

IIHR-HYDROSCIENCE & ENGINEERING

IIHR CURRENTS

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Making a Difference

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IIHR Research Engineer A. Jacob Odgaard was selected to receive the Environmental & Water Resources Institute's prestigious Lifetime Achievement Award for 2012. The award recognizes Odgaard for "making a difference" — exhibiting excellent technical competence, and significantly contributing to public service, research, or practice in the environmental and water resources profession.

PHOTO BY JAMES BUCHHOLZ



MAKING A DIFFERENCE

As a student, I chose to become an engineer because I wanted to make a difference in the world, and to help solve some of society's biggest challenges: an environment in dire need of protection; society's need for green, sustainable energy sources; clean water for all; and much, much more. I know most of my colleagues feel the same way.

Yet, I sometimes wonder if the intense day-to-day pressures of modern research occasionally allow us to forget that initial impulse to do good in the world. With so much to do, it's easy to lose sight of the big questions: Why are we doing this? Who does it serve? What's riding on the accuracy and quality of our work?

It's important to take time to think about these questions, because the answers represent the core of our mission at IIHR: research, education, and service. As engineers, we serve society — we do all we can to make a difference, to make things better, and to make life safer and more secure. This issue of *IIHR Currents* examines the many ways researchers, staff, and students are making a difference through the work they do.

Here are few examples from these pages:



PHOTO BY ANETA GOSKA

- **After fossil fuels, what next?** IIHR Assistant Research Engineer James Buchholz is part of a large research project designed to make Iowa a major player in energy-related research. James' work focuses on wind turbine blade reliability and performance. Sustainable, affordable new sources of energy can make a difference for every American.
- **Flooding remains a threat** in Iowa, and recent months have shown us that extreme weather events can strike anywhere. Two stories in this issue of *Currents* address the question of how flood preparedness can make a difference. The first of these stories explores an Iowa Flood Center project in which I am personally involved: the Iowa Watersheds Project. Researchers are working to learn how water moves in four Iowa watersheds, and to determine how innovative management practices could make a difference within these watersheds.
- The second flood-related story introduces new IIHR faculty affiliate Eric Tate, who looks at flooding in a new and innovative way: **how does a flood event affect people** in the water's path? Who is vulnerable, and why? How can knowing the answers make a difference in the way we prepare for future floods?
- Anyone who has undergone treatment for cancer, or who has watched a friend or family member do so, will understand why Assistant Research Engineer Sarah Vigmostad's research is making a difference. She's studying **metastatic cancer cells** — the cells that travel through the bloodstream to spread cancer throughout the body. Sarah wants to know why these cells are able to survive in the bloodstream when other cancer cells don't. It's a fascinating application of biomedical engineering and fluid mechanics.

These are just a few of the ways IIHR is making a difference in the world today. I invite you to spend a few minutes with these stories, and to share your thoughts about them with me. I truly enjoy interacting with alumni and other friends of IIHR. You can contact me at larry-weber@uiowa.edu. I look forward to hearing from you!

LARRY J. WEBER

Director, IIHR—Hydroscience & Engineering

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A Watershed Moment

HOW CAN
INNOVATIVE
MANAGEMENT
PRACTICES MAKE
A DIFFERENCE
WITHIN
WATERSHEDS?

In 2009, Iowans were grappling with difficult questions in the wake of devastating floods that had washed through Eastern Iowa a year earlier. One positive result was the formation of the Water Resources Coordinating Council (WRCC), a group of experts and leaders that developed a list of 22 flood-related recommendations for the Iowa Legislature. In 2010, the Iowa Legislature passed three of those recommendations, but without funding. One of these proposals came back to life and actually received funding, without any additional legislative action. That \$8.8M miracle resulted in the Iowa Watersheds Project.

A Fateful Phone Call

In August 2010, the U.S. Department of Housing and Urban Development (HUD) made money available to states that were federally-declared disaster areas in 2008. Iowa received more funds than any other state, largely because of the innovative responses it had shown in flood recovery — including the creation of the Iowa Flood Center at IIHR.

When Susan Judkins of the Rebuild Iowa Office called to give IIHR Director Larry Weber the news, he responded, “Well, if the state is interested in any more innovations, I’d be happy to help.”

Two days later, Weber got a second phone call. “What did you mean by ‘more innovations?’” asked Ron Dardis, director of the Rebuild Iowa Office. Weber answered with the first thing that came to mind — the unfunded legislation, and specifically watershed-level research. Dardis asked Weber to begin developing a cost estimate and project description, but before he could comply, Dardis called again to say that \$8.8M had been allocated for the watershed research project.

Today the Iowa Watersheds Project is well underway. Weber is leading a team that includes IIHR Research Engineer Marian Muste and IFC Research Support

Coordinator Sara Steussy, as well as four graduate students. Weber is proud that the Iowa Flood Center was able to acquire the funding without going back to the legislature, hat in hand. “They did their work — now we will do ours. I think it was just absolutely outstanding.”

Where Does the Rain Go?

As planning for the Iowa Watersheds Project was getting underway, Weber says he wanted to make sure the effort included funding to build improvements in the watersheds that could make a measureable difference.

Weber says the project has three components, all essential: the hydrologic assessment, building the improvements, and proving that they work. Without any one of those elements, the value of the effort drops off sharply. “At the end of the day, we wouldn’t be any smarter,” Weber says.

Earlier this year, the team assembled a watershed selection committee that represented many viewpoints and stakeholders from across the state. The committee analyzed proposals from nine watersheds and selected four to participate in the project, each representing a different geographical and topographical area, as well as a different land use pattern.

The first step is the hydrologic assessment, which Steussy defines as modeling to help us understand the movement of water in the watershed. “When rain falls, where does it end up?” she says. The hydrologic assessment will use computational modeling to identify areas in the watershed where the constructed improvements will have the most impact on reducing downstream flood damage.

Graduate students Nick Thomas, Matt Wunsch, Chad Drake, and Will Klingner use computational models to represent the terrain, land use, geography, etc., in each of the four watersheds. They’re

Can farm ponds and other constructed improvements make a difference in reducing flood damage? IIHR Director Larry Weber (right) leads the Iowa Watersheds Project, which is designed to help answer that question. The Iowa Watersheds Project team includes: (l to r) Chad Drake, Sara Steussy, Nick Thomas, Marian Muste, Matt Wunsch, and Will Klingner.

also collecting data and further developing the model.

It's rewarding work, says Drake, a first-year graduate student. He is researching the Upper Cedar River Watershed. "I've enjoyed studying the impact water can have on people," Drake says.

In the meantime, Weber and the rest of the team are holding regular meetings with constituents in the watersheds. It's impossible to overestimate the impact of this human aspect, which Weber calls the "most important element."

A 50-Year Vision

After 18 months of modeling and meetings, watershed representatives will choose a few very small areas of the watershed in which to build the improvements — with advice from the IFC researchers.

The improvements could include farm ponds, wetlands, floodplain easements, and more. They will be kept small, so researchers can clearly assess and analyze their impact. But even areas that don't directly benefit from the construction of an improvement will have an advantage moving forward, Weber says. They will be left with valuable documents and data developed through the hydrologic assessment, allowing them to better compete for funds in the future.

The payoff for researchers and Iowans will come at the end of the project when they can begin to understand what works best in each watershed, and which strategies can be scaled up for implementation throughout the state.

Weber hopes that the results of the Iowa Watersheds Project can help provide a long-term plan for improving the state's flood resiliency. "I like to think about vision," he explains. "In this case, a 50-year vision for watershed enhancement."



A Mussel Obsession

WHAT EFFECT DO MUSSELS HAVE ON WATER QUALITY?

For decades, IIHR has had a love affair with the freshwater mussel. Once students dig their first mussel from the Mississippi River mud, they are hooked. IIHR researchers have led countless mussel-based research projects, including efforts to re-establish endangered species in Midwestern rivers. At LACMRERS, a display of more than 40 different mussel species takes pride of place in the front lobby.

But why this special attraction to freshwater mussels? Well, says IIHR Research Engineer Anton Kruger, they are extraordinary creatures, and highly underestimated as well.

Mussels are filter feeders, and some species can live for 75 years or more. They move about and have preferences about where they choose to settle. Mussels draw in river water and pump it through their systems, filtering out nutrients. A large mussel bed, which can number in the millions, filters a lot of water. “They actually filter the amount of water that a major city, like Minneapolis, consumes on a daily basis,” Kruger explains.

All this has led to the question, what effect do mussels actually have on water quality?

Mussels with Backpacks

Kruger is leading a research project that aims to use mussels as water-quality sensors, equipping each mussel with a small “backpack” of electronic sensors to remotely transmit data at regular intervals. Funded by the Roy J. Carver Charitable Trust and IIHR, the project has developed into a true passion for Kruger.

“I am captivated with the idea of getting a backpack on a mussel,” he says.

Kruger, who is also an associate professor of electrical and computer engineering, says he and his team hope to create a remote wireless sensor network on the backs of the mussels in order to learn

more about the nitrogen cycle in the river water. Excess nitrates unintentionally exported from agricultural states in the Midwest to the Gulf of Mexico lead to algae blooms that deplete oxygen in the water and create a “dead zone.”

Born Wire-Free

The backpack itself, which student Hannah Taylor designed, contains all the electronics needed to make the measurements, as well as a small radio, but it is no bigger than a stack of quarters. Researchers glue the backpack to the mussel’s shell, and release the animal back into the river. No wires restrict the mussels’ movements. The goal is to make the sensors so inexpensive that they could be disposable.

The backpack-wearing mussels are currently in a laboratory microhabitat, with pumps to bring in fresh river water and lights to create artificial day-night cycles. Cameras track the mussels’ every move. When the researchers are ready, they will release the mussels back into the Iowa River, where they can roam free.

The mussels chosen for the project are a large species known as “pocketbook” mussels. “We want a big mussel, so the backpack doesn’t impact them,” Kruger explains. “We don’t want to take a baby and weigh it down.” The team has designed a study to determine whether or not the backpacks affect the mussels’ behavior. So far, the answer seems to be no, although the study is ongoing.

The trickiest part of the equation is powering the sensors. Most batteries would die within a year, and researchers hope to gather data for five years or more. Another plan was to use the movement of the water to power the electronics. That, too, failed.

“Mussels don’t like fast-moving water,” Kruger explains. “They like to stay where there’s some water movement, but not too much, so that works against us.”



The most promising idea uses ions in the river water to power the instruments. Scientists place two dissimilar metals in the water, which generate a small current that can be put to use. Kruger says they initially planned to use copper and zinc — two inexpensive and easily obtainable metals. Luckily, mussel expert Teresa Newton of the U.S. Geological Survey cautioned against the use of copper, which is toxic to mussels. She potentially saved the team considerable wasted effort, Kruger says.



“When you know just enough to get yourself into trouble, then you talk to an expert,” he says.

