

Bulletin *of the*

CONNECTICUT ACADEMY OF SCIENCE AND ENGINEERING



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SPOTLIGHT ON INNOVATION in the 21st Century ... ready or not?

As the world comes to terms with COVID-19, students and teachers are schooling from home, ordinary citizens are making face masks, Ford and Bauer and other companies are reconfiguring production lines to make much-needed medical equipment and IBM is helping launch a consortium that brings unprecedented computing power to understanding the virus, its treatments and potential cures. Innovative thinking like this is the subject of the CASE 2020 Annual Meeting keynote address "Innovation in the 21st Century...ready or not?" presented by CASE Members Nicholas Donofrio and David Ferrucci.

In 2017, Connecticut spent more than \$8.5 billion on research and development. While that number is impressive, it only tells part of Connecticut's innovation story.

"Innovation is about more than invention, creation and discovery," Donofrio said. "It is about creating real value for business, for government, for education, for society by applying your knowledge through products, services and technologies in unique and new ways to unlock hidden value."

Ferrucci agrees, saying that COVID-19 is forcing people to think differently, which will lead to innovation. "People are using knowledge and technology in ways never before imagined to develop new vaccines," he said. "People are looking at what has worked before in other domains, including Biomimicry (our knowledge of solutions that exist in the natural world), and transferring it to this domain. That is innovation.

"We need to be careful to never be satisfied with 'good enough'; that goes for companies and nations," Ferrucci said. "The desire to make tomorrow better than today is part of the DNA of innovative organizations and people."

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Donofrio, Ferrucci to Address [Virtual] CASE Meeting

Nick Donofrio, a CASE member since 2016, is IBM's former Executive Vice President of Innovation and Technology and was also named a Fellow in 2008 (now Fellow emeritus), the company's highest technical honor. He holds seven patents.



Nick Donofrio

During his 44-year career at IBM, he led many major development and manufacturing teams from semiconductor and storage technologies, to microprocessors and personal computers, to the company's entire family of servers.

In 2012, he served as an independent advisor for an American intelligence agency. The previous year, he chaired a year-long evaluation of the relationship between the State of Vermont and the University of Vermont. He was a member of the Prime Minister of Taiwan's Science and Technology Advisory Board (2008-11), a senior fellow at the Kauffman Foundation (2009-12) and co-chair for the Secretary of Energy's Advisory Board (2009-12).

He served for many years on the board of directors for the National Action Council for Minorities in Education (NACME) and as its chairman from 1997 through 2002. He spent years on the board of directors for INROADS, a nonprofit organization focused on developing talented minority students for careers in business and industry.

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CASE Statement on COVID-19

The Academy recommends that Connecticut residents use the most reliable, coordinated source of information about COVID-19 when making decisions to plan, prepare and respond to the outbreak. This recommendation follows from the National Academy of Medicine's commentary "COVID-19: An Urgent Call for Coordinated, Trusted Sources to Tell Everyone What They Need to Know and Do" (Mar. 5).

For Connecticut, Governor Ned Lamont has established <https://portal.ct.gov/Coronavirus> for the latest information, resources and guidance on COVID-19. The site includes updates from the CT Department of Public Health State Laboratory on the results of state testing for COVID-19 and is the source for state and national information.

Additionally, the Governor announced the launch of a COVID-19 Infoline in partnership with the United Way of Connecticut for general questions. The infoline can be accessed by calling 2-1-1 or texting "CTCOVID" at 898211.

The Academy's mission is to provide expert guidance on science and technology to the people and to the state of Connecticut and promote the application of science and technology to human welfare and economic well-being. CASE members are among the many scientists at institutions throughout the state actively engaged in research into all aspects of COVID-19, from the nature and origins of the virus itself to drug therapies and vaccines.

The Academy's members and member networks are available to provide guidance during this current outbreak and will remain available to respond to scientific and technological issues that affect the people and the state of Connecticut in the future.

Donofrio shared the following tips to encourage innovative cultures:

- Start with the problem ... stare at it; understand it better than anyone else in the world—then unlock hidden value in a unique way
- Enable people in the organization to act in an openly collaborative, multi-disciplinary way
- Believe that everyone in the organization is an innovator; being innovative is not the privilege of a chosen few, it is accessible to anyone who can start with a problem and sit back and think; nontechnical people are often closer to the problem or see it from a different perspective ... every person in the organization has innate value and innovation potential
- Inclusion, diversity and equity matter; the more people looking at a problem from different perspectives, the better the solution; no one person will be the singular innovator
- Real innovation exists at the intersection (not the overlap) of things; within the crack where no one has ever dared to tread

“When you build that environment, it becomes a petri dish that allows everyone to do great and wonderful things,” Donofrio said.

Ferrucci offered additional thoughts:

- Establish clear, ambitious top-level goals; don’t get distracted
- Hire great talent that is aligned with the vision
- Establish clear metrics; this is difficult, but critical, because you will lose morale if you don’t see progress

The Connecticut Academy of Science and Engineering

The purpose of the Academy is to “provide guidance to the people and the government of the State of Connecticut ... in the application of science and engineering to the economic and social welfare.”

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COPYING PERMITTED, WITH ATTRIBUTION

- Make incremental investments; as the project performs against the metric, increase the investment
- Be willing to start parallel efforts with one focused on a riskier approach and another following a more “legacy” trajectory; keep each team’s leadership separate, but rotate team members among the teams so they can think differently about the same problem—this can be disruptive, but yield more promising thoughts
- Be agile; be ready to kill projects/elements that don’t work so you can shift resources to the most promising things

“Shareholders must realize that the greatest long-term risk is the failure to innovate,” Ferrucci said. “Organization leaders must have a vision for the future and balance that with present demands. If you lose sight of the present, you lose the future, too; balance is key. Look at Kodak and digital photography; that was a tragic loss of missed opportunity. To make innovation practical, you have to be in touch with employees and customer needs.”

