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TechTalk

SERVING THE MIT COMMUNITY

Stability in uncertain times

State of the Institute Forum touts balanced budget, leadership

Stephanie Schorow
News Office correspondent

MIT's finances are not only in "terrific shape," but the Institute stands ready to provide service and leadership on key issues of energy and economics in a turbulent era, MIT President Susan Hockfield said Monday during the annual State of the Institute Forum.

"I cannot begin without commenting that these are unsettling times," Hockfield told a packed Kresge Auditorium. "No one can predict where [the economy] will be at the end of the week, never mind a month or a year. I want to reflect that at a time like this — even more so than in normal times — it's wonderful to be part of a place like MIT. The importance of what we do is only more important as the country and the world seek to solve the most-pressing problems. We can help."

Tellingly, MIT is in a strong financial position, according to Hockfield. MIT will have a balanced budget for fiscal

▶Please see STATE, **PAGE 6**

PHOTOS / **PATRICK GILLOOLY**

TOP: Chancellor Phillip Clay gives his address during the State of the Institute Forum at Kresge Auditorium on Monday. BOTTOM: President Susan Hockfield talks with students during the lunch after the event.

MIT on the ELECTION

Science priority

MIT experts weigh in ahead of election

Stephanie Schorow
News Office correspondent

In the run-up to the Nov. 4 presidential election, the News Office has asked MIT experts to weigh in on the presidential candidates, their policy ideas and aspects of the campaign. In this installment in the series, members of the MIT community share their thoughts on what should be the next president's top priority in the areas of science and technology.

Emery N. Brown, *professor of computational neuroscience and health sciences and technology:*

I believe the important scientific questions both candidates have to give serious attention to are global warming, energy and human health. All three of these issues are vital and require focused, concerted attention over the next several years.

Ian Hutchinson, *professor of nuclear science and engineering and head of the Department of Nuclear Science and Engineering:*

Federally sponsored research sets the nation's overall science and technology priorities. It exerts that influence by enabling or disabling faculty and graduate students and thereby attracting or repelling them from research areas. The recent emphasis on biological and health-related research has opened many fascinating new fields but has left the physical sciences, and particularly nuclear science and engineering, weakened by neglect. The result is a dangerous dearth of talent and expertise in fields critical to the major challenge of the century: sustainable energy. A top priority should be to renew the nation's educational and research talent in physical sciences and engineering.

▶Please see PRIORITY, **PAGE 6**

FOCUS on FINANCE

Experts to address MIT community on financial turbulence

October events include faculty panels, Soros remarks

Greg Frost
News Office

MIT community members will have several opportunities in October to hear world-renowned experts discuss the turbulence that has gripped global financial markets — and what, if anything, individuals should do.

Over the next week, faculty from the MIT Sloan School of Management and the Department of Economics will take part in two panel discussions on the financial crisis. And on Oct. 28, financier and philanthropist George Soros is scheduled to speak at Kresge.

MIT's Human Resources has also assembled a series of resources for employees who have questions or concerns about volatile financial markets. For more information, please visit http://hrweb.mit.edu/benefits/retirement/401k/market_volatility.html.

The Sloan faculty panel, "Perspectives on the Current Financial Crisis: A Panel Discussion," will

▶Please see FINANCE, **PAGE 3**

AWARDS

Can you spot Excellence?

The deadline for nominations for MIT's Excellence Awards is approaching.

PAGE 7

RESEARCH

Sniffing out success

Recent research could help to make 'artificial noses' a reality.

PAGE 4

NEWS

Energy and the presidency

MITEI/MIT Energy Club sponsored debate on energy will include representatives from the two campaigns.

PAGE 3

Events at MIT

Today

• **Energy Club lecture series**: "Oil Prices, Speculation and Fundamentals: Interpreting Causal Relations Among Spot and Futures Prices." Speaker: Dr. Robert Kaufmann, Director of the Boston University Center for Energy and Environmental Studies (CEES). 6-7 p.m. in 6-120.

• "**Ellen Swallow Richards**: In Her Own Words." 7-8 p.m. in 4-370. Come Celebrate MIT women's history and learn about MIT's extraordinary first alumna, Ellen H. Swallow Richards. $12 for AMITA members; $15 nonmembers; students free.

• **Grad Rat New Design Ring premiere**. 7-10 p.m. in 50-140, Morss Hall, Walker Memorial. Come to the unveiling of the newly redesigned graduate ring, the Grad Rat! Enjoy free food and refreshments, T-shirts, giveaways and entertainment. All graduate students from all schools and degrees welcome.

• **Auditions**: Dramashop student-produced, student-written one acts. 8 p.m. in W16, Kresge Rehearsal Room A. Performances take place Nov 6-8. *URL: http://dramashop.mit.edu/oneacts/index.php*

Thursday, Oct. 2

• **Page Hazlegrove Lecture in Glass Art**: Dale Chihuly. 6:30-8 p.m. in 10-250. Chihuly is most frequently lauded for revolutionizing the Studio Glass movement by expanding its original premise of the solitary artist working in a studio environment to encompass the notion of collaborative teams and a division of labor within the creative process.

• **Perspectives from Women in Engineering seminar**. 4-5 p.m. in 3-370. Perspectives from Women in Engineering: Choose Your Own Adventure. Seminar #3 with Megan Smith, MS, Vice President, New Business Development, Google.

• **Architecture Lecture Series: Climate Change — Urgent!** 6:30-8 p.m. in 34-101. Matthias Sauerbruch: "When Less is Really More," will speak. This lecture series showcases the state of practice in response to climate change, which is happening at an increasingly faster pace, and conveys a sense of urgency.

• **"Perspectives on the Current Financial Crisis: A Panel Discussion."** 5:30-7 p.m. at Wong Auditorium. All members of the MIT community are welcome to attend.

Saturday, Oct. 4

• **Smoot 50th anniversary.** All day, starting with a Charles River cleanup and BBQ at Kresge Oval from 11:30-4. Followed by several events marking the measurement feat.

PHOTO / **NASA**

The sky's the limit

The MIT Aero-Astro Department is keeping astronaut Greg Chamitoff PhD '92 company during his six-month stay aboard the International Space Station. In this recent photo, Chamitoff is holding a picture of department students, staff and faculty taken last fall in response to his request for an MIT memento that he could carry with him when he launched in May. Now, more than 200 Aero-Astrians can say that they have "flown aboard the ISS." Chamitoff noted that taking photos from space lets him "zoom in and see the building that I lived in on campus at MIT for many years — Tang Hall."

Development fair showcases world of opportunities

Students who might be interested in fostering development in a sustainable way in different parts of the world will have a chance to sample a wide range of opportunities this week at MIT's seventh annual International Development Fair.

The fair takes place from 11 a.m. to 1 p.m. Friday, Oct. 3, in Lobby 13. Patricia Weinmann, associate coordinator of MIT's Technology and Culture Forum, which co-sponsors the event, says that "this exciting event introduces incoming students and other members of the MIT community to the many student groups, classes, centers, programs and academic departments at MIT who, through their activities, have demonstrated an interest in sustainable international development."

The fair is a way for incoming and continuing MIT students to learn about ways that they can become engaged in international development through student groups, nonprofit organizations, or academic course offerings in and around MIT campus. More than four dozen groups and organizations of all types set up booths around Lobby 13 to display their development projects and reach out to interested students.

