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FLORIDA INSTITUTE FOR HUMAN & MACHINE COGNITION

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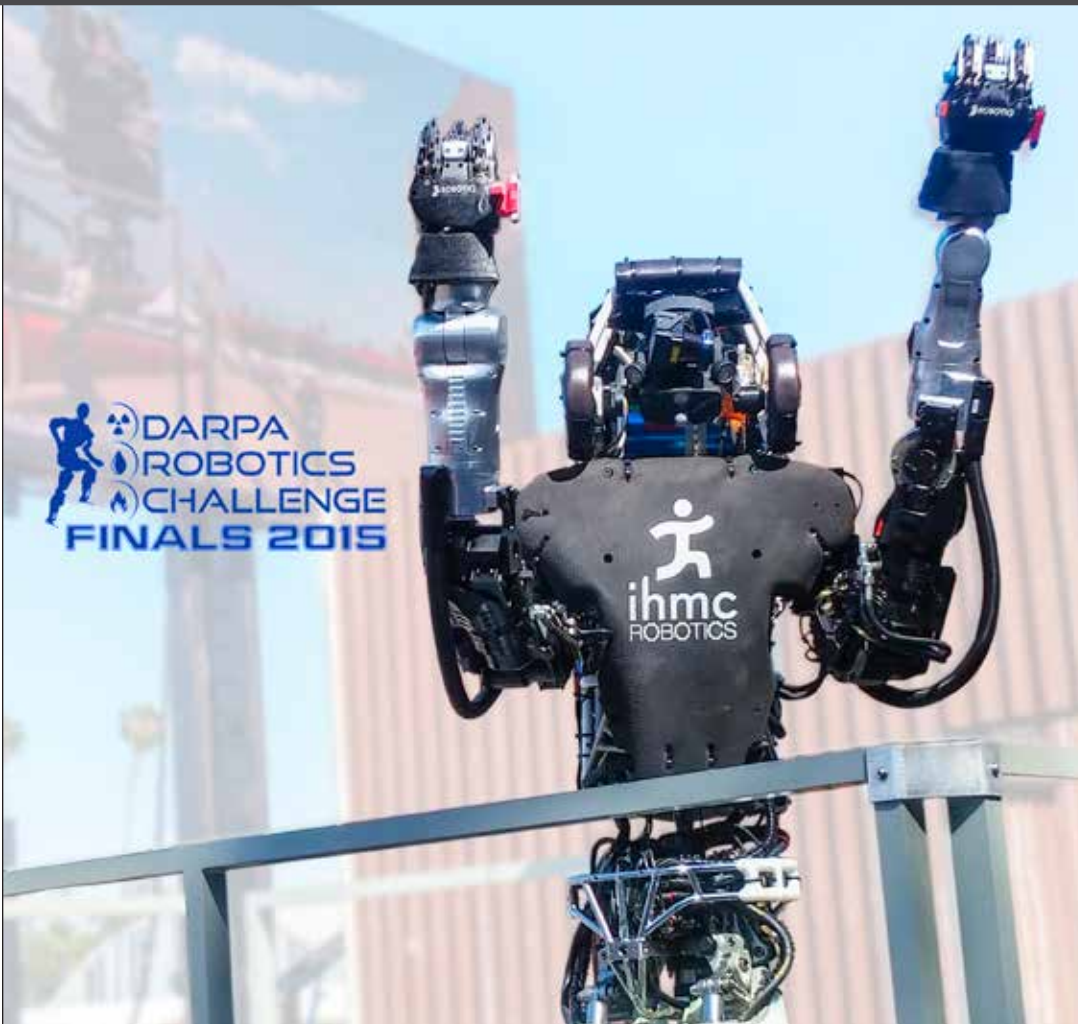
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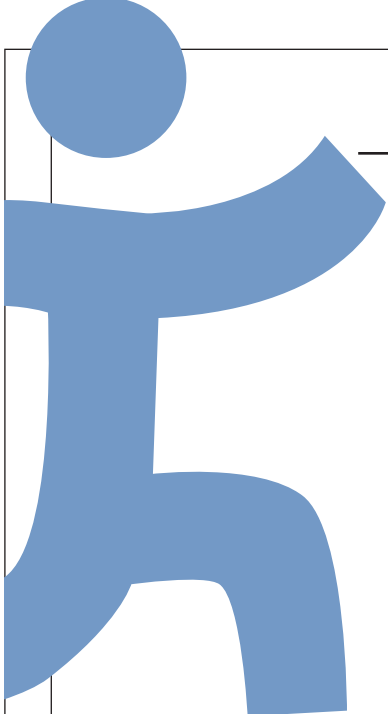
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Dear Friends:

The first half of 2015 has indeed been a busy and rewarding time for IHMC, with an amazing amount of national and international press attention, stellar achievements by the robotics team, ground breaking on our new research building, new colleagues joining the IHMC team, and, of course, continued breakthroughs by IHMC scientists and engineers.

I couldn't be prouder of the IHMC Robotics team, which, after almost three years of relentless work, placed second in the DARPA Robotics Challenge in June. IHMC's showing was especially sweet because our robot suffered significant damage on the first day as the result of two dramatic falls. Our team worked through the night repairing the robot, then achieved a perfect score, besting 21 other teams on the final day. IHMC's robot, known as Running Man, finished first among the teams that used the Atlas robot and first among the U.S. teams. The DARPA Robotics Challenge brought excitement and a world-wide focus on robotics. And of course, there is nothing like the crucible of competition to drive people to work day and night, which, in turn, can substantially accelerate R&D progress.

Also this year, Dr. Alberto Cañas and his colleagues introduced the world to not only CmapTools for the iPad but also CmapTools in the Cloud, allowing the three versions – iPad, Web and desktop/laptop – to integrate through the Cmap Cloud service.

IHMC also is pleased to announce the addition of one of the world's leading undersea medicine scholars to the staff of research scientists. Dr. Dawn Kernagis joined us in June from Duke University. Her research, which is focused on increasing human resilience and performance in extreme environments, is of great importance to divers, high-altitude pilots and astronauts.

Developing computer systems that can adapt and communicate in extreme environments such as warfare is the goal of Dr. Niranjani Suri, who has made significant contributions in this area and was recently elevated to senior research scientist at IHMC.

I'm also pleased to report that construction of IHMC's new, state-of-the-art building in Pensacola is progressing nicely. After months of delay following a 2014 flood, the building was elevated and redesigned. The steel framing went up in June, and the building is scheduled to be completed by next spring. We look forward to hosting visitors to the new facility this time next year.

Thanks to everyone who helped make the first half of 2015 a time of great strides (robotic and otherwise) for IHMC.

Best Wishes,

Kenneth M. Ford, Director

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# IHMC overcomes setbacks to shine in DARPA's global robotics challenge

He fell. He was put back together. He won a million-dollar prize. Call it the comeback story of the robotics world.

Like a wounded athlete playing through the pain, IHMC's bipedal robot surprised even his operators when he rose from the gurney and marched through all eight tasks at the DARPA Robotics Challenge Finals in June. He finished just behind the leader to capture second place, well ahead of twenty one other robots from around the world.

Dubbed "Running Man" in a salute to the IHMC logo, the black-chested machine was the only fully walking robot to place in the top three, and he did it all with an ominous hitch in his step left over from the tumbles he took on the first day of the tournament.

"In the lab, we were doing eight tasks in 45 minutes and we finished the Challenge with eight tasks in about 50 minutes with a damaged robot. So that was pretty good," said IHMC Research Scientist Dr. Matt Johnson, one of the leaders of IHMC's 23-member team of computer

scientists and engineers that traveled to Pomona, California, for the event.

In the end, almost every other team's robot fell at some point. Four teams completed only three assignments, and four others didn't finish any tasks at all.

"We got a bit lucky, and we also got unlucky, just like every team did," said team leader and IHMC Senior Research Scientist Dr. Jerry Pratt.