Friends and Collaborators

The concept of teamwork is important for Kruger. Each individual contributes essential skills and knowledge, and the project offers many opportunities for collaborations across disciplines. Besides Kruger, the team includes:

- IIHR Assistant Research Engineer Craig Just, an environmental engineer

and assistant professor of civil and environmental engineering, with a strong interest in the nitrogen cycle in rivers and streams;

- Teresa Newton, a fishery biologist with the U.S. Geological Survey (USGS) and an expert on mussels;
- Nate Young, also an IIHR associate research engineer, who has a long-term interest in mussels;
- Postdoc Jim Niemeier, whose expertise in electronics and wireless sensor networks, combined with his approachable, easygoing personality,

- make him a go-to guy for students;
- Senior electrical engineering student Hannah Taylor, who designs and assembles the electronics;
- Gabriel Hart, a student and certified scuba diver, who tests the sensors in the UI diving pool;
- Jonathan Durst, who helped design and build the mussel microhabitat;
- Other students who designed enclosures for the electronics; and
- ECE faculty Raghu Mudumbai and Soura Dasgupta and their students.

This team has developed a nice synergy, Kruger says, and students play an important part in the research. Hannah Taylor says she really likes being a part of the project, although it’s not always easy to explain to her friends. “When I say I put sensors on mussels, they all think I mean muscles,” she says. “They look at me like I’m insane.”

Crazy for Mussels

Kruger says he is no expert on mollusks, but he does love his mussels. “I’m quite fascinated by them,” he says.

Along with the rest of the team, he is part of a longstanding tradition at IIHR, where researchers are happy as clams to be working with mussels.

Anton Kruger (right) holds one of his backpack-wearing mussels, plucked from the laboratory microhabitat. From left, the team includes Craig Just, Jim Niemeier, Jon Durst, and Hannah Taylor.



The Human

PUTTING FLOODING'S

Hurricane Katrina was one of the costliest hurricanes in U.S. history, with damages totaling more than \$70 billion. It was also one of the deadliest, taking the lives of nearly 2,000 people.

The hurricane's human impact started Eric Tate on his journey to the University of Iowa, where in 2011 he became a member of the UI's first interdisciplinary faculty cluster. Tate, who is an assistant professor of geography and an assistant research engineer at IIHR, was shocked by Katrina's devastating effects on the people of the Gulf Coast. "Most of the time with floods, we're thinking about buildings and damage and dollar losses," Tate says. "But Katrina was about people, and engineering is not really the place to study people."

In Katrina's Wake

Katrina marked a defining moment for the young working engineer. He decided to return to graduate school, with the goal of studying the human costs of natural disasters.

He went to the University of South Carolina's Department of Geography to study social vulnerability modeling. His advisor, Susan Cutter, builds GIS models that help describe spatial variation in human vulnerability to floods. "I saw it as a way to do everything I was interested in," Tate says. His degrees in engineering and his previous work experience had given him a love of GIS modeling, hydrology, and maps as a method of communicating information. His new work in social vulnerability modeling brought in a fascinating and crucial aspect of flood modeling—what happens to the people in the floodplain, and why?

Eric Tate made a major change in his career goals after he recognized the huge human toll of Hurricane Katrina.

n Costs of Flooding

IMPACT ON PEOPLE FRONT AND CENTER

Social vulnerability studies a number of questions that flood research has historically overlooked. “What characteristics of people, of society, make certain people more vulnerable?” Tate says. “Where are they? Who are they? What kinds of things do we need to account for in planning? How do we model this?”

Research has shown that certain characteristics of people and communities can make them more vulnerable to the impacts of flooding: the disabled, the poor, racial and ethnic minorities, people with health problems, recent immigrants, the elderly, single mothers, and young children tend to have more difficulty with floods. “The idea of social vulnerability modeling is to identify these groups and try to model their numbers and their locations and produce a single number,” Tate explains. “You can look across a community and say, well, we know where the floodplains are. But where, in terms of social aspects, are the most vulnerable people?”

This information can enable community planners and others to put limited resources where they will do the most good, in human terms. It’s a new way of thinking about flood impacts—putting the human cost, rather than economic loss, front and center.

“If you look at a range of our public policies, they’re mostly focused on dollars and infrastructure,” Tate says. “You really need to assess human impacts on par with economic impacts.” He believes even a small investment in the social side of flood mitigation could produce a big payout.

Jumping the Language Gap

Tate thinks the multidisciplinary approach facilitated by the water sustainability faculty cluster is key to solving complex challenges. “In order to solve the really big problems in our society ... you have to be able to work across disciplines, or you can’t get holistic solutions.”

As an engineer himself, Tate has one big advantage in bridging the gap between engineering and geography — he speaks both languages. Language gaps are real, he says, and make interdisciplinary work harder. “Sometimes people are talking about the exact same thing, but they just use different terms.”

The interdisciplinary cluster encourages boundary-crossing collaborations and opportunities to go after the bigger problems. Being a part of this interdisciplinary group has definitely eased his transition to the university, Tate says. “From day one, I’ve been part of a high-profile effort,” he says. “It’s definitely made a difference.”

Monsoon Harvests

Tate’s status as a cluster member has already led to a new and interesting collaboration. IIHR Assistant Research Engineer Nandita Basu heard Tate present at a cluster seminar, and soon after invited him to join a research proposal (titled “Monsoon Harvests”) to support the study of groundwater sustainability in India.

Along with IIHR Assistant Research Engineer Craig Just, Basu and Tate will travel to India in the near future to begin the research. Tate says his contribution is studying sustainability indicators.

The concept of sustainability indicators can be hard to define. Indicators are quantitative metrics to represent a bigger idea, Tate explains. In this case, sustainability indicators could include hydrologic data gathered from sensors, as well as census data, personal interviews, and more. These quantitative facts can help researchers assess what kind of progress, if any, we’re making toward sustainability.

Is This Heaven?

Tate, whose wife’s family is from India, is looking forward to traveling to that South Asian country. But he and his family are also enjoying life in small-town Iowa. “I was kind of worried,” Tate admits. “This is the smallest town I’ve ever lived in.” But he says they appreciate Iowa City’s funky, unique atmosphere, and they especially like the freedom their two children have. “We live in a neighborhood that’s just packed with kids,” Tate says. “Kids just show up and ask if my children can play. They may go off about the neighborhood for hours, and I don’t feel worried about their safety, which is a big change.”

“YOU CAN LOOK AT A COMMUNITY AND SAY, WELL, WE KNOW WHERE THE FLOODPLAINS ARE. BUT WHERE, IN TERMS OF SOCIAL ASPECTS, ARE THE MOST VULNERABLE PEOPLE?”

—ERIC TATE

Winds of Change: Energy for

OVERCOMING
THE CHALLENGES
OF WIND ENERGY,
AND LEARNING
HOW TO MAKE
IT SAFE AND
EFFICIENT

Can wind energy provide 20 percent of U.S. electricity needs by 2030? That's the goal set by U.S. Department of Energy in 2007. More than five years later, a great many questions still need to be answered to make wind turbines work better, more efficiently, and more safely.

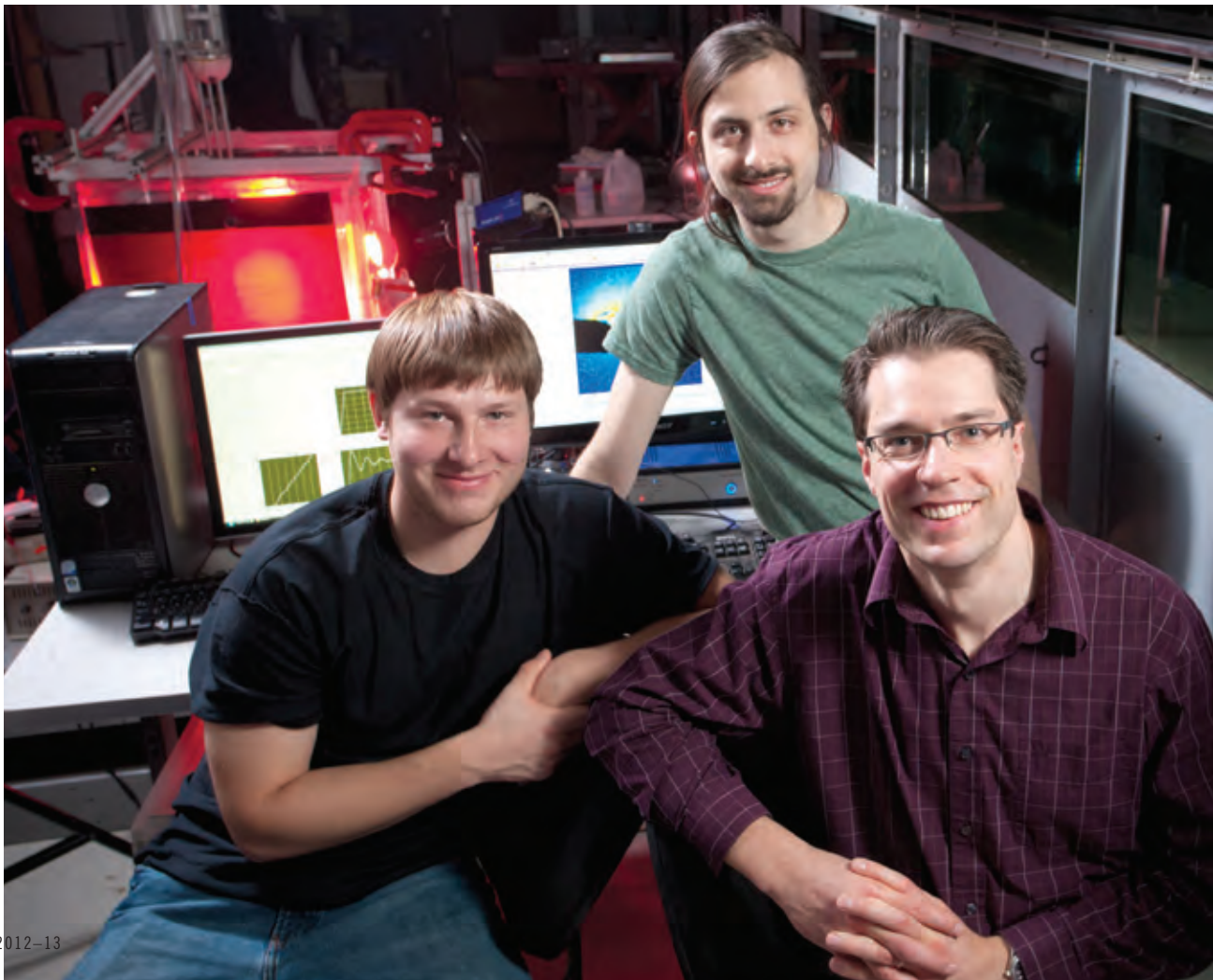
A team of researchers at Iowa's three public universities is working to help make Iowa a major player in energy-related research, with support from a \$20 million, five-year grant from the National Science Foundation. The grant will help build Iowa's research capacity in renewable energy and energy efficiency, with four different focus areas: bioenergy; wind energy; energy utilization; and energy policy.

The grant is part of NSF's Experimental Program to Stimulate Competitive Research (EPSCoR), which is designed to improve the research capacity of eligible states and help them become more competitive for future grants.

IIHR Assistant Research Engineer James Buchholz is focusing on wind turbine blade reliability and performance (part of the wind energy focus area). He explains that many uncertainties persist about wind turbine loads — wind speed and direction can change abruptly, and both are difficult to predict with accuracy. These uncertainties can bring about very dramatic results.

"Turbines have fallen down for no apparent reason," Buchholz says. "Blades will break, towers will collapse, drivetrains can fail. It can be dangerous and costly."

