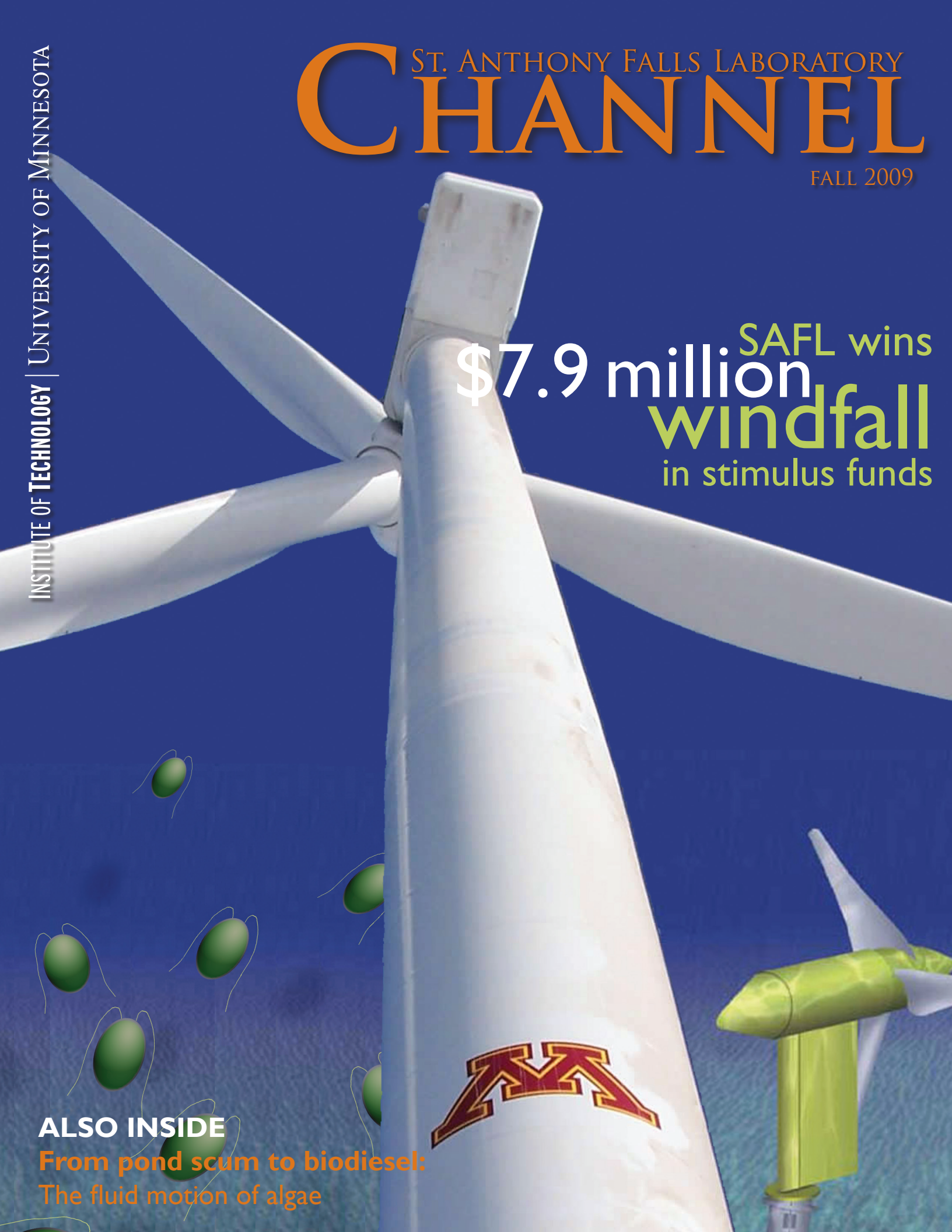
INSTITUTE OF TECHNOLOGY | UNIVERSITY OF MINNESOTA

ST. ANTHONY FALLS LABORATORY CHANNEL

FALL 2009



SAFL wins $7.9 million windfall in stimulus funds

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From pond scum to biodiesel:
The fluid motion of algae

fall 2009

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The SAFL Channel is published biannually by
St. Anthony Falls Laboratory
University of Minnesota
Minneapolis, MN 55414
www.safl.umn.edu

The St. Anthony Falls Laboratory is a research unit of the University of Minnesota's Institute of Technology in the Department of Civil Engineering. The laboratory is also closely affiliated with the Department of Geology and Geophysics, and the Department of Ecology, Evolution, and Behavior.

Cover: Model wind turbines in the SAFL wind tunnel

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The Director's Perspective

It gives me great pleasure to communicate with all of our alumni and friends during these exciting times for SAFL. A few years ago we began carving a new direction for the laboratory to become a national facility for renewable energy research. We envisioned applying our strengths in experimental and computational fluid mechanics toward solving one of the most pressing challenges of our time. In this issue you will read about the great strides we have made in recent months toward realizing this vision.

As a result of $7.9M awarded by the US Department of Energy to a SAFL-led industry/academe consortium, the University of Minnesota will become the home of a major new center on wind energy research in 2010. The consortium will develop a field-scale facility to tackle the technological road blocks in achieving the DOE's national goal of 20% wind power by 2030.

This issue also includes news about an exciting new grant led by Professors Miki Hondzo and Vaughan Voller, who are part of an interdisciplinary group researching biodiesel production from algae. This same grant will also fund a new biodiesel research facility at SAFL.

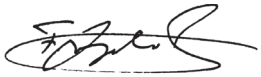
Coupled with earlier grants on wind farm modeling and hydrokinetic turbines, these new grants have strengthened the lab's role as a hub for partnerships between academia and industry, and provided resources for SAFL to become a leader in a range of renewable energy technologies.

