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THE BRIDGE

The Magazine of IEEE-Eta Kappa Nu

COVID-19

Oak Ridge National Laboratory Staff Mobilize to Combat Novel Coronavirus

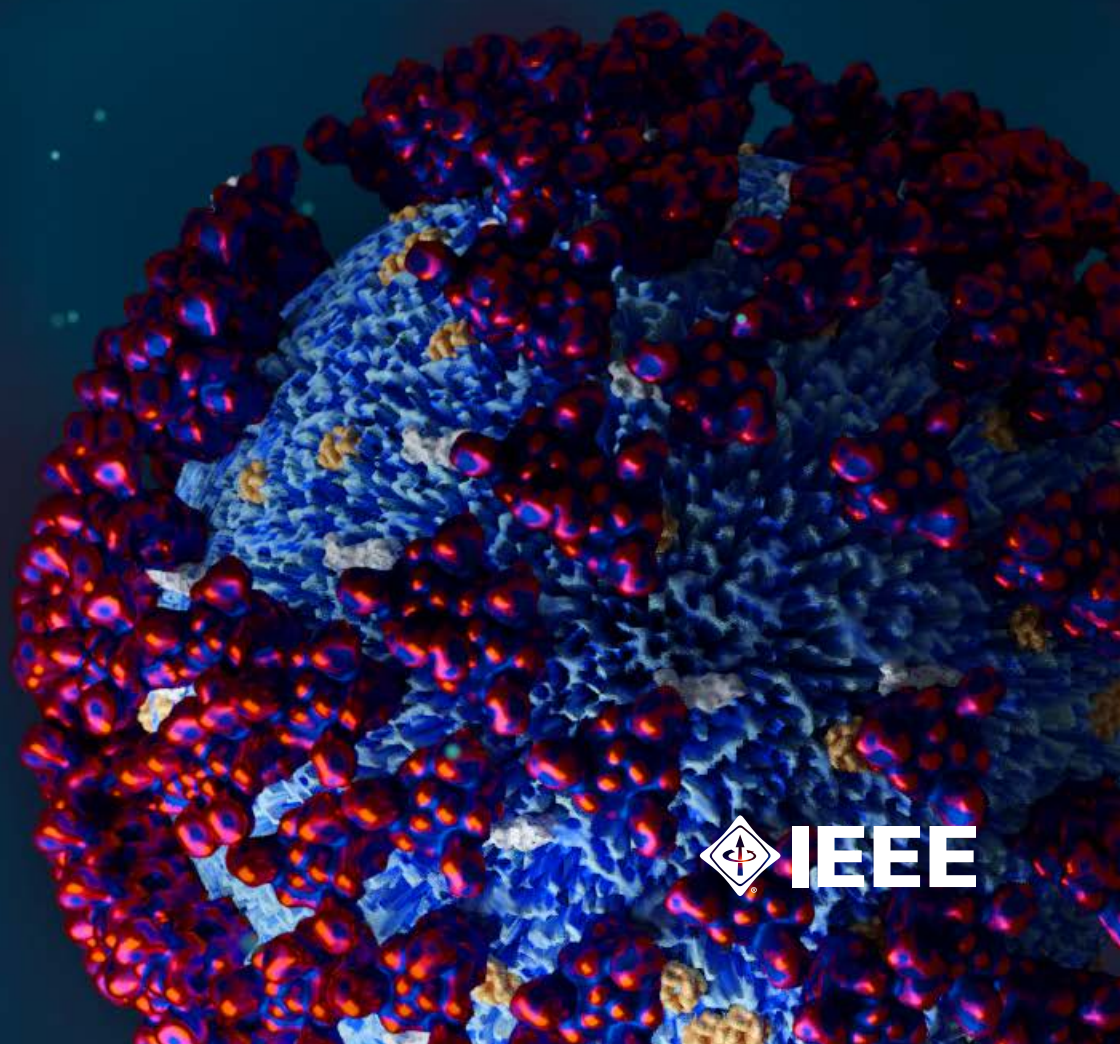
Advanced Manufacturing Innovation Helps Industry in COVID-19 Fight

Researchers Across Oak Ridge National Laboratory Team to Pursue COVID-19 Treatment Options

IEEE-HKN Year in Review

IEEE-Eta Kappa Nu

Team Science in the *Fight Against* COVID-19



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THE BRIDGE

The Magazine of IEEE-Eta Kappa Nu

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Editorial inquiries: IEEE-Eta Kappa Nu,
445 Hoes Lane, Piscataway, NJ 08854, USA
US Toll Free: +1 800 406 2590
Outside US: +1 732 465 5846
Email: info@hkn.org | www.hkn.ieee.org

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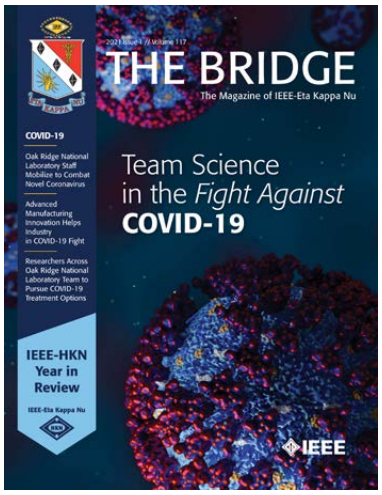


THE BRIDGE, February 2021 Letter from the Editors-in-Chief

Dear IEEE-HKN Members and Friends,

This issue of THE BRIDGE magazine has content provided by Oak Ridge National Laboratory (ORNL), https://www.ornl.gov. This facility is located in eastern Tennessee and is sponsored by the U.S. Department of Energy. While it is known for developing technological solutions related to clean energy and security, it also focuses on scientific activities related to various national areas of concern such as the pandemic. ORNL hosts numerous guest researchers and has many industry and academic partnerships. The research presented in the features illustrates the impact that science and engineering have on our world. We thank our ORNL guest editors Dr. Marti Head and Dr. Moody Altamimi for their work coordinating the features.

The cover art shows an illustration of a coronavirus. The characteristic structure consists of a spherical body with numerous surface projections. In an electron microscope image, the virus takes the appearance of solar corona. This imagery gives the coronavirus its name. We appreciate the opportunity to use this art.

The magazine is a collaborative effort of a hard-working editorial board, with members Emily Hernandez, Marcus Huggans, Hulya Kirkici, Zahra Manzoor, and Emmanuel Oyeykanlu. We are assisted by Nancy Ostin and Stacey Bersani, our talented IEEE-HKN staff. Thank you all.

To our readers, please let us know what you like about the magazine and what you want to see in future issues. We invite submissions for our technical features, Chapter happenings, etc. Visit our website at https://hkn.ieee.org/the-bridge/ or contact us by email at info@hkn.org. THE BRIDGE is available on the IEEE App.

Credit: Jill Hemman/Oak Ridge National Laboratory, U.S. Dept. of Energy

A Team Approach to COVID-19

Science and discovery are people-driven endeavors. The Department of Energy's (DOE) Oak Ridge National Laboratory (ORNL) is part of a vast, diverse scientific community filled with inquiring minds, and when inspiration strikes, the results can change the world. In early 2020, when a new virus appeared, ORNL addressed myriad new challenges with an engaging, team science approach, asking, "How can we help?"

Hundreds of ORNL scientists are currently members of IEEE organizations, with nearly 50 who have received IEEE honors and awards; over the years, 18 ORNL staff have been elected IEEE fellows. In addition to this breadth of expertise across engineering disciplines, ORNL staff are mathematicians, physicists, chemists, biologists, computer scientists, and every day, ORNL researchers bring their individual capabilities together in collaborative, cross-disciplinary teams to solve challenges in energy, materials, neutron science, high-performance computing, systems biology, and national security.

In addition to this deep people expertise, ORNL is also home to world-class user facilities including Summit, the nation's fastest supercomputer at the Oak Ridge Leadership Computing Facility; the Spallation Neutron Source, the world's most powerful pulsed neutron source; the Center for Nanophase Materials Science; the Manufacturing Demonstration Facility; the Carbon Fiber Technology Facility; and many other resources that enable groundbreaking scientific research and discovery.

ORNL's creative and skilled researchers responded to the current global crisis of COVID-19 by pivoting quickly, bringing together the scientific and engineering expertise of ORNL's people, the lab's world-leading computational and experimental capabilities, and a strong culture of team science, all in service of tackling the many challenges of the novel coronavirus pandemic. Some of these projects involved small teams of researchers working to chase an idea about how to have an impact on this disease. Other projects were larger efforts as part of the DOE's National Virtual Biotechnology Laboratory (https://science.osti.gov/nvbl), a consortium that brings together the capabilities of all 17 DOE national laboratories. These scientists and collaborators continue working with a sense of urgency in the fight against COVID-19.

This special issue is a snapshot of the many stories about ORNL's response to COVID-19, including

- engineering and manufacturing advances that transitioned to external partners to address critical shortages of personal protective equipment to quickly ramp up production of N95 masks and COVID-19 test kits;
- research advances in testing and diagnostic technologies to enable accurate understanding of the extent of disease transmission and to enable the possibility of easier, at-home detection of COVID-19 infections;
- integrated monitoring, modeling, and analysis of aggregated data to paint a broader picture of environmental and societal impacts of the pandemic and provide situational analysis for decision-makers; and
- structural studies to understand SARS-CoV-2 proteins with single-atom detail, along with new computational technologies to speed the discovery of potential therapeutics.

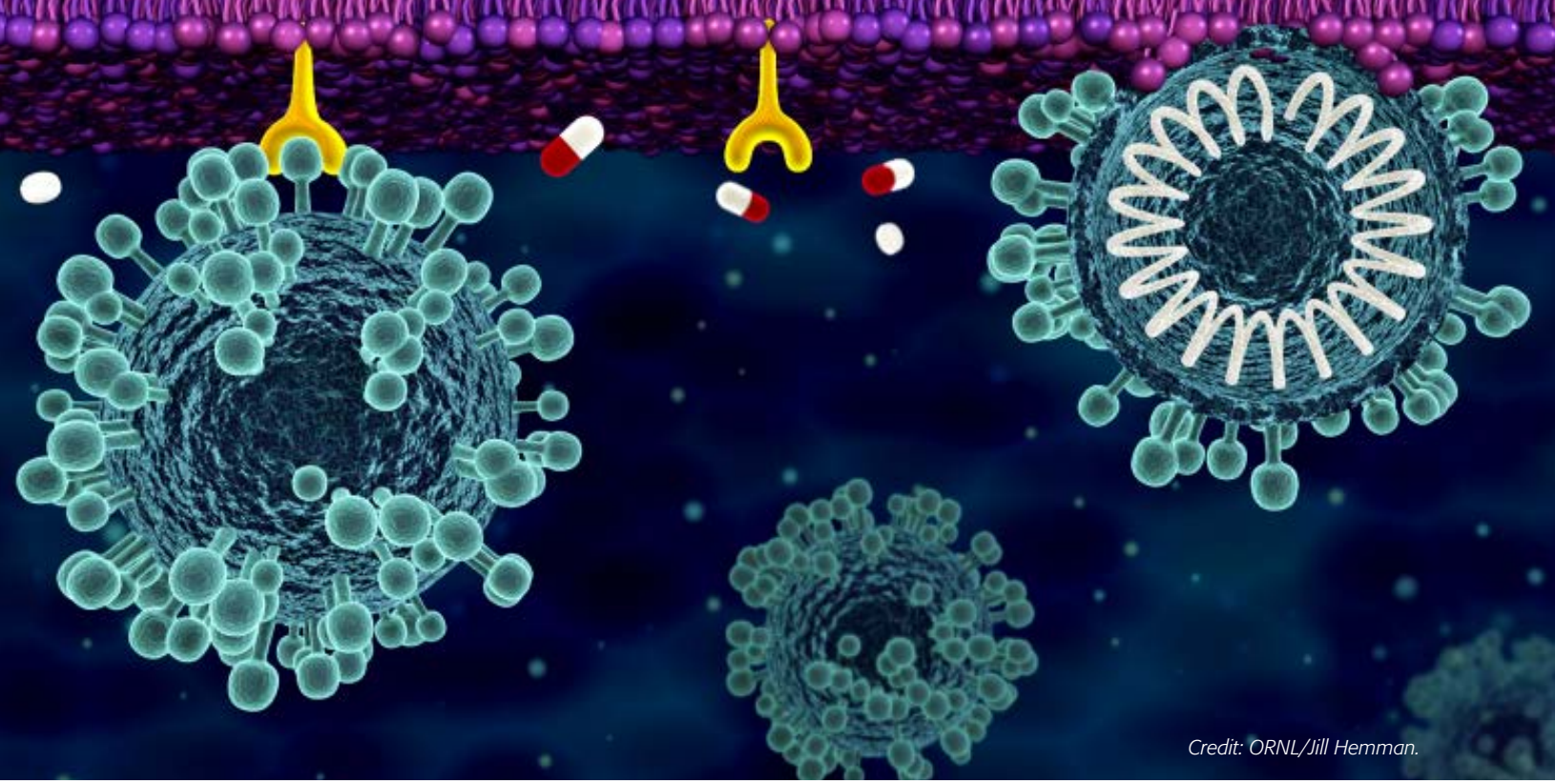
Research described in these pages was supported by ORNL's Laboratory-Directed Research and Development program and by the DOE Office of Science's National Virtual Biotechnology Laboratory with funding provided by the Coronavirus CARES Act. Although we focus on ORNL contributions here, the influence of the National Virtual Biotechnology Laboratory projects results from multiple national laboratory partners collaboratively and creatively working together.