The annual event is organized by the MIT International Development Network (IDN), which promotes and shares information about activities, programs, events and formal academic offerings related to international development. In addition to the Technology and Culture Forum, it is sponsored by the MIT Public Service Center, the Edgerton Center, the International Development Initiative, the Program in Developmental Entrepreneurship, the office of the Dean of the School of Humanities, Arts, and Social Sciences, and the office of Undergraduate Advising and Academic Programming.

The fair "celebrates and supports engaging in international development MIT-style, learning-by-doing," says Joost Bonsen, a lecturer in the Media Lab who co-teaches a course called "Development Ventures." "We first started the International Development Fair in 2002 to help everyone at MIT interested in development meet one another and make the most of the rich opportunities at the Institute. Students find out about classes to take, clubs to join, fellowships to apply for, events to attend, and people to team up with to pursue compelling projects."

In addition to the fair, the group publishes an annual booklet describing the many different groups, activities and courses featured there. The guide will be posted at web.mit.edu/idn.

Search under way for new OME director

Dean for Undergraduate Education Daniel Hastings has announced a national search for a new director of the Office of Minority Education. Karl Reid, the former director, was recently named senior vice president of academic programs and strategic initiatives at the United Negro College Fund.

The search committee will be led by Professor Robert Redwine, professor of physics and director of the Bates Linear Accelerator Center, and is composed of the following faculty, staff, student and alumni representatives:

- Martin Culpepper, associate professor in the Department of Mechanical Engineering;
- Claudia Espinoza, a junior in the Department of Civil and Environmental Engineering;
- John Essigmann, the William R. (1956) and Betsy P. Leitch Professor of Chemistry and Biological Engineering in the Department of Biological Engineering;
- Kimberly Francis '78, director of engineering for Acushnet Company;
- Margarita Ribas Groeger, director of Spanish Language Studies;
- Jarrell Johnson, a senior in the Department of Chemical Engineering;
- Sekazi Mtingwa, senior lecturer, Concourse, and faculty advisor in the Office of Minority Education;
- Kristala L. Jones Prather, the Joseph R. Mares (1924) Career Development Assistant Professor of Chemical Engineering in the Department of Chemical Engineering;

Community members are encouraged to share their suggestions and thoughts on this search with committee members.

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Oct. 6 energy debate to feature presidential campaign reps

The economy may be dominating the headlines right now, but anyone concerned about the long-term view will have a chance next week to find out what the two presidential candidates would do about one of the major issues of our time, one that has a significant impact on the world economy: energy.

Representatives selected by the McCain and Obama campaigns will face off next Monday, Oct. 6, in Kresge Auditorium for a debate on energy, moderated by NPR's Tom Ashbrook, host of the daily talk show "On Point." The debate, co-sponsored by the student-run MIT Energy Club and the MIT Energy Initiative, will start at 7:30 p.m. and last for 90 minutes. Questions will be asked by a panel of journalists, still being finalized, as well as by some MIT students, who were invited to send in their questions in advance.

McCain will be represented by James Woolsey, who was director of the Central Intelligence Agency under President Clinton and has served in four different administrations, both Democratic and Republican. Obama will be represented by Jason Grumet, executive director of the bipartisan National Commission on Energy Policy and former director of Northeast States for Coordinated Air Use Management.

"We decided the MIT Energy Club needed to fill a void that was sorely lacking in any other outlet," says MIT Energy Club Co-President Amy Fazen. "It goes without saying that members of the Energy Club are very interested in the energy platforms of the candidates, but we knew that there was something much bigger going on when club members were telling us that their family and friends with no particular interest in energy kept asking them about the energy platforms of the candidates."

Fazen adds, "Along with MITEI, we decided we would try to get high-ranking representatives of the campaigns to come to campus and educate not only our members, but the Cambridge/Boston community at large about this extremely important topic."

The debate is free and open to the public. For more information, please contact Fazen at energy-events@mit.edu.

MIT in the world

An a-maize-ing path out of poverty

D-Lab-developed device makes corn processing more efficient

David Chandler
News Office

Across Tanzania and elsewhere in Africa, processing the corn harvest is labor intensive: Families and friends gather to spend a day or two filling bags with the dried cobs, beating then to loosen the kernels, and then separating out the kernels from the cobs, or else simply removing the kernels by hand.

It would take one person about two weeks to complete the job alone, but thanks to a technology largely developed at MIT, there's a better, faster way.

Jodie Wu, an MIT junior in mechanical engineering, spent the summer traveling from village to village in Tanzania to introduce a new system for processing the corn: A simple attachment for a bicycle that makes it possible to remove the kernels quickly and efficiently using pedal power. The device makes processing up to 30 times faster and allows one person to complete the job alone in one day.

The basic concept for the maize-sheller was first developed in Guatemala by an NGO called MayaPedal, and then refined by Wu last semester as a class project in D-Lab: Design, a class taught by Department of Mechanical Engineering Senior Lecturer Amy Smith. Now, thanks to Wu's efforts, the technology is beginning to make its way around the world.

Wu developed the new version of the device after being inspired by the work of Bernard Kiwia, who teaches appropriate technology in Tanzania for an NGO called the Global Alliance for Africa. Kiwia visited MIT in the summer of 2007 for the first International Design and Development Summit and returned to Tanzania greatly inspired by the workshop, and immediately began producing a variety of devices to address local needs.

Among these were several bicycle-powered devices, including machine-shop tools like drills and bandsaws. A simple power-transfer system bolted onto the bicycle's frame allows the bicycle to be used normally for transportation, but then quicly converted by switching the chain so that it can be adapted for a variety of tasks — making or repairing furniture, sharpening knives or processing corn. Thus, the owner of a bicycle, with a small extra investment, can travel from village to village to carry out a variety of useful tasks. A simple bike thereby becomes an ongoing source of income.

Wu refined the corn-sheller system, which was originally designed as a permanent installation that required a bicycle dedicated solely to that purpose, to make it an add-on, like Kiwia's tools, that could be easily bolted onto an ordinary bike and removed easily. She traveled through Tanzania this summer, thanks to a grant from the Baker Foundation through MIT's Public Service Center, to demonstrate how to build the corn sheller and how to use it, and to encourage local people to adopt the new technology. In order to make it possible for more people to buy the simple devices, she worked with a microloan program run by the Global Alliance for Africa.

Wu found the experience highly inspiring and was especially impressed with Kiwia's workshop in Arusha, where new devices are being spawned and tested constantly. "It was the first place where I had seen local technology created right there in the workshop," she says.

Wu had tested the earlier, permanently mounted version of the sheller in Tanzania in January but found that it had some technical issues and was too expensive for the local people to afford. The key to making it practical was to turn it into an add-on, something she accomplished during the spring semester D-Lab class. "That made it a mobile device, something that could be used as a service" by pedaling from one village to another, Wu says. And while this version was developed for Tanzania, she says, corn is grown widely in Africa and Latin America, and the simple bicycle-based technology is readily available in most developing countries, so the device could find widespread application.

"It was exciting to see my device, which I'd worked on with other students, being used by people who are now making money from it," she says. Wu hopes to further refine the design this fall, and plans to return to Tanzania to continue demonstrating its construction and use during next January's IAP.