In addition to these exciting developments in our energy research portfolio, the Outdoor StreamLab continues to thrive and produce great science. A new advanced instrument carriage enables high resolution bathymetry measurements, bringing together the OSL with the Virtual StreamLab— a great step forward in our science-based approach to stream restoration.

But it is not only the major advances in research we are excited for this year. The renovation of the 70 year old SAFL building is steadily underway with the recently re-built upper deck, which now provides the structural requirements necessary for future renovation projects.

Finally, there are a few internal changes that sadden us as we lose Associate Professor Fernando Porté-Agel and OSL Research Associate Anne Lightbody to teaching positions elsewhere. We are grateful to both of them for what they have done for the lab, and wish them well in their new endeavors.

SAFL's future is as bright as it has ever been, and we hope that you will continue to be a part of it. As alumni and friends, there are many ways to become involved, from switching to the paperless SAFL Channel, to contributing financially to support the laboratory. However you decide to participate, we look forward to keeping in touch.



—Fotis Sotiropoulos
Professor and Director, SAFL

honors & awards

The University of Minnesota is the recipient of a recent $7.9M grant from the U.S. Department of Energy to foster wind energy development. Professor **Fotis Sotiropoulos** will lead a consortium of industrial and academic partners on this project.

Professor **Roger Arndt** has been elected a Fellow of the American Physical Society "*for his seminal contributions to our understanding of cavitation including inception physics, erosion mechanisms, noise and vibration and effects on turbomachinery performance; and for his outstanding contributions to research and education in aeroacoustics, hydroacoustics and hydroturbine technology*, " and Professor **Fotis Sotiropoulos** has been elected a Fellow of the American Physical Society "*for seminal contributions in vortex dynamics, flow-structure interactions, and chaotic dynamics in civil, mechanical and biomedical applications*." Election to Fellowship in the APS is limited to no more than one half of one percent of the membership, and is recognition by one's peers of outstanding contributions to physics.

Professor **Fotis Sotiropoulos** gave the keynote address "Advanced Computational Fluid Dynamics Modeling for Real-Life Hydraulic Engineering Flows: Toward the Virtual StreamLab," at the Chilean Congress of Hydraulic Engineering, Vina del Mar, Chile, October 19-22, 2009.

Assistant Professor **Kimberly Hill** received a 3-year $300k NSF award for *Rheology of dense sheared granular mixtures: Computational and experimental studies on the effects of particle size distributions.*

Professor **John Gulliver,** Research Fellow **Andy Erickson,** and visiting researcher Peter Weiss (Valparaiso University) were awarded a $404,000 research project from the MPCA/U.S.EPA 319 program, *Aqueous pollutant capture by enhanced filter media*. Their research will develop a design standard for enhancing sand and soil media that can be used in new or renovated sand filters, infiltration systems, rain gardens, and buffer strips to capture significant amounts of dissolved heavy metals, phosphorus, and nitrogen that are typically found in urban and agricultural runoff.

Graduate student **Vamsi Ganti** received the Institute on the Environment's (IonE) Interdisciplinary Doctoral Fellowship. Working with NCED Director Efi Foufoula-Georgiou, Ganti focuses his research on developing a new class of models for environmental transport processes; this work could lead to a greater understanding of the physics behind the processes that shape landscapes and could provide a better predictive capability in integrated watershed management.

SAFL alumnus **Doug Barr** (MS '49) is a recipient of the University of Minnesota's Outstanding Achievement Award, which recognizes graduates who have attained unusual distinction in their chosen fields or professions, and who have demonstrated outstanding achievement and leadership on a community, state, national, or international level.

Congratulations to **Nikki Strong** (PhD '06) and Professor **Chris Paola,** authors of the Journal of Sedimentary Research's 2008 Outstanding Paper Award, and **Matt Wolinsky** (former postdoc) and **Chris Paola,** co-authors on the JSR's 2008 Honorable Mention for Outstanding Paper.

NSF awarded Professors **Jacques Finlay** and Bob Sterner (EEB) $824,760 for their project "Sources and sinks of stoichiometrically imbalanced nitrate in the Laurentian Great Lakes."

Correction to the spring issue: The Freshwater Society's "2009 Outstanding Leadership Award" was given in part to Eric Novotny, not Eric Merten.

in other news

>>The release of SAFL's new Virtual StreamLab computer model made headlines in Discovery News, U News, MN Daily, and others.

>>Two articles on SAFL's stormwater research, and one article on the Outdoor StreamLab, appeared in a "Researching the Future" exclusive in Civil Engineering News online. Read them at www.cenews.com.