The Robotics Challenge was a three-stage, three-year event sponsored by the Defense Advanced Research Projects Agency, and the course was designed to emulate a nuclear-plant disaster area deemed unsafe for humans. The robots had to do what few robots had ever done in a real-world setting: drive a car and get out of it, open a door, cut a hole in a wall, turn a valve, traverse a field of rubble, climb stairs and perform a surprise task. The machines had to perform everything with on-board battery power, without support cables, and with only spotty communications with their operators.

After placing first and second in earlier

stages of the Challenge in 2013, IHMC was considered one of the favorites to win it all in the finals. And Running Man began his first attempt at the course in an almost flawless manner. The 6-foot-tall robot was literally striding through the tasks and was on pace to finish the course in under 40 minutes — well ahead of any of the other teams.

Dr. Pratt explained what happened next: At the seventh task, crossing over a crooked pile of cinder blocks, a single step made it painfully clear how far walking robots have to go before they can be considered humans' reliable surrogates.

"Had we taken just one or two additional steps, we wouldn't have fallen," said Dr. Pratt.

He produced a diagram he had sketched to show how to guide the robot across the jagged plain. "I said, 'OK, we're going to take steps one and two right here, then one, two, three.' There should have been a step four."

After an even harder fall going up stairs

**continued >>**



Team IHMC at the finals presentation ceremony



on its second attempt at the course that day, the robot was pretty banged up. Dr. Pratt, Research Associate Sylvain Bertrand and much of the team worked through the night, replacing part of an arm and a leg, fixing a bug in the software, and thoroughly testing the new arrangement.

IHMC team members called it three of the most intense years of their lives, involving months and months of almost non-stop research and development.

“Really, we just wanted to show our best work, and we pretty much did that,” Dr. Johnson said.

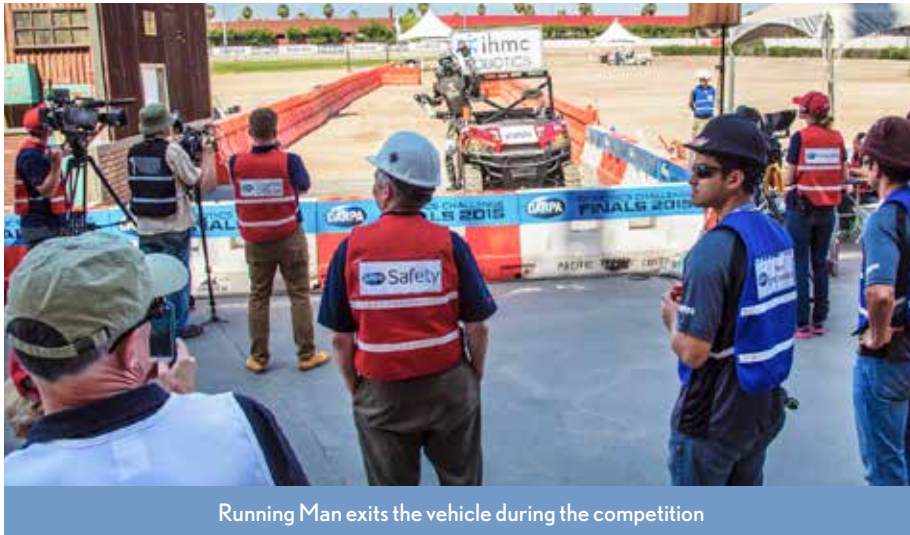
Pratt said. “It demonstrated that you can actually do useful things with these robots now. Before, everything was just pretty much simple laboratory set-ups.”

One advancement accelerated by the competition was the integration of multiple sensory inputs into a single user interface — something IHMC’s team had already done to a large degree, said Dr. Peter Neuhaus, a team leader and IHMC senior research scientist.

“There’s now a huge effort on integration,” Dr. Neuhaus said.

The event also underscored the fact that fully autonomous robots are still a long way off, and that systems focusing on human and machine collaboration will ultimately prove far more beneficial, the scientists said. Teams at the finals that relied on more autonomous machines, for example, did not fare as well as IHMC, which used a blended approach that allowed operators to provide instructions when the robot became stymied.

Team IHMC’s impressive showing in the DARPA Challenge earned it widespread national and international news coverage, from *The New York Times* to the *Economist*, not to mention scores of stories and videos on TV networks and online tech news outlets. *Time* magazine sent famed science fiction



Running Man exits the vehicle during the competition

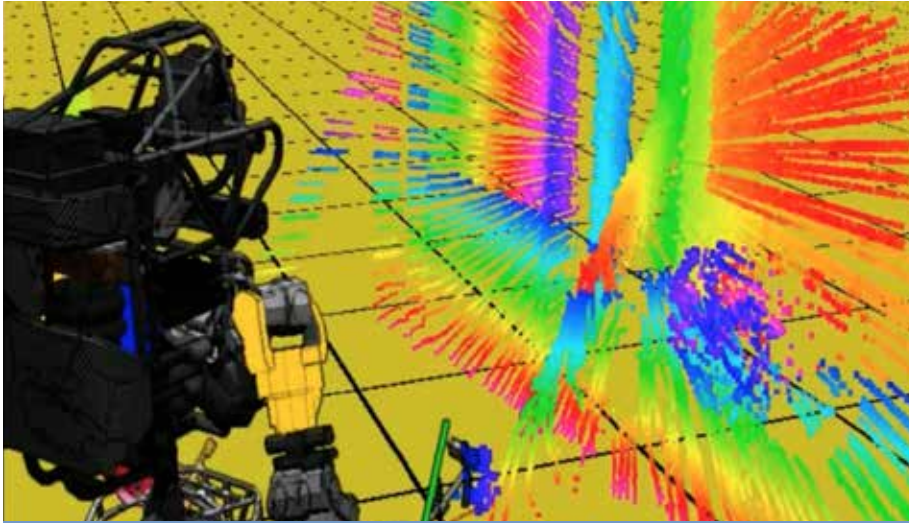
On day two of the finals, the team moved more cautiously, making sure the robot finished all eight exercises. Running Man finished just six minutes behind Team KAIST from South Korea, a wheeled-and-legged machine that took home the top prize of \$2 million.

The biggest winner may have been the science and engineering of robotics. The tournament exposed some of the shortcomings of android systems but also painted a roadmap for the future, participants said.

“It did push everything ahead,” Dr.



The operator’s station at the finals



A look at the user interface software developed by IHMC for the robot

author and journalist Lev Grossman and photographer Marco Grob to spend a few days at the IHMC Robotics lab just three weeks before the competition, and Running Man made the cover of the magazine's international edition.

"What makes the IHMC's robot different from the others, and on the evidence better, is the software that tells it how to walk and balance and interpret the world around it," the article said.

More than 30 people on Team IHMC have contributed improvements to that "whole body walking algorithm" software over the last few years. It is now considered so robust, in fact, that after the second round of the Robotics Challenge in 2013, DARPA asked that it be made available to the other teams in the competition and open-sourced to the world robotics community. This fall, the team plans to post its acclaimed walking algorithm online so it can be downloaded.

The chief operator of the robot, the man behind the curtain directing the machine through its paces, is Pensacola native John Carff. He developed the core of the software's user interface and the team has built on it over the last six years. It combines a wide range of information,

including visual images, LiDAR (laser-driven radar) and virtual reality to see a few steps ahead and help the robot navigate through complex landscapes.

NASA was so impressed with the IHMC software that it has requested that it be used on new versions of its own humanoid robots, Dr. Neuhaus said.

The Florida Legislature invited the team to the Capitol in June, and the Florida Senate adopted a resolution honoring IHMC's achievement.

"In competing in the DARPA Robotics Challenge, the 23 members of the IHMC team brought great honor and distinction to this state and successfully demonstrated the value of robotics in responding to natural and manmade disasters," reads the resolution sponsored by Sen. Greg Evers of Baker, Florida.