A blog detailing Wu's experiences in Tanzania can be seen at tumainicycles.blogspot.com.

PHOTO / **NASSIBU**

MIT junior Jodie Wu sits among the shelled corn in Tanzania.

FINANCE: Experts to address MIT community on market turbulence

Continued from **Page 1**

run from 5:30-7 p.m. on Thursday, Oct. 2, in Wong Auditorium. All members of the MIT community are welcome to attend.

"The financial sector runs to a great degree on confidence and trust, so if fear comes to rule and failures are expected, then failure becomes self-fulfilling," said David Schmittlein, the John C. Head III Dean of the Sloan School of Management. "That is why steps to restore confidence are so important, even as we ensure that those who made bad risky bets pay a price for those mistakes.

"This panel of MIT Sloan experts will discuss and shed light on the economic crisis and what should be done in the short and near term to avoid self-fulfilling failure," he continued.

Panelists at the Sloan event include David Geltner, the George Macomber Professor of Real Estate Finance; Simon Johnson, the Ronald A. Kurtz Professor of Entrepreneurship; Andrew W. Lo, the Harris & Harris Group Professor; Jiang Wang, the Mizuho Financial Group Professor of Finance; and Ross Watts, the Erwin H. Schell Professor of Management.

On Wednesday, Oct. 8, a separate faculty panel will discuss "The U.S. Financial Crisis: What Happened? What's Next?" The event will begin at 4:30 p.m. in Room 10-250 and is sponsored by the Office of the President, the Department of Economics, and the School of Humanities, Arts, and Social Sciences. As with the Oct. 2 event, all members of the MIT community are welcome to attend.

Ricardo Caballero, the Ford International Professor of Economics and the head of the Department of Economics, said the Institute-wide event would discuss the causes and consequences of this turmoil, which he characterized as "the most severe financial crisis since the Great Depression" and one that is jeopardizing the global economy.

"What happened to the real estate and financial markets? What are the public finance implications of the bailouts? Will these bailouts work? What else can we do? What are the main macroeconomic scenarios going forward? What are the global implications of this crisis? These are some of the questions that our expert panel will address," Caballero said.

Participants at the Oct. 8 discussion include Caballero; Bengt Holmstrom, the Paul A. Samuelson Professor of Economics; Andrew Lo; James Poterba, the Mitsui Professor of Economics; and William Wheaton, professor of economics and director of the Center for Real Estate.

AWARDS &HONORS

Sappok wins 2008 SAE Excellence in Oral Presentation Award

PhD candidate in mechanical engineering Alexander Sappok, who is also a graduate research assistant at the Sloan Automotive Laboratory, has received the 2008 Society of Automotive Engineers Excellence in Oral Presentation Award — the second time he has won the annual honor.

This award was for the presentation of the paper titled "Impact of Biodiesel on Ash Emissions and Lubricant Properties Affecting Fuel Economy and Engine Wear: Comparison with Conventional Diesel Fuel" at the 2008 SAE Congress. The SAE Excellence in Oral Presentation Award is bestowed annually only to a distinguished few.

Sniffing out success

Engineers mass-produce smell receptors in lab; 'artificial noses' to follow?

Anne Trafton
News Office

MIT biological engineers have found a way to mass-produce smell receptors in the laboratory, an advance that paves the way for "artificial noses" to be created and used in a variety of settings.

The work could also allow scientists to unlock the mystery of how the sense of smell can recognize a seemingly infinite range of odors.

"Smell is perhaps one of the oldest and most primitive senses, but nobody really understands how it works. It still remains a tantalizing enigma," said Shuguang Zhang, associate director of MIT's Center for Biomedical Engineering and senior author of a paper on the work appearing online this week in the Proceedings of the National Academy of Sciences (PNAS).

Artificial noses could one day replace drug- and explosive-sniffing dogs, and could have numerous medical applications, according to Zhang and his colleagues. DARPA recently approved funding for the team's MIT (microfluidic-integrated transduction) RealNose project.

Until now, efforts to understand the molecular basis of smell have been stymied by the difficulty in working with the proteins that detect odors, known as olfactory receptors.

"The main barrier to studying smell is that we haven't been able to make enough receptors and purify them to homogeneity. Now, it's finally available as a raw material for people to utilize and should enable many new studies into smell research," said Brian Cook, who just defended his MIT PhD thesis based on this work.

Smell is one of the most complex and least-understood senses. Humans have a vast olfactory system that includes close to 400 functional genes, more than are dedicated to any other function. Animals such as dogs and mice have around 1,000 functional olfactory receptor genes.

That variety of receptors allows humans and animals to discern tens of thousands of distinct odors. Each odor activates multiple receptors and this pattern of activation creates a signature that the brain can recognize as a particular scent.

The olfactory receptors that bind to odor molecules are membrane proteins, which span the cell surface. Since cell membranes are composed of a bilayer of fatty lipid molecules, the receptor proteins are highly hydrophobic (water-fearing).

When such proteins are removed from the cell and placed in water-based solutions, they clump up and lose their structure, said Liselotte Kaiser, lead author of the PNAS paper. That makes it very difficult to isolate the proteins in quantities large enough to study them in detail.

Kaiser and others spent several years developing a method to isolate and purify the proteins by performing each step in a hydrophobic detergent solution, which allows the proteins to maintain their structure and function.

The technique reported this week in PNAS involves a cell-free synthesis using commercially available wheat germ extract to produce a particular receptor, then isolating the protein through several purification steps. The method can rapidly produce large amounts of protein — enough to start structural and functional studies.

The team has also demonstrated a similar method that uses engineered mammalian cells to produce the receptors. That method, reported in PLoS One in August, takes more time and labor than the cell-free approach, but could have advantages in that the receptor is processed more naturally.

In future work, the team plans to work with researchers worldwide, including MIT's Media Lab and Department of Biology, to develop a portable microfluidic device that can identify an array of different odors. Such a device could be used in medicine for the early diagnosis of certain diseases that produce distinctive odors, such as diabetes and lung, bladder and skin cancers, Zhang said. There are also a wide range of industrial applications for such a smell-based biosensing device, he said.

Other authors of the PNAS paper are Johanna Graveland-Bikker, a postdoctoral fellow at MIT, visiting graduate students Dirk Steuerwald and Melanie Vanberghem, and Kara Herlihy of GE Healthcare Biacore.

The research was funded by the ROHM Corporation (Japan), the Knut and Alice Wallenberg Foundation (Sweden), the Netherlands Organization for Scientific Research, and a John Simon Guggenheim Fellowship. Joyce and Roger Kiley '60, MS '61 provided pure odorants.

Renewable energy regulations may miss the mark

Research shows different approach is needed

David Chandler
News Office

Well-intentioned rules passed by many states to combat climate change through the development of renewable energy technologies may not achieve the intended effects and may even be counterproductive, according to research by an MIT graduate student. But the problem is easy to fix: A modified set of regulations could be much more effective, the study found.

At least 25 states have enacted renewable portfolio standards (RPS), which require electric utilities to obtain a certain percentage of their power from renewable sources by a certain date (such as "20 percent from renewables by 2020"). But these standards will not achieve the desired effects and may actually end up delaying some of the most promising renewable-energy technologies, the study found.

