo courtesy of Kelly McFarlin). Top Center and Right: Robert Perkins (pictured) collects samples in the Arctic (INE photos courtesy of Robert Perkins).

Page 15: Top Left: Dr. Sonwalkar (pictured) at work (CEM photo courtesy of Vikas Sonwalkar). Top Center: The Aurora (NASA image courtesy of the Solar Terrestrial Relations Observatory). Top Right: Image of a Solar Storm depicting sequential blasts (NASA image courtesy of the Solar Terrestrial Relations Observatory). Bottom Right: Image of solar weather mapped over the earth (NASA image courtesy of the Solar Terrestrial Relations Observatory).

Page 16: Erica Betts conducts field work on the North Slope (INE photos courtesy of Erica Betts).

Page 17: Top Left: Graduate student Chuang Lin, pictured, sets up equipment in INE's soils and asphalt lab (AUTC photo by Rob Harper). Top Center: Maintaining technical instruments goes hand-in-hand with Lin's research (INE photo courtesy of Chuang Lin). Right: A typical work scene for Chuang Lin, graduate student and research assistant, who spends much of his time in the UAF Permafrost Tunnel (INE photo courtesy of Chuang Lin).

Page 18: Left: Boatwright helps with field research on frazil ice near the Tanana River (INE photo by Kala Hansen). Top Center: Sandra Boatwright, proposals and publications manager at INE, runs an office that helps more than 60 faculty and engineers from numerous fields write proposals and papers to fund and share their work (INE photo by Cecile Lardon, UAF). Top Right: Many types and styles of publications originate from Sandra's office. (INE photo by Rob Harper).

Page 19: Top Left: Peter Prokein, pictured, at a remote field site in the Brooks Range (INE photo courtesy of Sveta Stuefer). Top Center: Information technology up-close (INE photo by Rob Harper). Prokein is frequently sent to remote and inhospitable locations to support the institute's work. Right: Here Prokein works on a remote weather station (INE photo courtesy of Peter Prokein).

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