It's unlikely that DARPA will host another robotics competition for several years, but Team IHMC plans to apply some of its newfound wisdom toward other robotics projects. Those likely will include NASA's own challenge, which begins next year and aims to develop software to increase the autonomy of robots for space exploration. IHMC may also enter the 2016 Cybathlon, which allows disabled humans to compete in

Olympics-type events with the aid of robotic prostheses, Dr. Neuhaus said.

And Running Man has been joined in the lab by another humanoid robot: NASA's gleaming white Valkyrie robot has been made available to IHMC to study the uses of humanoid avatars for Mars exploration. The project, sponsored by NASA and the National Science Foundation through the National Robotics Initiative, aims to accelerate the use of robots that work cooperatively with people.

Meanwhile, the now-world-famous Running Man may stick around the lab for some time to come. IHMC has asked DARPA to loan it the robot for another five years for demonstrations and further research. Having two bipedal machines will be ideal for testing software on different platforms, Dr. Johnson said.

And the \$1 million in prize money that DARPA awarded to IHMC? That will go toward bonuses for team members and to finance further research and special equipment for the robotics lab, Drs. Pratt and Neuhaus said. 🤖



Running Man made the cover of *Time's* June 8 international edition



# IHMC's natural language research: Computers that understand, diagnose—and find bad guys

Studies by the Institute of Medicine and others have shown that serving in the military significantly increases the chances of developing amyotrophic lateral sclerosis (ALS), also known as Lou Gehrig's disease. More than 4,200 veterans now suffer from the degenerative nerve disease, and another 1,000 are diagnosed with it every year, the U.S. Department of Veterans Affairs reports.

Simply measuring the progression of ALS can be exhausting to the patient and frustrating to the caregiver. It involves forced deep breaths, swallowing tests and often-difficult conversation, with the medical professional having to subjectively gauge deterioration in speech.

That's why the James A. Haley Veterans Administration Hospital in Tampa this spring awarded IHMC a grant to try and find a better approach.

The project is called DESIPHER, for DEgradation of Speech as an Indicator of PHysiological degenERation, and it aims to put software to work recognizing ALS patients' speech, measuring the degradation and using speech signals to alert caregivers of underlying health problems. While natural language

processing and understanding has long been a key research area for the institute, the ALS project and others similar to it show that the field is becoming a primary focus at Ocala.

"A big hypothesis we're testing is: Can you tell from the way people pronounce things, or from speaking difficulties they have, that they may be having a problem with swallowing or breathing, for example," said Dr. Bonnie Dorr, IHMC associate director, senior research scientist and one of the country's recognized leaders in natural language processing.

The speech recognition software, now under development, combines the sound of the speech with data from the voice signature's waveform and spectrogram, as well as pitch variability. Dr. Dorr believes a viable system may be ready in three to five years. It will be similar to existing voice technology, but more powerful, able to understand dialects and quickly adapt to changing speech patterns.

Such a system would also be able to measure the tiny pauses between words and compare them over time, which can be helpful in measuring not only ALS progression but also in signaling

the onset of Alzheimer's disease, said IHMC Research Scientist Dr. Kristy Hollingshead. "Computers are good at counting things, so we want to be able to quantify the number of milliseconds between words and number of 'ums' and unusual words," she said.

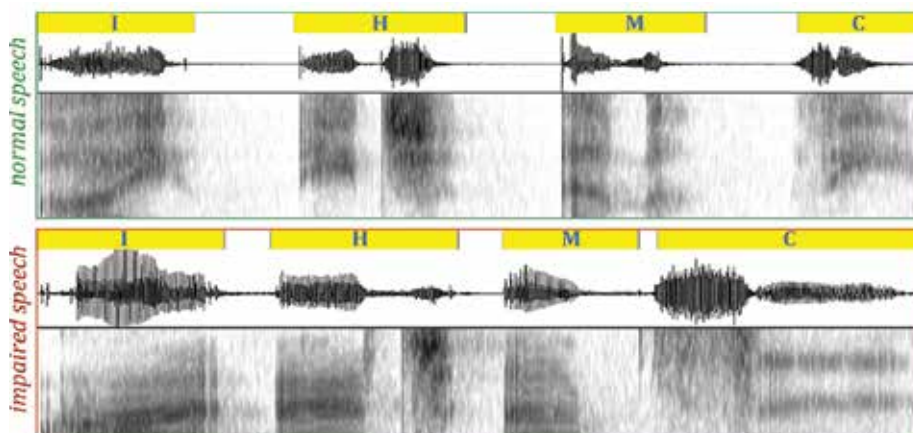
"I see this as a huge step toward human-centered ambient intelligence," Dr. Dorr said.

Just as most of us now keep a cell phone always within arm's length, in a few years, some of us may have a form of robust ambient intelligence with us at all times — for life. This could come in the form of a smart home, with multiple sensors and interaction points, or in the shape of a helpful robot. It would always be there, at the ready to remind us of recent conversations, to prompt us to take our medicines, or to turn on the news, or it could call the doctor if our vital signs get out of whack.

IHMC-Ocala now is in the initial planning stages for a smart home laboratory to test and develop these assistive technologies, and plans to collaborate with IHMC's Pensacola robotics team on a mobile household assistant, Dr. Dorr said.

Senior Research Scientist Dr. Yorick Wilks and others at IHMC are working with the Tampa VA hospital to take it a step further and build a companion agent that can hold meaningful conversations with wounded warriors, some of whom have significant memory loss and depression. The avatar can use family photos coupled with information gleaned from conversations and Internet searches to interact with the patient and reopen a door to his past life.

Research Scientist Dr. Brent Venable is developing ways in which companions



Normal vs. impaired speech patterns of the letters "IHMC," showing waveform and spectrogram

can think ahead and actually reason about all-important preferences — which actions and responses are most important for different patients.

These types of ambient intelligence are just the tip of the iceberg for IHMC's research into natural language processing. Twelve researchers at the institute's Ocala and Pensacola locations now work in the field, with applications ranging from the

are made. The software would be able to understand unusual languages, such as Kurdish, and adapt to the truncated verbiage used in text messages and social media posts.

Drs. Bhatia and Dubbin come at this challenge from a number of angles, including parsing the language and assigning semantic role labels to parts of speech. One method employs computer

participant is acting deceptively, long before the humans involved can.

IHMC researchers feel that major breakthroughs in all of these areas are on the horizon. Already, said Dr. Hollingshead, software analyzing the social media outlet Twitter can determine the gender of the sender within 100 Tweets with 92 percent accuracy for English-language text.



Dr. Greg Dubbin



Dr. Archna Bhatia



Dr. Kristy Hollingshead



Dr. Bonnie Dorr

VA projects to cybersecurity, to human-computer dialog, to using computers to comb through published text and social media with lightning speed and increasingly deep understanding.

In one project, Research Associate Adam Dalton is developing software that could analyze a wide range of social media to determine if some computer-based communications are malicious “phishing” attempts to glean personal information from online users.

“The idea is, just from analyzing language, can we pull out warning signs and alert people to a potential threat,” Dr. Dorr said.

Other realms pioneered by research associates Dr. Archna Bhatia and Dr. Greg Dubbin aim to let software scour social media for life-saving information. For example, one project analyzes vast amounts of postings to quickly determine where a disaster is unfolding, alerting rescue services long before official reports

learning algorithms and rule applications to calculate scores for event-trigger words. This scoring system is augmented with background information about the post's author and the date and time it is posted, among other data, Dr. Bhatia said.

On the other side of the coin, disasters can often disrupt and expose sinister activity that's hidden by everyday life, Dr. Dorr said. One IHMC project is designed to pick out unusual messages that could uncover illicit plans, she said. Also in disaster areas, even well-intentioned people can overstate the problem, which could send relief aid in the wrong direction. Computers that can understand emotions and sentiment implicit in language could spot exaggerations or misleading information.