Michael Hogan, the student who carried out the study as part of his master's thesis work in MIT's Environmental Technology and Public Policy Program, says that such standards push investments much too heavily toward technology that is already well proven and close to being economically competitive, especially land-based wind power. In the process, technologies that may have much more potential to replace coal plants in the longer term, such as solar thermal systems and offshore wind, get short shrift.

Current RPS programs, Hogan found, "are likely to play at best a very marginal role at an unnecessarily high cost in delivering the necessary reductions in greenhouse gases, with little in the way of long-term technological development benefits."

But by introducing a few refinements to these programs, he says, it is possible to greatly improve the chances that they will achieve the desired results.

Hogan's professional background is tailor-made for this line of research: He spent 28 years in the energy business, including leading roles in starting and running a number of energy companies and organizations, before deciding to resume his education with the MIT Department of Urban Studies and Planning master's program. During his years in the energy business he was responsible for the development of more than $8 billion in energy-related assets in seven countries.

The central problem, Hogan says, is that 80 percent of U.S. carbon dioxide from electricity generation, and about a third of the nation's overall emissions, come from just 620 coal-burning power plants. Thus, any attempt to reduce greenhouse gas emissions must focus squarely on addressing these plants. "In a very real sense," he writes, "nothing else matters."

While RPS tends to foster investment in wind farms, these almost never displace baseload coal-fired plants, he says, which is the key objective. Among other changes, he proposes that the rules be modified to create "bands" of technologies, based on their degree of commercial readiness, and that the regulations should strongly favor promising but still early stage technologies. Encouraging investment in technology that won't produce results until later in the process could actually foster much more significant progress, he says. "We have to bet on all the horses," he says.

In addition, it is important to recognize that rules should be tailored to the conditions in particular parts of the country, he says. For example, while land-based wind dominates the upper Midwest, solar thermal systems should be favored in the Southwest, deep-offshore wind in the Northeast, and biomass in the Southeast.

Lawrence Susskind, Ford Foundation Professor of Urban and Environmental Planning and Hogan's thesis adviser, says his student has demonstrated that renewable portfolio standards "are not working as well as they should."

Susskind says that in carrying out this study, Hogan "builds on his long experience developing energy facilities in many parts of the world" and through his analysis "offers a detailed package of reforms that could make a difference."

Hogan said the research changed his own perspective. "I went in thinking I would reaffirm things I already believed," he says, but that turned out not to be the case. For example, he said, "I went in very negative about offshore wind in the near term," but the study "completely changed my mind."

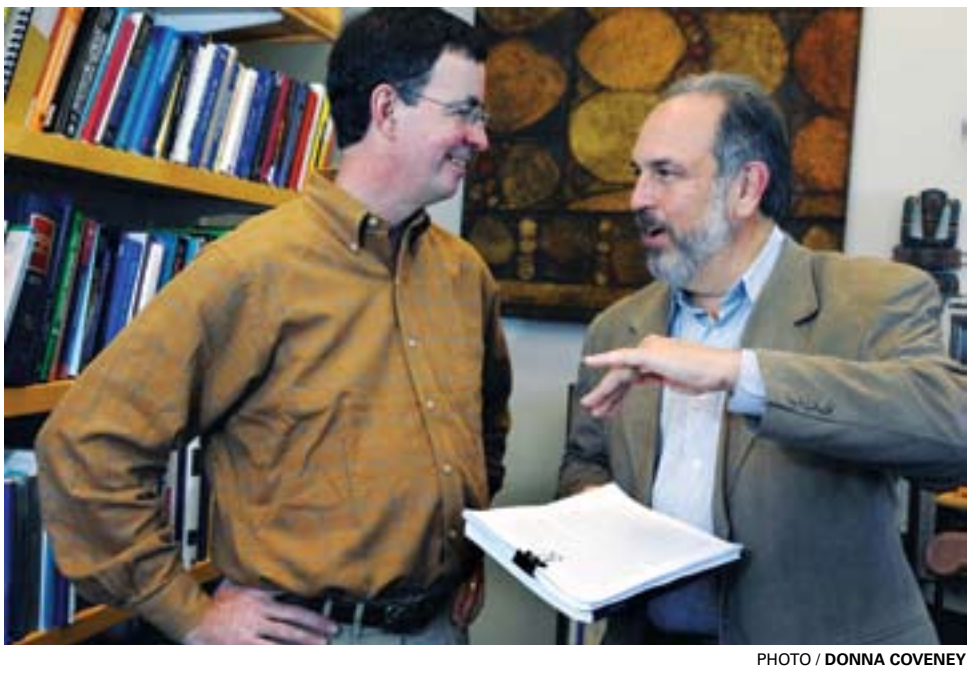


PHOTO / **DONNA COVENEY**

Graduate student in urban studies and planning Michael Hogan, left, and Larry Susskind, Ford Professor of Urban and Environmental Planning, discuss Hogan's thesis on government rules and renewable energy technologies.

MIT: Worms provide clues for treating brain diseases

Cathryn Delude
McGovern Institute

On the surface, the tiny roundworm bears little resemblance to a person. Its nervous system, for example, has just 302 neurons to our 100 billion. Yet it uses many of the same genes and signaling chemicals as the human brain, so studies of its system could have relevance to our own.

Now an MIT team has shown that even the simplest worm behaviors can be controlled by multiple signaling pathways. The results might have implications for the treatment of human brain disorders.

In a new study, published online in the journal Nature Neuroscience, H. Robert Horvitz and postdoctoral scientist Niels Ringstad investigated neural pathways of a mutant worm strain with defective egg-laying behavior. Horvitz, a Nobel laureate and Howard Hughes Medical Institute Investigator, is the David H. Koch Professor of Biology, a member of the McGovern Institute for Brain Research at MIT and affiliated with the Koch Institute for Integrative Cancer Research.

> *It's like having two brakes in a car. We removed the footbrake, expecting the car to roll away.*
>
> **Niels Ringstad**

Normally, a hermaphrodite worm fertilizes its own eggs within the uterus and lays them steadily as they mature. In certain mutant strains, though, this process is blocked, causing the animals to bloat with 50 or more retained embryos.

A genetic screen for such mutants had earlier identified a gene called egl-6. Ringstad and Horvitz discovered that this gene encodes a member of a class of proteins known as G-protein coupled receptors (GPCRs). GPCRs allow cells to respond to hormones, neurotransmitters and other signals, and they are important targets for many human drugs.

Ringstad and Horvitz found that the egl-6 mutants had an overactive form of the receptor, suggesting that the normal function of the receptor is to limit the rate of egg laying. So Ringstad and Horvitz postulated that blocking this signaling pathway genetically might cause the worms to lay their eggs faster. However, doing so produced no effect.

Suspecting the existence of a second inhibitory pathway, the authors tested a variety of candidates. They found an effect when they also blocked signaling by acetylcholine, a well-known neurotransmitter in both worms and humans. Animals lacking both pathways became hyperactive egg layers.

"Inhibition of this simple behavior uses two neurochemical signals," said Ringstad. "It's like having two brakes in a car. We removed the footbrake, expecting the car to roll away, but we also had to disable the handbrake."

The results support an approach to drug discovery in the field of neuroscience, suggest the authors. If multiple pathways control a neural output so that either pathway is capable of inhibiting that output, then drugs that target just one pathway might have absolutely no effect. Instead, appropriate combinations of drugs will need to be identified.