ORNL researchers will continue in the fight against COVID-19. And there are opportunities for professionals like you to lend your expertise—your inquiring minds—to change the world.

GUEST EDITORS

Dr. Marti Head is director of the Joint Institute for Biological Sciences, a collaborative research effort between ORNL and the University of Tennessee focused on new approaches to drug development, personalized treatment, and diagnosis and prediction of health outcomes. Before joining ORNL, Dr. Head built the Insights from Data team at GlaxoSmithKline Pharmaceuticals, where she was the Senior Director of Computational Chemistry US for many years. Dr. Head received her B.S. in chemistry from Hamline University in St. Paul, Minnesota, and earned her Ph.D. in chemistry at Duke University, where she completed a joint project with the computer science department developing algorithms to use a special-purpose, massively parallel computer to understand geometric properties of protein structures. She subsequently was a National Research Council postdoctoral fellow at the Center for Advanced Research in Biotechnology in Rockville, Maryland.

Dr. Moody E. Altamimi is the founding director for the Office of Research Excellence at ORNL. The office's mission is to foster an inclusive ecosystem for thriving research careers and impactful student research experiences, facilitate strategic engagement with leading institutions, and deliver evidence-based evaluations to support ORNL's aspiration to be the world's premier research and development institution. Dr. Altamimi's diverse skill set and expertise in research development and management, technology translation, and strategy development and implementation support efforts to advance ORNL's science and innovation culture. She works with students, postdoctoral candidates, and early career scientists to inspire them to pursue high-impact science by encouraging collaboration and team science, which leads to world-changing outcomes.



Credit: ORNL/Jill Hemman.

Oak Ridge National Laboratory Staff Mobilize to Combat Novel Coronavirus

In the race to identify solutions to the COVID-19 pandemic, researchers at the Department of Energy's (DOE) Oak Ridge National Laboratory (ORNL) are joining the fight by applying expertise in computational science, advanced manufacturing, data science, and neutron science. ORNL is providing remote access to its world-leading supercomputing and neutron facilities for researchers around the world to conduct critical scientific studies on severe acute respiratory syndrome coronavirus 2, or SARS-CoV-2, the novel coronavirus that causes COVID-19.

Computational science

ORNL's Summit, the nation's most powerful supercomputer, is accelerating COVID-19–related research through the new COVID-19 High Performance Computing Consortium (Figure 1). Several computing allocations are already running on Summit aimed at improving scientists' understanding of the virus' structure and biology toward developing targeted therapies and vaccines.

Researchers at ORNL and the University of Tennessee have used Summit to identify small-molecule drug compounds that might warrant further study. Dr. Colleen Jonsson of the University of Tennessee Health Science Center in Memphis directs one of the few labs permitted to perform live virus tests and is testing the efficacy of potential drugs from the ORNL list on the novel coronavirus.

ORNL researchers are also employing artificial intelligence techniques to study the systems biology and molecular mechanisms of the coronavirus; deliver "self-driving" ventilators; model hospital infrastructure; and mine past publications to advance understanding of COVID-19 diagnosis, treatment, epidemiological and management challenges, among other efforts.

"America's national labs are designed specifically to tackle the world's most complex scientific challenges, and our continued investments in high-performance computing and cutting-edge data analysis have proven critical in tackling this global pandemic," said ORNL's Gina Tourassi.

Figure 1: ORNL enlists scientists to use world-class user facilities, such as the Summit supercomputer, in the fight against COVID-19. Credit: Carlos Jones/ORNL, U.S. Dept. of Energy.

Accelerating drug discovery

To better understand the virus's spread, ORNL researchers have harnessed the power of supercomputers to accurately model the spike protein that binds the novel coronavirus to a human cell receptor. These simulations also shed light on the ligand molecules that can inhibit such binding and are therefore promising guideposts for potential therapies.

An ultrafast quantum chemical modeling method provides information about the critical electronic interactions between protein and ligand chemicals, going beyond classical models of such interactions that are normally employed in computational drug discovery workflows. The findings will enable accurate predictions of the performance of currently available inhibitors and inform the future development of even more potent, novel inhibitor compounds, demonstrating the effectiveness of quantum chemical approaches in simulation for drug discovery.

"Quantum mechanics on supercomputers accelerates computational COVID-19 drug discovery by accurately describing inhibitor–virus protein interactions," said ORNL's Stephan Irle. ORNL's Quan Vuong also worked on this research.

Neutron scattering

ORNL is also providing remote, rapid access to its advanced neutron source facilities, the Spallation Neutron Source and the High Flux Isotope Reactor (DOE Office of Science user facilities), to support research related to the COVID-19 pandemic (Figure 2). As part of the search for effective diagnostics and therapies, rapid access has been awarded for experiments to address necessary science and technical questions identified by the COVID-19 research community.

"Our Rapid Access program for neutron research at ORNL is designed to expedite outside user experiments related to COVID-19-related research and get them onto our beamlines in a matter of just days," said Hugh O'Neill of ORNL.

Neutron research has the potential to yield vital insights into the structure, dynamics, and function of viral proteins and their complexes with RNA and membranes–the components that enable viruses to function and replicate–as well as how they interact with potential antiviral inhibitors.

O'Neill leads an ORNL team that plans to study SARS-CoV-2 proteins constructed from synthetic DNA. The genes will be inserted into bacteria to produce proteins of the virus, which will be studied using a suite of neutron scattering instruments to gain a better understanding of the structure and function of the disease. Results will inform development of improved methods for mitigating the virus.

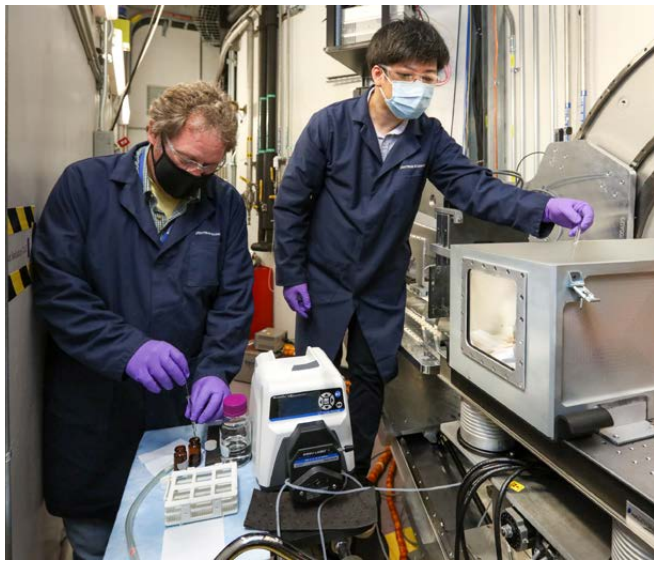


Figure 2: ORNL neutron scattering scientists John Ankner (left) and Minh Phan (right) preparing samples for the Spallation Neutron Source liquids reflectometer. Credit: Genevieve Martin/ORNL, U.S. Dept. of Energy.

Advanced materials

Collaborators at ORNL's Center for Nanophase Materials Sciences (a DOE Office of Science user facility) and the University of Tennessee Health Science Center are developing a breath-sampling whistle that could make COVID-19 screening easy to do at home.

ORNL and researchers partnered to design the device as an at-home alternative to traditional diagnostics, such as nasal swabs, with a goal to inform decisions on health and safety.

"Our motivation is to put actionable information in the hands of users to help them make timely decisions, such as whether to go to work or school, quarantine, or seek medical care," said University of Tennessee Health Science Center's Dr. Scott Strome.

The technology makes use of a familiar concept–a whistle—to capture aerosols from exhaled breath. Testers simply blow the whistle to make an audible sound. An app that monitors breathing rate may be integrated to help users operate the device correctly (Figure 3).

Inside the whistle, a unique hydrogel material preserves breath samples for later testing. These samples could either be sent to a lab for analysis or, preferably, transferred to an accompanying test kit that could detect the SARS-CoV-2 virus that causes COVID-19.

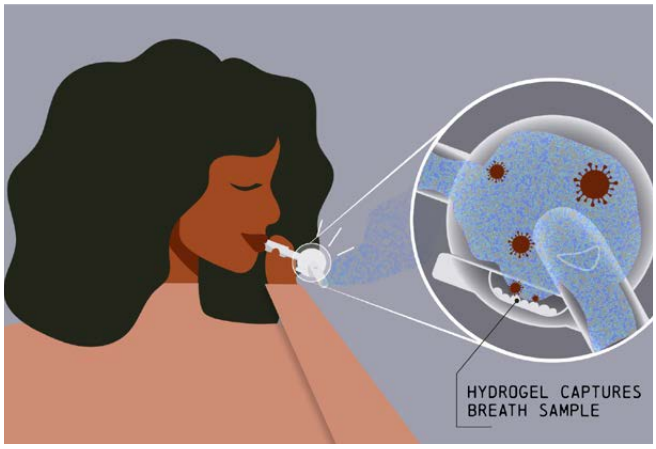


Figure 3: Collaborators at Oak Ridge National Laboratory and the University of Tennessee Health Science Center are developing a breath-sampling whistle that could make COVID-19 screening easy to do at home. Credit: Michelle Lehman/ORNL, U.S. Dept. of Energy.

"Our aim is for a complete at-home approach with a simple and robust test that could be used by anyone," said ORNL's Scott Retterer.

Ease of use makes the testing format suitable for a broad range of users, including children and elderly, and the simple design adds to scalability. Prototype whistles are 3D printed from a resin material but could also be molded for low-cost mass production.

This research was supported by the DOE Office of Science through the National Virtual Biotechnology Laboratory, a consortium of DOE national laboratories focused on response to COVID-19, with funding provided by the Coronavirus CARES Act.

Building a molecular picture

Researchers from Virginia Tech and ORNL are using neutron scattering to investigate how the virus infiltrates host cells and what therapeutics could help inhibit this process. Such information could help experts design strategies to slow the progress of viral infection and reduce its harmful effects.

Part of the team's study involves examining some of the biological tools the virus employs to infect host cells. This includes their spike proteins, barb-like proteins on the surface of the virus that initiate the infection process, and E-proteins, which help the virus replicate itself inside the cell and can trigger acute inflammation in the host's lungs.