James Buchholz (right)
at work in the lab with
students Craig Wojcik and
Jordan Null.



the 21st Century

Dynamic Stall

Buchholz, who is also an assistant professor of mechanical and industrial engineering, is particularly interested in the aerodynamics of the blades. Difficulties often begin, he says, when air flow separates from the surface of the blade instead of following it closely. What results is a phenomenon called dynamic stall, which can lead to large fluctuations in the aerodynamic loads on the blade, due to the strong vortices that are shed. These loads are difficult to predict, Buchholz explains, and can be detrimental to the blades and the entire wind turbine structure.

The rotation of the blades causes enhanced resistance to flow separation and increased stability of the vortices created by the blade — a phenomenon called rotational augmentation.



Surprisingly, this phenomenon is also found at small scales, such as in bird and insect flight, a topic of previous and ongoing research for Buchholz. Investigators want to understand the vortex structures formed in the air flow around wind turbine blades and flapping wings, with the goal of predicting how and when they occur, where they will go, and how strong they are.

With additional financial support from the Iowa Power Fund, Buchholz is designing a closed-loop recirculating wind tunnel to be constructed in one of the IIHR Oakdale Annexes to allow the team to further study these phenomena. It's not feasible to build a wind tunnel large enough to study a utility-scale wind turbine, so Buchholz is designing a scale model.

Researchers can compensate for the reduction in size by making the turbine turn faster — within limits. To actually spin fast enough, the model turbine would approach the speed of sound, causing more complications. The wind tunnel model will not yield performance measurements that can be scaled to utility-scale turbines, but they are expected to go a long way to improve our understanding of the fundamental mechanisms governing real aerodynamic loads.

Salad Dressing, or Science?

Buchholz says the model study will include the use of particle image velocimetry (PIV) to visualize the air flow in the wind tunnel. A key ingredient in the PIV process is actually more commonly used in salad dressing: olive oil. The scientists will build an atomizer to generate very small particles of olive oil, which follow the flow of air in the wind tunnel. A laser sheet will reflect and scatter light off the oil particles, allowing researchers to see the particles and track their motion.

It's inexpensive and very effective, Buchholz says. "A bottle of olive oil will last for several PhD students."

The long-term goal is to improve the accuracy of the aerodynamic design codes to predict wind turbine performance and loads. "Once we have a good handle on predicting the formation and evolution of the unsteady flow structures or vortices," he says, "then I think we can address the question of how to optimize the blades in a new way."

After Fossil Fuels, What Then?

Despite their great size, utility-scale wind turbines are highly engineered and graceful in design, with all the precision of a Swiss watch. "It's quite an elegant piece of machinery," Buchholz says.

He remains excited by the prospects of wind energy, which offer a clean and renewable source of energy. There are challenges ahead, and many of them, he freely admits.

"We can't stop doing things because there are challenges," Buchholz says. "We have to overcome those things, and figure out how to do this better."

A Powerful Beginning

IIHR'S FIRST DIRECTOR, FLOYD NAGLER

By Cornelia F. Mutel



Floyd Nagler, IIHR's founding director, focused his entire life on making a difference. One could see it in his tending of his large vegetable garden (he felt fresh foods were crucial to his family's health). And in how he took over the pulpit when his minister traveled elsewhere (he wanted to explain the workings of God's creation to the public). And, perhaps most profoundly, in the way he bull-headedly established IIHR as a growing and innovative hydraulics research and teaching center. Each of these actions was capable of carrying another person — and, through that person, the world — in a slightly different direction. Each action made a difference.

Nagler came to the nascent hydraulics laboratory in 1920 at the age of 28. He was hired to use the university's initial tiny laboratory to test electrical-generation turbines, but his energy and vision rapidly led him to attack additional practical questions. How could we transport water underneath the highways that were proliferating across the country? How could we decrease natural scouring of the riverbed around bridge piers? Questions such as these were addressed through the use of small-scale hydraulic models, a research practice then coming to the fore. Nagler's model work complemented other research being performed directly in rivers, such as the laboratory's program to test current meters for measuring water-flow velocity.

Nagler's research required a fully functional laboratory to house the hydraulic models. One of his major achievements was creating the physical and organizational structure that still largely describes IIHR today. In 1931, he officially transformed the Hydraulics Laboratory into the Iowa Institute of Hydraulic Research (today's IIHR—Hydroscience & Engineering), an organizational modification that increased the lab's stature and outlined its independent business configuration.

Left: Nagler was passionately dedicated to his institute, his research (such as this 1924 effort to measure the flow of the Mississippi at the Keokuk Dam), and his many personal interests.

Even before this restructuring, and decades before federal research monies became the norm, Nagler had succeeded in attracting funds from government agencies such as the U.S. Department of Agriculture, U.S. Geological Survey, and U.S. Army Corps of Engineers (Corps), in addition to private companies and engineering firms, thus establishing an unusually firm financial footing for the laboratory. In 1932, he opened the doors of the current Hydraulics Laboratory on Riverside Drive, an edifice more than 50 times larger than the original small building. This laboratory (which was extensively remodeled in 2000) still serves as the hub of IIHR's activities.

Nagler directed much of the laboratory's early research himself. Diverse projects reflected his love of rivers, his fascination with water's flow, and his desire to transform the energy of free-flowing water into a "useable" form that would better life in Iowa. He was instrumental in conceiving and shaping a reliable navigation channel in the Upper Mississippi River — its current nine-foot channel — and in convincing the Corps to use hydraulic models to design its lock-and-dam system. Soon the Hydraulics Laboratory was serving as a major Corps modeling site for Upper Mississippi constructs. Nagler also measured the Mississippi's flow over spillways of the Keokuk Dam, which early in the 20th century was the world's largest electrical generating plant.

He performed the first detailed surveys of many Iowa rivers, examining them both in terms of their physical traits and their potential for producing hydroelectric power, which he delighted in promoting. While tramping along the banks of Eastern Iowa's rivers and streams as he performed these river surveys, Nagler eagerly searched for abandoned mills and millstones, which fascinated him. Legend has it that he would carry these millstones back to his car. A pair of Nagler's millstones still preside over the

Below: Nagler (right) avidly collected discarded turbines, which he brought to the Hydraulics Lab to display for students.

west entrance to Stanley Hydraulics Lab. Nagler was a large, powerful man, who routinely returned from his ambles in the field loaded down with rocks, which he used to build a large rock garden at his home with a fountain, a waterfall, and three interconnected pools.

Nagler didn't forget the need of Iowans to relax and enjoy nature: he performed additional river surveys for the burgeoning Iowa State Park System, surveys that identified sites where rivers could be dammed to form recreational lakes.

Some of his interests and research were remarkably prescient. Consider for example his papers on water yield from small watersheds and on Iowa floods, as well as his successful efforts to institute a statewide stream-gauging program and a long-term monitoring system for multiple aspects of flow in the Ralston Creek drainage just east of Iowa City. Were he alive today, Floyd Nagler's research would still fit in well with the activities of the Iowa Flood Center, established at IIHR in 2009.

Despite his many responsibilities and efforts, Nagler was devoted to his family and his community. He included family members in as many of his daily activities as possible, taking his young son Robert with him to play at the Hydraulics Lab while he worked, and bringing his wife and young children with him to professional meetings and on field exercises whenever possible. Outside his own home, Nagler was active as a church officer and Sunday School superintendent; he also counseled his church's youth and worked with the Boy Scouts.

Floyd Nagler died unexpectedly in 1933 at age 41, from complications of a burst appendix. Looking back at his 13-year tenure at IIHR, one wonders how he could have accomplished so much in such a brief time period. His legacy certainly attests to his energy and focused attention. In addition to leaving behind the physical and organizational structure that identifies

Bottom: Nagler was fascinated by waterpower, and tirelessly promoted hydroelectric plants in Iowa. He solicited discarded turbines from abandoned mills around the state.

IIHR today, he established the standards of excellence and the traditions of high productivity, innovation in research, and devotion to problem-solving that still characterize IIHR. And he commenced certain fields of study that continue to the present day. But perhaps most important, Floyd Nagler created an institution that was ready to take on a life of its own and was primed to make a difference in many ways. That goal remains a guiding light for IIHR. With Nagler's firm guiding hand and passionate dedication, IIHR was set on the course it still largely follows today.



Vanishing Glaciers: What's Beneath the Surface?

As temperatures rise, glaciers are melting around the world. But exactly how fast are they disappearing? And what processes are going on out of sight, hundreds of feet beneath the ice? Answers to these questions are crucial for scientists hoping to understand the effects of climate change.

IIHR Associate Research Engineer Frank Weirich and his research team are conducting a multi-year research project designed to look beneath the ice using ground-penetrating radar. "It's a very simple idea," he explains. "All we're doing is taking the equivalent of atmospheric radar and aiming it down — but changing the frequency."



Frank Weirich (left) and student Phil Kerr check on the ground-penetrating radar unit in its reinforced transport sled.

PHOTO BY MIKE STENSON/VIU PHOTO SERVICES

An Evolving Plumbing System

Weirich, who is also an associate professor of geoscience, has been studying the meltwater tunnels inside the Exit Glacier in Alaska to learn how they affect the rate of glacier melt. "Essentially, it's a plumbing system that over the course of the summer evolves and gets larger and more complex," Weirich says. The question is, how much larger, and how quickly?

Weirich's radar is providing some answers. His team, which includes PhD candidate Susan Kilgore and several graduate and undergraduate students, has spent three summers studying the Exit Glacier. In the late spring, the team goes out on the ice with the ground-penetrating radar to create a 3-D image of the tunnels beneath the glacier's surface.

Weirich designed and constructed equipment to move the radar system safely across the ice. He started with a reinforced commercial car-top carrier and added instrument mounts and stabilizers, tow cable systems, and antenna-mounting structures. Researchers tow this radar "sled" over the ice surface using a harness and guide rope system. A carefully calibrated tow wheel connected directly to the radar system measures the distance covered, and a wireless transmitter sends all the data to a computer.

As the summer progresses, they also monitor drainage from the glacier using continuous stream discharge monitoring systems. In the fall, the team returns to repeat the radar study and compare the results to the spring data to understand the rate of melting and the tunnel evolution within the massive river of ice. These data are combined with climate data for the site and area to better understand the overall hydrologic processes at work in the glacier.

The news is not good. "The tunnel system inside is growing at a very rapid rate and causing more melting from the inside out," Weirich says. "It's essentially more like Swiss cheese than we thought."

Unseen Dangers

Even though the team does its work during the temperate months, there are still plenty of dangers — such as slipping into crevasses or vertical meltwater shafts, some hundreds of feet deep, which descend from the glacier surface. Weather can also pose real challenges. On one occasion, the weather closed in before they could retreat to safety, so researchers were forced to spend the night on the ice, weathering 40-mile per hour winds — fortunately with tents, thermal sleeping bags, a satellite phone, and five days' food and water.

Processing the data in the lab to create a 3-D image is a long and laborious process requiring three software programs. The team still has more work to complete on the glacier, but Weirich says one result is already clear. "It's melting faster than we thought."



Frank Weirich and his team at work on the Exit Glacier in Alaska.

PHOTO COURTESY OF FRANK WEIRICH

Solving the Mysteries of Metastasis: How Do Metastatic Cancer Cells Survive the Stresses of the Human Bloodstream?