The Life Sciences Research Foundation, The Medical Foundation and the National Institutes of Health supported this study.

PHOTO / **DONNA COVENEY**

Professor Tom Peacock in the lab where his group performed experiments on a new approach to unsteady flow separation, a limiting factor in the design of transport vehicles.

100-year-old engineering problem solved

Insights on fluid flow could impact fuel efficiency, more

Elizabeth Thomson
News Office

As a car accelerates up and down a hill then slows to follow a hairpin turn, the airflow around it cannot keep up and detaches from the vehicle. This aerodynamic separation creates additional drag that slows the car and forces the engine to work harder. The same phenomenon affects airplanes, boats, submarines and even your golf ball. Now, in work that could lead to ways of controlling the effect with potential impacts on fuel efficiency and more, MIT scientists and colleagues have reported new mathematical and experimental work for predicting where that aerodynamic separation will occur.

The research solves "a century-old problem in the field of fluid mechanics," or the study of how fluids — which for scientists include gases and liquids — move, said George Haller, a visiting professor in the Department of Mechanical Engineering. Haller's group developed the new theory, while Thomas Peacock, the Atlantic Richfield Career Development Associate Professor in the same department, led the experimental effort.

Papers on the experiments and theory were published in the Sept. 25 issue of the Journal of Fluid Mechanics and in the September issue of Physics of Fluids, respectively.

Fluid flows affect everything in our world, from blood flow to geophysical convection. As a result, engineers constantly seek ways of controlling separation in those flows to reduce losses and increase efficiency. One recent accomplishment: the sleek, full-body swimsuits used at the Beijing Olympics.

Controlling fluid flows lies at the heart of a wide range of scientific problems, including improving the performance of vehicles, Peacock said.

For example, picture air flowing around, over and past an object. "Instead of flowing smoothly past the object, the air tends to dramatically part from the surface, or separate," said Peacock. Like the wake behind a boat, the water doesn't automatically reconfigure into a single stream. Rather, the region is quite turbulent. "And that adversely affects the lift [or vertical forces] and drag [or horizontal forces] of the object."

In 1904, Ludwig Prandtl derived the exact mathematical conditions for flow separation to occur. But his work had two major restrictions: first, it applied only to steady flows, such as those around a car moving at a constant low speed. Second, it only applied to idealized two-dimensional flows.

"Most engineering systems, however, are unsteady. Conditions are constantly changing," Haller said. "For example, cars accelerate and decelerate, as do planes during maneuvers, takeoff and landing. Furthermore, fluids of technological interest really flow in our three-dimensional world," he added.

As a result, ever since 1904 there have been intense efforts to extend Prandtl's results to real-life problems, i.e., to unsteady three-dimensional flows.

A century later, Haller led a group that did just that. In 2004, Haller published his first paper in the Journal of Fluid Mechanics explaining the mathematics behind unsteady separation in two dimensions. This month, his team reports completing the theory by extending it to three dimensions. Haller's coauthors are Amit Surana, now at United Technologies; MIT student Oliver Grunberg; and Gustaaf Jacobs, now on the faculty at San Diego State University.

Equally important, this month Peacock and colleagues report important experimental work. Said Peacock, "while we fully trust George's new mathematical results, the engineering community is usually skeptical until they also see experimental results." Haller added, "while giving a beautiful validation of the 2-D theory, Tom's work also gives strong experimental backing to our new 3-D theory." Coauthors on the experimental work are Haller, Jacobs, Matthew Weldon, now at Penn State, and Moneer Helu, now at the University of California, Berkeley.

The research was initially supported by an internal source, the MIT Ferry Fund. Currently the work is supported by the Air Force Office of Scientific Research and the National Science Foundation.

The researchers said it's too soon to quantify the level of improvement in performance of cars and planes that might stem from the work, noting that more work must be done before it can be applied to commercial technologies. "This is the tip of the iceberg, but we've shown that this theory works," Peacock said.

IMAGE / **PEACOCK LAB**

The spike in this experimental 2-D image shows where a fluid is separating from the surface it is flowing past. Spikes such as these can now be reliably predicted thanks to a new MIT theory.

STATE: Institute in 'terrific' shape, administrators say

Continued from Page 1

year 2009.

"This is the first balanced budget MIT has had in many years," Hockfield said. "A balanced budget means we can focus on the future."

The balanced budget is a result of a new framework for the university's operating finances and new policies for endowments, Hockfield said. Last year, endowments — which now provide 20 percent of operating revenues — had a 3.2 percent return on investment, in line with similar university endowments, Hockfield said. "The stratospheric rates of return of the past are likely to be in the past for quite a while. And there are more difficult times ahead," she said.

But the Institute's financial officers will rigorously continue to monitor the nation's economics: "Our watchwords are 'prudence' and 'vigilance,'" she said.

Hockfield outlined progress in other key areas:

- Building. The extension of the Media Lab will enhance its programs while new construction for the MIT Sloan School of Management "will enable the school to undertake 21st century business education and research … increasingly tailored to individual needs." The new David H. Koch Institute for Integrative Cancer Research at MIT, a collaboration between the School of Science and School of Engineering, will "change the frontier of cancer diagnosis, treatment and prevention," Hockfield said.
- Admissions. Despite new admission and financial aid policies by schools such as Harvard, MIT applications increased by 8 percent; moreover, 91 percent of this year's freshmen were in the top 5 percent of their high schools. Students are also increasingly appreciative of their MIT education; participation in the "Senior Gift" has increased from 27 percent to about 64 percent in recent years, a record Hockfield noted.
- Faculty. MIT faculty continue to receive accolades, including two MacArthur "genius" grants and three NIH Pioneer awards this year.

MIT also plays a major role in national policy initiatives; MIT-related witnesses appeared at 23 congressional hearings on energy in the last year and a half. "The world is hungry for the kind of solutions that MIT provides," Hockfield said.

Hockfield's remarks were followed by those of Provost L. Rafael Reif, who noted that MIT's strength came from the interaction among its five schools: "MIT works as a single community."

Reif cited various significant ongoing programs, such as a School of Engineering initiative to replace batteries with devices charged by vibrations or body heat.

"MIT Sloan just launched a master's of finance program. Recent events on Wall Street suggest the world's financial system needs the kind of business leaders that MIT uniquely develops, with deep knowledge of uncertain, complex systems," Reif said.

Chancellor Phillip Clay emphasized the physical improvements to the campus, asserting, "The MIT of today is better than the MIT any of us attended as alumni."

Vice President and Treasurer Theresa M. Stone outlined specific examples of how MIT's Energy Initiative was spearheading cost-effective innovations in heating conservation in campus buildings. Such breakthroughs can change long-term patterns around the country, she said.

"It's not just the engineering solutions that are critical, it's the behavioral solutions," she said.

PHOTO / **PATRICK GILLOOLY**

President Susan Hockfield reacts to remarks by Chancellor Phillip Clay during the State of the Institute Forum held on Monday in Kresge Auditorium.

NEWS IN BRIEF

Broad Institute awarded major grant

Researchers at the Broad Institute of MIT and Harvard have received a five-year grant of about $15 million from the National Institutes of Health (NIH) to map the epigenomes of a variety of medically important cell types, including human embryonic stem cells.