So how does that translate to real-life?

Long before E-ZPass, Donofrio and his colleagues at IBM used existing and emerging technologies to devise a traffic management system for the Swedish city of Stockholm. “There was no blueprint for this at the time,” he said. “We got into the primordial ooze of the traffic and congestion issues. We started with the problem and worked our way to a solution that involved a road-charging system that varied tolls by certain time and day, enhanced park-and-ride services and improved transit options.

“The solution cost less than building a bridge, took into account the views of all factions of the government (Left, Centre and Green Parties), reduced traffic flow by 40-50% during certain hours and reduced greenhouse gases by 50%,” he added. “There wasn’t any new technology developed, but the creative, new application of existing knowledge provided societal, governmental and economic value ... THAT was the innovation!”

Another example he cited is the iPod. In the late 1990s, MP3 players were not user friendly, had limited storage and took a long time to upload music. The alternative was an awkward hard drive player. “And Napster had proven exactly how not to do it,” Donofrio said.

“Steve Jobs started with the problem and dug deeper,” Donofrio said. “There was no discovery or technology innovation; yet that product is viewed as one of the most innovative things in the world. Jobs saw a problem, worked his way backwards and understood the problem in such a way that he applied his knowledge to unlock a hidden value.”

“If there is no real social, economic or educational value created, there is no innovation,” Donofrio said. “Just to invent, with no value, is not innovation.”

Ferrucci agreed, saying that without practical value, people will not invest in the innovation. He also encouraged company leaders to invite and reward critiques of their products. “If you make dog food, eat your own dog food,” he said. “Ask your employees to tell you all of the ways your product falls short. Honest critiques are the precursor to innovation.”

Donofrio and Ferrucci agree that organizations need buy-in from top management to foster innovation, but Ferrucci believes that innovation also can come from grass roots efforts. “It’s a hard thing, but it can be done,” he said. “It has to be tied to a pending threat or opportunity and be timely in nature and be presented persuasively to upper management.”

He cites his own experience with AI technology and, ultimately, as principal investigator for Watson, a computer capable of answering

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IN BRIEF

Science and Engineering Notes from Around Connecticut



Biomedical Research

UCONN HEALTH PIONEERS HERNIATED DISC TREATMENT.

UConn Health's Comprehensive Spine Center announced it was the first facility in Connecticut to use the AnchorKnot® Tissue Approximation Kit for herniated disc repair. This system uses tools that control and stabilize tissue closure, allowing surgeons to suture tissue when the procedure is performed in a minimally invasive fashion through a less than 1" incision.

YALE DNA SEQUENCING PROJECT LAUNCHED.

Yale School of Medicine and **Yale New Haven Health System** recently launched Generations, one of the largest DNA sequencing projects of its kind in the United States. The program will enroll more than 100,000 patients in and near Connecticut whose DNA will then be analyzed by Yale scientists to develop useful data for predicting, preventing, and treating hundreds of gene-related conditions. Generations will provide those who give blood samples with the relevant personal genetic information that it finds.

UCONN HEALTH REPORTS INCREASED PATIENT CARE VOLUME.

UConn Health issued its final biennial Bioscience Connecticut Report to the **Connecticut General Assembly** in October. According to the report, UConn Health's patient care volume has steadily risen by 7-9% per year since 2013; clinical revenue from patient care currently represents 50% of UConn Health's annual \$1.2 billion budget. In fiscal year 2019, outpatient visits were up by 7% compared to the prior year for a total of more than 800,000 visits.

ABCT TAPS BIOSCIENCE VENTURES FOR PROGRAM.

Accelerator for Biosciences in Connecticut (ABCT) announced the second cohort of emerging biosciences ventures invited to participate in the annual program. Twelve ventures participate in the 6.5-month-long program to develop fundable business plans and a professional network. Startups receive an entrepreneur coach, access to business professionals and support with preparation to pitch to investors.

BIOTECH FIRM TO EXPAND TO BRANFORD.

Azitra Inc. recently announced plans to relocate to **Branford** for larger lab space than it presently occupies in **UConn's Technology Incubator Program** in Farmington. Azitra, founded by **Yale** scientists in 2014, is a biotech firm developing dermatological medicines by leveraging the good bacteria that live naturally on the skin.

YALE STUDY EXAMINES VASCULAR GRAFTS FROM STEM CELLS.

Jiesi Luo, a postdoctoral associate in medicine at **Yale School of Medicine**, was first author of a study that researched development of vascular grafts from stem cells that are as strong as the original blood vessels they would replace. Currently, most grafts come from blood vessels located elsewhere on the patient's body or Teflon and Dacron, as well as grafts donated from another person's vein.



Business & Industry

SIKORSKY ADVANCES TO PHASE TWO IN FARA COMPETITION.

The US Army has selected **Stratford**-based **Sikorsky Aircraft**, a

Lockheed-Martin company, and Bell to advance to the second phase of a competition to design and test Future Attack and Reconnaissance Aircraft (FARA) Competitive Prototypes. During phase two, the two companies—selected out of an initial field of five—will complete a detailed design, build and test helicopters. The winner of the FARA contest will be selected in a fly-off competition no later than the fall of 2023. According to *Defense News*, "the Army is planning to procure both a FARA and Future Long-Range Assault Aircraft (FLRAA) that will slowly replace the current fleet of Sikorsky-manufactured UH-60 Black Hawks utility helicopters and Boeing-made AH-64 Apache attack helicopters."