Another aspect of this research is focused on the cell membrane, which serves as the cell's outermost line of defense against the virus (Figure 4). The scientists aim to better understand how cell membranes change when they encounter spike proteins and what therapeutic candidates could make them more resistant to viral entry.

This project tapped into the wide range of expertise within the laboratory. "At ORNL we are able to work with experts from many fields, such as physics, chemistry, and biology," said ORNL's Jessy Labbé, a cellular and molecular geneticist involved in this study. "When the crisis began, we applied this combined knowledge to develop research projects that address some of the biggest challenges related to the pandemic."

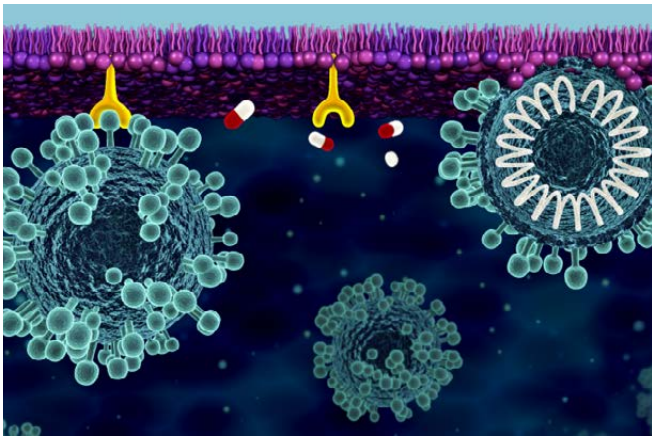


Figure 4: The cell membrane is the cell's first line of defense against the coronavirus responsible for COVID-19. The virus uses its spike proteins and E-proteins to penetrate the cell membrane and create copies of itself within the cell. Researchers are investigating how this process works and what treatments can help to stop it. Credit: ORNL/ Jill Hemman.

The team is using the liquids reflectometer (LIQREF) at ORNL's Spallation Neutron Source to examine the conformation of membranes and viral proteins, as well as the effects of certain therapeutic candidates. With the instrument, scientists can measure the trajectories of neutrons as they interact with different biological materials. They then use this information to determine how a sample is organized at the molecular level.

"Neutrons are highly penetrating and nondestructive particles, allowing our team to explore how these biological materials operate at the molecular level without damaging them. Such information could help experts develop strategies for slowing the spread of infection within patients and mitigating the severity of the disease," said Labbé.

The researchers performed their experiments with a membrane model that closely mirrors the shape and composition of cell membranes within human lungs, where respiratory viral infections primarily take place.

Using LIQREF, the team first characterized the membrane's original structure. They then introduced the spike protein or E-protein to the membranes and analyzed how these structures change shape when they interact. They also measured how the membrane's properties change when exposed to either melatonin or azithromycin—commonly available products that are currently being investigated by medical experts as possible treatments for mitigating COVID-19 symptoms. This change could potentially make membrane intrusions more challenging for viral spike proteins.

The initial results suggest that membranes pack more closely together when introduced to melatonin or azithromycin. Furthermore, they demonstrated that the readily available and approved inhibitor, amantadine, significantly affects the interaction between the cell membrane and E-protein. Their findings suggest that the inhibitor should be further investigated as a potential therapy to combat the virus's lethality.

Going forward, the researchers envision these methods could be used to rapidly and systemically screen treatment candidates for the COVID-19 pandemic and future viral respiratory threats.

Pandemic modeling and analysis

Argonne, Oak Ridge, Los Alamos, and Sandia National Laboratories are collaborating to develop an integrated COVID-19 pandemic monitoring, modeling, and analysis expertise, leveraging the labs' collective scalable data and computing.

Geographic data scientists at ORNL continue to track reported COVID-19 outbreaks by maintaining a series of maps that monitor the speed of transmission and rate of growth across all 50 U.S. states and their more than 3,300 total counties, as well as across nearly 250 countries worldwide. The map draws on ORNL's foundational population distribution databases, LandScan USA and LandScan Global (Figure 5).

A model built with this data and developed in collaboration with the University of Tennessee provides seven-day forecasts, updated daily, of new case counts with confidence intervals for every county in the United States. The first seven-day forecast was produced in June, using ORNL's Compute and Data Environment for Science high-performance computing resources.

"We wanted to provide that situational awareness for county-level decisionmakers on what to expect, so they can allocate resources and structure

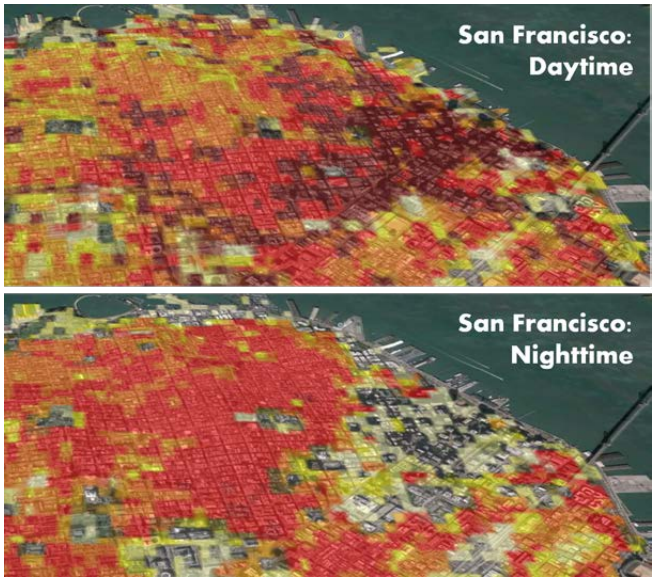


Figure 5: In concert with other national labs, ORNL is using modeling and analysis tools to determine what is happening in different regions of the country and how different areas and populations are responding and reacting to COVID-19. Credit: ORNL, U.S. Dept. of Energy.

openings and closings," said Jesse Piburn of ORNL who constructed the model with Nicholas Nagle, a University of Tennessee professor of geography. "That's where the major decisions that really affect people are made."

Aggregated and anonymized commercial location data provide a unique window into human activity during such events as the national, regional, and local shutdowns amid the pandemic. ORNL researchers used aggregate mobility data to build empirically sound estimates of where people spent time away from home during the pandemic—work, school, or elsewhere—as case numbers rose and fell.

"We use these digital traces to assess the extent of individual behavior changes aimed at slowing COVID-19 spread," said ORNL's Christa Brelsford. "We can measure how local and national case rates change in response to mitigation efforts across all three waves of the pandemic so far. This is useful for policymakers who want to understand how their intervention strategies, like lockdowns or school closures, influence behavior—which is the factor that actually matters for reducing COVID-19 cases."

The lab also made LandScan USA, which provides day-and-night population dynamics data at a spatial resolution of 90 meters, available to the public in support of the pandemic response.

"Our goal is to provide improved situational awareness and insight into what is happening in different regions of the country and how different areas and populations are responding and reacting to conditions and interventions," said ORNL's Budhu Bhaduri.

This research was supported by the DOE Office of Science through the National Virtual Biotechnology Laboratory, a consortium of DOE national laboratories focused on response to COVID-19, with funding provided by the Coronavirus CARES Act.

ATOM collaboration

ORNL is part of a multi-lab effort within the Accelerating Therapeutics for Opportunities in Medicine, or ATOM, consortium, a public-private partnership focused on dramatically reducing the time it takes to discover and develop new medicines through the application of leading-edge technologies like machine learning and artificial intelligence.

"ATOM applies computational workflows and supercomputing to optimize the safety and effectiveness of new molecules with the potential to become drugs," said ORNL's Marti Head, a co-creator of ATOM. "These computational tools were created to accelerate cancer drug discovery. But we can apply these tools to SARS-CoV-2, the virus that causes COVID-19, as more data becomes available from laboratories across the world on the interactions of small molecules with Sars-CoV-2 proteins."

–Ashley Huff, Scott Jones, Matt Lakin, Morgan McCorkle, and Olivia Trani

FEATURED RESEARCHERS

Dr. Christa Brelsford is a research scientist in the Geospatial Science and Human Security Division at ORNL. Her research uses data science tools from economics, geography, network science, and spatial statistics to describe the coevolutionary processes between human systems and the built and natural environment. These analyses have focused on urban contexts, exploring themes of urban water management, infrastructure provisioning and resilience, and human behavioral responses to surprising events. Dr. Brelsford was a Liane B. Russell fellow at ORNL and a postdoctoral fellow at the Santa Fe Institute. She obtained her Ph.D. from the School of Sustainability at Arizona State University in 2014 for research on the determinants of residential water demand. She is currently leading efforts to use novel data sources such as digital trace data to generate real-time measures of community structure and behavior change and to describe the drivers and consequences of those outcomes from a national security perspective.

Dr. Stephan Irle is a senior researcher and leader of the Computational Chemistry and Nanomaterials Sciences Group at ORNL. He is a founding principal investigator at the Institute of Transformative Bio-Molecules at Nagoya University and a member of the Japanese "post-K supercomputer" support project. His specialty is the quantum chemical study of complex systems on exascale and quantum computing platforms. Target areas are soft matter and biosimulations, excited states of large molecules, electrochemistry, catalysis, and geosciences. Complementary studies of physicochemical properties, theoretical spectroscopy, and the development of methodologies including approximate quantum chemical methods accompany this research. He holds a B.Sc. in chemistry from the University of Siegen, Germany; an M.Sc.in chemistry from the University of Siegen, Germany; and a Ph.D. in chemistry from the University of Vienna, Austria. He is a fellow of the American Association for the Advancement of Science.

Dr. Jessy Labbé is staff researcher and leads the Fungal Systems Genetics and Biology Laboratory in the Biosciences Division at ORNL. He is a molecular geneticist with expertise in medical and environmental mycology. He is also a faculty member at the University of Tennessee, Knoxville, in the Biochemistry, Cellular and Molecular Biology Department and the Genome Science and Technology program. After training as an M.D. in infectious disease research, Dr. Labbé also received a Ph.D. in forest microbiology from the University of Lorraine, France. His research interests focus on interactions of fungal systems in natural and synthetic environments. His laboratory uses a combination of cutting-edge technologies, ranging from next-generation sequencing, post-genomics, molecular genetics/synthetic biology to microcosm systems biology, with specific emphases on the genetic and molecular mechanisms of the host–fungus and microbe–fungus interactions.

Jesse Piburn is a research scientist in geographic data sciences at ORNL and is a member of the Geographic Data Sciences Group within the National Security and Emerging Technology Division. His primary responsibilities include identifying, developing, and implementing data science–based solutions to help solve a variety of national and global issues involving national security, population dynamics, energy assuredness, natural resources, and critical infrastructure. Jesse is currently finishing his Ph.D. in data science and engineering at the University of Tennessee, Knoxville. His research interests include data science, machine learning, geographic information science, spatial-temporal statistics, and statistical software development.

Dr. Scott Retterer is a senior staff scientist in the Biosciences and Center for Nanoscale Materials Sciences Divisions at ORNL. His work focuses on the development of material interfaces that can be used to shape soft materials and biological systems with an emphasis on understanding the effects of nanoscale structure, molecular transport, and chemical patterning on material formation and biological processes. With continued work in refining methods for integrating nanostructures into functional arrays and microfluidic systems, his current research focuses on understanding how these structures can be used to control the physical and chemical environment within microfluidic platforms to replicate complex natural environments in tractable experimental systems. Dr. Retterer received his Ph.D. in biomedical engineering from Cornell University in 2005. He is a faculty member in the Bredesen Center for Interdisciplinary Research at the University of Tennessee, Knoxville.

Figure 1: ORNL researchers in advanced manufacturing, materials science, and engineering collaborated to produce face shields and reusable mask molds that industry can quickly mass produce. Credit: Carlos Jones/ORNL, U.S. Dept. of Energy.

Advanced Manufacturing Innovation Helps Industry in COVID-19 Fight

In the fight against the COVID-19 pandemic, it's a race against the clock not only to find a vaccine but also to supply health care workers with life-saving equipment such as face shields, masks, and test kits.