Another area pioneered by Dr. Wilks aims to model and understand the underlying motives and beliefs of individuals engaged in a dialog. Soon, computers may be able to tell when a

“The reason that language provides such a nice signal into mental and neurological health and other information is because language is a pretty complex process,” Dr. Hollingshead said. “Whether it's speech or text or a Tweet, a lot goes on in your brain to try and produce that. It's really hard to fake language.” ✨



Dr. Yorick Wilks

# FastRunner 2.0:

## Lighter, leaner, with a swing in its step

In 2011, IHMC researchers won a grant from DARPA to build a prototype of an ostrich-like, bipedal running robot. The idea was to someday augment military and emergency forces with a speedy machine that could go where wheeled vehicles cannot.

In computer simulations, the IHMC FastRunner behaved beautifully, reaching

to the drawing board and developed rotary, spoked runners, one of which came to be known as the HexRunner (for its three spokes on each side). That self-stabilizing machine roughly re-created the ground-reaction forces observed in running ostriches and in 2014 set a world speed record for legged robots, topping 30 miles per hour.

one of the country’s leading robotics authorities. “A lot of people won’t admit it’s a running robot, so we want to build something that has an articulated leg and moves like a bird.”

The IHMC team is now hoping to take FastRunner in a slightly new direction, one that relies less on heavy actuators and more on autoresonance — the



FastRunner

speeds of 40 mph. But on the treadmill, the actual robot, with its meter-long aluminum legs and powerful hydraulic actuators, slammed the ground with too much force and failed to achieve optimal running performance.

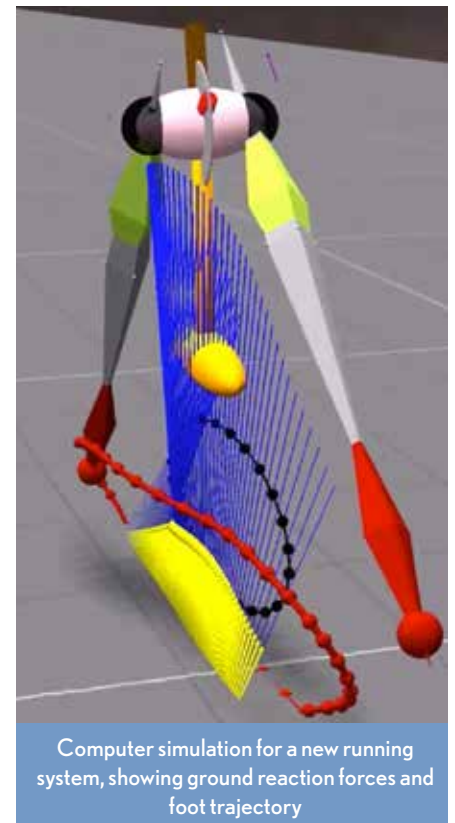
To better understand the characteristics of bipedal running, the team went back



HexRunner

The HexRunner “demonstrated that high-gain feedback and actively controlled foot placement is not necessary for stable bipedal running,” said IHMC Research Associate Johnny Godowski.

But the HexRunner “looked too much like wheels” for most people, said IHMC Senior Research Scientist Dr. Jerry Pratt,



Computer simulation for a new running system, showing ground reaction forces and foot trajectory

self-sustaining waves of energy found in animal and human gaits.

“Now that we’ve broken a world record, and shown that fast running is a matter of geometry rather than high-bandwidth sensor feedback, we can show that fast running can be achieved with autoresonance, which is the most efficient



# ihmc *FastRunner*

way a physical system can move,” said Godowski.

The next step is to find grant funding to incorporate the concepts in a new, lightweight version of FastRunner, said Dr. Pratt. Initial prototypes will probably be smaller and less expensive than the full-sized FastRunner, which stands almost five feet tall.

“It’s moving along,” Dr. Pratt said. “Our simulations keep getting better and better, and our prototypes are getting better and better. Just putting it all together now is the tricky part.”

An ostrich-like runner, including one that soldiers could hop on and ride through rough terrain, or perhaps over the deck of a damaged aircraft carrier, has huge advantages over wheeled vehicles, said Dr. Chris Schmidt-Wetekam, mechanical engineer and IHMC research scientist.

“You can have tremendous torque with a bipedal that you just can’t get with wheels,” he said. “And you can have much better ground clearance, which is really a big deal.”

Employing the HexRunner spoked design for real-world applications may not be practical at full size, he said, because spoked runners need a minimum velocity to remain stable. And they need more help getting started.

“What we’re looking for is something that can go from standstill to walking to running in a heartbeat,” Dr. Schmidt-Wetekam said.

The team hopes to harness natural forces in ways that other labs haven’t considered. That means utilizing a

natural swing motion found in animal locomotion — not only a front-to-back motion but also the side-to-side swing produced by the pelvis. That makes for greater efficiency, a lighter step, and reduces the size of the motor needed for propulsion, the researchers said.

An oscillator, a small prototype of a running mechanism built in June by IHMC intern Will Stillman, seems to

one on the inside, and ones front and aft, the machine becomes more self-sustaining and highly efficient, Stillman said. At top speed, the oscillator used less than 15 watts of power, which suggests that a scaled-up version would require less energy than the original FastRunner.

Ultimately, the team hopes to apply its innovative ideas to not only running robots, but also to underwater swimmers,



Dr. Chris Schmidt-Wetekam works on FastRunner

bear that out: Springs placed in the correct positions act like muscles. With a spring on the outside of the “thigh bone,”

to exoskeletons that let paralyzed people walk again, and perhaps even to flying machines. ✨

# IHMC launches all-new CmapTools software for Web, iPad and Cloud

Thinking through a complex concept? Need to brainstorm it with others around the world, or around the classroom?

Now there's an app for that. As well as new, Web-based software, downloadable software, a Cloud to integrate them, and a new website to learn about it all.

"It's a whole new architecture for CmapTools," said IHMC Associate Director and Senior Research Scientist Dr. Alberto Cañas, the leading developer of what has become the world leader in concept-mapping software.

A downloadable version of CmapTools has been available from IHMC for more than a decade, and is used by millions

elementary and high school students," Dr. Cañas said. "It's amazing how fast elementary school students built the maps, and the speed at which they can build them using the iPad."

Concept maps are graphical tools for representing knowledge in an organized fashion. CmapTools empower users to construct, navigate, share and critique concept maps. The new iPad app is free, but to sync it with the Cloud and share the maps costs \$4.99.

The proliferation of the iPad created a demand for adapting the software for the versatile tablet, and should further spread Cmap use in the United States, where