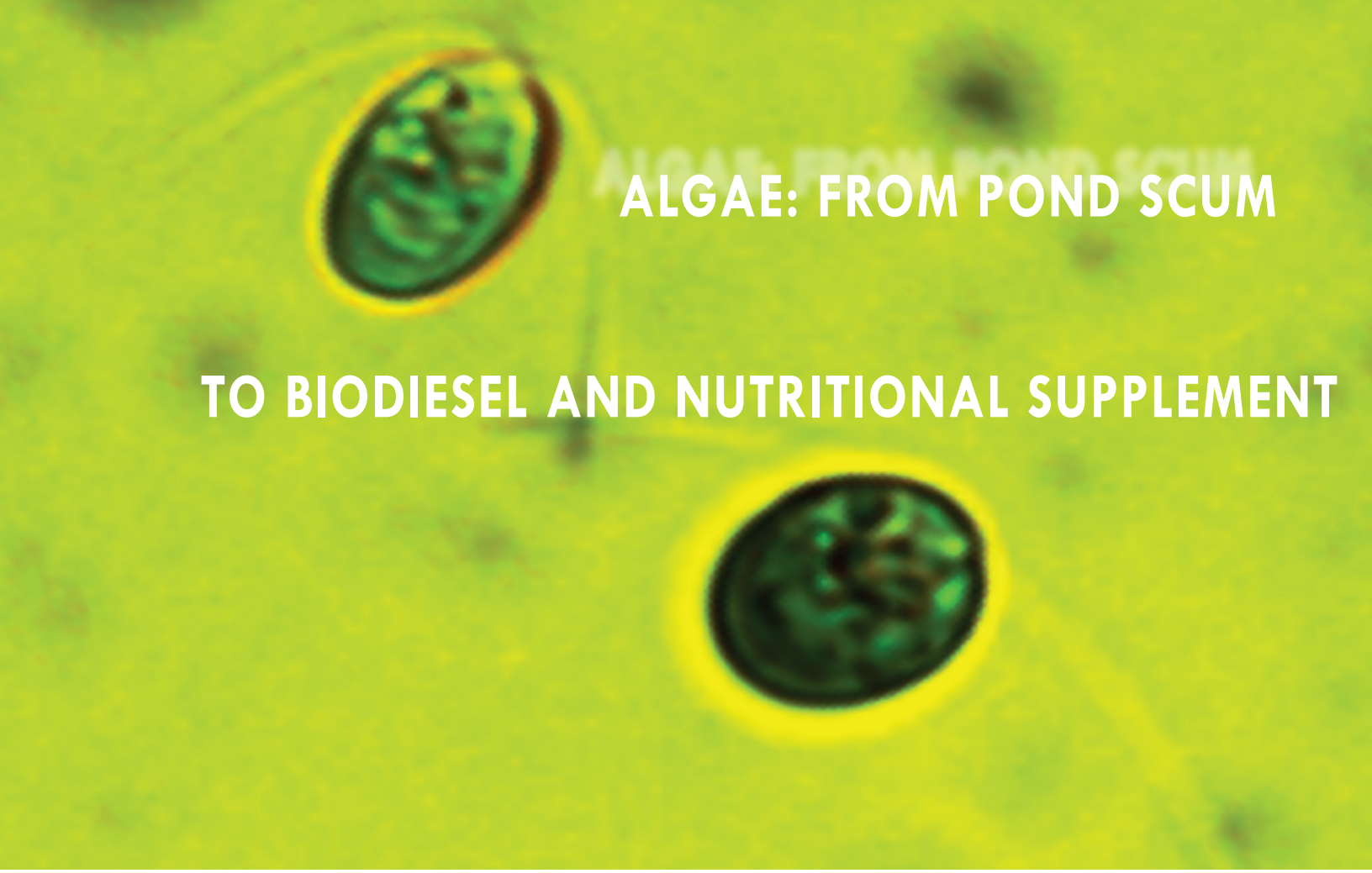
>>The recent $7.9M DOE award for a SAFL-led wind consortium made headlines in the St. Paul Pioneer Press, MPR, UNews, North American Windpower, and others.

>>Prof. Heinz Stefan talks to WCCO about the effects of road salt on Minnesota waters. An article about Stefan's research on road salt will also appear in the Jan/Feb issue of Minnesota Conservation Volunteer.

>>SAFL monitors real-time water quality data, which can help make local lake water safer, reported WCCO.

>>Jeff Marr, SAFL's associate director of applied research, was a guest on WCCO AM's The Don Shelby Show on July 29. His appearance was part of Shelby's weekly "E-Day" show on energy and the environment.

>>Stormwater pollutant tracking at SAFL makes the news: Star Tribune, Kare11, and UNews.



ALGAE: FROM POND SCUM TO BIODIESEL AND NUTRITIONAL SUPPLEMENT

ABOVE
The single-celled green algae *Dunaliella primolecta* used in biodiesel research at SAFL.

IN THE LATEST DEVELOPMENT OF SAFL's renewable energy research initiative, professors Miki Hondzo and Vaughan Voller have begun an interdisciplinary and collaborative new research project to explore the potential of microscopic algae for human nutrition and biodiesel production. With recent funding from the Office of the Vice President for Research at the University of Minnesota, Hondzo and Voller are teaming up with professors from plant biology (P. Lefebvre, C. Silflow), electrical and computer engineering (M. Jovanovic), aerospace engineering and mechanics (J. Sheng) and food science and nutrition (D. Mashek) to combine their varied expertise in maximizing algal growth, and lipid and polyunsaturated fatty acid production.

Integrating fundamental genetic research with applied engineering research, the scientists will explore the unicellular green alga's production potential from the laboratory scale to the field scale. If biodiesel feedstock can be produced at large scales, its potential as a sustainable energy resource will have wide-ranging benefits over typical land-dependent crops such as corn, soy, and switchgrass.

The project is a new research direction for all of the team members, who have come together because of the opportunity provided by the Minnesota Futures Grant program. Hondzo and Voller will focus on the design of biologically inspired bioreactors across a range of scales, bringing important expertise in the kinetics and physiology of microscopic organisms, fluid mechanics, wireless monitoring sensors, and computational fluid mechanics.