USAF ELECTRONIC FUSE ORDER TOPS \$270M.

Kaman Corp.'s aerospace unit received a \$42 million order from the US Air Force for electronic fuses for arming warplane bomb loads last fall. This brings their order for joint programmable fuses to \$271 million, including an order in April for \$48.6 million. The fuses are produced at Kaman facilities in **Middletown** and Orlando, Florida.

CT SEA GRANT TO LEAD SEAWEED HUB INITIATIVE.

Connecticut Sea Grant will lead the establishment of a **National Sea Grant Seaweed Hub** using \$1.1 million in federal funds. An additional \$1.2 million in federal funds will support the growth of southern New England shellfish aquaculture. The hub will offer resources on seaweed research and **UConn Aquaculture Extension** efforts, as well as planning and outreach for government agencies, seaweed growers and stakeholders in the culinary and nonfood sectors. The shellfish project will expand training for growers and for those who make aquaculture permitting decisions.

P&W WINS RECORD F135 PRODUCTION CONTRACT.

Pratt & Whitney announced that it was awarded a contract for F135 propulsion systems, powering all three variants of the F-35 Lightning II aircraft. This award represents the largest-ever F135 production contract, funding more than 332 engines for the US armed services and international customers, and includes program management, engineering support, production support, and tooling. The total contract value is approximately \$5.7 billion.

AMERICAN GREENFUELS GETS ENVIRONMENTAL AWARDS.

Bridgeport-based **American GreenFuels, LLC**, announced that its biodiesel product received two UL Environmental Claim Validations: (1) Recycled Content and, (2) Byproduct Synergy. American GreenFuels' manufacturing plant, located in **New Haven**, uses waste products from other industries to produce its certified biodiesel, which often includes waste oils like used cooking oil from restaurants and/or food factories.



Communication

HOSPITAL ADOPTS EPIC RECORDS PLATFORM.

Charlotte Hungerford Hospital has merged their medical information onto the Epic Systems EHR platform. With Epic, the patient, providers, and specialists will all be on the same portal and can access health records, test results, and other health data instantly. Providers will be able to quickly access patient documents and connect with their patients. This new platform will eliminate redundancies and ensure high quality results, health system representatives said.

EPLUS WINS STATE TECHNOLOGY CONTRACT.

ePlus Technology, Inc., was awarded a five-year contract to provide Cisco

Items that appear in the In Brief section are compiled from previously published sources including newspaper accounts and press releases. For more information about any In Brief item, please call the Academy at (860) 571-7143, or contact us at acad@ctcase.org.

IN BRIEF

Science and Engineering Notes from Around Connecticut

technology products and services to the state of Connecticut. K-12, state government and local governments, and higher education Institutions. ePlus services include a combination of hardware, software, peripherals, telecommunications, networking, maintenance, integration, leasing, asset disposition, and support services.

CT TO PARTNER WITH AT&T TO ENHANCE SERVICE. The state is joining with AT&T in a new public-private partnership to deploy cutting-edge technology along the **New Haven Line**—the busiest commuter rail line in the United States—that will vastly enhance and improve the traveling experience of commuter. Under the plan, which includes a multi-million dollar investment from AT&T, the state will give AT&T access to state property for the build-out of the network, which includes 30-foot towers and rooftop antennae along the New Haven train corridor. Network enhancements will provide 4G LTE service today, which the company can upgrade, via software, to 5G as that technology matures and customer demand calls for it.

Education & Cognition

QUINNIPIAC TO LAUNCH RURAL FAMILY MEDICINE RESIDENCY. **Quinnipiac University** has received an award of \$750,000 from the US Department of Health and Human Services to start a medical residency program at Northern Maine Medical Center in Fort Kent, Maine, and Northern Light AR Gould Hospital in Presque Isle, Maine. The award will help fund the university's first family medicine residency program to train residents to help with the shortage of physicians in rural parts of the country.

CT STUDENTS NAMED AMONG 'TOP 300 MASTERS.' **Gabriella "Ella" Brown** (grade 7, **Westside Middle School Academy**, Danbury), **Lorraine F. Hillgen-Santa** (grade 7, **Hamden Hall Country Day School**, Hamden), and **Payton Noe** (grade 8, **Sacred Heart School**, Groton) were the three Connecticut students named **Top 300 MASTERS** in the 2019 Broadcom MASTERS, a program of Society for Science & the Public. The students were three of the six students awarded at **2019 Connecticut Science & Engineering Fair**.

UCONN CAMPUS AMONG SUSTAINABLE. **UConn** was ranked among the top five of more than 800 schools in the Association for the Advancement of Sustainability in Higher Education's (AASHE) 2019 Sustainable Campus. Categories include: building design, food and dining, waste, water, and grounds. UConn has 23 LEED certified or registered buildings, raising its standard from LEED Silver to LEED Gold, with a goal to achieve carbon neutrality by 2050.

CT SCHOOLS AMONG TOP IN STEM EDUCATION. Nineteen Connecticut schools made the top 500 list for STEM education in the country. The top three are **Hopkins School** in New Haven, ranked 21st; the **Academy of Aerospace and Engineering** in Windsor, ranked 45th; and **Choate Rosemary Hall** in Wallingford, ranked 56th.