Researchers at the Department of Energy's (DOE) Manufacturing Demonstration Facility (MDF) and Carbon Fiber Technology Facility (CFTF) at Oak Ridge National Laboratory are using their materials science, fiber production, and additive manufacturing expertise and capabilities to produce tooling such as custom molds for injection molding to provide U.S. industry with the necessary resources to mass produce health care supplies in record time (Figure 1).

It's what Lonnie Love of ORNL's COVID-related advanced manufacturing initiatives describes as "catalyzing industry."

"This is what national laboratories and user facilities like the MDF and CFTF were made to do," Love said. "We do the scientific research, overcome the challenges, and then provide industry a turnkey solution that allows them to take our tools and rapidly manufacture critical equipment to meet U.S. demand."

In partnership with the U.S. Department of Defense (DOD) Industrial Base Analysis and Sustainment program from the Office of Industrial Policy and the U.S. Department of Health and Human Services, ORNL has mobilized advanced manufacturing researchers at the MDF to develop tooling such as molds that will enable the production of face masks, shields, and test collection tubes in quantities estimated from hundreds of thousands to millions. These efforts are at the heart of a collaboration between DOE and DOD called the America's Cutting Edge (ACE) program, a national initiative for machine tools technology development and advancement.

"ACE is intended to help the United States recover the technical and manufacturing leadership position and enable our ability to design and make the machine tools required to produce so many of the products that are used in modern society," said Adele Ratcliff, director of the Industrial Base Analysis and Sustainment program. "We are proud that this partnership was able to pivot its formidable capabilities toward helping relieve the COVID-19 pandemic. Efforts like prototyping tooling to enable industry to be more responsive to economic opportunities and when national security issues arise are central to ACE's continuing mission."

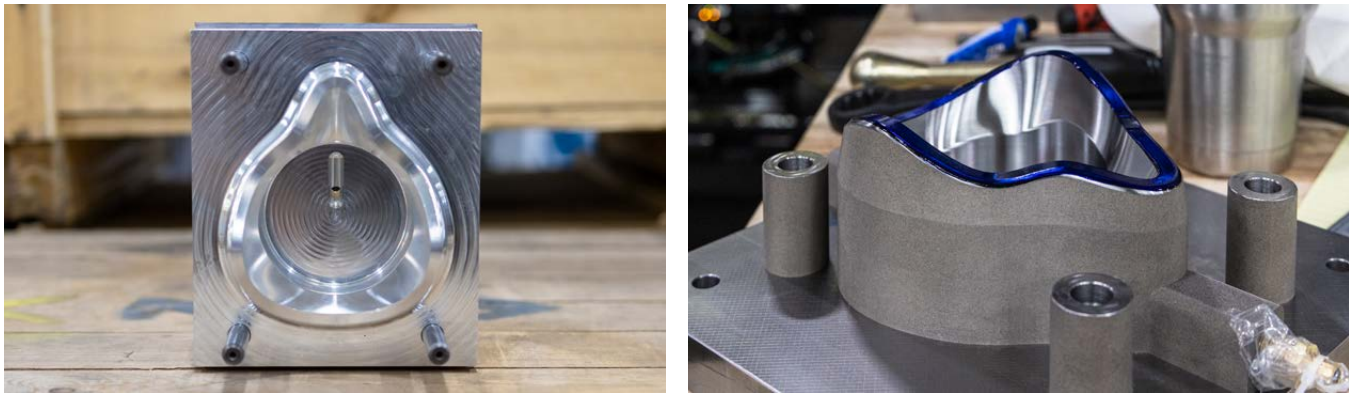


Figure 2: Researchers at ORNL's MDF developed a reusable face mask prototype with injection molding that will enable industry to rapidly manufacture masks. The injection-molded reusable mask includes five parts, and with five sets of tools, industry can potentially make 300,000 reusable masks per week. Credit: Carlos Jones/ORNL, U.S. Dept. of Energy.

According to Love, face shields can be 3D printed, but the only way to achieve production volume is through injection molding. "To do injection molding, you need tooling," Love said (Figure 2). "We're creating tools in days instead of months. Our efforts make it possible for industry to scale up production."

Face shield production

Health care workers depend on face shields to protect the entire face from hazards such as infectious diseases like COVID-19. A method commonly used to manufacture face shields is injection molding, which works by filling a metal mold with molten plastics to produce large volumes of shields.

At the MDF, researchers worked with Uday Vaidya—ORNL/University of Tennessee Governor's Chair in advanced composites manufacturing and chief technology officer for the Institute for Advanced Composites and Manufacturing Innovation—to design molds for the mass production of face shields. Working with industry partner DeRoyal Industries, a global manufacturer of medical supplies headquartered in East Tennessee, Vaidya and team produced a mold for use in making the plastic band that fits to the head and holds the shield in place.

"We needed a mold that could be used to exponentially increase the production of face shields, and we didn't have the time to research and determine the best way to do this on our own," said DeRoyal Chief Executive Officer Brian DeBusk. "Working with ORNL, we were able to find an immediate solution."

ORNL's research team designed, printed, and machined a mold ready for industry production within three days.

"We're driving unparalleled speed to market for important health science materials desperately needed during this crisis," Vaidya said. "Our team of internationally recognized academic and business leaders, scientists, and students have the flexibility, full support, and forward-thinking leadership to remove typical barriers and catalyze the rapid innovation that will help millions of people."

DeRoyal is using the ORNL-made molds on their injection molding machines.

"We're making 30,000 shields per day on a single shift working six days per week and using a manual process," DeBusk said. "However, we're in the process of automating that process to make them faster and less expensive."

DeBusk said these shields will be used in thousands of medical facilities throughout the United States.

Millions of masks

In addition to face shields, ORNL developed a reusable face mask prototype for DeRoyal to deploy. Vaidya designed the tooling for the prototype, and ORNL collaborated with heavy equipment manufacturer John Deere on the initial mold design.

The mask is made of five parts and includes a retention ring band, a hard outer shell, filter material, a softer inner shell, and an inner retention ring

Figure 3: ORNL is designing reusable face masks using the lab's advanced manufacturing facilities. Credit: ORNL, U.S. Dept. of Energy.

(Figure 3). Rectangular holes can be drilled into the outer mask to add straps.

"Uday's tooling is enabling us to use metal additive manufacturing to rapidly produce injection molding dies for reusable masks," Love said. "With five sets of tools, industry can potentially make 300,000 reusable masks per week."

DeRoyal, in turn, is working with another company to do final assembly work on the mask, DeBusk said. After assembly, DeRoyal will handle distribution of the masks throughout the United States.

According to Love, the masks can be used hundreds of times by replacing the filter layer made of N95 material. "We worked out the production process for the N95 material too," Love said. "And, we consulted with the expert, Dr. Peter Tsai, the inventor."

Filter material breakthrough

ORNL researchers were presented with the challenge of how to produce filtration material for masks on existing equipment typically used to mass produce precursor material for carbon fiber production.

ORNL's Merlin Theodore, who directs the CFTF, turned to the precursor line's melt blowing capability for the answer (Figure 4). The N95 mask is made of two plies of melt-blown polypropylene, a non-woven material that is permanently electrostatically charged with millions of microfibers layered on top of each other. The filter is capable of removing more than 95% of submicron particles found in viruses like COVID-19.

Melt blowing is a nonwoven process that makes microfibers into a fabric by scattering a polymer resin at a high air velocity. Randomly deposited fibers form a sheet of material applicable for filtration.

"We have the capability to melt blow polypropylene, but we didn't have the capability to charge the fibers," Theodore said. "The charge is what's needed to enhance the filter efficiency."

That's where Tsai's knowledge was critical to the CFTF's COVID-19 research. A retired University of Tennessee researcher, Tsai invented electrostatic charging, a process in which permanent charges are embedded into a fiber to enhance filter efficiency by electrostatic attraction. Tsai was consulted about how a charging capability could be integrated into the melt blowing line at the CFTF.

Tsai worked with the CFTF team to develop an inline charging technology for the melt blowing line and coordinated with staff at the MDF on material blending. Materials were mixed using the reservoir that normally holds polymers for 3D printing on the Big Area Additive Manufacturing machine at MDF.

"We've been successful in melt blowing polypropylene continuously on a belt," Theodore said. "And, we've translated it through an electrostatic charging system to make the filter material."

Researchers across multiple disciplines at ORNL in materials science, characterization, and systems and electrical engineering collaborated to adjust the speed and feed of the material to achieve the optimum production target of 65 grams of material per minute with a fabric weight of 30 grams per meter squared.

"In just one week, we produced a material that meets N95 requirements," Theodore said.

Figure 4: Researchers at ORNL's CFTF used melt blowing to produce electrostatically charged material for reusable masks and worked with N95 inventor, Dr. Peter Tsai. Credit: Carlos Jones/ORNL, U.S. Dept. of Energy.

"We're also working with Cummins (an engine and power generation manufacturer), which has melt blowing capability presently used for other filter applications, in an effort to enable commercial production of the N95 filter material."

The Cummins technology used in air, fuel and lube filtration is typically found in heavy-duty diesel engines to prevent long-term engine wear but can also be used in N95 respirator masks.

"Cummins is re-evaluating its supply base and manufacturing capabilities to identify how to support healthcare professionals who rely on critical personal protective equipment to do their jobs," said Amy Davis, vice president of Cummins filtration.

The CFTF team has met speed requirements for production scale-up so the material can ultimately be supplied to companies like DeRoyal for distribution. ORNL will work with industry on production, and DeRoyal is testing the material for use in masks and has placed an initial order.

N95 mask production

A collaboration between ORNL and a Florida-based medical device manufacturer, DemeTech, has led to the mass production of N95 respirator masks.

DemeTECH, a medical device manufacturer, is the state's only National Institute for Occupational Safety and Health certified producer of the respirator masks needed to protect U.S. health care workers in the fight against COVID-19.

"We had no capability to make this material but wanted to be able to ramp up the production quickly," said Luis Arguello Jr., vice president of DemeTECH. "Through a connection at the DOD's Advanced Functional Fabrics of America, we were introduced to ORNL and its success in making filter media material."

Scientific research that began at ORNL provided melt blown filter material to DemeTECH so that it could develop its mask manufacturing processes. At the beginning of the COVID-19 pandemic in the United States, ORNL researchers were presented with the challenge of how to produce filtration material on existing equipment typically used to mass produce precursor material for carbon fiber production.

Before COVID-19, DemeTECH primarily manufactured wound closure medical devices such as surgical sutures and hernia mesh. The company began production of surgical and N95 masks in response to health care supply demand. Since pivoting the company's capabilities to producing masks, DemeTECH has also opened two additional production facilities.

Test tubes

ORNL was also tasked by the Department of Health and Human Services to develop injection molding tools for the mass production of plastic tubes for COVID-19 test kits. The kits include a swab, saline solution, and the plastic tube to enclose the swab during transport.

"The U.S. goal is to ramp up production to enable one test per person per month, which is 330 million test kits per month," Love said. "If we created a mold that's designed to make 36 test tubes in a batch every 10 seconds, and the injection molding machine ran for three shifts, manufacturers could make 300,000 tubes per day. With multiple machines working around the clock, you could achieve the 330 million goal."

Love said test kit production is limited to one million per week but is rapidly scaling up to 10 million per week, which matches testing capacity.

"As testing capacity grows, so will the need to grow the test kits," he said. "We are in a race to rapidly solve manufacturing problems currently facing the

health care system. Every industry we talk to wants to help. Our role is to provide them the tools they need to be successful."

ORNL scientists designed a mold prototype made of polymer, which Lawrence Livermore National Laboratory will print and deliver to a nearby industry partner for evaluation. After industry testing, ORNL will use additive manufacturing and machine tooling to produce a metal mold from the prototype that can be used to make millions of parts.