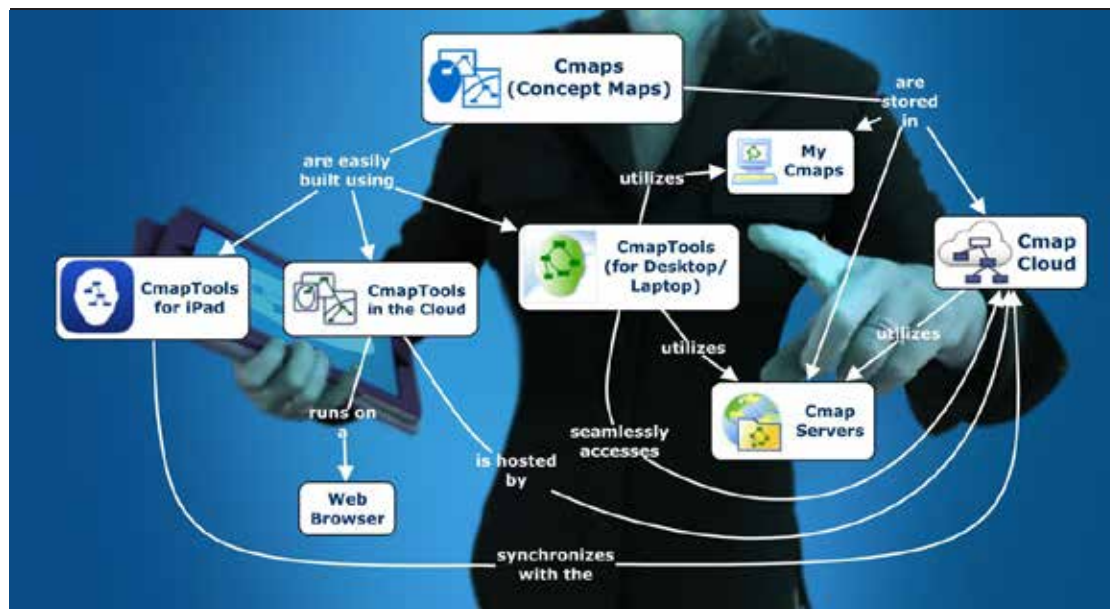
desktop or laptop, and also want to build your Cmaps on your iPad, you need a way to move the maps around," Cañas said. "We created the Cmap Cloud, which enables the iPad to sync the maps."

CmapTools is particularly useful because it forces users to think. Linking terms must be established between concepts. Users can also place links to documents, websites and videos directly on each concept box to provide further information. IHMC studies have shown that high school students in Costa Rica, for example, showed significant gains in graduation exams in the years after CmapTools were introduced there.

"Many people use concept mapping to brainstorm about ideas; they have a project or a paper to write, and might not be carrying their laptop around, but have their iPad. Just as you wouldn't write *War and Peace* on an iPad, but would use it for short documents, you want to be able to do your concept maps on it and, once it becomes a larger project, work with it on your laptop or desktop."

Cañas said concept maps originated with

Dr. Joseph Novak. Novak, an IHMC senior research scientist and professor emeritus at Cornell University, developed the idea in the 1970s with his research group at Cornell. They sought to track and understand changes in children's knowledge of basic science.



of people around the world to map out concepts and improve learning. After extensive development and testing, IHMC this spring launched the suite of new and updated software.

"During our testing, the iPad version of CmapTools was particularly popular with

iPads are most popular, Dr. Cañas said. Since the app was released in April, tens of thousands of users have downloaded it, and the web version has been adopted by a huge number of users, particularly educational institutions.

"If you are using CmapTools on your

“Once they started using concept maps, it was black and white,” said Dr. Novak. “Everyone could easily see how children were understanding the

out there, and Alberto has been traveling all over the world promoting it.”

Others at IHMC who helped develop the software include Research Associates

and web links that explain NASA’s Asteroid Redirect Mission. The mission aims to capture part of a large asteroid and move it into a stable orbit around



Dr. Alberto Cañas



Dr. Joseph Novak



Roger Carff



James Lott



Ron Van Hoof


concepts. It was amazing to us to see the precision with which they expressed their understanding.

“IHMC has been a godsend for me,” Novak said, “because they developed CmapTools, which is the best software

Roger Carff and James Lott and Senior Research Associate Ron Van Hoof.

To further complement the new Cmap releases, IHMC and NASA this spring published a jointly built iPad app that uses Cmaps to navigate through videos

the moon for further exploration and sampling. “This App is the best showcase of the power of concept maps and of the Cmap software suite,” Cañas said.

For more about the Cmap apps and web software, visit <http://cmap.ihmc.us>. 

# Dr. Suri promoted to senior scientist

Dr. Niranjan Suri, one of the country’s recognized leaders in making computer systems communicate in new and difficult conditions, has earned promotion to senior research scientist at IHMC Pensacola.

The position is something akin to a full professorship at a university, and recognizes Dr. Suri’s years of contributions to the field of computer science, particularly in the areas of agile and adaptable systems.


“I’ve known Niranjan for almost 25 years, and this recognition is well deserved,” said IHMC Director/CEO Dr. Ken Ford.

Dr. Suri, who has worked at IHMC since 1994, said he was honored by the promotion. “I’m looking forward to continuing my work here at IHMC and mentoring young researchers in this field,” Dr. Suri said.

Dr. Suri, 43, earned his master’s degree

in computer science at the University of West Florida, and a doctorate at Lancaster University, England. His latest projects involve work for all branches of the U.S. military, including enhancing network capabilities for software that allows soldiers to use Android-system smartphones and tablets for mapping, chatting and targeting. Another project helps computers sense the quality of a network and adapt the information being transmitted.

One area of his research aims to manage the flow of information to soldiers, using systems that learn the soldier’s surroundings, needs and preferences. Too much information in a battlefield setting can overload the soldier, or much of it may not get through on degraded and congested communications networks. That means computers must be able to discern the value of information in a given situation.

“It needs to figure out where you are, who you are, what the situation is, and what your likes and dislikes are so it can prioritize the information that’s being sent,” Dr. Suri said. “The old proverb of having the right information in the right place at the right time is still the end goal.” 



Dr. Niranjan Suri



## Undersea medicine scholar joins IHMC from Duke

A funny thing happened on the way to Dawn Kernagis' doctoral degree: She won a major research grant from the U.S. Office of Naval Research.

It was the first time ONR's Undersea Medicine program had awarded a grant to a pre-doctoral applicant — but it certainly was not the last major research project for Kernagis, whose work continues to shed new light on why some divers get the bends and some don't.

"The idea is that some divers are susceptible and some aren't because of genetics," said Kernagis, whose study will be published later this year.

Dr. Kernagis, who earned her doctoral degree from Duke University in 2012, has become known as a leader in the field of undersea medicine. She joined IHMC in Pensacola this spring, opening a new field of research for the Institute.

"I'm really excited to have the opportunity to build an undersea program through IHMC," Kernagis said.

A big part of her work will be focused



Dr. Kernagis at a cave dive in Peacock Springs, Florida

on optimizing performance and risk mitigation for war fighters in extreme environments. That includes Navy divers, who can face unseen enemies: decompression sickness, oxygen toxicity and nitrogen narcosis. Her location on the Gulf Coast is well-suited for work with the Navy's Experimental Diving Unit and diver training school, based in Panama City.

"We are very pleased to have Dawn join the IHMC team and I have every confidence that she will play a leadership

role in developing a focused research effort aimed at increasing resilience for operators in extreme environments, such as those working undersea, in space, or in high-altitude aviation," said IHMC Director/CEO Ken Ford.

Under pressure or when breathed at higher concentrations over an extended period, too much oxygen can damage the lungs and trigger seizures in the brain.

"The holy grail is to find a way to prevent oxygen toxicity," Dr. Kernagis said.

Dr. Kernagis, who earned her bachelor's degree in biochemistry from North Carolina State University and was a recipient of the Sigma Xi Undergraduate Research Award, knows first-hand about the risks and rewards of diving. She grew up in North Carolina, but learned to cave dive near Gainesville at age 15. She has spent many hours cave- and wreck-diving in Florida and around the world on research and exploration projects. For more than a decade, she was a diver and dive manager for a world-record breaking deep exploration project focused on the caves in and around Wakulla Springs State Park near Tallahassee. ✦

## New employees and a retirement at IHMC

IHMC welcomed several new staff members and lost one to retirement in the first half of 2015.

Communications Manager Carl Wernicke retired in April after almost

four years at IHMC. Prior to joining the Institute, Wernicke, a Pensacola native, was editorial page editor and writer for the Pensacola News Journal for 33 years. While at IHMC, he produced the

IHMC newsletter, wrote viewpoints for the newspaper, recorded radio interviews with lecturers and consistently spread the word about IHMC achievements and accomplishments.