'TECH FOR TEACHERS' PROGRAM LAUNCHED. **MakerspaceCT** has launched its Tech for Teachers program in partnership with the **Hartford Foundation for Public Giving**. The Tech For Teachers program spans one year with two cohorts of teachers who will be introduced to electronics, computer science and advanced manufacturing concepts through intensive workshops for a total of 18 hours of direct instruction in the Arduino microcontroller, Linux and the Raspberry Pi single board computer, and the assembly and use of a 3D printer. Each teacher enrolled in the program receives a standard membership to MakerspaceCT's electronics, digital fabrication and software stations for the duration of the program. Afterwards,

participants can return for a series of ongoing 3D printing workshops where they have the opportunity to bring their printers for service, support and continued education with MakerspaceCT instructors and experts. All materials, supplies, electronics components, support, consumables, and kits are supplied by MakerspaceCT.

UCONN, SYNCHRONY EXPAND PARTNERSHIP. **Synchrony** and **UConn** have expanded their four-year partnership to advance technology education and digital expertise. The partners celebrated the opening of the **Digital Technology Center** at the **UConn Stamford** campus and announced the first \$1 million gift to **UConn's Connecticut Commitment**, an initiative that provides free tuition to low-income, in-state undergraduate students. The new center focuses on research, education and innovation around digital and mobile capabilities.

Energy

FIRST COMMUNITY SOLAR PROJECT ENERGIZED. **Ameresco, Inc.**, announced that the first project under Connecticut's **Shared Clean Energy Facility Pilot Program** has been energized. In conjunction with the **Clean Energy Collective** (CEC), the 2MW community solar project is located on the grounds of the **Bloomfield Board of Education**. This initial community solar offering allows the option for residents, governments and businesses to choose community solar energy for the first time.

STATE OKAYS MILLSTONE CONTRACT. **Connecticut's Public Utilities Regulatory Authority** (PURA) has approved a contract between the owner of the **Millstone Nuclear Power Station** and the state's two major electric distribution utilities: **Eversource** and **The United Illuminating Company**. Connecticut officials say the agreement will give the state and region more time to expand renewable and other clean energy resources, including offshore wind power.

CHP TECHNOLOGY BRINGS MORE FOCUS ON ENERGY ISSUES AT UCONN. **CASE member Lee S. Langston**, Professor Emeritus at **UConn's Mechanical Engineering** department, published an article outlining the benefits of UConn's natural gas-fueled turbines that have generated the energy for UConn's Storrs' campus since 2006 using CHP (Combined Heat and Power) technology. According to Langston, since using CHP technology and its reliance on recycling waste heat, the university is more attentive about general energy issues, including building a Reclaimed Water Facility in 2013 to pump treated water from the university's sewage treatment plant to the CHP plant for both cooling towers and for boiler makeup water, eliminating the need to use drinking water to cool the plant.

VINEYARD WIND AWARDED CT OFFSHORE WIND PROJECT. **Vineyard Wind's** 804 MW Park City Wind Project was selected as the winner of a major offshore wind solicitation by the **Connecticut Department of Energy and Environmental Protection**. The company will negotiate with **Eversource** and **The United Illuminating Company**, with completion of the project in 2025. Vineyard Wind competed with Orsted and Shell for the project.

HARTFORD FIRM FOCUSES ON ENVIRONMENTALLY FRIENDLY BOILER TECHNOLOGY. **Hartford's Enviro Power** reported it has raised \$1.5 million from **Connecticut Innovations** and Pennsylvania-based Burnham Holdings to bring environmentally friendly boiler technology to market. Enviro Power's SmartWatt Boiler is designed to generate "close-to-zero-cost" electricity and backup power. Enviro Power is a seven-employee company based in the Fuller Brush complex on Main Street in Hartford.

IN BRIEF

Science and Engineering Notes from Around Connecticut



Environment

UNACCEPTABLE PFAS LEVELS IDENTIFIED. Testing conducted late last summer showed high levels of potentially toxic PFAS draining out of the long-closed **Hartford** landfill, through a sewage treatment facility and into the **Connecticut River**. State officials also found PFAS pollution at unacceptably high levels in a drinking water well near the **Ellington** landfill. The well is located at a currently unoccupied house, and the **Department of Energy and Environmental Protection** (DEEP) will supply bottled water to the home once someone moves there. DEEP officials also tested runoff from the Hartford landfill and found various PFAS compounds present in groundwater at “significantly higher” levels than current recommended limits for drinking water.

CT RESTORING LARGEST REMAINING SALTWATER MARSH. State and federal officials are using more than \$1 million from Superfund penalty settlements to restore the largest remaining salt-marsh in Connecticut — 63 acres at the mouth of the **Housatonic River** in **Stratford**. Most of the money derives from environmental penalties paid because of major pollution at the **Lordship Point Gun Club**, formerly known as the **Remington Gun Club**, and at the old **Raymark Industries** site.

CT SETS 2040 ZERO CARBON GOAL. Last fall **Governor Ned Lamont** signed an executive order to eliminate Connecticut’s dependence on fossil fuels by 2040, expanding the responsibilities and size of the **Governor’s Council on Climate Change** and requiring the **Department of Energy and Environmental Protection** to develop strategies to achieve “a 100% zero carbon target for the electric sector by 2040.” The governor’s goals go beyond what the **General Assembly** previously set out as a goal.

STATE TO ADD TO OPEN SPACE. As part of Connecticut’s **Comprehensive Open Space Acquisition** or **Green Plan**, hundreds of acres in eastern Connecticut will be acquired by the state to expand existing parks and wildlife conservation areas. The plan sets a target of preserving 673,210 acres or 21% of the state’s land by 2023. The **Department of Energy and Environmental Protection** last year estimated that 508,718 acres or 75.5 % of the state’s total open space goal had been reached but that more land must be attained or protected in order to meet the 2023 goal.