"ORNL's additive design experts and state-of-the-art equipment make this quick turnaround possible," Love said. "It would take months to manufacture this tooling in the traditional way, but our researchers are doing it in days."

The final step, Love said, is to confirm that the mold works so it can be replicated quickly and enable the mass production of collection tubes.

Ventilators and more

ORNL is also researching how to reverse engineer ventilators to 3D print tooling so companies can mass produce them and investigating how to assist with drug delivery and automation.

–Jennifer Burke

ACKNOWLEDGMENTS

This research was supported by the DOE Office of Science through the National Virtual Biotechnology Laboratory, a consortium of DOE national laboratories focused on response to COVID-19, with funding provided by the Coronavirus CARES Act.

FEATURED RESEARCHERS

Dr. Merlin Theodore is the director of the Carbon Fiber Technology Facility at ORNL, where she also leads the Advanced Fibers Manufacturing group in the Manufacturing Science Division of the Energy Technology and Science Directorate. In these roles, she leads the development, maturation, and transfer of innovative advanced fiber technology and supports the associated fabrication of advanced fiber composite components for use in high-volume energy applications. Dr. Theodore holds a Ph.D. in material sciences from Tuskegee University in Alabama.

Dr. Uday Vaidya is the University of Tennessee–ORNL Governor's Chair in advanced composites manufacturing; a professor in the Mechanical, Aerospace, and Biomedical Engineering Department at the University of Tennessee, Knoxville; and the chief technology officer for the Institute for Advanced Composites and Manufacturing Innovation. He received his Ph.D. in mechanical engineering from Auburn University in Alabama. His research interests include advanced composites; composite materials and manufacturing; applications development; dynamic response; nondestructive evaluation; sustainable and green materials; composites design; process modeling and mechanics; composites recycling and sustainability; sound and vibration damping; hybrid materials; and multiscale, multifunctional, and nanobio materials.

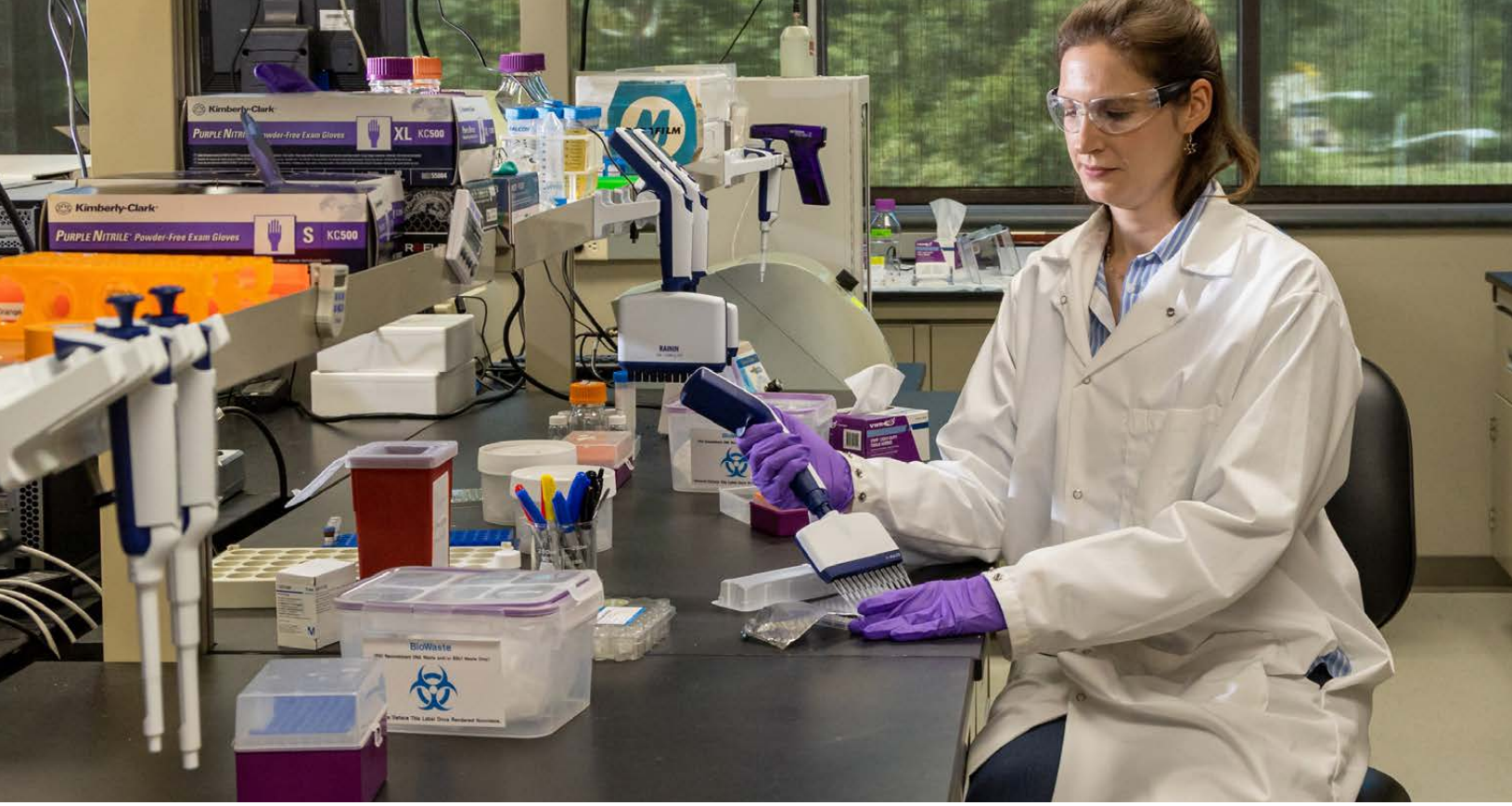


Figure 1: Stephanie Galanie tests the results of computational simulations, neutron scattering experiments, and x-ray studies in the laboratory. Experimental validation is necessary for researchers to refine their approach and is critical to advance new treatments for COVID-19. Credit: Carlos Jones/ORNL, U.S. Dept. of Energy.

Researchers Across Oak Ridge National Laboratory Team to Pursue COVID-19 Treatment Options

Virtual laboratory for drug discovery

One of the biggest challenges of drug discovery lies in the fact that scientists must search through an almost infinite space of chemical compounds to find one that might be capable of interfering with the infectious disease process. When the SARS-CoV-2 virus that causes COVID-19 began sweeping the globe, scientists knew that finding treatments would be no easy feat. The novel coronavirus was uncharted territory. Any protein–small molecule interaction might be the key to thwarting it.

A multi-institutional team, led by a group of investigators at the U.S. Department of Energy's (DOE) Oak Ridge National Laboratory (ORNL), has been studying various SARS-CoV-2 protein targets, including the virus's main protease. This protein plays a key role in viral replication by snipping the virus's newly made protein chain into smaller functional units that do the work to help it replicate.

This project began with the launch of a collaborative effort with NVIDIA and Scripps Research to create and run a new version of the AutoDock-GPU molecular modeling code, optimizing it for high-throughput molecular docking simulations on the Summit supercomputer at the Oak Ridge Leadership Computing Facility (a DOE Office of Science user facility).

For each separate docking simulation, the team generated 20 possible poses, or configurations, showing how each synthetically producible compound might fit inside of the viral protein structure's binding pocket. To accurately model the protein, the team used crystallographic structures from neutron scattering experiments performed at the High Flux

Isotope Reactor and the Spallation Neutron Source at ORNL.

After generating the poses, the team had a lot of data analysis work left to do. The team calculated features of the poses to apply different machine-learning models to reevaluate them and to better determine whether or not each compound was a strong binder to the main protease. To analyze the massive amount of data—1.3 terabytes per large-scale calculation—the team implemented a "virtual laboratory" on Summit to sort, manipulate, and join data pieces together.

Results are being validated experimentally by ORNL's Stephanie Galanie, who is performing test-tube experiments of the main protease binding to different compounds (Figure 1). Based on her results, the researchers are refining their approach and informing future predictions. They also expect to look at other proteins in the future—including ones that may be even better targets for computational approaches.

X-ray study explores potential of hepatitis C drugs to treat COVID-19

Experiments led by researchers at ORNL have determined that several hepatitis C drugs can inhibit the SARS-CoV-2 main protease, a crucial protein enzyme that enables the novel coronavirus to reproduce.

Inhibiting, or blocking, this protease from functioning is vital to stopping the virus from spreading in patients with COVID-19. The study, published in the journal Structure, is part of efforts to quickly develop pharmaceutical treatments for COVID-19 by repurposing existing drugs known to effectively treat other viral diseases [1].

"Currently, there are no inhibitors approved by the Food and Drug Administration that target the SARS-CoV-2 main protease," said ORNL's Daniel Kneller. "What we found is that hepatitis C drugs bind to and inhibit the coronavirus protease. This is an important first step in determining whether these drugs should be considered as potential repurposing candidates to treat COVID-19."

The SARS-CoV-2 coronavirus spreads by expressing long chains of polyproteins that must be cut by the main protease to become functional proteins, making the protease an important drug target for researchers and drug developers.

In the study, the team looked at several well-known drug molecules for potential repurposing efforts including leupeptin, a naturally occurring protease inhibitor, and three FDA-approved hepatitis C protease inhibitors: telaprevir, narlaprevir, and boceprevir.

The team performed room temperature X-ray measurements to build a 3D map that revealed how the atoms were arranged and where chemical bonds formed between the protease and the drug inhibitor molecules.

The experiments yielded promising results for certain hepatitis C drugs in their ability to bind and inhibit the SARS-CoV-2 main protease—particularly boceprevir and narlaprevir. Leupeptin exhibited a low binding affinity and was ruled out as a viable candidate.

To better understand how well or how tightly the inhibitors bind to the protease, they used in vitro enzyme kinetics, a technique that enables researchers to study the protease and the inhibitor in a test tube to measure the inhibitor's binding affinity, or compatibility, with the protease. The higher the binding affinity, the more effective the inhibitor is at blocking the protease from functioning.

"What we're doing is laying the molecular foundation for these potential drug repurposing inhibitors by revealing their mode of action," said ORNL's Andrey Kovalevsky. "We show on a molecular level how they bind, where they bind, and what they're doing to the enzyme shape. And, with in vitro kinetics, we also know how well they bind. Each piece of information gets us one step closer to realizing how to stop the virus."

The study also sheds light on a peculiar behavior of the protease's ability to change or adapt its shape according to the size and structure of the inhibitor molecule it binds to. Pockets within the protease where a drug molecule would attach are highly malleable, or flexible, and can either open or close to an extent depending on the size of the drug molecules.

Before the paper was published, the researchers made their data publicly available to inform and assist the scientific and medical communities. More research, including clinical trials, is necessary to validate the drugs' efficacy and safety as a COVID-19 treatment.

"The research suggests that hepatitis C inhibitors are worth thinking about as potential repurposing candidates. Immediately releasing our data allows the scientific community to start looking at the interactions between these inhibitors and the protease," said ORNL's Leighton Coates. "You can't design a drug without knowing how it works on a molecular level, and the data we're providing is exactly what developers need to design stronger, more tightly binding drugs for more effective treatments."

"These experiments have been scaled up to test hundreds of potential inhibitors at a time, which allows the researchers to test predictions from molecular biophysicists and computational chemists using docking approaches," said ORNL's Stephanie Galanie. The structural biologists and medicinal chemists on the cross national laboratory team are also designing new molecules based on structural insights to be assayed.

The research team plans to conduct neutron scattering experiments to locate the hydrogen atom positions and the network of chemical bonds between the protease and the inhibitor molecules.

The paper's co-authors also include Stephanie Galanie, Gwyndalyn Phillips, and Hugh M. O'Neill.

—Rachel McDowell and Jeremy Rumsey

ACKNOWLEDGMENTS

This research was supported by the DOE Office of Science through the National Virtual Biotechnology Laboratory, a consortium of DOE national laboratories focused on response to COVID-19, with funding provided by the Coronavirus CARES Act.