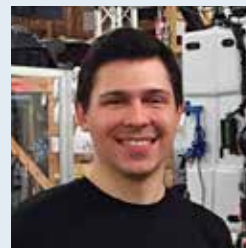
Carl Wernicke



Will Rabb



Stephen McCrory



Igor Kalkov



Tobias Meier

## Dr. Pratt named to Florida Inventors Hall of Fame

IHMC Senior Research Scientist Dr. Jerry Pratt, one of the world's leading researchers in the field of robotics, has been named to the Florida Inventors Hall of Fame. He joins an august group of inventors that includes the likes of Thomas Edison and Henry Ford.

Dr. Pratt holds four patents on robotics inventions and is one of seven people with Florida connections who will be inducted into the Hall at an October ceremony in Tampa. Others in this group, the second year of inductees, include scientist Dr. Robert Grubbs, winner of the 2005 Nobel Prize in chemistry, and Dr. Robert Holton, developer of a widely used cancer-fighting drug.

"Collectively, the seven 2015 inductees hold more than 430 U.S. patents," said Randy Berridge, chairman of the selection committee. "Their high merit has been recognized by national and international institutions and communities."

Dr. Pratt, leader of the IHMC Robotics

team that was awarded \$1 million in the DARPA Robotics Challenge Finals in June, said he was honored and humbled by the recognition.

"Sometimes I think what's most fun about working in robotics is that we are practically inventing the field every day," he said. "There's a long way to go before robotics is a mature field, and I am honored to join so many other people



Dr. Jerry Pratt

who are working to create the future."

Dr. Pratt, 43, holds a Ph.D. in computer science from the Massachusetts Institute of Technology. Before joining IHMC in 2002, Pratt's company developed a powered exoskeleton that

allowed a person to carry large loads over rough terrain with little effort. His other patents cover technology that allows bipedal robots to know where to place their feet when walking, and to maintain their balance and prevent falls.

His work has been instrumental in changing the stereotype of robots as clunky machines with jerky movements to ones that maximize speed, agility and biological similarity, said IHMC founder and CEO Dr. Ken Ford.

"We're really proud of Jerry; it's a well-deserved honor," Dr. Ford said. "Jerry's work personifies the subtle and rather beautiful virtuous cycle between acts of invention and acts of scientific discovery."

Dr. Pratt is married to former Pensacola city councilwoman Dr. Megan Benson Pratt. They have two children. Together the couple co-founded the Pensacola MESS Hall, a hands-on learning center where kids can explore Math, Engineering, Science and Stuff.

The Florida Inventors Hall of Fame, begun in 2013, is based in Tampa and seeks to recognize the leading scientific and technological accomplishments in the state. Nominees, who must have at least one U.S. patent, are submitted through an open nomination process and are elected by a committee of distinguished leaders in research and innovation throughout Florida. ✨

Wernicke and wife Patti raise chickens and till a large garden next to their solar-powered home on Garcon Point, just east of Pensacola. Their goal is to live off the land and off the grid as much as possible.

His role has gone to Will Rabb, another longtime newspaperman who worked in Pensacola, as well as Mobile, Ala., Charlotte, NC, and Jackson, Miss.

On the other side of the staffing picture, IHMC welcomed three new robotics research associates: Stephen McCrory, Igor Kalkov and Tobias Meier.

McCrory is from Pensacola and recently graduated with a bachelor's degree in physics and computer engineering

from the Massachusetts Institute of Technology. This spring, he worked on interface and control tools to help the Atlas robot drive the vehicle used in the DARPA Robotics Challenge.

A talented juggler and unicyclist, he plans to spend some time this summer performing with his friends on the streets of Boston, Mass.

Kalkov earned his master's degree in computer science in 2011 from RWTH Aachen in North Rhine-Westphalia, Germany. His research area for his doctoral thesis is real-time operating systems for mobile devices, but he found that much of that platform is similar to

the software used by Atlas. This spring, he worked to reduce delays in Java programming controls for Atlas, and to develop a "mission control" that allowed the robotics team to access all computer processors on the robot without having to input extensive commands. Kalkov returns to Germany this fall.

Meier is studying mechanical engineering at ETH Zurich in Switzerland, and holds a patent on a new type of elevator brake. At IHMC, he worked on his master's thesis while tackling a fundamental issue for the Atlas robot: using force feedback control for manipulation. ✨

## Hundreds turn out for Robotics Open House 2015



Running Man was the star attraction at the Robotics Open House

The IHMC Robotics Open House in Pensacola once again was a big hit with local students, teachers and parents, setting a new attendance record of 885 people. Despite a problem with leaking hydraulic seals that required the Atlas humanoid robot to be partially disassembled just an hour before the event began, all went well.

“It was really good. A big thing we learned was how important teamwork is, and how people all have to work together,” said a sixth-grader from St. John Catholic School in Panama City. Students from the school demonstrated the Lego Mindstorm robots they had built and programmed.

The 330 students and more than 500 adults at the event, held annually in conjunction with National Robotics Week in April, were able to watch Atlas rehearse most of the tasks he was slated to perform at the DARPA Robotics Challenge in June. (See related story.) NASA also allowed a video sneak peek at its own bipedal robot named Valkyrie, for which IHMC researchers contributed significant advances in 2015.

Niceville High School students also brought their own competition robot, known as Louis XV, and showed off some tricks it can do, said Brooke Layton, project manager and research librarian for the robotics group at IHMC Pensacola.

Students and teachers also watched video and demonstrations of other IHMC robots, including the FastRunner and its offspring, the HexRunner, which in 2013 set a speed record for legged robots.

“The reason I wanted to bring the robotics students was to see the FastRunner project,” said Adam Kelly, a teacher at St. John. “As a team, we’ve had a lot of discussion about using organisms as inspiration for mechanisms and behaviors in robotics. The FastRunner project did not disappoint in this regard.”

Kelly, in fact, had much to say about the open house, which was held at the IHMC Robotics Lab on Wright Street:

“This was a great opportunity to see it firsthand. Otherwise, the team can only see videos on the Internet. Robotics captures the imagination, but a firsthand

experience with what is being developed at the cutting edge of technology — that truly inspires,” Kelly said, “especially when the team can see big ideas such as the FastRunner being developed using prototypes such as the HexRunner. It shows how things as small as the Lego Mindstorm robots can develop concepts for much bigger creations.”

Other groups at the open house included the STEM (Science, Technology, Engineering and Math) Club from the Florida Panhandle Technical College in Chipley. Just a few months earlier, the club won first place in a regional school robotics competition after members were inspired by some of the innovations they saw at a November visit to IHMC, said Kathy Nelson, teacher at the college and sponsor of the club. 🤖



Students from St. John Catholic School in Panama City



## Science Saturdays teach, enthrall

“How does the throttle work? Do both wheels, or legs, move at the same time?”

That was the sharp-eyed question from 11-year-old Andrew Rhodes as he and 28 other school kids explored the world of running robots at the IHMC Science Saturday session in April.

“Oh, yeah, the kids asked wonderful questions,” said Dr. Sebastien Cotton, who led the April 25 session. Cotton, a former

popular learning experiences this spring.

The sessions are held once a month during the school year, and are led by IHMC researchers, university professors and other scientists, with help from student volunteers from area high schools.

The spring sessions in Pensacola this year included: Pendulums by Dr. Sylvain Bertrand; Lasers, Waves and Holography by Dr. Chandra Prayaga and Dr. Aaron Wade; and




Colton Black shows how the running robot is put together

IHMC research scientist, has formed his own company and plans to market a spinoff from IHMC's HexRunner robot project. Cotton and former IHMC intern Colton Black demonstrated how the running robots use gears, motors and sensors to speed across the floor and recover quickly from obstacles.

The session was the last of the spring season for the hands-on science education program that's designed for students in grades three through five. Altogether, almost 300 students from area schools participated in the ever-

Electric Circuits by Dr. Matthew Johnson.