In 2011, more than half a million Americans died from metastatic cancer — cancer that spread from its original site to another location in the body.

IIHR Assistant Research Engineer Sarah Vigmostad is part of a research team working to learn more about these metastatic cancer cells and how they survive the remarkable stresses of the human bloodstream.

Vigmostad, who is also an assistant professor of biomedical engineering, says the metastatic cancer cells have an almost uncanny ability to undergo shear stresses in the bloodstream and emerge stronger than before. “It appears that the metastatic cells are somehow adapting, so that over time, their survival rate improves. If they continue to be exposed to shear stress, they seem to somehow improve their survival.”

Challenging Puzzles

It’s easy to start thinking about these metastatic cancer cells as almost supernaturally resilient, Vigmostad admits. “Cells are crazy!” she says. “Cells are living things, and so you observe this in a lot of different instances — this quick response of cells to mechanical stimuli.”

Vigmostad and her team are hoping to learn what’s at play with the metastatic cells, and what this might mean for scientists trying to better understand the disease and identify metastatic cancer cells within the circulatory system. She says the team is using fluid mechanics knowledge and the ability to model cell dynamics to understand some of the processes that take place during cancer metastasis. This area offers a number of challenging puzzles. Circulating cancer cells are often found in a cancer patient’s bloodstream, but that’s not necessarily an indicator that the cancer is going to metastasize. Researchers want to learn why some cells are successfully metastasizing after they enter the bloodstream, and how they differ from other cells.

Shedding Light

She is collaborating with Michael Henry from the UI Department of Molecular Physiology and Biophysics. His group observed differences in the behavior of metastatic cancer cells and non-metastatic cancer cells. They have been struggling to understand and explain these disparities, Vigmostad says. She hopes the computational tools and experimental mechanics can help shed some light on the question.

Vigmostad’s research team is using micro-pipette aspiration to quantify the cells’ material properties that may help the cells survive in the bloodstream. Researchers apply suction to the

metastatic cancer cell through a micro-pipette smaller than the individual cell diameter, and very slowly aspirate part of the cell into the micro-pipette. “The material properties of the cell are going to dictate how quickly the cells come into the pipette and what kinds of pressures are needed,” Vigmostad says. “That can help us quantify the material properties of those cancer cells.”

Using micro-PIV (micro-resolution particle image velocimetry), Vigmostad also hopes to be able to visualize the interactions between cells as they flow through the body. “We’re interested to see what the dynamic is between cancer cells and blood cells, and whether there’s a different dynamic when we have metastatic cells versus healthy or non-metastatic cells.”

It’s a promising area of research where much still remains unknown. “I think we have a lot of potential to explore important questions related to metastasis,” Vigmostad says. “It’s very exciting. But it’s never as straightforward as you think it’s going to be.”

Sarah Vigmostad is studying metastatic cancer cells and how they are able to survive the human bloodstream.



Magic Microbes: Bioremediation Strategies Offer New Methods to Clean Up Persistent Groundwater Contaminants

You might call Tim Mattes a magician of sorts — he may not pull a rabbit out of his hat, but he can transform known human carcinogens into safer substances, using only naturally-occurring microbes.

With funding from the National Science Foundation, the IIHR associate research engineer is exploring the use of microorganisms to transform vinyl chlorides in the groundwater into environmentally benign products. The project is a collaborative effort between Mattes and Alison Cupples at Michigan State, an expert in stable isotope probing.

Groundwater Contamination

For decades, the military used chlorinated solvents such as TCE (trichloroethene), which was allowed to seep into the groundwater. Dry cleaners used a similar solvent, PCE (tetrachloroethene). Through natural processes, TCEs and PCEs change into intermediate products in the groundwater such as vinyl chloride (VC) — a known carcinogen.

Mattes, who is also an associate professor of civil and environmental engineering, says molecular biology tools allow scientists to detect and quantify the bacteria that in the presence of oxygen consume vinyl chloride and transform it into benign substances — carbon dioxide, chloride, and water.

Abracadabra!

There are at least two variations in this process. In the first, the bacteria (VC-cometabolizers) oxidize the vinyl chloride fortuitously, forming reactive and potentially harmful metabolites; in the second, a specialized subset of these bacteria (VC-assimilators) grow on the vinyl chloride, assimilating the carbon into their cell material. The latter offers advantages, but scientists can't yet distinguish between the two types of microbes at a contaminated site.

Using stable isotopes, Mattes and his team hope to develop new molecular tools to detect and quantify the abundance and activity of VC-degrading microorganisms in the environment. Specifically, they aim to develop a procedure to differentiate VC-assimilating bacteria from VC-cometabolizing bacteria by using stable isotope probing techniques (SIP), along with existing tools.

Tim Mattes says there is great interest in new methods to clean up PCEs and TCEs in the groundwater. "You can't just pump that stuff out," he says.

Mattes says that the VC-assimilators actually become weightier when fed VC containing the stable isotope carbon-13, which is slightly heavier than normal carbon molecules. After feeding carbon-13 VC to a mixed microbial community containing both VC-assimilators and VC-cometabolizers, researchers extract their DNA to see if it has become heavier.

This might seem like a simple thing, but it has eluded scientists for many years, Mattes says. He became interested in using bioremediation techniques to clean up chlorinated solvents in the groundwater in the mid-1990s as a graduate student at Johns Hopkins University. It's a subject that has continued to fascinate him through his professional career at IIHR and the University of Iowa.

Groundwater is an increasingly important source of drinking water for millions, and bioremediation techniques of this sort (which Mattes called the "intelligent use of nature") hold great promise for the future.

It may not be magic, but clean drinking water makes a big difference to us all.



The Science of the Small: Can Nanotechnology Make a Difference in Innovative Water Treatment Research?

For IIHR Assistant Research Engineer David Cwiertyny, developing sustainable technologies to make impaired water usable again makes perfect sense on a planet with finite water resources and an increasingly impaired water supply.

Cwiertyny's research focuses broadly on the fate of chemical pollutants in natural and engineered aquatic systems. A major effort in his research program is the development of innovative, materials-based strategies for water treatment. In the past 12 months, he has won grants from the National Science Foundation, the Environmental Protection Agency, and the U.S. Department of Agriculture, all focusing on different aspects of this research.

Can Carbon Nanotubes Change the World?

While the problems are big, the answer may be very small — about 1/100,000th of the width of a human hair. Nanotechnology, or the design and engineering of materials at the atomic and molecular scale, ranges in size from 1 to 100 nanometers (one-billionth of a meter).



Substances behave in a unique manner at this size, Cwiertyny says, and he wants to know if nanomaterials can be successfully incorporated into responsible water treatment strategies. He's investigating innovative uses of carbon nanotubes to optimize advanced oxidation processes in water treatment.

Carbon nanotubes are cylindrical carbon molecules with properties that make them particularly useful. With cylinder walls just one atom thick, these hollow tubes of carbon find their way into consumer products such as golf clubs and ultra-lightweight bicycles. They're exceptionally strong, and have remarkable electrical and thermal conductivity. Carbon nanotubes could be called the rock stars of nanotechnology.

Cwiertyny is using carbon nanotubes to enhance chemical oxidation in water treatment; a thin mesh of carbon nanotubes can behave like a filter, which, when in contact with ozone, allows for a reactive filtration process in water treatment. So far, he says, this groundbreaking technique appears to be more effective than treating water with ozone or filtration alone.

Electrospinning uses an electrical charge to synthesize nanofibers of different materials to develop porous networks of these fibers for filtration. Small and highly portable, Cwiertyny believes nano-filtration systems may one day be a good water treatment solution for small isolated communities, or even at the tap.

Nano-Risk Management

With nanotechnology popping up everywhere — from stain-resistant fabrics to sunscreen to the scratch-resistant coating on your eyeglasses — Cwiertyny believes it's vital to understand what happens when these new materials enter the environment. Is nanotechnology a new scientific marvel, or a persistent new class of highly-reactive pollutants — or both? By studying the potential uses and risks of nanotechnology at the same time, Cwiertyny has an unusual opportunity to make a difference.

He hopes one day these technologies will improve water sustainability by promoting beneficial reuse of impaired water supplies, including wastewater. "I'm a big believer that we can take impaired water supplies and make them usable," Cwiertyny says.

David Cwiertyny believes that Iowans, having lived through the devastating floods of the last few years, are ready to hear the message of water sustainability.

Paradise with a Paddle: The DNR's River Clean-up Is Like RAGBRAI on the River — Minus the Partying

As the record-setting drought of 2012 dragged Iowa's river levels down, plenty has come to the surface — and not all of it pretty. "It's easy to ignore a problem if you don't know it exists," says IIHR Engineer Dan Ceynar.

Turns out, a lot of garbage has been hiding under the river's surface: tires, water heaters, stoves, snowmobiles, refrigerators, bicycles, and more. "You name it, it's been pulled out," Ceynar says.

Ceynar has firsthand knowledge about pulling trash out of rivers; in fact, he's something of a river clean-up fanatic. His idea of paradise is paddling down a river in his canoe; if he's collecting trash, he's even happier.

Raising AWAREness

It all started with Project AWARE (A Watershed Awareness River Expedition), one of the state's first big river clean-up movements. Project AWARE moves to a different Iowa watershed for one week each July, bringing hundreds of canoe-based volunteers to clean up the stuff that shouldn't be there. The clean-up effort is sponsored by the Iowa Department of Natural Resources (DNR), with help from other sponsors such as IIHR and the Iowa Flood Center.



Ceynar compares Project AWARE to RAGBRAI on the river — minus the partying. Most people camp in tents and share evening campfires along the river after a catered meal and educational programs. There's often music, and lots of low-key socializing. Bathing? It's optional, but if everyone smells a little river-y, who cares?

Ceynar got involved in Project AWARE in 2006, when it came to the Iowa River near Iowa City. He's now a river clean-up veteran who brings shovels and other tools to excavate the big stuff out of the mud — such as sections of cars, or, in several instances, boats — including a 17-foot fiberglass ski boat.

How Did That Get There?

Some of it is "legacy trash," dumped in the river decades ago before people understood the value of preserving the environment. Some of it washed in during recent flooding. And some of it is just dumped by people who should know better, Ceynar says.

One way to change the "dump it in the river" mentality may be by bringing Project AWARE to town. Last year, the clean-up crew pulled more than 32 tons of trash out of the Turkey River near Elgin. Just seeing what has been lurking under the river's surface can change hearts and minds, Ceynar says — especially for kids. He hopes to help bring about that change of attitude, "one kid at a time."

One Project AWARE experience is usually all it takes to make a conversion, Ceynar says. "Something happens — it gets in your blood."

He's got no regrets. In fact, Ceynar has gotten involved with other river clean-ups in the state, including the creation of the Iowa River Clean-Up and organizational responsibilities for the Lower Wapsie River Clean-Up.

"If we're lucky," Ceynar says, "we all find a passion in this life." He's found his — paddling down one of Iowa's rivers, balancing a pyramid of trash on his canoe.

Dan Ceynar and his daughter Grace enjoy a day on the river with Project AWARE.

Working the Numbers

For IIHR Assistant Research Engineer Gabriele Villarini, the flood that struck Iowa City in 2008 led him to a new interest in extreme weather events. The flood also affected him in a more personal way.