A major component of the project, and Hondzo's central objective, is to analyze the growth characteristics and kinetics of *Dunaliella* under altered environmental and nutrient conditions. At the microscopic scale, algal cells experience fluid strain rates which modulate the thickness of the diffusive sub-layer surrounding individual cells, and therefore also modulate their nutrient uptake. At a much larger scale (such as in a field bioreactor), fluid motions export algal cells through illuminated regions, altering their ability to photosynthesize. Based on previous studies by Hondzo's team which demonstrated that fluid flow mixing and the corresponding strain rates affect growth rates (up to twofold) and nutrient uptake

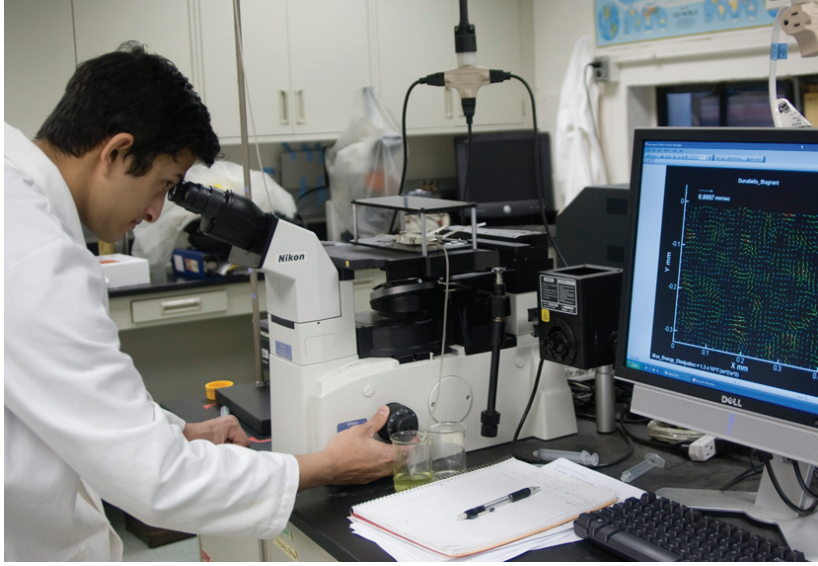
of algae, they now intend to test various types of algae to optimize biomass accrual and production of lipids under varying fluid strain rates, water temperatures, and nutrient conditions.

For example, growth under nitrogen-limiting conditions has been shown to stimulate lipid accumulation in several algal species. In addition to limiting nitrogen availability, researchers will also grow cells at different temperatures, pH conditions, light intensities, and hydrodynamic conditions. Three types of experiments will be conducted. The first set of experiments will investigate algal kinematics under a variety of strain rates at microscopic scales. A micro particle image velocimetry (uPIV) system at SAFL will enable in situ visualization and quantification of algal mobility, and the corresponding fluid motion in the proximity of the cells. The second set of experiments will be conducted in a dynamic respirometer where the physiological responses of algal cells will be investigated over a 7-10 day period in a moving fluid. The third set of experiments will be conducted in two field bioreactors located in the Outdoor StreamLab, with in situ measurements and online data access over the Internet.

A major challenge for this project is the development of cost-effective bioreactors, and the results of the first two sets of experiments will guide the design of the SAFL field bioreactors, with the aim of enhancing bioconvection of algal cells. Scaling relationships will be developed by Voller and Hondzo between governing fluid flow parameters, algal biomass, lipid species, and photosynthetic rates. These relationships will provide fundamental tools for the design and optimization of algal bioreactors across a range of scales. Similar methods will also be used to analyze new mutants with enhanced lipid production and/or carbon fixation rates isolated by the genetic team in the Department of Plant Biology.

HERE'S TO YOUR HEALTH

The second societal need addressed by this research is the need for increased amounts of polyunsaturated fatty acids in the human diet. Dietary omega-3 polyunsaturated fatty acids have been shown to improve health outcomes and decrease the risk of a number of chronic diseases including coronary artery disease and a wide spectrum of neurological disorders. Unfortunately, the major source of these compounds currently is fatty fish, such as salmon or halibut. The fisheries of the world, however, are unable to keep up with the current trends in fish consumption, much less a greatly increased consumption for the purpose of increasing polyunsaturated fatty acids intake. Unicellular green algae such as *Chlamydomonas* have potential to serve as a source in dietary supplements for humans. The interdisciplinary team working on this project will investigate the potential of green algae for the production of polyunsaturated fatty acids.

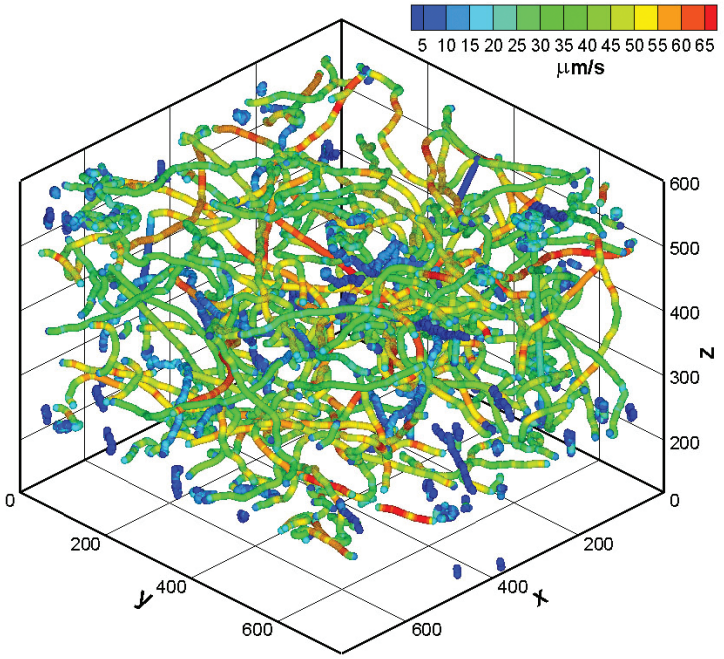


RESEARCH AS EDUCATION

The research team also intends to initiate an interdisciplinary curriculum that relies heavily on visualization of microbiological and physical processes, utilizing online data access and control of the proposed bioreactors. This data will be used for existing courses at the UofM, as well as for the development of a multimedia web-based instructional aid for undergraduate and graduate students funded by the NCED and IGERT programs. Mutants generated and explored in the bioreactors will provide a large number of interesting demonstrations of the fundamental microbiological and physical basis of renewable energy and nutrition resources.