The grant, part of the NIH Roadmap for Medical Research, designates Broad as one of four Reference Epigenome Mapping Centers nationwide that will aim to transform the understanding of an exquisite control system — a code of so-called "epigenetic" cues that specify when and where in the body genes are made active.

To systematically decipher and analyze these controls, researchers from across the MIT and Harvard communities will come together to study at least 100 distinct types of human cells using the latest methods in stem-cell biology, genomics, technology, computation and production-scale research.

Draper Lab holding Tech Expo

MIT faculty and students are invited to visit Draper Lab's Technology Exposition on Oct. 7-8 to see Draper projects and technologies and discuss them with staff. Draper's Tech Expo will be open to students and faculty from 12:30-3:30 p.m. on Tuesday, Oct. 7, and from 9 a.m. to 1 p.m. on Wednesday, Oct. 8. Both events will be held in Draper's Hill Building, located at the intersection of Broadway and Hampshire streets.

Exhibit topics will include space systems, robotics, microelectromechanical systems, biomedical engineering and independent research and development projects. A number of projects have been worked on by teams that include students, particularly through the Draper Fellow Program. Visitors will need to present photo identification, such as a driver's license, for admittance. For more information, contact communications at 617-258-2600.

MIT hosts first UrbLab conference

The MIT Urbanization Laboratory is organizing a symposium on the culture and politics of urban change that will be held from 1-5 p.m. on Friday, Oct. 3, in 7-431.

This event will use Mumbai, India, as a case study to examine how architects, urban designers and planners are responding to the challenges and opportunities of rapid urbanization in the developing world. Speakers include professionals and academics from India as well as economists from the World Bank and Rockefeller Foundation.

The symposium will be opened by Adele Naude Santos, dean of the School of Architecture and Planning.

Library book sale next week

MIT Libraries' book sale will be held from 10 a.m.-3 p.m. on Oct. 9 in the Bush Room, 10-105.

The sale offers a selection of material including biology, computer science, economics, earth science, engineering, history, philosophy, miscellaneous science, political science and social science. Proceeds will benefit the Libraries' Preservation Fund. The sale is open to the MIT community only; dealers and their representatives by appointment only.

For more information, contact the MIT Libraries' Gifts Office at 617-253-5693 or gifts-lib@mit.edu.

PRIORITY: MIT experts weigh in on how the next president needs to focus on science

Continued from Page 1

Marc Kastner, *dean of the School of Science and the Donner Professor of Science:*

The next president must invest in research on carbon-free energy technologies, not only to limit greenhouse gases, but also for U.S. competitiveness in what is likely to be a huge part of the world economy. However, we know too little of the fundamental science underlying these technologies to implement them safely and economically. Furthermore, the nation's science cannot be strong if there is only support for research obviously related to energy and competitiveness. The new president should make a commitment to broad-based support of basic science, implementing the plan to double the budgets of the NSF and the DOE Office of Science, as well as putting the NIH on a trajectory with reasonable growth.

David Mindell, *the Frances and David Dibner Professor in the History of Engineering and Manufacturing and director of the Program in Science, Technology, and Society:*

The United States stands at the start of a new, if uncertain, era in human space flight. Events of the past five years have thrust NASA and the country into a major transition, exemplified by the impending retirement of the space shuttle. The transition has begun, but how it evolves remains undefined. In its first term, the new administration will make the most important decisions in U.S. human spaceflight in a generation. These include when/how to retire the shuttle, how to transition to the new constellation system, what to do with the International Space Station, and what should be the appropriate scale and goals for a U.S.-led program of human exploration of space. MIT's research group in Space, Policy and Society is preparing a white paper to help chart these choices for the next administration.

Phillip Sharp, *Institute Professor*:

The recent heart-touching national television appeal for funds to advance cancer research by Stand Up to Cancer reminded the country of the need for better treatment of this disease and further research. However, federal funding for cancer research has actually decreased over the past several years. This is at a time when decades of science have uncovered more targets for treatment and there are more drugs and treatments ready for testing in clinical trials than ever before. Further, here at MIT and elsewhere there is a highly promising convergence of engineering and cellular science that will generate new means of diagnosis and treatment of cancer. Thus, the next administration needs to develop a long-term strategy for funding biomedical research that assures as much as possible that better treatments for cancer continue to advance into routine care.

Subra Suresh, *dean of the School of Engineering and the Ford Professor of Engineering:*

The next administration needs a grand plan for our collective future — one that will galvanize the talents and enthusiasm of current and future scientists and engineers and support them in their quest to address the major issues of our time. Solutions to the challenges of energy, environmental sustainability and transportation will not come easily. So, too, are the political challenges of reversing the last decade's decline in funding for scientific research. Our next president must bring a long-term, science-oriented perspective into government, and he must quickly and decisively reverse the more recent, opposing trends. The United States's economic leadership has always depended on its ability to foster and maintain an ecosystem of scholarship and innovation in all fields. This system— our system — is perilously close to a tipping point. We need leadership that will invest in and help create a future as brilliant as our past.

Rosalind Williams, *the Bern Dibner Professor of the History of Science & Technology:*

You are asking which dish should be served first when science isn't even on the menu. It needs to get back on the table for serious consideration, not as a special interest but as an essential element of every major challenge facing American society. This will not happen if the habits of mind and conduct associated with science and engineering — curiosity, self-awareness, modesty, accuracy, respect for education — are dismissed as elitist. A top priority for all Americans — not just the next president — is to cultivate these habits and to defend them vigorously. They are as essential for democracy as for science.

CLASSIFIED ADS

Members of the MIT community may submit one ad each issue. Ads should be 30 words maximum; they will be edited. Submit by e-mail to ttads@mit.edu or mail to Classifieds, Rm 11-400. Deadline is noon Wednesday the week before publication.

FOR SALE

Nikon FE camera with carrying case and lenses: Skylight 1A 55mm, 67mm haze-uv telephoto, automatic extension tube 12,20,36 mm, 2x telephoto converter 4E/MC N1, 3x telephoto converter N/A1, lightmeter, tripods. $300. Call 508-224-6135.

New Steelcraft front grill guard for 2008 Toyota Highlander, black finish. $325. Call Paul 617-253-4211 (MIT) or 617-698-8581 (home).

Pegasus brushed nickel kitchen faucet with side spray. Model 481-670F. Excellent condition. $50. Call Cheryl 617-258-5673 or cheryl@mit.edu.

FOR RENT

Cambridge. Two totally furnished apartments. Walk to MIT. 2 BR/$1900/avail Oct. 15. 1 BR/$1500/avail Nov. 1. Photos avail. John 781-729-7725. johnnatale@verizon.net.

IMAGES COURTESY OF ALEXANDER D'HOOGHE AND NADER TEHRANI

Architectural drawings of a proposed city built on landfill in South Korea, including, on left, a spaceport.

Designing a landfill of epic proportions

MIT-led team among winners for Korean project

Stephanie Schorow
News Office correspondent

Alexander D'Hooghe

Nader Tehrani

Many architects dream of being given a "tabula rasa" — a blank slate — upon which they could let the imagination soar when designing a home, building or other project.

A team led by MIT architects Alexander D'Hooghe and Nader Tehrani are working on what could be the largest blank slate in the history of construction.