The rising waters hit just as he was preparing for his PhD defense, and all university buildings were closed. He couldn't postpone the defense, because one of the committee members was leaving for Europe the next day.

So Villarini successfully defended his PhD thesis in advisor Witold Krajewski's basement. The experience only piqued Villarini's interest in extreme weather.

Understanding the Past

Villarini spent the next several years at Princeton University working with Professor James Smith, broadening his research perspective and working with new colleagues. Through these connections and Smith's guidance, Villarini was able to develop his growing interest in climate change and extreme weather events — in particular flooding and hurricanes.

In 2012, Villarini returned to IIHR—Hydroscience & Engineering, where he is now affiliated with the Iowa Flood Center. Villarini is especially interested in learning how current weather events relate to the past. "Can we learn from the past to say something about the future?" he asks.

Villarini studies climate records that stretch back more than 100 years. He admits the data are often far from clear. Changes in land use, construction of dams or other structures in the watershed, and changes in agricultural practice have all made a big impact. These alterations make it hard to determine a clear climate signal, Villarini explains.

Researchers are left with a persistent problem: the increasing occurrence of extreme weather events could be anthropogenic (manmade), or it could be the natural variability of the climate system — or some combination of the two.

But this complexity has not dimmed Villarini's enthusiasm for studying historical data. "Before jumping into the future, we should try to understand the past."

Villarini is starting a new project with the U.S. Army Corps of Engineers to determine how that agency can incorporate an understanding of climate change into its practice. He's excited about this new venture, although it presents a difficult problem. "How do we account for climate change when working on projects that should function for decades?" Villarini explains.

He believes this work could have a major impact on many people in the future, and that's important to him. "I do hope my work makes a difference," Villarini says, "by providing information about possible changes in the frequency and magnitude of extreme events, resulting in improvements in our adaptation and mitigation strategies."

Roman Holiday

Villarini is a native of Rome, Italy, and planned a career as a civil engineer in the family construction company. Work on his master's thesis introduced him to an area of study that he found fascinating: remote sensing and hydrology.

He decided to pursue a PhD in this area, and came to the University of Iowa to work with Witold Krajewski. Villarini says Krajewski was a very effective mentor. "You don't want to let him down, so that makes you push even harder," Villarini explains.

Villarini met another person in Iowa City who would dramatically shape his life: his wife Amie. "I decided I was going to propose four months after we started dating," Villarini remembers. The couple now has a 2-year-old daughter, Eleonora.

"Iowa City has been very generous to me," Villarini says. "When it comes to education, when it comes to personal life. ... It's no Rome, but it's getting there!"

Gabriele Villarini says he spent many happy hours riding around Rome on a Vespa scooter similar to this one.



A Revolution in Ship Hydrodynamics

For 17-year-old Fred Stern, the future looked bright from the deck of a sailboat racing across the waters of Lake Ontario. The young man from Syracuse, N.Y., took advantage of every opportunity to go sailing.

With a small push from his father, Stern channeled his love for sailing into a successful career as a mechanical engineer focusing on ship hydrodynamics. Stern started with a correspondence course in yacht design, followed by BS, MS, and PhD degrees in naval architecture and marine engineering from the University of Michigan.

Revolutionary Research

Today, Stern heads up the ship hydrodynamics program at IIHR—Hydrosience & Engineering, where he is one of his field’s foremost visionaries, leading a revolution in naval ship design.

No longer must the navy “build and test” its ships — with real sailors aboard, risking their lives — to find out how vessels will perform under real-life conditions. Researchers at IIHR are using simulation-based design (SBD) — a sort of virtual reality of ship hydrodynamics, supported by model-scale experiments — to

develop a safer, less expensive way to design modern high-performance naval vessels.

“This is revolutionizing engineering,” the IIHR research engineer says. In an interview with the Big Ten Network, Stern explains, “Engineering will become more and more based on simulation techniques as time evolves.”

Cracking the Code

Under his leadership, researchers at IIHR have developed a groundbreaking computer code, CFDShip-Iowa, simulating air and water flow around a virtual ship. CFDShip-Iowa is the most advanced computational fluid dynamic (CFD) computer code in the world for ship hydrodynamics, allowing researchers to predict the performance of a virtual ship prototype under extreme environmental conditions.

Computer simulations at IIHR guide model-scale physical experiments conducted in a towing tank and in a state-of-the-art wave basin at the University of Iowa Research Park. The experiments help evaluate the limitations of current mathematical



Fred Stern (second from left) with students (l to r) Ryan TeGrootenhuis, James Carey, and Timothy Hunziker working in the IIHR towing tank.

PHOTO COURTESY OF UI NEWS SERVICES

models and allow researchers to develop better models. With uncertainty analysis and optimization methods, researchers are able to develop the best possible design, Stern explains.

UI engineering students, in particular, benefit from this revolution in engineering. Graduate students have been the co-developers of CFDSHIP-Iowa since its genesis in the early 1990s. Undergraduates also participate, Stern says. “We need to ensure that they’re highly-trained, expert users of tools such as computational fluid dynamics,” he explains.

Stern believes an understanding of CFD is a crucial part of a 21st century engineering education. Sharing his expertise with students, particularly undergraduates, is a passion — it’s his way of making a difference that will extend for decades into the future. “Undergraduates are a joy to teach,” Stern told *Iowa Engineer* magazine. “They are so enthusiastic and open to new ideas and approaches.”

Sayed Maysam Mousaviraad began as one of Stern’s students and went on to be a postdoc and now assistant research scientist. He says that Stern’s solid mentoring and dedication have helped shape his research and advance his career. “He keeps the standards very high, which inspires you to face the challenges and meet the expectations,” Mousaviraad explains.

The Iowa Paradigm

Stern himself shows no signs of slowing down. “There’s still plenty of work for us to do,” he says. Over the next decade, he hopes to build on the “monumental strength” of the current program, based on the “Iowa paradigm” of integrated computational fluid dynamics, experimental fluid dynamics, uncertainty analysis, and optimization research.

He won’t do it alone. The Iowa program has always depended on the talents and hard work of students, both undergraduate and graduate, as well as collaborators at IIHR and around the world. Stern’s vision emphasizes international collaborations and the building-block, step-by-step approach, focusing on second-generation simulation-based design tools, supported by physical experiments in IIHR’s towing tank, flumes, and wave basin.

Stern hopes to mentor his young faculty colleagues at IIHR so they can carry on the ship hydrodynamics program that has been a strength of the institute since Lou Landweber arrived in 1954.

Like Landweber, Stern has helped build IIHR’s unique combination of resources, facilities, and people, which promises an ongoing role for the University of Iowa in the front lines of naval ship design.

Stern Honored for Excellence

IIHR Research Engineer Fred Stern recently received two significant honors recognizing his focus on excellence. He is a key member of a group that was presented with NATO’s highest research group award, the NATO Research and Technology Organization (RTO) Scientific Achievement Award. The honor went to the Applied Vehicle Technology (AVT) group, AVT-161; Stern is co-chair of the Sea Team. The group focuses on “Assessment of Stability and Control Prediction Methods for NATO Air and Sea Vehicles.”

Stern says this award highlights the outstanding work being done by the entire group. “Many, many people have worked tirelessly to advance AVT-161’s research mission of advancing the technology of these vehicles.” CFDSHIP-Iowa, developed by researchers at IIHR, was used for all the test cases.



Stern was also named the Georg P. Weinblum Memorial Lecturer in recognition of his contributions to ship hydrodynamics. The lecture series is sponsored in Germany by the Institut für Schiffbau of the University of Hamburg, and in the United States by the Society of Naval Architects and Marine Engineers, along with the Naval Studies

Board of the National Research Council. The lecture series was created to honor Weinblum’s long and distinguished career in education and scientific research.

“I feel very proud to be chosen as the Weinblum Lecturer,” Stern says. “It is gratifying to be recognized, and it also reflects on the quality of work from the entire ship hydro team at IIHR.”

Making an Impact

One phone call has been known to change history. For IIHR Research Engineer Jacob Odgaard, such a call changed his life. In the mid 1970s, Odgaard was traveling worldwide for his work with the Danish Hydraulics Institute (DHI), and these travels brought him to California Institute of Technology, where he had been invited to present a seminar. Then-IIHR Director Jack Kennedy was at Cal Tech on sabbatical, hoping to recruit a talented engineer for IIHR. Someone suggested Odgaard might like the job.

“I remember saying, ‘No, I’m not interested,’” Odgaard says. “I didn’t even think about it.”

No Means No ...

Strangely, the day after the seminar, Odgaard got a phone call from Kennedy. “How he got the number, I have no idea. He was not at my seminar — he wasn’t even at Cal Tech that day,” Odgaard says.

Kennedy said, “I hear you want to come to Iowa.” Of course, Odgaard wanted no such thing — but he is a polite man, and he agreed to discuss the matter with Kennedy at an upcoming conference. In the meantime, Odgaard intended to write a polite but firm letter declining the position.

“Then I got busy,” he says. “The whole thing completely slipped my mind.”

When Odgaard arrived at the conference in Baden Baden, Germany, it was already too late. A message from Kennedy was waiting for him at the hotel desk, inviting him to coffee. “By that time, the whole institute [DHI] knew,” Odgaard explains. His director at DHI advised him to take the job for one year, go and learn, and then return.

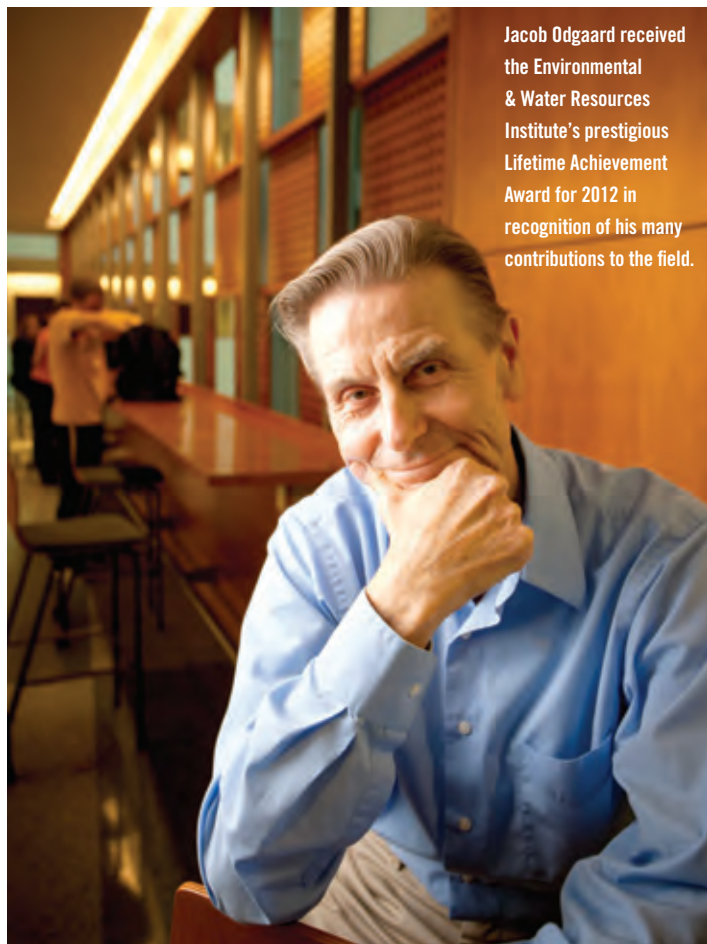
“My wife was not very happy about it,” Odgaard recalls. “I had to promise her it was only for one year.”