ABOVE
Graduate student Anwar Chengala uses microfloroscopy to study algal swimming trajectories under abiotic stress conditions.

BELOW
Three dimensional swimming trajectories of individual algal cells observed by a digital holographic microscope in experimental bioreactor (Courtesy of A. Ahammed, J. Sheng, and M. Hondzo)



ANNUAL PICNIC


Gretchen Lund
Luke Carlson
Lam Le
Efi Foufoula
ROBERTO BALLARINI

Alumni Spotlight:

SAFL graduation year: 1962
Degrees: M.S. and Ph.D. (Civil Engineering, UMN)
Advisors: Alvin G. Anderson and Lorenz G. Straub

On returning to India in 1962, Dr. Zal Tarapore joined the Central Water and Power Research Station in Pune, India, where he rose to the position of Director in 1985. Upon his retirement he became Development Adviser of Ports at Water & Power Consultancy Services (WAPCOS), a government engineering consulting firm catering to the needs of developing countries. In this position he sought to integrate hydraulic model studies into a package of site investigation, design, and construction supervision of port projects. In 2002, he assumed a new position as Director of DHI Water and Environment (India) when the parent company in Denmark opened a branch in New Delhi. In addition to a busy professional life, he continues to maintain his connections and commitment as a SAFL and UMN alumnus, visiting at every possible opportunity.

In addition to a visit to SAFL this summer, you recently attended the first UofM alumni meeting in Delhi, India. What is it about alumni involvement that you value most, and what drives you to maintain these connections, particularly from so far away?

Well for one thing the world has grown smaller. In the 1950s, when I lived in Minneapolis for 8 years, one could not afford a holiday home. On returning to India, a United Nations Development Program fellowship enabled me to visit, among other places, SAFL. Another opportunity in October 1988 enabled me to attend the Golden Jubilee of SAFL. I was able to visit again in 1998, 2000, 2004, and 2009. So opportunity is indeed a factor, but the driving force remains the thrill of learning new things from old friends, a resuscitation of the spirit.

In 1991 you retired from the Central Water and Power Research Station (CWPRS), a research and development unit of the Ministry of Water Resources in Pune, India. Can you tell us more about your role there, both as director, and leading up to the position?

The first eleven years were the most thrilling, having been asked to head the Ports unit at CWPRS. I was forced to interact with clients who needed advice, and my earlier work at SAFL on waves came in handy. But I had to go beyond textbook knowledge or what was available in the literature. I was forced to examine phenomena from scratch, seeking to develop new concepts on the frontiers of knowledge – at that time attenuation of waves in a dredged channel was not noticed, much less explained (similarly, the transport of sediments in the tidal environment). And then a period of paper presentations at conferences etc. followed.

The next eleven years saw an undesired and unwanted thrusting of administrative duties, a burden reluctantly carried, a sapping of the spirit. But it was a period in which I developed an interest in thermal flows, purely as a result of external demand.

Then the final six years of being Director provided enormous powers but little time to use it as one would have wanted– freedom yes, but far too much dissipation. 1991 was a whiff of fresh air. I retired at the age of 58 and glorious opportunities came my way. That was the year the government of India shifted gears, in a sense, allowing the private sector to enter port activity. Consulting engineers were far too few and none offered a total service, which was the requirement of any private sector entrepreneur who wanted single point responsibility. Quickly gathering a new team of youngsters, and putting them through the grind, led to much success for the Government Consulting Engineer (WAPCOS), which hitherto was only in the fields of irrigation and hydropower, becoming a leader in the area of Ports and Harbours. Of course the support of CWPRS was vital.

1997 was another landmark year, as WAPCOS wanted me to join their Board of Directors. I agreed on the condition that I continue my technical work. When the approval from the government came, the order said I was not to hold an office of profit in the company! Out I was again on a second retirement! But opportunities came my way for small works, since I had no organizational support. That honed other skills for which I earlier depended on assistants! And I continue advising clients on a personal basis, even though I have had the organizational support of DHI (India) which I joined in 2002.

Reflecting back on your career at CWPRS, what were the largest changes in water policy, public value of resources, and/or engineering advancements during your tenure?

I had little to do with water policy, though I was on the fringes during my tenure as Director at CWPRS. The National Water Policy was framed in this period, though I can hardly claim any credit for that. But the biggest change was the shift from government owned ports to what has now become an exclusively private sector activity. The other major change was the adoption of the Environment Act in 1986 and the Coastal Regulation Rules of 1991, which required much more attention to ecological and social issues, in order that necessary permissions are obtained for ports, shipyards, coastal thermal power stations, etc.

Zal S. Tarapore

How do you feel leadership came about in your career? Did you have particular mentors that encouraged you, or specific projects that inspired you?

[It was] pure opportunity. The head of the Ports and Harbours Division, Mr. C. V. Gole, was selected as the Director of CWPRS and a vacancy arose with no internal takers. Stepping in and being encouraged by him was a great advancement in my first 11 years in India. The projects that inspired me were many, and the similarity with the inspiration derived from projects at SAFL, was, to say the least, uncanny.

At a time in their lives when many people are settling into retirement, you have begun a new position as director at DHI. What motivated you to take this position, and what will you be doing there?