GRANTS TO IMPROVE LONG ISLAND SOUND ECOSYSTEM. According to federal and state environmental officials from New England and New York, 35 grants worth \$2.6 million will be distributed to state and local governments and community groups to improve the ecosystem of **Long Island Sound**. Twenty grants totaling \$1.4 million will benefit **Connecticut**. This grant program combines funds from the **US Environmental Protection Agency**, **US Fish and Wildlife Service** and the **National Fish and Wildlife Foundation**. The grants support environmental education programs and conservation projects, as well as water quality improvement projects.

INSURER TO FACTOR FOSSIL FUEL REVENUE INTO DECISIONS. **The Hartford** announced in December that it will no longer insure or invest in companies that generate more than 25% of their revenues from thermal coal mining or more than 25% of their energy production from coal. In addition, the company will also stop insuring and investing in companies that generate more than 25% of their revenues directly from the extraction of oil from tar sands.

YALE CREATES NEW CLIMATE CHANGE AND HEALTH CENTER. The **Yale School of Public Health** has established the **Yale Center on**

Climate Change and Health (YCCCCH), to address climate change. The new Center, which evolved from the **Yale Climate Change and Health Initiative**, works to incorporate research, education, public health practice and service to help achieve a stable and safe climate. The Yale School of Public Health is one of few public health schools worldwide to have a center dedicated to climate change and health.



Food & Agriculture

MOSQUITO MONITORING SHOWS RISE IN EEE AND WEST NILE IN 2019. As of September 10, the number of mosquitoes testing positive for Eastern Equine Encephalitis and West Nile virus had increased, with 25 Connecticut cities and towns affected. According to the **Connecticut Agricultural Experiment Station**, a total of 83 mosquitoes tested positive for Eastern Equine Encephalitis, or EEE, in 2019; they were found in **Chester, Groton, Haddam, Hampton, Killingworth, Ledyard, Madison, North Stonington, Plainfield, Shelton, Stonington** and **Voluntown**. Fifty-six mosquitoes tested positive for West Nile virus. The **Ledge Light Health District** urged residents of **Groton, Ledyard, North Stonington** and **Stonington** to avoid outdoor activities from one hour before dawn and dusk to one hour after.

STATE’S FIRST SPOTTED LANTERNFLY REPORTED. A crop- and tree-killing invasive insect called the spotted lanternfly was detected in Connecticut for the first time in October 2019, according to scientists with the **Connecticut Agricultural Experiment Station** in **New Haven**. A single live adult of this “sap-feeding plant hopping” species was identified in **Southbury**. According to a news release from Station officials, spotted lanternflies can “severely impact” apple, grapes, peaches, cherries, hops and other agricultural crops, as well as forest trees like maples.

INVASIVE PIGWEED FOUND IN CT. An invasive type of Palmer amaranth, also known as pigweed, toxic to livestock and resistant to herbicides, was discovered in two pumpkin fields in **East Windsor** in the fall of 2019. Agricultural officials described the weed, which is more common in warmer climates, as “highly aggressive” and said it can “outcompete many crops, causing dramatic losses in yields.”

NEW APP TO HELP CONNECT CONSUMERS TO FARMERS. There may soon be an app to help Connecticut consumers order local, organic produce from their smartphones. **Rosemary Ostfeld**, a 31-year-old East Lyme native, is developing an app called **Healthy PlanEat** which will create a direct connection between consumers and farmers. Ostfeld sees her app as a way for customers to buy in-season food without genetically modified organisms (GMOs), fertilizers, or pesticides. Healthy PlanEat will allow users to see which local fruits and vegetables are available for purchase. They can order the produce and either pick it up directly at the farm that grew it, at a farmers market, or at pop-up locations across the state.



Health

ACQUISITION OF ST. VINCENT’S COMPLETED. On October 1, **Hartford HealthCare** completed its acquisition of **St. Vincent’s Medical Center** in **Bridgeport**. The parent of Hartford Hospital and five others in Connecticut will operate St. Vincent’s as a Catholic hospital. St. Vincent’s, founded in 1903 by the Daughters of Charity, is part of Ascension, the nation’s largest nonprofit health system. With 473 beds, it will be Hartford HealthCare’s second-largest hospital, after the 867-bed Hartford Hospital. Hartford HealthCare now employs more than 24,000 in over 350 Connecticut locations.

IN BRIEF

Science and Engineering Notes from Around Connecticut

YNHH TO COLLABORATE IN LOW-COST PORTABLE MRI STUDY.

Hyperfine Research Inc. is collaborating with the **Yale School of Medicine** to pioneer the use of the world's first portable, low-cost magnetic resonance imaging (MRI) system at the bedside of patients in the neuro intensive care unit of **Yale New Haven Hospital** (YNHH). YNHH is the first hospital to use the Hyperfine POC MRI system on patients as part of a two-year study in conjunction with the American Heart Association, with hopes of reducing barriers to the routine use of MRI on patients who cannot be transported.

PROTON BEAM THERAPY CENTER ANNOUNCED.

Hartford Healthcare and **Yale New Haven Health System** announced construction of a \$72 million proton beam therapy center in Wallingford for cancer patients. Proton beam therapy is a highly advanced form of radiation treatment for cancer, using protons rather than X-rays to treat cancer. Proton International (PI) was hired as the project manager and operator for the proposed proton facility.