One Year Becomes Two ...

But one year became two, and before long, Odgaard was firmly ensconced at IIHR.

Odgaard accepted the position planning to focus solely on research. But when Kennedy asked Odgaard if he would teach a course for him — starting tomorrow — Odgaard rose to the challenge.

“Apparently, I did a reasonably good job,” Odgaard says. “It was quite typical of Jack. I learned to be on the toes all the time.” When offered a faculty position at the University of Iowa, he accepted it with the newfound recognition that he enjoyed



Jacob Odgaard received the Environmental & Water Resources Institute’s prestigious Lifetime Achievement Award for 2012 in recognition of his many contributions to the field.

teaching. “My guiding principle has always been, go where you can have the biggest impact,” he says. And as he now knows, teaching is that place.

A Danish Farm Boy

Odgaard was born in Denmark, where he grew up the son of a local politician and farmer. He studied engineering at the Technical University of Denmark, where he graduated with degrees in civil engineering.

Odgaard’s professional career took him from teaching at the Technical University of Denmark to a position with the United Nations, and later, a postdoc at Cambridge, U.K. Next came a job at the Danish Hydraulic Institute, which took him to nearly all corners of the world.

At IIHR, Odgaard has worked on an astonishing number of research projects, including some of the institute’s most influential work.

Submerged Vanes

For Odgaard, perhaps the most exciting moment of his career came unexpectedly one afternoon at Oakdale, where he was running experiments in a curved sediment flume. The U.S. Army Corps of Engineers had commissioned him to study bend scour and bank erosion in rivers, and ways to prevent it. Based on an earlier model study, Odgaard and Kennedy wondered what effect small submerged vanes or foils might have on the bend scour if correctly aligned. Odgaard asked Mechanical Shop Supervisor Jim Goss to cut several pieces of metal, which he placed in the flume, slightly angled to the flow.

Odgaard was astonished by what he saw. “They actually started moving sediment out to the bank!” He called Kennedy and asked him to come see for himself. The vanes completely flattened the bed, eliminating all the scouring. “It was fantastic!” Odgaard says. “Neither Jack nor I really thought they would work that well.”

Together, they wrote the first journal paper on submerged vanes and the complex flow patterns they create, which can reduce scouring along riverbanks. This groundbreaking work produced technology still in use today, although Odgaard says vanes are not the solution for all bank erosion issues. “For certain problems, they can certainly do the job,” he says.

Odgaard also started fish passage research at IIHR in 1981, which has grown to be one of the institute’s most important research areas. “We started out knowing absolutely nothing about how to deflect these baby salmon,” Odgaard says. He and his team worked with clients in the Pacific Northwest to help guide fish safely through hydroelectric dams. “This was very rewarding, because we learned so much about complex flow patterns in water intakes,” Odgaard says.

When Odgaard was approached for a position as associate dean for research and graduate studies in the UI College of Engineering, he did not accept right away. “I didn’t want to be a paper shuffler,” he says. He preferred to do work with more concrete results. But when Odgaard learned that he could influence the college’s plans for expanding and renovating the engineering facility, he saw that this work could have a tangible impact on generations of students. “It really became interesting,” he says. “The more impact, the better.” He served as associate dean for 10 years.

Odgaard continues his teaching and research, and shows no signs of slowing down. When he’s not at work, he enjoys serving as a flight instructor and spending time with his family.

Even today, when faced with a dilemma, Odgaard thinks about the man who brought him to Iowa and IIHR. “What would Jack have done?” Odgaard asks. “I learned so much from him.”

Paying It Forward: Honoring IIHR’s John F. Kennedy

John F. Kennedy, who served as director of IIHR for more than a quarter of a century, was a dynamic presence whose spirit and enthusiasm propelled the institute to unprecedented growth and achievement. A brilliant engineer and hydraulician, he loved people as much as he loved research. Kennedy’s quick wit and unpretentious manner made him the center of any group.

IIHR Research Engineer Emeritus Tatsuaki Nakato says he delighted in his relationship with Kennedy. “He was very strict, but very fair and friendly — so energetic.” Under Kennedy’s management, IIHR became a magnet for hydraulic engineers and students from around the world.

Kennedy’s fairness in particular endeared him to graduate students, especially those who were lucky enough to have him on their thesis committees. Despite his busy schedule, Kennedy spent many hours carefully reviewing and editing to help each student improve his or her thesis — not only for his own students, but for others as well. Kennedy also spent time with students who had failed their oral examinations, drilling them so they could answer the questions correctly and pass the exam the next time. “He wanted IIHR students to be successful in the world,” Nakato says.



So when an opportunity presented itself to help further develop the John F. Kennedy Memorial Fellowship, Nakato was thrilled. During a recent international hydraulics conference held at the University of Iowa, Nakato hosted a dinner for IIHR alumni from around the world. Nakato, who is a native of Japan, encouraged fellow alumni to support the John F. Kennedy Memorial Fellowship. Nakato made it his personal mission to convince his former classmates and colleagues to give.

Kate Metcalf, assistant director of development for the College of Engineering, says that the success of the Kennedy Fellowship, which in the 20-plus years of its existence has had more than 250 donors, is a reflection on Kennedy himself. “That’s how many fans he has out there!” she says. She hopes that the fund can be bolstered to allow for a \$2,500 award to an undergraduate engineering student each year.

Nakato has never stopped his efforts to honor his former mentor and colleague. “What an amazing, dynamic person he was!” Nakato says. “People all over the world respected him so much.”

To make a gift to the John F. Kennedy Memorial Fund, visit the IIHR website (www.iihr.uiowa.edu) and click on “Make a Gift.”

The Experimentalist

While studying for his master's degree in Iran, Ali Reza Firoozfar discovered an article by IIHR's Jacob Odgaard. For Firoozfar, reading that article was a turning point. From that day on, he dedicated himself to one goal: earning a PhD at IIHR.

"That was my dream," he says. "Nothing can satisfy me except doing the research that I'm interested in."

When he arrived in Iowa City, the first person Firoozfar met was Jacob Odgaard. "It was a dream," he says. "And it came true."

Home Away from Home

Firoozfar grew up in a small town in a rural area of central Iran. He observed many of his country's water problems firsthand: erosion, water scarcity, etc. His parents, both teachers, urged their children to study hard and learn as much as possible. "I always try to follow their example," Firoozfar says. "I really appreciate their support and guidance."

As a young student, Firoozfar loved math and physics, so engineering was a natural choice for him at the university. He focused on hydraulic structures and sediment engineering. When he decided to study in the United States, his parents supported the decision, but Firoozfar says it has been painful for the whole family — especially his mother — to be separated for so long.

"It has been almost two years and two months," Firoozfar says. "They accepted it because they knew that I would be successful here."

Fortunately, a warm and lively Iranian community was waiting to welcome him to the University of Iowa. His fellow IIHR student, Seyed Mohammad Hajimirzaie (Haji), had an apartment rented and ready for him when Firoozfar arrived. It helped a lot to have new friends in Iowa, Firoozfar says — especially friends who share his love of soccer. He tries to play twice a week when he can.

"Here, we are like family," Firoozfar says.

The Experimentalist

Firoozfar's PhD research focuses on rock scour or erosion downstream of dams — work he is pursuing with his advisors, Larry Weber and Thanos Papanicolaou. Rock scour is a significant concern, primarily for safety reasons. It's complicated research, he explains, because it is challenging to replicate existing rock and scale it down for a model study. Firoozfar is experimenting with cohesion material, or a mixture

of cohesive and non-cohesive materials, to simulate the properties of rock found in the field.

As a member of Weber's team, Firoozfar is also part of two hydraulic structure projects. The first is a large-scale laboratory model study of a fish bypass system for juvenile salmon migration at Priest Rapids Dam, located on the Columbia River in the state of Washington. The team has also undertaken a laboratory model study of the Box Canyon Dam on the Pend Oreille River in northeastern Washington state to investigate the hydrodynamic forces on the gate and gate instability during operation. Both of these efforts are very satisfying to Firoozfar, because he is at heart an experimentalist. "I like to work on something I can really feel," he explains. Numerical models are wonderful, robust tools for researchers, he adds, but for every computational model, he believes there should be a physical model. "They need to be validated," Firoozfar explains.

Firoozfar says IIHR has lived up to the high expectations he had when he first dreamed of coming to Iowa. "I really love the place where I am right now," he says. He likes the work and the people at IIHR, and the community as well. He hopes to be able to translate what he has learned into a career that truly makes a difference for others.

"I would like to be helpful to the people," Firoozfar says. "That's the goal I've always had."



Ali Reza Firoozfar loves working on large-scale laboratory models such as this one.

PHOTO BY MIKE STENSON/UI PHOTO SERVICES

The Human Factor

Harvest Schroeder admits that earning an engineering degree is challenging. “It is hard, but so is everything else that’s worthwhile,” Schroeder says. She likes to think about the human results of her work, and making the world better for the real people.

“It’s totally worth it,” the IIHR engineer says.

Small-Town Scientist

The Calamus, Iowa, native earned a B.S. in civil and environmental engineering at the University of Iowa, and she’s now pursuing an M.S. degree while working full-time on the Iowa Flood Center’s (IFC) Statewide Floodplain Mapping Project.

After being home schooled through her freshman year of high school, Schroeder graduated from Calamus-Wheatland High School. Her father taught science at the tiny school system, and his enthusiasm for all things scientific trickled down to Schroeder and her four siblings. He took the family on long vacations in the summer, tent camping in national parks and exploring the natural world.

Schroeder loved science and math classes, but she wasn’t set on engineering as a high school student. Like many younger students, she wasn’t entirely sure what an engineer does.

She learned more about engineering from her older brother, who went to Iowa State to study chemical engineering. Job shadowing a civil engineer also opened her eyes to what engineering actually entails. Being outdoors at least part of the time appealed to her, and she also appreciated the fact that engineers can actually see the results of their work. “You’re building something,” she explains.

Engineering a Bright Future

When Schroeder was just starting her engineering classes at Iowa, she remembers looking around and finding herself one of only a few women in the room. It was a little intimidating, she says, but that doesn’t bother her these days. Although Schroeder knows that old-school resistance to women in engineering exists, she has never experienced it firsthand.

“I think I’ve been kind of fortunate,” she says.

Schroeder interned with the City of Iowa City in 2008 — the year of the big flood. That experience made her acutely aware of the importance of water-related engineering and its impact on people and communities.



Harvest Schroeder with a flood inundation map of Des Moines.

It was something she never forgot. So when Schroeder heard about an opportunity for students to work on the IFC’s Statewide Floodplain Mapping Project, she immediately wanted to get involved. After she completed her undergraduate degree, Schroeder’s position at the IFC evolved into a full-time job, and she was later chosen to serve as one of the project leaders.

The five-year effort has a big goal: to create new floodplain maps for the 85 Iowa counties that were declared Presidential Disaster Areas after the 2008 floods. Schroeder shares the leadership duties with Engineer Derek Chang, and she says they’re fortunate to have great supervision from IFC Associate Director Nate Young, as well as an excellent team of dedicated engineers.