The Director in a company is very different from the Director of an institution. A company as per law must hold four meetings a year to consider various policy and financial matters. The day-to-day running is undertaken by the Managing Director. The opportunity of working with DHI (India) gives me institutional support by way of staff, equipment, software, etc., for client related consulting.

If you could develop your ideal experiment, what would it be?

Sediment transport was, and perhaps still is, my subject of interest, firstly because of the controversy my Master's thesis (regarding the finiteness of clear water scour) aroused from the Delft Hydraulics Laboratory. At that time I was quite enthusiastic about repeating the experiments, but the work load at Pune precluded that. The second reason for choosing sedimentation was the fact that the single largest factor in the Indian context was sedimentation in rivers, estuaries, and the open coast. I did speak to Vanoni on the subject when I visited him in 1972, explaining to him that all the experiments to date, except mine, were restricted to a working day. His response was that it could be done only at St. Anthony Falls and only under Straub. Puzzled, I asked why. "Slave labor," was the reply!

Today I think I would not consider it the most important topic for research. Scale modeling has been overtaken by mathematical modeling, what with the speed of computers going up unimaginably, but the fact remains that there are still many unknowns, and I think these deficiencies have to be investigated in Nature rather than on scale models- topics like lateral dispersion under different turbulent conditions (effect of wave action), deposition of muds in estuaries and stable slopes (if there is such a thing), and the age old question of boundary friction.

What is your strongest memory of Straub?

A brash young 20 year old walks in to Dr. Straub's office four days after the fall quarter has started and asks about the work to be done for a Ph.D. "Well, first comes the Master's." So I ask what shall be my thesis topic. "You tell me," comes the shock reply. "What do you mean?" I ask. "At Edinburgh I was offered a topic to work on for a Ph.D." The reply: "You go to the library, study the various theses, see what subject attracts you, then come back with a topic and then we can discuss." My first hard lesson at SAFL!

Thank you donors!

SAFL gratefully acknowledges the following individuals, who have generously provided support during this past calendar year.

Mrs Geneva N Anderson
Prof Roger E A & Jane E Arndt
Barr Engineering Co
Mr Curtis W Bauers
Mr George Bugliarello
Mr Ronald E Carlson
CH2M Hill Foundation
Chevron Energy Technology Co
Clara Margolis Revocable Trust
H Richard Coleman
Coleman Family Fdn Inc
Thomas & Marilyn Condon
ConocoPhillips Co
Dr Christopher R & Gayla Ellis
Ms Karen S Erickson
Dr Xing Fang
Prof Efi Foufoula-Georgiou
Jeffrey & Stacy N Glass
Ms Cuiling Gong
Dr John S Gulliver
Mr Carlton K Gutschick
Mr George G Hebaus
Mr Harry M Howe
Drs Mary B & John M Killen
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Prof Fotis Sotiropoulos
The Teagle Fdn Inc
Mr C K Teng
Texas Instruments Fdn
Dr Joel W & Suzanne K Toso
Dr Frank Y & Julie C Tsai
Prof Vaughan R Voller
Drs Alwin C H Young & So Lian Tio

If you would like to discuss designating a gift for any purpose, please contact Sally Euson at (612) 625-6035 or email euson@umn.edu.

congrats grads

Andrew Sander (M.S. '09) with advisors Heinz Stefan and Omid Mohseni

Eric Novotny (Ph.D. '09) with advisor Heinz Stefan

Chandana Gangodagamage (Ph.D. '09) with advisor Efi Foufoula-Georgiou

Megan Flanagan (M.S. '09)
Advisor: Kimberly Hill (not pictured)

Paola Passalacqua (Ph.D. '09) with advisor Efi Foufoula-Georgiou

upcoming events

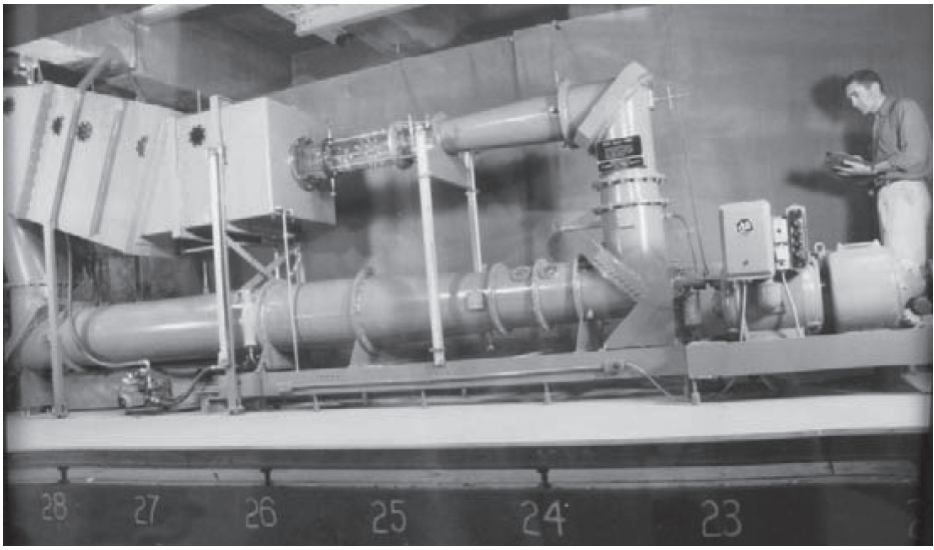
Feb. 21-24: Inaugural Upper Midwest Stream Restoration Symposium in LaCrosse, WI, hosted by the Partnership for River Restoration and Science in the Upper Midwest (PRRSUM). (Registration ends Jan. 15.)