LONE STAR TICK NUMBERS ON THE RISE. The lone star tick, spotted in **Norwalk** and **Fairfield** in previous years, has increased its population in **New Haven County**, according to researchers at **The Connecticut Agricultural Experiment Station** (The Station). **Goudarz Molaei**, a research scientist and the Director of Environmental Sciences at The Station, reported that "In a single day, in a matter of an hour, we collected 200 specimens of this tick in that region." The tick carries multiple diseases and viruses, some known to be deadly, including tularemia, ehrlichiosis, rickettsiosis, heartland virus disease, and southern tick-associated rash illness, and is responsible for causing red meat allergy.



High Technology

INDOOR FUEL CELLS TO POWER NEW DATA CENTER. A high-speed data center housing computers powered by an indoor fuel cell center is under construction in **New Britain**, at what was once the site of a **Black and Decker** plant. Construction began in October, adding over \$200 million in revenues to the state and \$45 million in revenues to the city of New Britain. The first phase of construction involves renovating two buildings and installing 19.98 MW of grid-connected fuel cells from **Doosan Fuel Cells** in **South Windsor**. A total of 44 fuel cells will be installed. **Mark Wick**, the project developer, said they've had conversations with both **Yale** and **Jackson Labs** about their "high-performance computing requirements."

STUDY FINDS EHR PROBLEMS FRUSTRATE PHYSICIANS. A **Yale** study, "The Association Between Perceived Electronic Health Record Usability and Professional Burnout Among US Physicians," released November 14 in the Mayo Clinic Proceeding journal describes the frustration doctors are experiencing as they use electronic health record systems, or EHRs. Since 2009, the federal government has invested almost \$30 billion in incentives to modernize health record systems in hospitals across the United States, but the difficulties with using the system have resulted in high rates of physician burnout and medical errors. The study found physicians spend up to twice as much time as they spend with patients trying to complete desk work, in addition to several hours of their personal time.

NEW ALGORITHM OFFERS IMPROVED CELL DIFFERENTIATION.

The December 3 edition of *Nature Biotechnology* published an article featuring **Smita Krishnaswamy**, an associate professor of genetics and computer science at **Yale**, whose team developed a new algorithm called PHATE that overcomes many shortcomings of existing data visualization tools. PHATE can visualize the differentiation of human embryonic stem cells into neuronal cells,

neural stem cells, cardiac cells, and endothelial cells, compared to the visualizations created by three other technologies. This more detailed representation can help generate new hypotheses.

UCONN STARTUP USING ROBOTS FOR SPECIAL ED. A **UConn** startup, **Movia Robotics, Inc.**, announced plans to bring robots into special education classrooms worldwide to help children on the autism spectrum with social skills, learning readiness, and academics. **Tim Gifford**, president and chief technical officer of Movia, says he began developing the technology in 2008 when researching social robotics as a grant-funded researcher in **UConn's Institute for Collaboration on Health, Intervention, and Policy** (InCHIP). The software is licensed to the **Bristol, Suffield** and **Wallingford** school systems, where it will be used for special education with about 75 students.



Transportation

SIKORSKY LANDS MARINE ONE CONTRACT. Stratford-based **Sikorsky Aircraft**, a **Lockheed-Martin Company**, has been awarded a second production contract by the US Naval Air Systems Command to build VH-92A helicopters for the US Marine Corps. The VH-92A will be used to provide transport for the president of the United States, the vice president and other high-level government officials. The helicopter will replace the 19 VH-3D Sea King and VH-60N "White Hawk" helicopters now operated by Marine Helicopter Squadron One. The Corps plans to acquire a total of 23 VH-92As. Under the \$470.8 million contract, Sikorsky, a Lockheed Martin company, will deliver six VH-92A helicopters in 2022 and 2023. The contract comes after the company initially secured a \$542m contract last June to build six VH-92A helicopters.

KAMAN DEAL SENDS K-MAX COPTERS TO GEORGIA FIRM.

Kaman Aerospace, a division of **Kaman Corporation** will deliver a new K-MAX® medium-to-heavy lift helicopter to Helicopter Express of Chamblee, Georgia. Helicopter Express currently operates 24 aircraft used for heavy lifting, utility construction, firefighting and disaster relief. Development of the K-MAX® was led by Kaman founder and former CEO, aviation pioneer **Charlie H. Kaman**, and received Federal Aviation Administration certification in 1994. The single-engine, single-seat K-MAX® features a counter-rotating rotor system for external load operations and designed for vertical reference flight. The aircraft can lift up to 6,000 pounds.

DEEP REPORT OFFERS ROADMAP TO CT'S ELECTRIC VEHICLE GOALS. The "Electric Vehicle Roadmap for Connecticut" — a state report on accelerating the use of electric vehicles — was released last fall. The report outlines policies and strategies to reach the goal of converting 500,000 fossil fuel-powered vehicles to electric by 2030. The **Connecticut Department of Energy and Environmental Protection** was required to produce the report under legislation passed in February 2018. Connecticut is one of eight states with active rebate programs for electric vehicles, according to Plug In America. Another three states offer income tax credits for electric vehicle purchases, and one offers a sales tax exemption.

WALLETHUB STUDY RATES CT LOW FOR DRIVING CRITERIA.

A recent WalletHub study ranking all 50 states for best and worst places to drive ranked **Connecticut** in 40th place. Data was compiled from the US Census Bureau, Federal Bureau of Investigation, US Department of Energy and the Centers for Disease Control and considered four criteria: cost of ownership and maintenance, traffic and infrastructure, safety and access to vehicles and maintenance.

— *Compiled and edited by Wendy Swift*

From the National Academies

The following is excerpted from press releases and other news reports from the National Academies of Sciences, Engineering and Medicine.