When the Statewide Floodplain Mapping Project is complete, most Iowans will have up-to-date, reliable floodplain maps to turn to, which will make a positive difference in the lives of many Iowans. “I do feel you’re getting a useful product that people will use,” Schroeder says. “That provides a lot of motivation for me.”

Schroeder hopes to continue working in the field of hydrology and hydraulic engineering after the project is done. “I love being in the water research world,” she says.

An Intense Competitor

When she’s not working, Schroeder likes to spend time with her family and help out at her church, where she teaches Sunday school to second and third graders. She also loves to get outside and be active. She took up downhill skiing a couple of years ago, after cross country skiing throughout her youth. She also likes sand volleyball and Ultimate Frisbee.

When it comes to sports, Schroeder says, her normally low-key personality disappears. “My competitive side comes out,” she says. “It gets intense sometimes!”

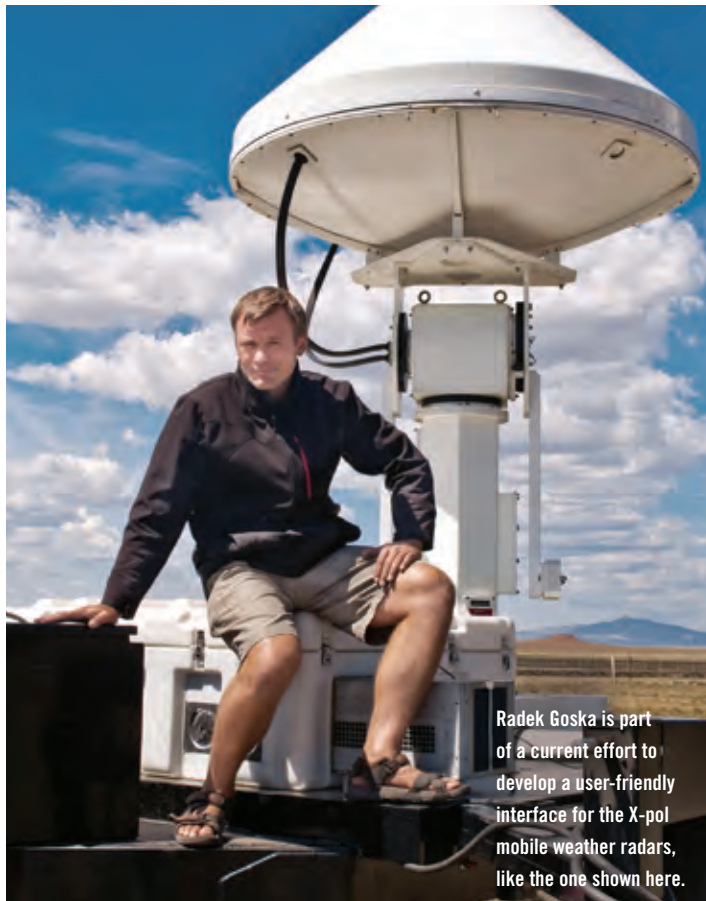
Making a Home in Iowa

The sweet spot for Radek Goska is where work and fun intersect. The IIHR engineer has become the institute's resident expert in graphics, photography, software, and a host of other areas outside his official duties. "I kind of connect my hobbies with my job," he explains.

Goska, a native of Warsaw, Poland, likes work that tests his skills, and he finds plenty of challenges through his job at IIHR and the Iowa Flood Center. Goska met IIHR Research Engineer Witold Krajewski, also a native of Poland, at a judo club in Warsaw. A passionate judo enthusiast, Goska was Poland's junior national judo champion as a teenager. The two hit it off, and Krajewski invited Goska to the University of Iowa to pursue a PhD.

But Goska was fed up with school, having already completed undergraduate and master's degrees in engineering at the Warsaw University of Technology, and he offered to come and work for Krajewski instead. And so, in 2002, Goska arrived in Iowa with his wife Aneta and their oldest daughter, Zofia, then 2-1/2 years old.

It was an experience in culture shock for the whole family. For Goska, the change was good. He liked the challenges at IIHR. "I had to learn quickly," Goska says. "It was a great time for me."



Radek Goska is part of a current effort to develop a user-friendly interface for the X-pol mobile weather radars, like the one shown here.

PHOTO BY ANETA GOSKA

For his family, though, the change was harder. Aneta, who spoke little English, stayed home with Zofia, and she often felt isolated and far from home. The family found little comfort in the new and bewildering American culture — especially the food. Even food that Americans think of as Polish in origin bears little resemblance to the real thing. "For example," Goska says, "the thing you call Polish kielbasa doesn't have anything to do with Polish kielbasa!" So the family traveled to Chicago every two weeks or so to buy food. It was an unsustainable situation.

After 10 months, Aneta had had enough and returned to Poland. "What could I do?" Goska asks. "I had to follow her."

Back in Poland, the couple had another child in 2004, a son, Jan, and shared a Warsaw apartment with in-laws. Goska found a job with a German software company. And while it was work, it wasn't very exciting. "It was killing me," Goska says.

"I was always thinking about coming back here," he says. In 2006, Krajewski again invited him to Iowa, and Aneta agreed to try Iowa again.

Things went better for them this time. Skype allowed Aneta to talk to family in Poland often. The children started school and made friends quickly. Their third child, Anna, was born in 2008 — just five days before the flood struck Iowa City.

Goska spent the summer of the flood working in Krajewski's home, and he was present when the idea for the Iowa Flood Center was born. The evolution of a new research center was an exciting thing to be a part of, Goska says, and things moved quickly.

Goska was especially grateful that his family was in Iowa City when the unthinkable happened: Aneta was diagnosed with Stage 3C colon cancer. She had surgery and chemotherapy at the University of Iowa Hospitals and Clinics. "Chemo was horribly difficult for her," Goska says. Fortunately, family members came to help them through the worst of it, and to help look after the kids. Now, with about a year behind them since the completion of chemotherapy, Goska says Aneta is slowly recovering.

When he thinks of the health care system in Poland, Goska shakes his head and says he's grateful that they were here in Iowa City, where world-class health care is readily available, when she got sick. "I cannot tell you how glad I am," he says.

The work at IIHR and IFC continues to go well, Goska says. Because of his broad range of interests and expertise, Goska has helped almost everyone at IIHR at one time or another. Whether the subject is photography, graphic design, database design, or software, Goska has answers, or will try to find them. "I am always trying to be helpful," he says with a smile.

Chasing Grants and Butterflies

As a little girl, Carmen Langel spent many happy hours darting around the backyard, chasing winged things and many-legged creatures with her butterfly net. Insects were her first love — Langel even had a pet praying mantis.

Now director of development and communication at IIHR, Langel always knew she had a passion for science. She's grateful for the consistent encouragement she got from her parents. Her dad kept her on track through school in advanced math and science courses, and both parents cheered her on, whether she was chasing butterflies or collecting rocks.

Langel earned BS and MS degrees in geology at the University of Iowa, and she met her future husband, Rick, on a spring break geology field trip to Death Valley. After a long day of mapping geologic formations, Rick invited Langel to sit next to him near the campfire. "He shared his rock with me," she laughs. "That means something!"

Life in the Museum

After graduation, Langel worked for the Office of the State Archaeologist for a couple of years, and then took a position with the Putnam Museum in the Quad Cities, where she worked to classify and categorize the human remains in the museum's collection. In the process she discovered her great love for museum work.

When Langel had the opportunity to join the staff of the National Czech and Slovak Museum in Cedar Rapids, she jumped at the chance. Langel served as the first curator at the museum's new facility. "It was really an exciting time to be there," Langel remembers. The institution's collections and reputation were growing rapidly; it was, she says, "the little museum that could." In 2004, Langel accepted a position as the museum's director of development, which brought with it new challenges and a big change in focus. She organized annual fundraising appeals, special campaigns, and events such as "BrewNost," an annual beer-tasting party that attracts hundreds of beer enthusiasts to the museum.

The Thrill of the Chase

With two sons, Nathan and Tony, a full-time job, and newly-begun MBA studies at the University of Iowa, Langel found her plate full and then some. So when she saw a new position had opened at IIHR—Hydroscience & Engineering, Langel applied and was hired.

Langel started work at IIHR a little more than a year before the floods of 2008. That extreme event opened her eyes to the exceptional people she worked with. "You get to see what people

are made of in a situation like that," Langel says. Staff, faculty, and students willingly pitched in do whatever was needed; even though the event was very traumatic, no one complained. The experience seemed to bring people together.

Before long, Langel's position at IIHR grew to include leadership of the institute's communication and development efforts. She's proud of projects such as the institute's redesigned website, which debuted in 2011. But grant writing is still her first love — especially the large proposal efforts. "I like the thrill of the chase," Langel says.

Langel says she's proud to see IIHR growing and thriving, in part due to her efforts, and she's happy to dedicate her talents to something so worthwhile. "You want to make a difference in the job you're doing," Langel explains.

With her MBA completed in 2010, Langel has more time to enjoy adventures in the outdoors with her family, which now includes Ruby, a rescue dog adopted last year.

And every now and then, when the moment is just right, Langel admits she is still tempted to chase a butterfly.



Carmen Langel loves the "thrill of the chase" she experiences in helping IIHR researchers write large research grant proposals.

PHOTO BY MIKE STENSON/UI PHOTO SERVICES

The Inquisitive Engineer

According to Paul Dierking's parents, he was the kind of kid who asked "how?" and "why?" ... a lot.

That inquisitive nature has taken Dierking from the family farm to a career in water resources engineering with a major engineering consulting firm. Dierking, an IIHR alumnus and a member of the institute's Advisory Board, says he finds his work with HDR in Chicago increasingly interesting and challenging — but that doesn't mean he's forgotten his farm roots.

In fact, Dierking thoroughly enjoyed his boyhood on the rolling hills of eastern Nebraska, and he looks forward to visiting each fall to help with the harvest. He grew up observing occasional flooding and his family's efforts to mitigate those problems. "That's part of where my interest in water resources originates," Dierking says.

An IIHR Education

He studied civil engineering at the University of Nebraska-Lincoln, and learned about IIHR through an internship with the U.S. Army Corps of Engineers (USACE). After visiting the institute, Dierking and his wife Darcia, an audiologist, both decided to continue their studies at the University of Iowa. The choice was a good one.

"It couldn't have worked out much better," Dierking says. At IIHR, he was a part of the Hells Canyon model study, led by IIHR Research Engineer Larry Weber. The team investigated flow

regimes at the dam, and how modifying the flow with structures such as deflectors affects total dissolved gas levels that can impact migrating salmon. Dierking particularly liked working on a project with real-world implications.

Dierking began his professional career with HDR at the firm's Omaha headquarters. He spent nine productive years in this busy office, which includes some 300 engineering staff members. When a position opened up at HDR's Chicago office, Dierking and his wife decided they were ready for a new adventure. Dierking serves as section manager of the water resources team in Chicago, and with his colleagues, he has been tasked with developing the water resources practice in the Chicago area.

Stopping the Invaders

The Chicago HDR team got an instant boost in visibility from a contract with the Great Lakes Commission to study the feasibility of building a physical barrier between the Great Lakes and the Mississippi River basins. The threat of Asian carp entering the Great Lakes through the Chicago Area Waterway System (and other invasive species transferring in either direction) has raised concerns among environmentalists, fishery managers, and scientists. The HDR team looked at the potential locations, costs, benefits, and impacts of such a barrier; the study indicated that the most viable separation scenario was to construct barriers that closely replicate the original hydrological divide.