This summer, the MIT team was among the winners of an Urban Design Institute of Korea-sponsored contest to design a mammoth landfill project on South Korea's western coast — a 401-square-kilometer area that will house farms, cities and developments ranging from a spaceport to an amusement park.

Intended to fill between the long fingers of land that project into South Korea's Saemangeum Bay, the project could cost billions of dollars and be eight times bigger than the record-breaking Palm Deira landfill development under way in Dubai.

For about nine months, D'Hooghe, the Class of 1922 Career Development Associate Professor of Architecture and Urbanism; Tehrani, associate professor of architectural design, and their team crafted their entry. While hewing to the contest's requirements of hardnosed realism, they envisioned islands created with soil dredged from the sea floor and filled with farms and small cities, with a total population of 600,000.

By any measure, the challenge was huge. "Our field has never been asked to deal with this scale of design," D'Hooghe said. "It's effectively a new scale. And who knows, maybe in the long term, like urban design, it becomes a new discipline. Maybe today we're facing the birth of a new sub discipline: territorial art."

Making trips to South Korea and working with Assistant Design Director Nida Rehman, urban economist Regina Armstrong of Urbanomics, MIT engineers and students, Tehrani and D'Hooghe developed a proposal that reflected Korean cultural norms and demographic trends, such as an aging population as well as a tech-savvy, urban citizenry. They envisioned "mega parcels" for tourist attractions, such as a racetrack and spaceport.

About 30 percent of the new land, which would be built significantly higher than sea level, would be dedicated to agriculture, but D'Hooghe and Tehrani wanted to see a "relationship between production and consumption" with the farms operating alongside culinary institutes; the result would be a "South Korean Tuscany."

The area's 15 urban centers would be dense and compact to enhance employment, transportation and sustainability. Construction would be phased in such a way that programs could change over time; the form might be final but the function would be fluid. People would be living many years in one section before the total project was completed.

"A city can truly be a laboratory for a certain kind of urban or territorial speculation and you can see its results in a much shorter plan of time than you would 50 years ago," Tehrani said.

The MIT team was a finalist along with teams from Columbia University and London Metropolitan University. Now D'Hooghe and Tehrani are waiting for the South Korea government to move forward.

The project also faces numerous logistical issues as well as environmental concerns. A sea wall, already built around the peninsula, has been slammed as an ecological disaster, but D'Hooghe and Tehrani believe that their plan, by creating wetlands and biological diversity, would mitigate the damage already done.

But something will be done in some form — the pressure for new land is that great. Seventy percent of South Korea is mountainous and thus unsuitable for building. "It's more valuable to create new land because then you can compete on a global scale with new economic models," Tehrani said.

And the two are intrigued with the challenge of creating new land — "the notion of being able to establish a tabula rasa in the way we would not see in the United States," Tehrani said.

Celebrate excellence at MIT

Nominations for the Institute's annual Excellence Awards due later this month

Kathryn O'Neill
Human Resources correspondent

What does an administrative assistant in the Department of Economics have in common with the varsity volleyball coach, the head humanities librarian and a project technician in the Research Laboratory of Electronics? All are among the most outstanding employees at MIT — recipients of MIT Excellence Awards.

Nominations are due Oct. 27 for this year's Excellence Awards, which recognize exceptional accomplishments by support, service, sponsored research, administrative and other academic staff. (The due date is Oct. 20 for Lincoln Lab employees.)

"The Excellence Awards recognize the great contributions that individuals make to help maintain the leadership position of MIT," said Vice President for Resource Development Jeffrey L. Newton. "I encourage everyone to think about an outstanding individual who could be nominated."

This year's seven award categories are:

- fostering diversity and inclusion
- innovative solutions
- fostering community
- bringing out the best
- creating connections
- serving the client
- unsung hero

Kande Culver, who administers the Rewards and Recognition Program for Human Resources, said that every nomination is carefully reviewed by a diverse committee of 14-15 people, drawn from across the Institute. Last year, 16 winners were chosen from a pool of 110 nominees.

"It was incredibly inspiring to read about all these people on campus whom I've never come in contact with who do phenomenal jobs," said Mary Frances Gydus, who served on the MIT Excellence Awards Selection Committee last year, when she was assistant to the director of the MIT Press.

Newton, who also served on the committee, agreed. "Reviewing the nominations gave me a wonderful opportunity to learn how the desire to achieve excellence permeates every department at the Institute. We need to recognize these achievements."

Committee members say the key to a good nomination is meeting the award category criteria and offering examples of excellence, not simply praise. "Really pay attention to the award description and keep that in mind as you're writing the nomination," said Paree Pinkney, an administrative officer for the Program in Science, Technology, and Society and a committee member last year.

"It doesn't matter what you do or who you are. If your colleagues think you really go above and beyond, then you should be nominated," Gydus said.

Awardees receive $2,000 each and will be honored at a ceremony on March 4, 2009, at Kresge Auditorium. For more details, visit hrweb.mit.edu/rewards/excellence.

MIT releases endowment figures for 2008

The Massachusetts Institute of Technology Investment Management Company (MITIMCo) has announced that the Institute's endowment generated a return of 3.2 percent for the fiscal year ending June 30, 2008.

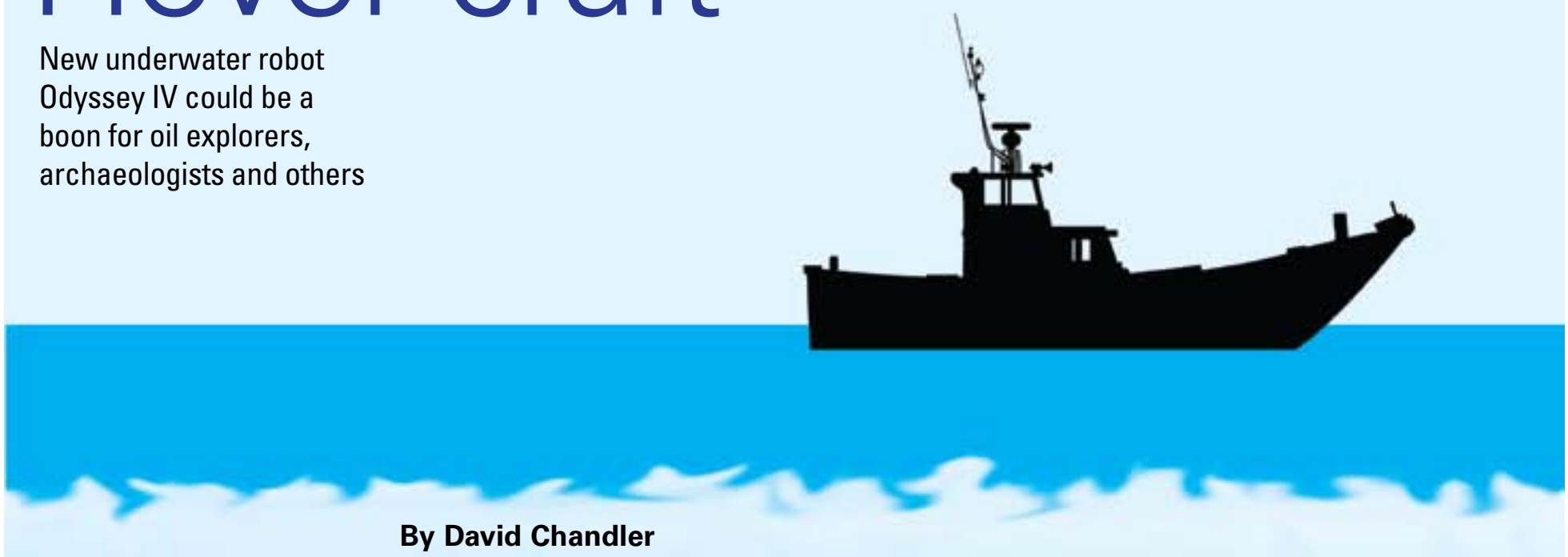
As a result of solid investment performance in a turbulent market, and as a result of gifts, the endowment's assets totaled $10.1 billion as of June 30, 2008, an increase of $88 million from the previous year, net of spending. For the past 10 years, the Institute's endowment has had an annualized return of 13.2 percent.