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FEATURED RESEARCHER

Dr. Stephanie Galanie is a Liane B. Russell fellow in the Biosciences Division's Metabolomics and Bioconversion Group at ORNL. Dr. Galanie is a biological and analytical chemist interested in biosynthesis, biocatalysis, and natural products. She applies high-throughput heterologous microbial expression and mass spectrometry techniques to probe metabolism and help answer systems biology questions. Current efforts involve *Populus* (poplar tree) enzyme and pathway discovery for accelerated domestication to reduce recalcitrance to deconstruction, increase drought tolerance and productivity, and manipulate metabolic profiles. She earned her Ph.D. in chemistry at Stanford University, engineering yeast with up to 23 genes to synthesize medicinal natural products and detect levels of molecules altered by metabolic engineering. She then joined Codexis, a publicly traded protein engineering company in the San Francisco Bay area, where she was responsible for high-throughput biocatalysis and analytical chemistry, initiated high-throughput mass spectrometry efforts, and co-led an enzyme-directed evolution program that resulted in collaborator Tate & Lyle's introduction of Tasteva® to market.

IEEE-HKN Welcomes New Members of the Board of Governors

The 2021 IEEE-HKN Board of Governors welcomed four new members, and a fifth member was elected to a second term as Student Governor. Ronald Jensen will lead the society as President in 2021.

Ronald Jensen, Nu Chapter and IEEE Life Senior Member, was elected IEEE-HKN President for 2021. Ron served as President Elect in 2020, IEEE-HKN Treasurer from 2015 to 2020, and Region 3-4 Governor from 2016-2018. He has led numerous HKN committees, including Journey Mapping, Finance, Strategic Planning, MGA Alignment, Faculty Advisor, Membership and PR & Communications.

James M. Conrad, former IEEE-USA President and current Professor and Associate Chair of the Department of Electrical and Computer Engineering at the University of North Carolina, Charlotte, was elected 2021 President-Elect. He is a member of the Beta Eta Chapter and has served as the MGA Governor at-Large on the HKN Board since 2018.

Edward Rezek, Delta Zeta Chapter and an IEEE Fellow, serves as Past President of the Board this year. He retired after 35 years from Northrop Grumman Space Technology. He has received 19 patents and has more than 50 publications in refereed journals.

Christopher Sanderson, Zeta Lambda Chapter, will serve a three-year term as Region 5-6 Governor. Sanderson currently serves as R5 Houston Section Chair and is the recipient of the 2020 IEEE Educational Activities Board Section Professional Development Award.

Hulya Kirkici, Xi Chapter, will serve a three-year term as Governor at-Large. Dr. Kirkici is a Professor and the Department Chair of Electrical and Computer Engineering at the University of South Alabama and a member of THE BRIDGE Editorial Board.

Sean Haynes, Gamma Beta Chapter, will serve a three-year term as MGA Governor at-Large. Sean is a Software Engineer at Northrop Grumman Undersea Systems and was Program Chair for the 2020 IEEE-HKN Experience.

Sandro Sartoni, Mu Nu Chapter, will serve a second term as Student Governor. He is pursuing a PhD in Computer Engineering at Politecnico di Torino University in Turin, Italy. He is chair of the IEEE-HKN Social Media Subcommittee and leads the monthly Chapter Leaders Calls.

Joseph Greene, Kappa Sigma Chapter, will serve a one-year term as Student Governor. He is pursuing a Ph.D. in Computational Imaging at Boston University with the support of a NSF Neurophotonics Research Trainee Fellowship and a BU Nanotechnology Innovation Center Cross-Disciplinary Fellowship.

2021 IEEE-HKN Awards: Call for Nominations

IEEE-Eta Kappa Nu encourages Chapters and individuals to nominate all eligible candidates for the 2021 IEEE-HKN Awards. The awards promote and encourage excellence in electrical and computer engineering and allied fields. These awards recognize outstanding accomplishments by students, professors and industry professionals who make significant contributions to society, and who exemplify a balance of scholarship, service, leadership, and character.

Deadlines begin 3 May 2021.

For information and a description of each award, click here.

The 2021 award categories are:

- Asad M. Madni Outstanding Technical Achievement and Excellence Award (Deadline to submit applications: 03 May 2021)

Bruce Eisenstein, 2020 winner of the Distinguished Service Award

- C. Holmes MacDonald Outstanding Teaching Award (Deadline to submit applications: 03 May 2021)
- Distinguished Service Award (Deadline to submit applications: 03 May 2021
- Outstanding Young Professional Award (Deadline to submit applications: 03 May 2021)
- Alton B. Zerby and Carl T. Koerner Outstanding Student Award (Deadline to submit applications: 30 June 2021)

To submit your nominations, visit the IEEE-HKN Awards Portal.

Ming Hsieh, 2020 winner of the Madni Award

Jennifer Marley, 2020 winner of the Outstanding Teaching Award

MIT Alfred P. Sloan Scholarship Winner and GEM Fellow Named IEEE-HKN Outstanding Student of the Year for 2020

Alvaro Sahagun, who was instrumental in helping to re-establish the IEEE-HKN Iota Lambda Chapter at the University of Illinois at Chicago (UIC), has been selected as the 2020 Alton B. Zerby and Carl T. Koerner Outstanding Electrical or Computer Engineering Student Award recipient.

He currently is pursuing a master's of science degree in Electrical Engineering and a Ph.D. in Electrical Engineering at the Massachusetts Institute of Technology.

Alvaro pictured in the clean room

Alvaro served as Iota Lambda Chapter President in 2019 while working to reinvigorate the Chapter, which had been dormant for seven years. A total of 51 new members were inducted into IEEE-HKN during his tenure.

"These 51 individuals would not have been members without Alvaro's efforts and concerns for his fellow students," wrote Daniela Tuninetti, Ph.D., Professor and Interim Department Head of Department of Electrical and Computer Engineering at UIC, in her letter of recommendation.

During his undergraduate studies Alvaro performed research in the areas of nanotechnology and the electrical and optical property of two-dimensional materials, Dr. Tuninetti wrote.

Alvaro works in the clean room

Alvaro is the recipient of MIT Alfred P. Sloan Scholarship 2020 and is a GEM Full Fellow (Ph.D. Engineering Fellowship Program). He has served as an undergraduate researcher at Micromechatronic Systems Laboratory, UIC; as an Undergraduate Research Associate at Marvell Nanofabrication Laboratory, University of California, Berkeley; a Summer Research Intern at the Center for Nanoscale Systems, Harvard University; and a Summer Research Intern at Microsystems Technology Laboratories, MIT, among other research positions.

He was the co-founder and Vice President of the Society for Advancement of Chicanos/Hispanics and Native Americans in Science at UIC and served on the university's Honors College Advisory Board. He also received the UIC Chancellor's Student Service Award three years in a row.

Asked what HKN means to him and why he worked to reinstate the Iota Lambda Chapter, Alvaro said: "I believe IEEE-HKN helps bring increased recognition and visibility to our ECE department and our excellent students. In our chapter, we aimed to not only acknowledge but celebrate the hard work of our ECE students. In addition, we encouraged our members to widen their professional networks by attending workshops or seminars and connecting with alumni, which may lead to future internships or full-time jobs. I also hoped to use our Chapter as a bridge between ECE faculty and ECE students to cultivate

First University of Illinois at Chicago HKN Induction Class, 2019

an environment where personal experiences in education can be shared and professional connections can be made. I want students to not only meet their professors but also learn from their professors' experiences in academia, such as what inspired them as an undergraduate student to pursue a Ph.D. in their field and the professoriate career instead of working in the industry.

Alvaro will receive a US$1,000 award honorarium and an engraved plaque.

IEEE-HKN's Alton B. Zerby and Carl T. Koerner Outstanding Electrical or Computer Engineering Student Award recognizes outstanding scholastic excellence and high moral character, coupled with demonstrated exemplary service to classmates, university, community, and country. This program is administered by the Los Angeles Area Alumni Chapter of IEEE-HKN.

The Outstanding Student Award Finalists for 2020 were:

Maxwell Lewis
Omega Chapter
Oklahoma State University

Chelsea Shaffer
Gamma Theta Chapter
Missouri University of Science and Technology

Susan K. "Kathy" Land

2021 IEEE President
Eta Chapter

Susan K. (Kathy) Land is a Program Manager for the U.S. Department of Defense's Missile Defense Agency. She has more than 30 years of industry experience in the application of software engineering methodologies, the management of information systems, and leadership of software development teams.

Kathy served as the 2018 Vice President, IEEE Technical Activities. She also served two additional terms on the IEEE Board of Directors as Division VIII Director/Delegate in 2011 and 2012 and as Division V Director/Delegate in 2014 and 2015. She was President of the IEEE Computer Society in 2009. Kathy was a member of the IEEE-USA Board of Directors in 2013 and 2016.

Kathy has been an active member of the IEEE Standards Association for more than 20 years and served as the Computer Society Vice President for Standards in 2004. She was the recipient of the 2007 IEEE Standards Medallion.

An IEEE Fellow, and Professional member of IEEE-HKN, Kathy is the author and co-author of a number of texts and publications supporting software engineering principles and the practical application of software process methodologies. She is an IEEE Computer Society Richard E. Merwin Award recipient.

What inspired you to choose your career field?

My professional background is a bit different from most of HKN members inducted as students. My induction into HKN was as a professional member later in my career. It is important for people to understand that IEEE brings together, and welcomes to membership, not only engineers, but also technologists from the fields of computer sciences and information technology, physical science, biological and medical science, mathematics, technical communications, education, management and law and policy.

When I started college in the 1980s, presenting an obvious aptitude in math and science, I was not encouraged to pursue engineering or science. In fact, the University of Georgia Department of Computer Science was established the year I graduated, in 1984. When I entered the work force it was the 'wild, wild, west' of computing. It was the advent of personal computing and team programming and the challenge was to keep up with an evolving and constantly changing technical landscape. It was an exciting and wonderful time to be a woman in technology, as opportunity was abundant.

The computer science landscape for women in the 1960s and 1970s was vastly different from that of the 1980s. The pioneers of women in computing, the true groundbreakers, were regarded as second-class citizens, not receiving full credit for their contributions. Given the legacy of women in computer science, the biggest question for me personally was 'Why?' 'Why the field of computer science?' This was a new field, and I knew no one–male or female–in this field. In addition, the examples of women in early computing were not very attractive. My answer, is that in the 1980s and 1990s, employers were willing and able to hire anyone, regardless of gender who understood computing technology. Employers understood that this new and growing field was critical to their future success and they were willing to hire based upon performance–rather than academic pedigree. I went into Computer Science, because of the equitable opportunities available and what looked like a promising career.

What do you love about your career?

Like many working in the field of Computing, my success is based on my ability. What I love most about my career field is that it is not about what is on the 'outside' but what is on the 'inside' that counts. If you are in a room full of people and you have the best technical idea that is what is important. It is that simple. Our message to those considering technical careers should be that technology allows individuals (regardless of their color, gender, or nationality) to express their intellect and allows them to be evaluated on their performance; that working in technology is the great equalizer. We should tell kids, who have an aptitude for the sciences, that a career in technology is a career where they will be in high demand and where they will never lack for opportunities. We should also emphasize that jobs in technical fields will provide for lifelong learning, excitement and satisfaction. That these jobs never become routine or boring. This is where IEEE and HKN come in, providing career assistance and life-long mentoring.

Best advice for new graduates…

To pay attention to your soft skills. There is a joke, 'How can you tell if an engineer is an extrovert?'… 'They look at your shoes when they are speaking to you.' Most programmers and engineers are introverts preferring to focus on their 'inner worlds.' Interpersonal soft skills are important because they help us develop and foster strong working relationships; they contribute to increasing team and organizational productivity, and are particularly important when working in fast-paced or constantly changing technical work environments.