The Life and Times of the Six-Inch Water Tunnel

THE SIX-INCH WATER TUNNEL was originally designed and built as a 1:10 scale model for a 60-inch tunnel to be constructed at the David Taylor Model Basin of the U.S. Department of the Navy. Work began in 1946 when SAFL first came back to life after WWII. The tunnel design and construction became an instructional tool in experimental fluid mechanics for a number of staff people and graduate students. The people principally responsible were Lorenz Straub (then-director of SAFL), Professor John Ripken, and PhD candidate James Holdhusen. Holdhusen, on graduation, became cofounder of Fluidyne Engineering Corporation. Fluidyne became an international design institution for water and wind tunnels and other fluid flow apparatus. Many others at SAFL worked on design aspects of the tunnel, both in the tunnel and in other venues. The work is covered in SAFL Project Reports 10 through 15. The six-inch tunnel was used in two additional studies for the David Taylor Model Basin (DTMB) in the early 1950's: to study open- and closed-jet test sections in a 1:4 scale model for a 24-inch tunnel (Project Report 22), and to study the effects of an air bubble resorber on flow quality in a 1:6 scale model for a 36-inch tunnel (Project Report 29). The 60-inch and 24-inch tunnel prototypes were never constructed at DTMB; the 36-inch Variable Pressure Cavitation Tunnel was built at DTMB/Carderock in 1961.*

The six-inch water tunnel was used for many experimental projects through the years. Its design was especially useful in cavitation studies using controlled air nuclei. Professor Ed Silberman recalls that he once dabbled with carbonated water in the tunnel. Reuben Olson, a PhD candidate in Mechanical Engineering, and an instructor in the undergraduate course in fluid mechanics, undertook several studies in the tunnel to illustrate principles for instruction. After Olson left the University to become a professor at Ohio University, he published an undergraduate textbook on fluid mechanics that was used in UMN courses for a time. SAFL alumnus Frank Schiebe (PhD '71) used the tunnel in his development of "Schiebe Bodies," which were advocated to compare propensity for cavitation in different tunnels, and became an international topic for discussion.

The tunnel fell into disuse in the late 1970's, but was reactivated in 1983. SAFL was engaged in a large Navy sponsored program in hydroacoustics, and the demand for tunnel time could not be met with SAFL's high-speed water tunnel alone. The six-inch circular tunnel was refurbished with a new test section (seven-inch square, with fillets), fitted with optical glass windows for LDV measurements (using a new system specifically purchased for this project), and was used for tip vortex research, while the high-speed tunnel was used for boundary layer acoustic measurements. Visiting researcher Dr. Andreas Keller, from the Technical University Munich's hydraulic laboratory in Obernach, Germany, made the last major study in the tunnel in 1991, and produced a number of high-speed movies of tip vortex cavitation.



ABOVE
SAFL six-inch tunnel fitted with a gas collection dome upstream of the test section.

The tunnel was used only sporadically since the early 1990's. During electrical upgrades on the turbine mezzanine in 2003, the six-inch tunnel motor and drive were disconnected. At the same time, SAFL's large high-speed tunnel was fitted with a new motor and controller and became the exclusive facility for various cavitation and drag reduction projects. Hence there was no further need for the six-inch tunnel that served so well for many years, and was now taking up valuable space.

In July 2008 the six-inch tunnel was dismantled and moved to the University of New Hampshire by Martin Wosnik, who was a post-doctoral research associate with Roger Arndt at SAFL from 2003-2006. Through CFD studies a new contraction and test section (six-inch square, with fillets) were designed. The renovated six-inch tunnel will be used for research on control of cavitating flows, hydrofoil development, and general cavitation studies.

—Ed Silberman, Roger Arndt, and Martin Wosnik

* These studies were also utilized during SAFL's hydrodynamic design of the US Navy William B. Morgan Large Cavitation Channel (the world's largest water tunnel) during 1982-1985.


A Mighty

Windfall

THE UNIVERSITY OF MINNESOTA IS ONE OF THREE $7.9M RECIPIENTS OF A RECENT GRANT FROM THE U.S. DEPARTMENT OF ENERGY TO FOSTER WIND ENERGY DEVELOPMENT IN THE UNITED STATES. FOTIS SOTIROPOULOS, SAFL DIRECTOR AND PRINCIPAL INVESTIGATOR ON THE PROJECT, WILL LEAD A POWERHOUSE CONSORTIUM OF INDUSTRIAL AND ACADEMIC PARTNERS TO HELP REACH THE DOE'S GOAL OF ACHIEVING 20% WIND POWER BY 2030.

A consortium of wind energy researchers led by the University of Minnesota will receive up to $7.9 million from the U.S.Department of Energy (DOE) for fostering wind energy development in the United States. The consortium was one of only three across the country receiving funding.

The grant, funded from the American Recovery and Reinvestment Act, will support research to improve both land-based and offshore wind generation.

Fotis Sotiropoulos, director of the University of Minnesota's St. Anthony Falls Laboratory and principal investigator on the project, along with a group of faculty from the University of Minnesota's Institute of Technology, University of Minnesota Morris, Syracuse University, and Dakota County Technical College, will work in close collaboration with a powerhouse consortium of industrial partners to help reach the DOE's nationwide goal of achieving 20 percent wind power by 2030.

LEFT
A UofM turbine on the Morris campus

"This is about a new way of doing research with major societal impact, bringing together academia with industry," Sotiropoulos said. "The success in securing this grant is a result of the excellence of our industrial partnerships and the academic caliber and expertise of our faculty at the University of Minnesota."