Through this high-profile study, Dierking and his colleagues made connections with government officials and agencies in the Chicago area, including USACE's Great Lakes and Mississippi River Interbasin Study (GLMRIS) team. GLMRIS is investigating a broader array of control technologies to reduce the risk of invasive species transfer through numerous aquatic pathways around the Great Lakes. While a long-term permanent solution may be decades away, the HDR team has recently focused on near-term measures for partial separation, which would further reduce the risk of invasive species transfer.

Family Man

Outside of work hours, Dierking is active in his church and community, and he likes to run and play basketball. Basketball has been a passion since he played for his high school team in Scribner, Neb. Dierking admits he's pretty competitive on the court. "I have fun with it too," he says.

But Dierking dedicates most of his free time to his young and growing family. He and Darcia have two children: Jonathan, 3, and Elsie, 7 months. Before long, Dierking fully expects to be answering endless rounds of "how?" and "why?" as his own children learn about the world around them.



Paul Dierking believes the appropriate role for an engineering consultant is to remain objective and provide technical expertise, while sharing information and representing the interests of the greater community.

PHOTO BY MIKE STENSON/II PHOTO SERVICES

Going with the Flow

Computer modeling is invaluable for a water-quality researcher, but IIHR alumnus J.V. Loperfido still likes to get his feet wet.

“I think you gain a lot of insight from being out in the stream,” the U.S. Geological Survey (USGS) researcher says. Loperfido says he learned the value of field studies at IIHR, where he earned much more than a degree — he became a researcher.

“I absolutely loved my time at Iowa,” he says.

Urban Runoff

Loperfido spends plenty of time in the water in his position with the USGS Eastern Geographic Science Center, based in Reston, Va. His current research on urban stormwater management and water quality hearkens back to his time at Iowa, much of which was spent working in the small streams of the Clear Creek watershed. Now he’s in the small streams near the Chesapeake Bay.

The Chesapeake Bay suffers from the same sort of nutrient-laden runoff that causes summer hypoxia problems in the Gulf of Mexico. Loperfido studies excess nutrients in the Chesapeake Bay watershed, and how different spatial patterns of stormwater treatment facilities can be used to mitigate urban runoff problems. These facilities can include the use of retention/detention ponds, wetlands, infiltration trenches, and underground storage tanks in centralized and distributed configurations.

Forecasting Water Quality

In his graduate research at IIHR, Loperfido collected real-time remotely sensed water-quality data with the goal of making water-quality forecasts in the same way meteorologists make weather forecasts. People need to know the water quality just as they need to know whether it will rain or storm before the day is done, Loperfido explains.

Loperfido first met his soon-to-be faculty advisors, Jerry Schnoor and Craig Just, when he visited Iowa as a prospective grad student. Their knowledge and professionalism impressed him right from the start, along with a certain approachable quality. “They were very down-to-earth and easy to talk to,” Loperfido says.

Loperfido’s PhD dissertation, “High-Frequency Sensing of Clear Creek Water Quality: Mechanisms of Dissolved Oxygen and Turbidity Dynamics and Nutrient Transport,” won the 2009 Graduate Deans’ Distinguished Dissertation Award.

J.V. Loperfido doesn’t mind getting his feet wet.

A Big-City Adventure

Loperfido and his wife Kim Lamon-Loperfido (also a UI alumnus) are currently enjoying a big city adventure (with their three cats) in the Washington, D.C., area, which offers an almost endless abundance of cultural resources and historical landmarks. Loperfido says they have a long list on the refrigerator of the museums, galleries, and monuments they still want to explore.

The avid hiking buffs have also found great trails within driving distance of their home in Arlington, Va. They especially like the mountainous terrain they’ve encountered in the Shenandoah National Park.

A Lego Guy

The Stillwater, Minn., native says he benefitted from growing up with two scientifically-inclined parents. “I’m definitely their son,” Loperfido says. His father is a retired PhD chemist at 3M, and his mother is a technical service engineer, also at 3M.

Engineering appealed to him early on. With his parents’ encouragement, Loperfido knew by the 8th grade that he wanted to be a civil engineer. Still, he wasn’t one of those kids who takes apart every toy in the house to find out how it works. “I was more of a Lego guy,” Loperfido says.

Loperfido says if he hadn’t become an engineer, he might have been an artist, like his grandmother. “I love colors; I love different patterns,” he explains. “I have a real interest in art.”



THE FISCAL YEAR IN REVIEW

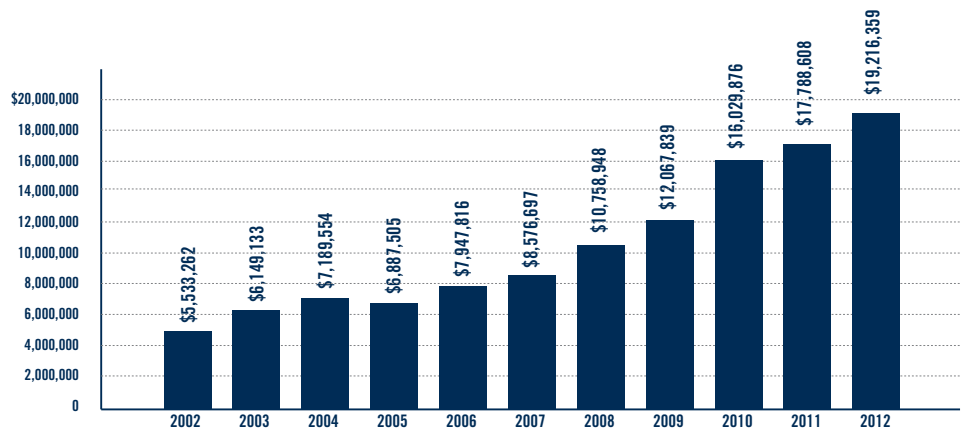
IIHR's overall health is reflected in the increasing size of the institute. Today, 47 research engineers and scientists work with 106 graduate students (33 percent pursuing a master's degree, and 66 percent pursuing a PhD). In 2002, 28 faculty/research staff worked with 62 graduate students. The pace of grant proposal writing is increasing at a comparable rate, forecasting a healthy financial future for the institute.

Despite this growth, IIHR continues to keep administrative expenses under control. Between June 2010 and June 2012, total IIHR expenditures on sponsored research increased from \$11.8M to \$15.1M; meanwhile, administrative expenses dropped from \$4.2M to \$4.0M.

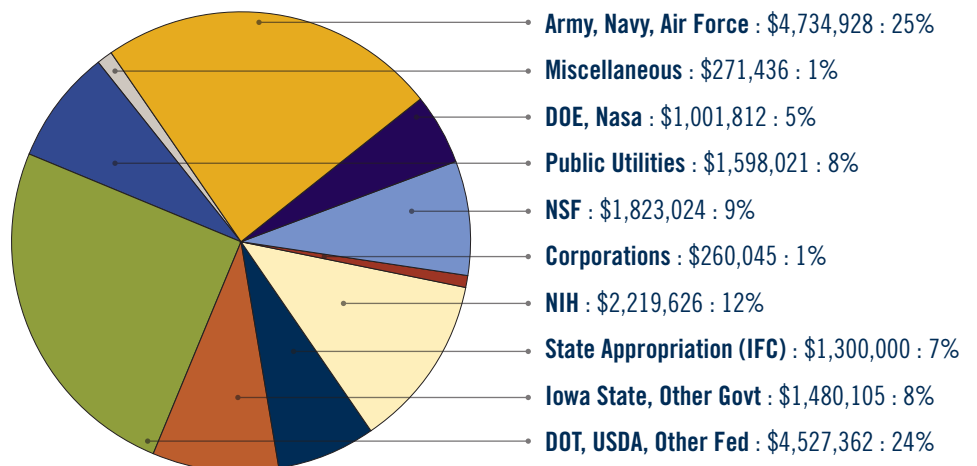
IIHR continues to re-invent itself to stay at the forefront of fluids-related fundamental and applied research. It is clear that the global water-related challenges we face are only increasing, and the need for innovative ideas and solutions is becoming more acute. Now more than ever, IIHR is in a position to reach a new level as a prominent center for education, research, and service.

Looking ahead, IIHR's strategic initiatives include projects such as the National Science Foundation and NASA's Experimental Program to Stimulate Competitive Research (EPSCoR); the Iowa Flood Center, which derives funding from the state of Iowa and other sponsors; watershed-scale research funded by the U.S. Department of Housing and Urban Development and UNESCO-HELP; and biofluids projects with support from the National Institutes of Health.

Fiscal Year 2002 to 2012 External and Internal Research Funding



Fiscal Year 2012 External Funding by Sponsor (\$19,216,359 Total)



IIHR Internal Investments

	2011	2012
Graduate Students	\$369,560	\$187,986
Postdoctoral Associates	\$85,749	\$205,032
Research Engineers	\$367,378	\$409,225
Facilities & Equipment	\$363,385	\$513,218
Total IIHR Internal Investments	\$1,186,072	\$1,315,461

Major Funding Announcements in Fiscal Year 2012

Watershed Demonstration Project (Larry Weber and Witold Krajewski)	\$3.6M	Iowa Economic Development
Multiphase Flow Tools (Pablo Carrica)	\$970K	Office of Naval Research
High-Speed Catamaran (Fred Stern)	\$527K	U.S. Department of Defense, Navy (DURIPS equipment grant)
Electrospun Nanofiber Filters (David Cwiertny)	\$499K	U.S. Environmental Protection Agency
Multi-Body Fluid-Structure Interaction (Fred Stern)	\$450K	U.S. Department of Defense
Cowlitz Falls Dam (Troy Lyons, Marcela Politano, and Larry Weber)	\$405K	City of Tacoma, Wash.
Hybrid Nanostructures (David Cwiertny)	\$349K	National Science Foundation
Carbon Nanotubes (Richard Valentine, David Cwiertny, and Tim Mattes)	\$300K	National Science Foundation
Maneuvering in Waves (Fred Stern)	\$240K	U.S. Department of Defense
Anthropogenic Organic Compounds (Guangshu Zhai, Jerry Schnoor, and Keri Hornbuckle, et al.)	\$237K	National Science Foundation (MRI equipment grant)

IIHR Advisory Board Members

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Harindra Joseph Fernando (2012–16), University of Notre Dame
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Larry J. Weber, Director, IIHR—Hydrosience & Engineering, University of Iowa
Carmen Langel, Director of Development and Communications, IIHR, University of Iowa



PHOTO BY MIKE STENSON/UI PHOTO SERVICES

IIHR Advisory Board (front, l to r): Carmen Langel, H.S. Udaykumar, Kevin Richards, and K.B. Chandran; (back, l to r): James Smith, Troy Lyons, Paul Dierking, and Larry Weber.



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Eagles gather near the Burlington Street dam in winter to take advantage of open water.



Our Mission

To be a leader in fluids-related fundamental and applied research; to provide interdisciplinary education for future leaders in science and engineering; and to advance knowledge in support of sustainable natural and engineered systems.

Our Vision

To be an international leader among academic institutions in hydroscience and engineering research recognized for integrating laboratory, field- and simulation-based experimentation, and participatory interdisciplinary education.