Recent data I found backs this up: 72 percent of CEOs believe that soft skills are more important to the success of their business than hard skills. Some 94 percent of recruiters believe that soft skills outweigh experience and 94 percent of recruiting professionals believe that an employee with stronger soft skills has a better chance of promotion to a leadership position (than an employee with more years of experience but with weaker soft skills).

This is where graduates should leverage IEEE and HKN. I can tell you, without question, that the technical information, leadership experience and mentorship I gained through my volunteer activities with IEEE placed me in front of my work colleagues. I was promoted earlier, got better assignments, and better raises. It is that simple. Employers recognize when you bring the excellence of IEEE and HKN into their organization. I would encourage recent graduates to stay engaged with IEEE. Sometimes it is hard to find opportunities for engagement. The IEEE Young Professionals launched a web portal last year to help with these connections, visit the site at volunteer.ieee.org to explore and find an opportunity where you might connect.

Do you have any final parting words for our IEEE-HKN readers?

Today, within IEEE and HKN their missions and purpose are broader than what those originally conceived. IEEE's mission 'to advance technology for humanity' requires embracing these broader technology fields and individuals during all stages of their technology development. HKN's has grown from that original mission of helping engineering graduates find employment and gain footholds in their careers to the addition of assisting its members throughout their lives in becoming better professionals as well as better citizens. I am proud to be a member of IEEE and HKN. As a member of HKN I am inspired when I see this purpose put into action by the peer advising, exam prep, mentoring and tutoring programs, and programming activities at each one of the over 260 HKN chapters across the globe.

When each of us took the HKN pledge, we promised to live up to the principles of IEEE-Eta Kappa Nu and to bind ourselves to the faithful observance of these promises. I would like to encourage each of you, particularly during these challenging times. Remember how special you are. Remain steadfast and committed to the goals you set and do not waiver, we will all move forward together toward a brighter future. By belonging to IEEE and HKN, you are building character and enhancing the meaning of your life.

In closing, I found a great quote by Jim George: "Serving Others Prepares you to Lead Others"

2020 Year in Review

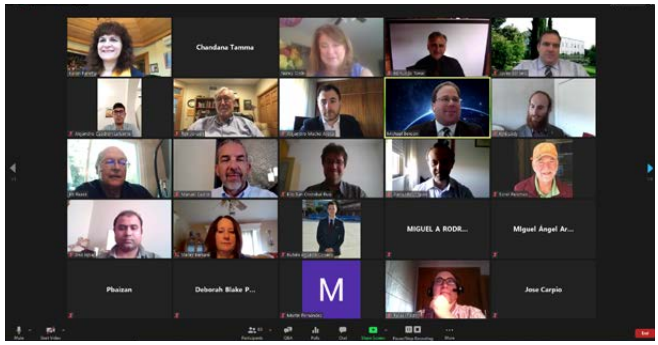
by Stacey Bersani, HKN Program Manager, Beta Epsilon Chapter

When you tell stories about the year 2020, what do you focus on? What will historians say about a year in which a pandemic stopped the world in its tracks for at least a little while?

When we at IEEE-Eta Kappa Nu talk about 2020, we cannot ignore the impact COVID-19 has had on our members across the globe. There has been loss and heartbreak. However, we also can choose to discuss how our global community of students and alumni, faculty advisors, Department Heads, and volunteers reacted with honor and compassion.

The Year in Review for the 12 months just passed will read differently than those that have come before it. It will have its share of statistics and percentages. Mostly, however, it will discuss how the honor society transformed its operations and offerings to ensure that Chapters could maintain operations, and members in all stages of their careers could live up to the promises they made when inducted. It will also report on the ways our members faced the challenges with creativity and hard work.

Beginning in March, the IEEE-HKN Board of Governors and staff developed online programming, resources, and delivery methods to maintain Chapter support and operations.



Chapter Installation and Member Induction Ceremony for Nu Alpha and Nu Beta, our new Chapters in Spain

By 5 April 2020, the society unveiled a Remote Induction Ceremony, which holds fast to the 116-year-old ritual, and was and continues to be used by Chapters in all regions. More than 1,650 student and professional member inductions were reported for 2020 as of the date of this report.

Soon after, a new Chapter Installation Ceremony was introduced and used in July to welcome our first Chapters from Spain. Nu Alpha and Nu Beta were soon joined by Mu Omega and Nu Gamma. So, despite the pandemic, IEEE-HKN added four chapters in 2020.

On 31 May, IEEE-HKN held its first Graduation Celebration to recognize those who more than likely would not have in-person graduation ceremonies. HKN Eminent Member and Broadcom Founder Henry Samueli offered advice over a live broadcast, which also featured our graduates in a Virtual Procession.

2020 YEAR IN REVIEW

1,650+ **STUDENT AND PROFESSIONAL**
member inductions reported as of publicaton

45,000+
CRITICAL SERVICE HOURS
provided by students to their universities and communities in 2020 despite COVID-19

1,150+
ACTIVITIES REPORTED
by our Chapters (compared with 1,302 for all of 2019)

4 **NEW CHAPTERS**
Florida Polytechnic University, Mu Omega Chapter
Universidad Nacional De Educación A Distancia, Nu Alpha Chapter
Universidad Politécnica de Madrid, Nu Beta Chapter
The College of New Jersey, Nu Gamma Chapter

10
YEARS TOGETHER
IEEE | IEEE-Eta Kappa Nu

1 SEPTEMBER 2020
marked the
10TH ANNIVERSARY
of the IEEE and HKN merger

2ND MOST DOWNLOADED
magazine on the IEEE App

WINNER 2020 APEX® AWARDS FOR PUBLICATION EXCELLENCE

WON 7TH CONSECUTIVE
APEX Award in 2020

2020 YEAR IN REVIEW

1,032
INDIVIDUAL DONORS

$116,000
RAISED
during our special giving campaign, which helped fill budget gaps caused by COVID-19

IEEE-HKN VIRTUAL EVENTS REACH IN 2020

1,550	937	410	77%
TOTAL REGISTRANTS	TOTAL LIVE ATTENDEES	TOTAL ON-DEMAND ATTENDEES	OVERALL CONVERSION RATE (industry average is 50%)

TOTAL NUMBER OF EVENTS: 38

Pathways to Industry: **5** Diversity and Inclusion: **1**

2020 IEEE-HKN EXPERIENCE (IEEE-HKN MEMBER-EXCLUSIVE EVENT)

11	32	59	508	26
DAYS	SESSIONS	SPEAKERS	ATTENDEES	HOURS OF CONTENT (available for viewing on-demand)

21
COUNTRIES REPRESENTED
(up from 7 last year)

USA, Egypt, Saudi Arabia, South Africa, Singapore, Qatar, Malaysia, Canada, India, Italy, Australia, Taiwan, UK, Spain, Algeria, Thailand, S. Korea, Sri Lanka, Mexico, Antigua and Barbuda, Panama

147
CHAPTERS REPRESENTED
(up from 45 last year)

508
REGISTRANTS
(up from 200 last year)

The Pathways to Industry workshops, which prepare students to go into the workforce, attracted five-times the usual number of attendees, as the former day-long series of small, in-person seminars was brought online and offered as five individual webinars.

Professional development sessions, such as the Conducting an Effective Job Search Panel, were part of the HKN Experience

Inspired by the protests for racial equality in the USA, the IEEE-HKN Student Governors sought to host an online Diversity and Inclusion Roundtable discussion. A panel of experts spoke to each other and attendees about how IEEE-HKN chapter leaders and members can thoughtfully incorporate best practices to build a stronger society and be inclusive in their programs and community outreach.

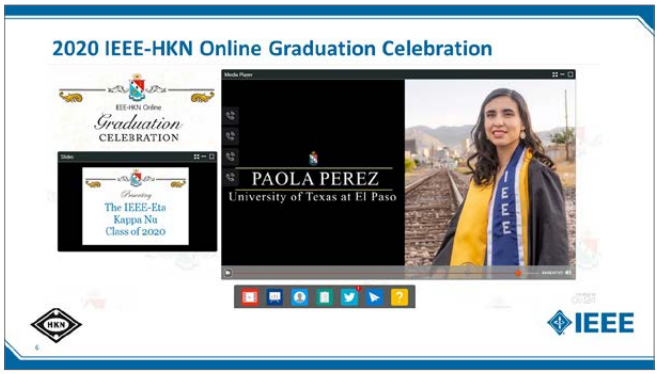
The society's premier educational and networking event, the annual Student Leadership Conference, was reimagined as an 11-day, interactive online event exclusively for IEEE-HKN members, students and professionals alike. The 32-session event drew more than 500 attendees. Some 147 Chapters and 21 countries were represented. Twenty-six hours of professional development and technical sessions offered live during the event are available for viewing on-demand.

From the Experience emerged our new IEEE-HKN X-Factor series, conversations with our Eminent Members. Leonard Kleinrock, one of the Fathers of the Internet, and Robert Metcalfe, spoke about their game-changing inventions and what they are studying now. Look for more offerings in 2021, including our X-Factor conversation with Marty Cooper, Father of the Cell Phone, now available on-demand.

Our Chapters were just as ambitious in their outreach and programming efforts. They took advantage of our Virtual Tutoring Center Initiative and created their own opportunities to provide more than 45,000 hours of critical services to their universities. They hosted online tutoring and exam prep sessions for students having difficulty learning virtually. Several chapters wrote curricula and developed delivery methods to help their schools transition to online learning environments.

Watch our "We Are in This Together" video, a compilation of videos created by 13 of our Chapters illustrating what they did academically, socially and in service to others throughout the pandemic. Read about other Chapter programming in our Chapter Spotlight on page 38.

Quarantine orders throughout the world made it impossible for Chapters to hold in-person meetings, community outreach and social events. So, they brought it online. For the first time ever, Chapters from three different countries held a joint Founders Day event (see page 39), and members of the Kappa Psi Chapter at the University of California, San Diego and the Epsilon Epsilon Chapter at the University of Houston interacted with each other while completing puzzles from the Microsoft College Puzzle Challenge.



2020 IEEE-HKN Online Graduation Celebration

Of course, none of these achievements could have been reached if it were not for the dedication and support of our members, our volunteers, and our donors.

Your gifts of time, talent and treasure were greatly needed–and you delivered. The IEEE-HKN Board is so very thankful to our tens of thousands of members, our hundreds of volunteers and the 1,032 individual donors–28 percent more than in 2019–who supported us this year.

The Board of Governors and staff wish you a healthy, hopeful 2021 and we look forward to seeing how we can grow together in 2021 and beyond.

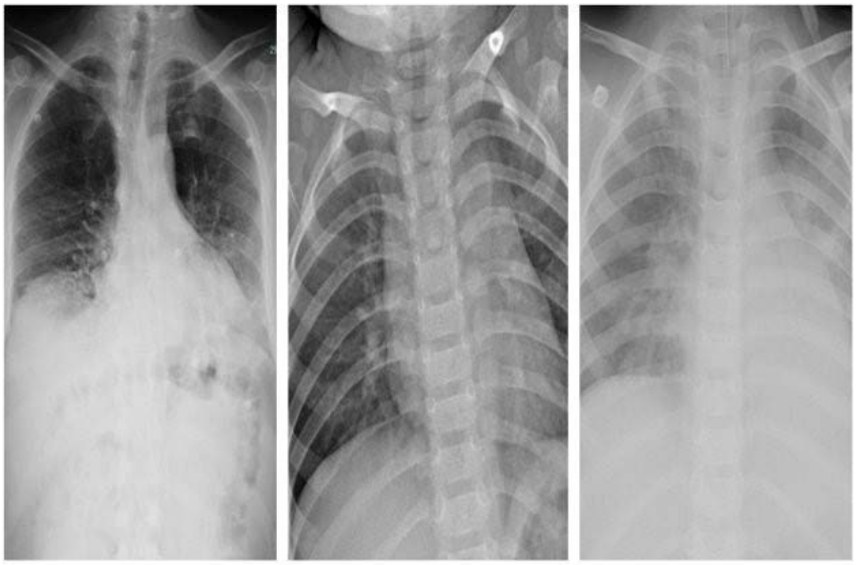
SPONSORED CONTENT

Using Artificial Intelligence to Diagnose COVID-19 Pneumonia

by David Levin

For patients with COVID-19, terrifying shortness of breath can set in virtually overnight. In many cases, it's caused by an aggressive pneumonia infection in the lungs, which fills them with thick fluid and robs the body of life-giving oxygen.