Sotiropoulos said the vision of the Institute of Technology (the University of Minnesota's college of science and engineering) to build strong ties with elite companies such as 3M, Honeywell, WindLogics, Lockheed Martin, Eaton Corp. and

"Minnesota is fourth with respect to wind energy generated in the United States. But what really separates us is the combination of the University and industrial collaborators [in this state] to drive the technology forward."

— Rod Larkins, associate director of the Initiative for Renewable Energy and the Environment (IREE), a signature program of the University's Institute on the Environment

others, made it possible to put together this winning consortium. The Initiative for Renewable Energy and the Environment (IREE), a signature program of the University of Minnesota's Institute on the Environment, was also a key player in the group's development and provided significant early-stage research funding in addition to matching funds of more than $500,000 in support of the project, he said. Cost share for this project was provided in part by customers of Xcel Energy through a grant from the Renewable Development Fund.

The activities of the consortium will be focused on a new 2.3 MW Siemens turbine to be built at the University of Minnesota Outreach Research and Education (UMore) Park in Dakota County. Plans for the consortium's activities uniquely dovetail with the University's vision for the 5,000-acre UMore Park property—development of a sustainable community of 20,000 to 30,000 residents. This planned community will integrate University research, teaching, and public engagement with innovations in renewable energy, environmental quality, health, and education. The 80-acre experimental facility portion of the UMore Park will be a one-of-a-kind co-laboratory where industry specialists can work together with university researchers in developing new technologies to drastically reduce the time from conceptual design to implementation in real-life wind farms. Existing wind turbines at the University of Minnesota Morris campus will also be instrumental in research, education, and outreach.

Besides Siemens Energy, industrial partners include Barr Engineering, Eaton Corporation, Honeywell, Lockheed Martin, Luna Innovations, 3M and WindLogics.

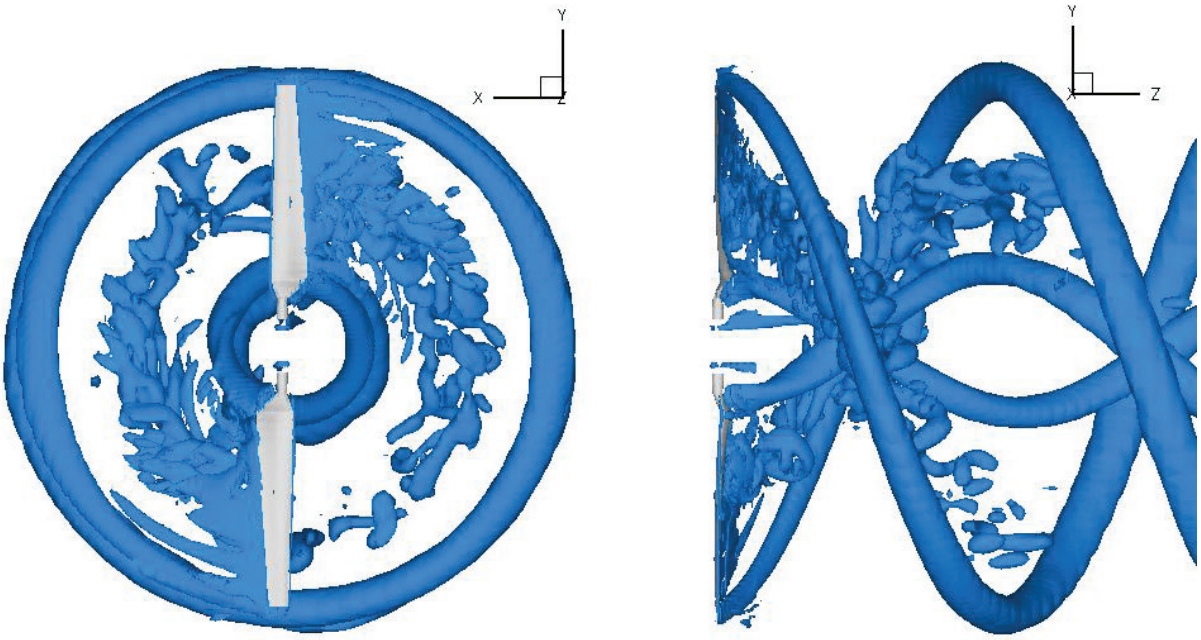
Among University of Minnesota faculty wind energy projects are mechanical engineering professor Kim Stelson's work to make the wind power transmission system more durable. Now, problems arise when the wind blows too fast and puts pressure on the system. Another is one by Susan Mantell , also a mechanical engineering professor, to place sensors on turbine blades to detect signs of failure before they become acute—and expensive to fix.

"To become a world leader in wind energy we need to do several things to develop the most advanced, efficient, and reliable wind turbines," Sotiropoulos said. "We need to come up with bigger and better turbine rotor designs to capture more energy more efficiently. We need to figure out how to optimally design wind farms and develop novel mechanical energy transmission systems and electric generators. We need to figure out how to quickly detect and fix upcoming component failures before the turbine breaks. We need to design stronger and cheaper turbine foundations. We also need to better integrate wind with other renewables."

In addition to research, the consortium will undertake an ambitious educational and training program, targeting undergraduate and graduate students, technical community students, and practicing power-industry engineers. A Web-based wind power curriculum will be made available to universities across the country, as well as opportunities for hands-on training programs, industrial internships for students, and continuing education courses for engineers

"This project is a tremendous opportunity for the State of Minnesota," Sotiropoulos said. "It is about leading the way in educating the next generation of technicians and engineers who will fill the many new jobs in the emerging wind energy sector of our economy."

The other two grant awardees are consortia led by the Illinois Institute of Technology and the University of Maine.



LEFT
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