Ocala sessions included: Food: What's in It? by Dr. Sunny Ferrero; Dolphins: Brainiacs of the Sea, by Dr. Lori Marino; Bridges, by Adam Dalton; and Paper Helicopters by Dr. David Atkinson.

“This was pretty good for me because I'm real interested in stuff like this,” said future engineer Andrew, of Cantonment, just north of Pensacola. “I like to figure out how things work before I use them. It's good to run some tests and get information first.” 

## Science Saturdays

*Science Saturdays is a hands-on science program for kids in grades 3, 4 and 5. Sessions are held one Saturday a month during the school year.*

*Past activities have included a widely diverse list of subjects, including lemon batteries, roller coasters, bridges, slime and secret codes.*

### FALL 2015

#### PENSACOLA

**September 26** - Mathemagic  
*Presented by Dr. Jerry Pratt, IHMC*

**October 24** - Fun with Chemistry  
*Presented by Jamie Zigterman, UWF*

**November 21** - Paper Helicopters  
*Presented by Dr. Chris Schmidt-Wetekam, IHMC*

**December 19** - Biodiversity  
*Presented by Dr. Sandy Raimondo, EPA*

#### OCALA

**September 12** - Oceanography  
*Presented by Deidra Boodoo of Rasmussen College*

**October 3** - Jello Lenses and Lasers  
*Presented by Dr. Greg Dubbin, IHMC*

**November 7** - Roller Coasters  
*Presented by Dr. Kristy Hollinshead, IHMC*

**December 5** - The Water Cycle  
*Presented by members of the Florida Engineering Society*

## Rogacki named deputy director of Doolittle Institute

IHMC Associate Director John “Row” Rogacki has been named deputy director of the Fort Walton Beach-based Doolittle Institute, a not-for-profit organization designed to support the U.S. Air Force Research Laboratory.

Dr. Rogacki will continue working with IHMC in Pensacola, and the arrangement will allow synergy between the two organizations and help IHMC expand its interaction with defense-based research across the Florida Panhandle.

“It’s good for all parties to see that IHMC has boots on the ground in the Fort Walton Beach area,” said Dr. Rogacki, who has been with IHMC since 2010. Doolittle has daily interaction with Eglin Air Force Base and Hurlburt Field near Fort Walton Beach, and regular interactions with Tyndall Air Force Base and the Naval Surface Warfare Center in nearby Panama City. “This will help IHMC form more relationships and collaborate with research programs in this area,” Dr. Rogacki said.

“His experience, expertise and judgment

make Dr. Rogacki an ideal selection to serve as deputy director at the Doolittle Institute,” said IHMC Director/CEO Dr. Ken Ford.

The Doolittle Institute, which started in 2012, is named after famous World War II aviator Jimmy Doolittle, who led the

bombing raid on Japan in 1942, four months after the attack on Pearl Harbor. Not only was Doolittle a brilliant aviator, Dr. Rogacki said, he also was a technical wiz and innovator with a doctorate in engineering. He and his crews trained for their carrier-based bombing run at what later became Eglin AFB.

The Doolittle Institute is the fifth such institute funded by the Air Force Research Lab, with others scattered around the United States. Doolittle will be the first one in the Southeast, and was needed in part to support the lab’s Munitions Directorate at Eglin, which develops conventional air-delivered munitions technology.



Dr. John “Row” Rogacki

Besides working to transfer appropriate technological advances to and from industry and academia, Doolittle also is charged with supporting and promoting STEM education (science, technology, engineering, mathematics and medical fields); workforce development; and providing neutral-ground meeting facilities that are outside the gate of government installations.

Dr. Rogacki graduated from the Air Force Academy with a degree in engineering mechanics, then earned his Ph.D. in mechanical engineering from the University of Washington. Prior to joining IHMC, he served as director of the University of Florida’s Research and Engineering Education Facility, which supports the Air Force’s research and education needs. ✚



Jimmy Doolittle

## IHMC launches podcast featuring top people in science

This fall, IHMC will embark on an ambitious series of interviews featuring some of the most interesting people in the world of science and technology.

“This new podcast will feature interviews with fascinating people who passionately inhabit the scientific and technical frontiers of our society,” said IHMC Director Ken Ford. “It’s just the most interesting people thoughtfully interviewed in long-format discussions.”

Initial hosts for the shows include IHMC Communications Coordinator Will Rabb, a veteran journalist; IHMC

Research Scientist Dawn Kernagis, a leader in the field of undersea medicine; and Tom Jones, a planetary scientist, former astronaut and IHMC senior research scientist.



Dr. Dawn Kernagis



Dr. Tom Jones

Podcasts have taken the world by storm in recent years, Ford said. They have proven to be popular because, with the ubiquity of smart phones, tablets and laptops, people can listen to the segments anywhere, anytime, while doing other, less interesting things, such as driving, cooking or running.

“I’m really excited about this,” Dr. Kernagis said. “This is a great opportunity for IHMC to explore some of the boldest ideas in science and technology today.”

To hear the podcast series later this year, check the IHMC website. ✚

## Ron and Phyllis Ewers honored for community service

The Ocala-based Interfaith Foundation this year honored IHMC Board Chairman Ron Ewers and his wife Phyllis with its Legacy of Love Award for the couple's years of philanthropy and community service.

The Ewers' community involvement is well known in central Florida. Among other efforts, they are credited with being the force behind fundraising efforts that built the Ewers Century Center, the flagship building at the College of Central Florida in Ocala, as well as a recent expansion of the nursing program at the college, officials said.

"I often think, 'What would this community look like if it weren't for Ron and Phyllis Ewers and the impact they've had here?'" said Ann Spang, IHMC's assistant director for community relations in Ocala.

Ron Ewers is president of Ewers Consulting in Ocala and has been part owner of a number of companies, including Classic Fire, known for its innovations in fire-fighting equipment. Before that, he was president of E-One, one of the world's largest manufacturers of fire trucks and equipment. He also has served as chairman of the board for the local economic development council and for the Munroe Regional Medical Center, and has been a board member for the Boys & Girls Club, the College of Central Florida, and Workforce Connection, among other organizations.



Ron and Phyllis Ewers

Phyllis, who also was involved in the fire equipment companies' leadership, has served as a board member for the College of Central Florida Foundation for 12 years, and is a founding member of the United Way's Women of Worth and the American Heart Association.

The Ewers' giving spirit also has been widely recognized: In 2007, the couple was honored nationally as one of the top 10 Benefactors of the Year to the nation's community colleges, according to news reports.

The Interfaith Foundation of Marion County is a not-for-profit organization that works to help the neediest families in the Ocala area.

## New IHMC building going up in downtown Pensacola

Construction of the new IHMC building in Pensacola is progressing smoothly and should be completed by spring 2016, according to architects and contractors involved in the 30,000-square-foot project. In June, crews erected five truckloads of steel framing, and poured the first-floor concrete slab two weeks later.

"Right now, it's about 25 complete," Phil Turner, IHMC's director of architectural and engineering services, said in July.

Work on the \$8 million project began in February and has proceeded with only minor delays due to spring rains, Turner said. Hewes and Company of Pensacola is the general contractor.

The three-story brick-and-glass structure is going up next door to IHMC's main building in downtown Pensacola, and will be both an expansion and a consolidation for the institute. It will more than double the laboratory and office space and will put most of IHMC's Pensacola work, now spread between four buildings, at one location.

The ground floor will include a three-story, open-air lobby area, an expanded Robotics Lab and a multi-modal interfaces lab focused on sensory displays and human-centered interfaces. One corner will house a huge sphere designed to research devices that can help people with vision and balance problems. The second floor will feature a glass-walled

observation area for public tour groups.

Another interesting feature will be the DIRT walls in one lab, Turner said. DIRT stands for Do It Right This Time, and offers a modular approach, with pre-finished wall panels, glass marker board with video screens behind the glass. Much of the wall space will include magnet board for notes and posters.