Investment gains were broadly spread across MITIMCo's diversified portfolio, with private equity, real estate, and fixed income securities performing particularly well.

MITIMCo is a division of the Massachusetts Institute of Technology, created to manage and oversee the investment of the Institute's endowment, retirement plans and operating funds. As of June 30, 2008, MITIMCo had $14 billion of total assets under management.

Hover craft

New underwater robot Odyssey IV could be a boon for oil explorers, archaeologists and others



By David Chandler
News Office

MIT researchers have designed a new robotic underwater vehicle that can hover in place like a helicopter — an invaluable tool for deepwater oil explorers, marine archaeologists, oceanographers and others.

The new craft, called Odyssey IV, is the latest in a series of small, inexpensive artificially intelligent submarines developed over the last two decades by the MIT Sea Grant College Program's Autonomous Underwater Vehicles Laboratory. The Odyssey series revolutionized underwater research in the 1990s by introducing the thrifty and highly capable underwater robots. But the previous Odyssey vehicles still had one significant limitation: Like sharks, they could only operate while continuously moving forward.

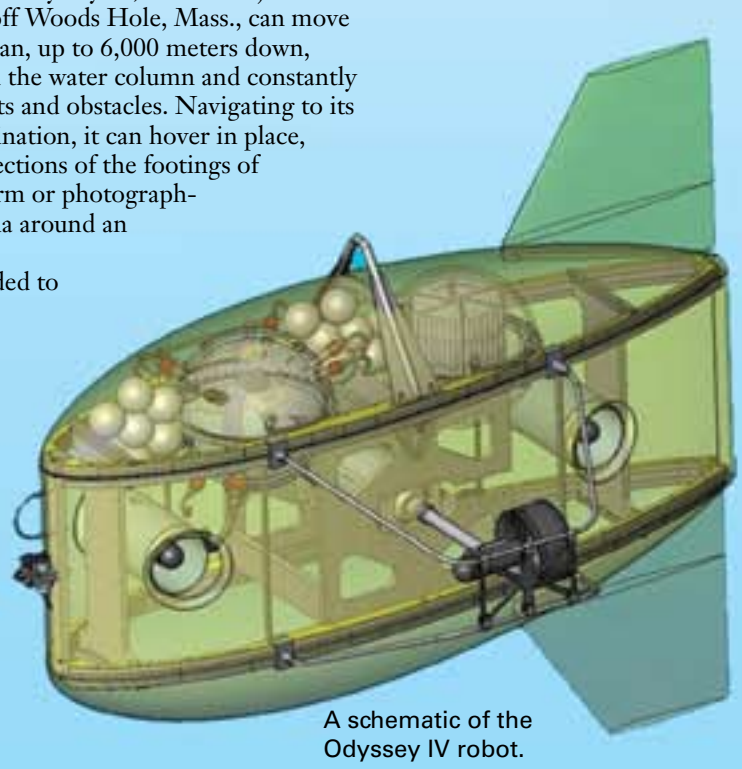
No more. The new Odyssey IV, which has just completed sea trials off Woods Hole, Mass., can move through the deep ocean, up to 6,000 meters down, stopping anywhere in the water column and constantly correcting for currents and obstacles. Navigating to its preprogrammed destination, it can hover in place, making detailed inspections of the footings of an offshore oil platform or photographing the flora and fauna around an undersea vent.

"Our old subs needed to swim, to go forward, in order to maintain maneuvering capability," says Chryssostomos Chryssostomidis, director of the MIT Sea Grant Program. "People wanted to be able to work in the ocean and stop and hover to do a specific task. In the past, you could only fly over a scene, take a picture, then fly over again and take another picture. Now, I can stop over a scene that's of interest, and stay and make measurements. We'll be able to observe underwater scenes in much more detail."

Last summer, this latest-generation craft demonstrated its new abilities on its first scientific mission, a study of the George's Bank area of the Gulf of Maine, which is hugely important to the region's commercial fisheries. Odyssey is being deployed in a series of dives to map and observe an invasive species of sea squirt called Didemnum that has been infesting New England waters. MIT Sea Grant's Judy Pederson has been tracking the Didemnum invasion for several years, hoping to prevent it from smothering important native species; Odyssey IV will be her eyes on the seafloor.

And the new craft's unique capabilities go beyond just looking at objects. "Like a giant helicopter, this can pick up cargo underwater," Chryssostomidis says. "Now, we can visit an oil well, pick up a sample and bring it back to shore." With the addition of a mechanical arm, the vessel will be able to do manipulations such as twisting a valve open or closed.

Not only can the craft hover, it can move quickly, up to two meters per second going straight ahead. Both its speed and its ability to stop in place are achieved through the combined action of fins and thrusters on each side, and at the bow and stern of the two-meter-long craft.



A schematic of the Odyssey IV robot.

PHOTO / **JUSTIN G. ESKESEN**
Crews work to test the Odyssey IV robotic craft.

The new vehicle may be able to stop in place, but Chryssostomidis and his colleague Franz Hover, an assistant professor in the Department of Mechanical Engineering, and their team, research engineers Jim Morash, Victor Polidoro, Justin Eskesen and graduate student Dylan Owens, certainly are not. With the initial sea trials of Odyssey IV just completed, they are focused squarely on moving ahead to their goals. They need to develop vastly improved power-storage and communications capabilities, to enable these vehicles to stay underwater longer, cover more terrain, and send back more data to scientists on shore. Ultimately, Chryssostomidis says, he hopes his team will produce an AUV that can spend a full year underwater, collecting data and transmitting it to its home base, without any need to surface at all.

"Once we prove the hovering capability foolproof, as we think it is now, the next challenge for me to worry about is the issue of recharging, so that I can be free of the surface vessel," he says. He also hopes to develop better manipulator arms that will be able to interact more flexibly with the undersea environment, to pick up objects or carry out repairs.

But for now, Chryssostomidis is reveling in the fact that Odyssey IV, after years of development, has passed its initial tests in the ocean with flying colors. No matter how good the design, that's not something you can take for granted, he explains. "The sea is very unforgiving. If there's anything that can go wrong, the sea will find it."

ON THE WEB

While Odyssey IV successfully passed its first sea trials over the summer, its progress over the last few years has been detailed in a series of MIT Sea Grant technical papers, journal articles and conference presentations. A listing is available at **http://seagrant.mit.edu/media/browse_pubs.php?cat=26.**