◆ Taking Action Against Clinician Burnout

A projected 35-54% of US nurses and physicians have substantial symptoms of burnout with a range of 45-60% in medical students and residents, a problem spanning all clinical disciplines and across care settings. In this report, the National Academy of Medicine attributes this to “an imbalance in which the demands of the clinician’s job are greater than the resources available,” further intensified by demands for improved performance, technology that “hinders rather than supports” patient care, changing professional and societal expectations and policies poorly aligned with professional values or with achieving better patient care. Concluding that commitment to health system improvement by all parties is required, the report outlines six goals and system wide actions for redesigning clinical systems with focus on activities that patients feel important for their care and which empower clinicians to provide this.

nam.edu/ClinicianWellBeingStudy

◆ Regulating Medicines in a Globalized World

A prime mission of medical regulatory authorities/agencies is to promote and protect public health but a major challenge is to achieve this without impairing innovation during “unprecedented” advances in drug development and supply chain complexity. Medical regulators are pressed to stretch finite personnel and financial resources during unprecedented globalization and pressure for faster drug approval. This report examines the risk-benefit challenges facing regulatory agencies in utilizing “mutual recognition agreements”(MRAs) in trade agreements as well as less stringent forms of recognition and identifies opportunities in 5 areas: improving public health through better-designed MRAs; responding to evolving science & technology; better utilization of the narrowly written European Union-US MRA; information sharing among international regulators and evaluating public health impacts of international arrangements.

www.nap.edu/read/25594

◆ Social Isolation and Loneliness in Older Adults

Nearly 25% of Americans 65 and older living in community settings have few social relationships or infrequent social contact in ways that risks their health. Social isolation and loneliness are associated with an increased likelihood of early death, dementia, heart disease, stroke, and more. While these individuals may not be identified in their own communities, nearly all interact with the healthcare system; thus healthcare providers may be best able to identify those at highest risk for social isolation. Recommendations include strategies for expanding research on clinical interventions, improved communication between researchers and practitioners, team-based care involving health care system and community-based social care providers and inclusion in major federal health strategies.

www.nap.edu/read/25663

◆ Artificial Intelligence in Health Care

The emergence of artificial intelligence (AI) in health care provides unprecedented opportunities to improve patient care, clinical team outcomes and impact population health while reducing costs. Though there have been a number of promising examples of AI applications in healthcare, this special publication from the National Academy of Medicine urges caution in proceeding so as not to risk user disillusionment, another artificial intelligence “winter,” or further exacerbation of existing health and technology-driven disparities. The publication synthesizes current knowledge as a reference document for relevant healthcare “stakeholders”; outlines current and near-term solutions while highlighting the challenges, limitations and best practices for AI development, adoption and maintenance; provides an overview of the legal and regulatory environment for healthcare

application; prioritizes the need for equity, inclusion and a “human rights lens” and outlines considerations for moving forward.

nam.edu/artificial-intelligence-special-publication/

◆ Opioid Use Disorder and Infectious Disease Services: Integrating Responses to a Dual Epidemic

Infectious diseases related to substance abuse include human immunodeficiency virus (HIV) and Hepatitis A,B, and C as well as bacterial, fungal and other infections. While these disorders are closely interrelated, US health care systems have not sufficiently prevented infections pervasive among substance abusers. In part this is because treatment for substance abuse is provided independent of other medical care, particularly for infectious disease. Efforts to limit access to prescription opioids have led to increased injection use of heroin and increased risk of infectious disease. The report calls for integrating substance abuse with the delivery of comprehensive health care in a general medical setting, thus providing more seamless delivery for overlapping illnesses.

www.nap.edu/catalog/25626

The following Connecticut scientists were elected to the National Academies in 2019:

NATIONAL ACADEMY OF MEDICINE

Nita Ahuja, MD, MBA

William H. Carmalt Professor of Surgery and Chair, Department of Surgery, Yale School of Medicine

Jorge E. Galán, DVM, PhD

Lucille P. Markey Professor of Microbial Pathogenesis, Professor of Cell Biology, and Chair, Department of Microbial Pathogenesis, Boyer Center for Molecular Medicine, Yale School of Medicine

Akiko Iwasaki, PhD

Waldemar Von Zedtwitz Professor of Immunobiology and Professor of Molecular, Cellular, and Developmental Biology and of Dermatology, The Anlyan Center for Medical Research, Yale School of Medicine

Rafael Perez-Escamilla, PhD

Professor of Public Health (social and behavioral sciences) School of Public Health, Yale University

David G. Schatz, PhD

Waldemar Von Zedtwitz Professor of Immunobiology, Professor of Molecular Biophysics and Biochemistry, and Chair, Department of Immunobiology, Yale School of Medicine

Nenad Sestan, MD, PhD

Harvey and Kate Cushing Professor of Neuroscience and Professor of Comparative Medicine, of Genetics, and of Psychiatry, Yale School of Medicine

NATIONAL ACADEMY OF SCIENCES

Pinelopi K. Goldberg, PhD

Elihu Professor of Economics, Yale University

Paul E. Turner, PhD

Elihu Professor, Department of Ecology and Evolutionary Biology, Yale University

Keynote *(continued from page 1)*

He led the Council on Competitiveness's National Innovation Initiative (NII) working group (2002-3). In 2005, he was appointed to the US Department of Education Commission on the Future of Higher Education.