Crews arrived before sunrise to pour the first-floor concrete slab





## ROGER SMITH

As apex predators, raptors can quickly let us know if something's out of kilter in the environment. "When they're not there, it means some other piece of the puzzle is not there as well," said Wyoming raptor biologist Roger Smith.

A few years ago, Smith began finding dead fledgling red-tailed hawks all around Teton National Park. After careful observation, he found still-living birds covered in black flies. The flies were native to the nearby Snake River, but because summers have come earlier in recent years, the flies had begun hatching earlier – which for the first time coincided with the hawks' hatching season. The flies transmitted protozoa that damaged the birds' organs.

Smith is the founder of the Teton Raptor Center in Jackson Hole, Wyoming, which has become famous for its pioneering studies on birds of prey.



## DR. TONY RYAN

Regardless of global warming, humanity must make a major shift to solar and wind energy if it hopes to survive the next few decades, said Dr. Tony Ryan, who spoke in February at IHMC as part of the University of West Florida's William D. Smart Lecture Series in Chemistry.

The world's population by mid-century will reach 10 billion, a figure that is unsustainable with a fossil-fuel-based economy, said Ryan, who is pro vice chancellor and chemistry professor at the University of Sheffield in England. With coal and petroleum – and petroleum-based fertilizers and pesticides – in finite supply, and costs and pollution rising, humans must return to their pre-Elizabethan roots of relying on solar energy for food production, Ryan said. Ryan's book, *The Solar Revolution*, explains the urgency and the advances being made in this field.



## LEON KRIER

Leon Krier is a leading proponent of what's called "New Classicism" in architecture and community design. It is a revolt against Modernism, which critics say has burdened us with increasingly expensive, overcrowded big cities.

Krier spoke March 25 at IHMC in Pensacola, where he argued that the most livable cities reflect the natural development of diverse, walkable communities that meet the needs of people through human-scale streetscapes. He charges that the Modernist movement, led by architects such as Le Corbusier in the 1920s, has produced high-rise urban nightmares now choking on skyrocketing costs and drowning in street-clogging density.

He spoke highly of the changes in downtown Pensacola, which he had last visited 13 years earlier. Since then, the downtown area, where IHMC is located, has blossomed with retail, office, entertainment and residential growth.



## DR. RHONDA PATRICK

Mom was right: Eat your vegetables. Especially green, leafy vegetables. But the reasons for that are far more complex than mom ever dreamed of, said Dr. Rhonda Patrick, a biochemist at Children's Hospital Oakland Research Institute, who spoke April 8 to an overflow crowd at IHMC in Pensacola.

Greens contain magnesium, which helps DNA repair itself and prevent cancer. Green veggies also provide folic acid. People who are folic acid-deficient can see their chromosomes damaged as much as if they had been irradiated, Patrick said. Other micronutrients are also more important than once believed. A lack of vitamin D, for example, may now be linked to many diseases, Patrick said. It also has been shown to protect telomeres and slow the aging process. Patrick is not only a leading researcher in this field, but she has made an effort to inform the world. Her educational videos can be seen at her website, FoundMyFitness.com.



## GRANT PETERSEN

The first bicycle, circa 1816, was born of necessity when a German forest ranger and carriage maker's horses fell ill after climate change and crop failure. The "Draisine" was made mostly of wood and was foot-powered.

Since then, bicycles have evolved in fits and starts, and not always for the better, said Grant Petersen, an author and bicycle designer who spoke at IHMC Pensacola in May. He blamed racing's influence for some of the worst designs of the past and the present, suggesting that racing has taken some of the fun out of biking.

For bikes to flourish as commuter vehicles in the near future, more cities should add bike paths that separate them from cars, said Petersen, whose California company manufactures a brand of sturdy, old-school, steel lugged-frame bikes. He also predicted that in the near future, more big-name companies, including Apple and Tesla, will offer electric bicycles.



## DR. SHALESH KAUSHAL

The retina is the most metabolically active tissue in the body per unit weight, and the eye has the largest blood supply per unit weight in the human body. It has at least nine identifiable structural layers, with at least 15 different cell types. Thus, it serves as an excellent organ system to demonstrate energy metabolism, homeostasis, nutritional modulation and endogenous stem-cell activity of disease states as well as inflammation, oxidative stress, mitochondrial dysfunction, and immune regulation that lie at the heart of so many chronic diseases, Dr. Shalesh Kaushal told an audience at IHMC Ocala in January.

Kaushal practices at the Retina Specialty Institute with three offices in Florida. He earned his bachelor's degree at Yale University in molecular biophysics and biochemistry, and his M.D. at Johns Hopkins and a Ph.D. at MIT. While at the University of Florida, Kaushal held the Shaler Richardson Chair in ophthalmic services.



## DR. THOMAS SEYFRIED

Dr. Thomas Seyfried has taken a somewhat unconventional view on the causes of cancer, arguing that it's not in our genes, after all. Emerging evidence, he said, now indicates that cancer is primarily a metabolic disease involving disturbances in energy production through respiration and fermentation. Cancer is suppressed following transfer of the nucleus from the tumor cell to cytoplasm of normal cells containing normal mitochondria. These findings indicate that nuclear genetic abnormalities cannot be responsible for cancer despite commonly held beliefs in the cancer field. The genomic instability observed in tumor cells and all other recognized hallmarks of cancer are considered downstream of the initial disturbance of cellular energy metabolism.

Dr. Seyfried is a senior editor of ASN Neuro. He was a postdoctoral fellow in the Department of Neurology at the Yale University School of Medicine and then served on the faculty as an assistant professor in neurology.



## DR. LORI MARINO

Just because it's not human doesn't mean it's not intelligent. And we now know that dolphin and whale intelligence is similar to human cognition, said Dr. Lori Marino, a neuroscientist, cetacean expert and founder and director of the Kimmela Center for Animal Advocacy in Utah. She spoke March 5 at IHMC in Ocala.

Humans haven't shared an ancestor with dolphins for 97 million years, and we evolved in very different environments. Yet we recognize so much of cetacean behavior, including social mores, synchronized actions, self-awareness, even use of tools, Dr. Marino said. Dolphins and whales evolved brains that are larger than humans' brains, starting about 35 million years ago. Although human brains are the largest on the planet compared to body size, dolphins are close behind. And we didn't evolve our large brains until about one million years ago.



## DR. JAY DEAN

The air war over Europe was as much a physiological war as it was a battle of planes and artillery, said medical historian and hyperbaric research professor Dr. Jay Dean. While American bombers flew as high as 40,000 feet in World War II to evade Nazi anti-aircraft fire, pilots faced extreme cold, hypoxic conditions, blurred vision, impaired judgment and decompression sickness, said Dean, who spoke at IHMC Ocala on April 15.

To overcome these unprecedented physiological challenges, the military poured resources into labs that simulated low-oxygen and low-pressure environments. One courageous researcher even jumped from an airplane to learn the best way for crews to parachute from extreme altitude. One of the biggest lessons learned is still in use today: American researchers determined that pre-breathing oxygen-rich air before high-altitude flights prevented decompression sickness.



## DR. BRUCE AMES

A huge chunk of the American population, particularly poor people, do not gain enough essential vitamins and minerals in the diet. This leads to premature aging, disease and diminished cognitive ability, said Dr. Bruce Ames, who is perhaps the world's best-known biochemist-turned-nutrition-researcher.

"Are we getting enough of these micronutrients? The answer is a big, fat, 'no,' said Ames, a senior scientist at Children's Hospital Oakland Research Institute. Over the eons, humans have evolved a way to deal with this problem: The body channels precious nutrients toward survival and reproduction – but sacrifices longevity, Ames' research has shown.

Ames is best known for inventing the test that determines the mutagenicity of compounds. But in recent years, he has turned his lab's attention to nutrition, which he calls "a wonderfully muddy field."



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