He is a Fellow of the Institute for Electrical and Electronics Engineers and the British Royal Academy of Engineering as well as the American Academy of Arts and Sciences. He is a member of the US National Academy of Engineering, a member of the board of directors for the Bank of New York/Mellon, Liberty Mutual, Delphi Automotive, AMD and MITRE. He is also a member of the board of trustees at Rensselaer Polytechnic Institute and Syracuse University, as well as former chair of the Connecticut Board of Regents for Higher Education.

David Ferrucci, a new CASE member as of 2020, is the founder, CEO and Chief Scientist at Elemental Cognition and Director of Artificial Intelligence at Bridgewater Associates. Prior to that, he worked at IBM Research for nearly 20 years, where he was named an IBM Fellow in 2011. At IBM, he led four successful projects, two of which had broad public impact: Unstructured Information Management Architecture (or UIMA) and Watson.

Innovation *(continued from page 2)*

questions posed in natural human language. "I was committed to the vision that our future would be tied to the ability of computers to talk fluidly with humans," he said. "People, including my mentors, laughed at me. I was told that I shouldn't continue to pursue AI if I wanted to be successful. They didn't understand that it wasn't even a choice for me. I had to keep working on it. It was so much more interesting for me to be innovating in that space. My definition of success wasn't managing 300 people."

Ferrucci believes bigger organizations need to cultivate "creative field generals," people he describes as technocrats who want to manage at the field level. "These people are innovators at heart, and they don't want to manage more than a small group of people," he said. "They want to solve problems and innovate. Give these people an ambitious goal, incrementally invest in them and reward their success with more money. Let them roll up their sleeves and give them room to create."

Ferrucci and his team spent years investigating open-domain question answering, a sub-field of AI dedicated to developing machines that can read text and answer questions. As a result, they were ready when the opportunity to create an AI that could play Jeopardy! came along. In fact, Ferrucci and his team were the only ones in IBM who thought that it was even possible!

Jeopardy! Watson, a computer contender, was put to the ultimate question-and-answer

With UIMA, Ferrucci advanced the view that efficient and scalable artificial intelligence (AI) applications can be developed across technologies and modalities using a single, reusable architecture and software framework for integrating text, voice, image and video analytics. He fought the conventional approach and focused on a level of representation that was modality and domain independent, but that still provided broad utility and interoperability. It was adopted as a standard, and the framework was used in many IBM products and provided the technical infrastructure upon which he built Watson.

As principal investigator for Watson, he led his team to create a single, extensible intelligent systems architecture dubbed DeepQA (Question Answering). DeepQA uses pervasive machine learning to integrate and train many independently developed NLP algorithms that are integrated into a holistic architecture. The result was a single system that could be trained and adapted to meet the challenging language-processing demands required to win at the game show Jeopardy!, a task thought unachievable at the time. Ferrucci led the development of the Adapt Watson methodology, which was the foundation for IBM's Watson Division.

In 2013, Ferrucci joined Bridgewater Associates to explore applications of AI in

challenge against Jeopardy champions Ken Jennings and Brad Rutter. (Jennings had the longest unbeaten run while Rutter had earned the biggest prize pot.) In the end, Watson won the game with \$77,147; Jennings and Rutter earned \$24,000 and \$21,600 respectively.

Ferrucci's hard work had paid off. "A colleague who started at IBM at the same time, later explained to me that, while he continued to find ways to move up the management chain, he noted that I continued to invest in technology that I felt would matter in the long run; and that, in the end, I leapfrogged him because Watson ended up having a huge impact for IBM and was a landmark in the scientific community," he said.

Watson became the foundation for IBM applications in a number of different areas, including healthcare, banking, telecommunications and insurance. Ferrucci, though, wanted to take the research much further. He wanted to create an AI that did more than Machine Learning to exploit recurring patterns in text; he wanted to get machines to deeply understand what they read and be able to provide reasons and explanations for their answers. As a result, in 2015, he started Elemental Cognition based in Wilton, CT.

So what does all of this mean for Connecticut?

"Connecticut has an abundance of technical specialties," Donofrio said. "We need to do a better job of identifying the technologies



David Ferrucci

markets and management based on the company's commitment to explicable machine intelligence. In 2015, with investment from Bridgewater, he founded Elemental Cognition, which is driving the future of AI by changing the way machines learn and ensuring that they can explain the 'why' behind their answers. He sees this as key to developing a symbiotic relationship that will lead to a new era of human-computer collaboration—one in which machines can read, understand and interact as partners.

He is a member of the Association for Computing Machinery, the Institute of Electrical and Electronics Engineers and the Association for the Advancement of Artificial Intelligence. He also served as an expert panelist at the 2016 US Senate Science Forum, where he advised senators on the future of AI.

and capabilities that exist in our state, knowing where they exist and how we can work together to develop real innovation and foster creative thinking. For example, we can do almost any kind of modeling and simulation work with a supercomputer, which we don't have access to in Connecticut. Could we work together to create a supercomputing infrastructure that everyone in the state (or region) could use? Do we have anyone dreaming that this technology ecosystem is possible?"

"Connecticut has a long and strong history of innovation," said Peter Denious, President & CEO, at AdvanceCT (formerly the Connecticut Economic Resource Center). "The state is committed to making significant investments to create the business conditions and ecosystems necessary to attract more companies and keep them here."

AdvanceCT is a public/private partnership with the state, funded by the state's Department of Economic Development and the private sector, that works to attract and keep companies in Connecticut. CTNext and Connecticut Innovations are two additional resources available to entrepreneurs in the state.

"There is a saying that the hero is the ordinary person who stayed a little longer, tried a little harder and was able to bear a little more," Donofrio said. "Everyone has the potential to be a hero and an innovator. — **Karen Cohen, freelance science writer and owner, The Write Stuff, LLC.**