Detecting these severe cases early on is essential for treating them successfully. At the moment, however, the only way to tell whether a patient's pneumonia is caused by the coronavirus is by examining X-ray and CT scans of the chest–and as cases rack up worldwide, radiologists are being deluged with images, creating a backlog that may delay critical decisions about care.



Lung X-ray images, from left, of COVID-19, normal, and viral pneumonia patients. *Images courtesy of Dean of Graduate Education Karen Panetta, Tufts University School of Engineering.*

One solution, said Dr. Karen Panetta, may involve taking some of that workload away from humans. Panetta, the Dean of Graduate Education and a professor of electrical and computer engineering at Tufts University School of Engineering, is working to create artificial intelligence (AI) that can spot cases of COVID-19 pneumonia and flag them for review.

Using X-rays and CT scans from an international COVID-19 database, her lab is training AI software to comb through thousands of images, matching those that share similar traits. By comparing X-rays of pneumonia caused by bacterial infections, chronic smoking, and COVID-19, she says, the AI can gradually learn to identify features unique to each one, be it a particular shape, area of contrast, or other trait. Once the software finds potential matches, it uses statistical analysis to sort COVID cases from non-COVID ones.

Panetta's COVID-19 work builds on research that her lab has already been doing to detect cancerous tumors. In breast cancer, she notes, her AI software looks at the nuclei of individual cells in a biopsy sample, and searches for distinct patterns that match known cases.

Cancer-free samples tend to have orderly nuclei contained in an oval structure, but if the cancer progresses, those patterns tend to break down. Using AI and machine learning, it's possible to train the AI to spot new cancer cases autonomously based on those traits.

"We had already developed all these tools for image processing, machine learning, and AI methods for cancer, so COVID-19 was just a more timely application of the same technology," she said. "We're just tuning the software for a different use case."

The results are already promising. So far, her lab's software has been successful at identifying COVID-19 pneumonia in more than 99 percent of the images it processes.

Getting to that point hasn't been so simple, however. The machine learning tools she uses to train the software are only as good as the data they're fed–and

while humans can easily ignore slight imperfections in an image, those same glitches can trip up even the best machine.

"X-ray and CT scans aren't always in pristine condition. They require a lot of enhancement and pre-processing to clean up those imperfections so they're on equal footing," she says. The AI also has to be smart enough not to misdiagnose an image because it sees anomaly.

"Everyone thinks AI is this magical black box, but it's not Zoltar," Panetta said, referring to the all-knowing fortune-telling machine from the Tom Hanks movie, Big. "You have to constantly tweak it to improve it."

Another complication, she added, is that while AI can identify images that look like other cases of COVID pneumonia, it can't tell exactly why those images meet the criteria from a medical point of view. To fill in those gaps, Panetta is looking to team with experienced radiologists at Tufts, and wants to add medical annotation and context to each image.

Even if that improved AI software isn't available to clinicians during the current pandemic — which it very well may not be, since FDA approval can take years–Panetta hopes it could still be used in the future to educate medical personnel. If another outbreak happens down the road, she reasons, hospitals will need all the training they can get.

"Right now, even doctors on the front lines have probably only seen a few hundred cases of COVID-19 pneumonia, but there are hundreds of thousands of cases happening worldwide," she said. "If we can aggregate all that data into one place with images, symptoms, and patient info, it may be possible to use AI to study the disease more effectively."

That could help identify the patterns the cases all share. "For doctors who have never seen a patient with COVID-19," said Panetta, "it could generate a portfolio that tells them what to look out for."

A team of dedicated graduate students works with Panetta in the Vision and Sensing Lab. The School of Engineering is accepting applications now for talented MS and PhD students to join their ranks conducting life-changing research and scholarship at Tufts University. Learn more at go.tufts.edu/engmasters.

FEATURED RESEARCHER

Dr. Karen Panetta
Epsilon Delta

Dean of Graduate Education for the School of Engineering, Tufts University

Professor, Electrical & Computer Engineering

IEEE Fellow

IEEE-HKN (Eta Kappa Nu) Honor Society President 2019

Tufts UNIVERSITY | School of Engineering

Considering Graduate School?

Be sure to watch ***"Applying to Graduate School: Advice on How, Why and When,"*** a session first presented during the IEEE-HKN Experience, for practical advice from experts. The panelists discuss how, why and when to apply to graduate school, what to look for and how to decide if it is the right fit for you.

You can watch this session and the dozens of others presented during the 2020 HKN Experience by clicking here.

VIEW NOW

The IEEE-Eta Kappa Nu Board of Governors

cordially invites

the members of the 2021 Graduation Class, Family, & Friends

to the

IEEE-HKN Graduation CELEBRATION

Saturday, 5 June 2021
2 pm (ET)

The event will include a virtual procession of the members of the Class 2021, the presentation of the Outstanding Chapter Awards, remarks from the 2020 Outstanding Student Award recipient, recognition of the 2020 Key Chapters and the elevation of Dr. Maxine Savitz, Vice President, National Academy of Engineering, to HKN Eminent Member.
More details to come.

GRADUATES: BE PART OF THE CEREMONY!
Submit a photo of yourself in your graduation regalia and be a part of the Virtual Graduation Procession.
Photos are due by 21 May 2021.

REGISTER HERE

IEEE

https://event.on24.com/wcc/r/3010208/2CA812A5197EA0E891F4DA6FBD2AE403

Nancy Ostin

Director,
IEEE-Eta Kappa Nu

Letter from the Director

Dear HKN Community,

As we transition into 2021, I am reflecting on just how grateful I am for this network. HKN members are some of the brightest minds in electrical engineering and the allied fields, and despite the hurdles we faced over the last year, we adapted and found new ways to connect with one another.

As we look to the potential of 2021, we are excited for all that is to come. Over the last two years, our organization has been focused on what we can do to both enhance the HKN experience and position our organization for a strong future. Today, we have a vision for maximizing our impact — creating opportunities for each and every member to experience HKN at its best and to grow as leaders.

Members like you play an important role in this work. We know that HKN is the difference that develops promising young professionals into the engineering and technical leaders our world needs, and as we shaped plans to explore what's possible for HKN we knew it was important to engage our members in the process. Dozens of members participated in interviews and focus groups spanning young alumni, long-time members, and Eminent Members to help us set our priorities for elevating the HKN experience.

Through this process we identified three priorities:

- Launching a Chapter Support Fund, giving every HKN student member the chance to be part of a strong, well-supported Chapter;
- Supporting the Student Leadership Conference, growing Chapter participation to 100 percent every year and expanding digital access to this important event, and;
- Investing in a robust Alumni Network that allows members to maintain their connection to HKN throughout their careers.

By investing in these areas, we'll create the best possible HKN experience for members everywhere. Member support will determine how far we can reach and how fast we can go toward our vision for HKN's future, and we look forward to sharing more developments with you soon.

Thank you for all that you do for HKN. It is a privilege to serve such a brilliant network of engineering and technical leaders in our fields!

Sincerely,
Nancy Ostin
Director, IEEE-Eta Kappa Nu

Joseph L. A. Hughes

IEEE Fellow
Delta Chapter
Illinois Institute of Technology

Supporting a Bright Future for Engineering Students

Joseph L. A. Hughes' association with IEEE made an indelible mark on his life and career–so much so that he's now helping to provide opportunities in engineering education for others. After joining IEEE and the Delta Chapter of Eta Kappa Nu (IEEE-HKN) as a student at Illinois Institute of Technology, Chicago, IL, US, Hughes joined the faculty of Georgia Institute of Technology Atlanta, GA, US in 1986 and became actively involved in IEEE and the Accreditation Board for Engineering and Technology (ABET).

Among other milestones, Hughes went on to serve as President of the IEEE Education Society, as well as serving as a member of the IEEE Technical Activities and IEEE Educational Activities boards. Both involvements enhanced his professional development and widened his network of industry colleagues and friends.

Upon his recent retirement from Georgia Tech after 34 years, Hughes opted to include the IEEE Foundation in his estate plan as an esteemed member of the IEEE Goldsmith Legacy League, through which members can leave a legacy gift to benefit future generations of engineers. He directed his bequest to IEEE-HKN and IEEE educational programs designed for pre-university and university students. "I've become more attentive to the concept of legacy -- not because I worry about how I'll be remembered, but because I want to ensure the future of things that matter to me," he explained.

Hughes encourages other IEEE members to pay tribute to those who helped them by helping others coming up in the field. "If someone spends their career in one or more IEEE fields of interest, an estate gift is a way to pay back those who came before you and created your opportunities as well as a way to pay it forward to ensure that opportunities will be there for the next generation," he said. "Supporting the IEEE Foundation with an estate gift accomplishes these objectives while allowing for the inevitable changes that will occur within our profession in the coming decades."

You can choose to directly support IEEE-HKN or any of the strategically identified IEEE initiatives that help meet the world's most pressing challenges and help us to realize the full potential of IEEE.

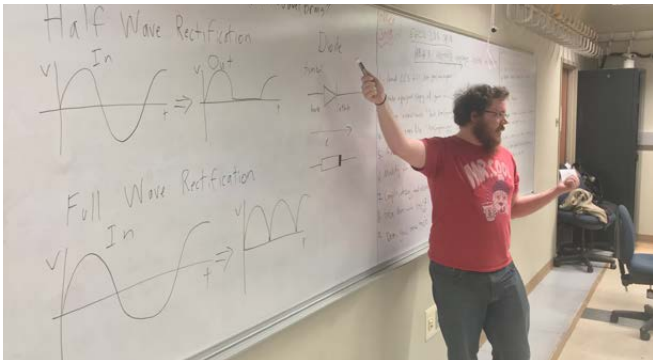
Zeus Gannon

Gamma Iota Chapter
University of Kansas

Zeus Gannon was born and raised in Florida and graduated high school in 2007. He spent the next five years working before he built up the motivation to go back to school. He chose the University of Kansas because of its partnership with a local community college. He earned two associate's degrees while completing core classes for his bachelor's degree. Attending the community college also gave him the opportunity to see if college was something he wanted to continue. The next three years were spent at the University of Kansas, where he earned a bachelor's degree in Electrical Engineering. He was invited to join HKN in his junior year, an indication that all his hard work was paying off. He was elected Chapter President. He graduated in May 2019 and was chosen as the outstanding senior for the Electrical Engineering Department. He continued as Chapter President during his first year of graduate school. He remains an active member of his Chapter. He also assists the IEEE-HKN Social Media Subcommittee.

Do you have a best IEEE story to share?

Our Chapter has an awards ceremony called the Underclassmen Achievement Awards. It recognizes the top three performers in each of our sophomore-level Electrical Engineering and Computer Science (EECS) classes. Planning and executing that event was one of the most fulfilling experiences I've had with IEEE-HKN. It felt great to be able to celebrate their accomplishments with our faculty and their parents.



Gannon teaching a lab for the university's IEEE Student Branch

Why did you choose to study the engineering field?

My uncle is a mechanical engineer, so I figured engineering was something I was capable of. I chose electrical because of my name and I thought it would be funny. When I started going to college, I didn't even know what an electrical engineer did. The more I learned, the more I enjoyed it and became passionate about it. I'm fascinated by electromagnetics, which is why I chose to focus on that for my master's degree.

What do you love about engineering?

I love the problem solving involved. I'm the most engaged in my work when someone gives me a problem and says, "I don't know how to solve this, which is why I'm giving it to you."

What is your dream job?

I would like to be a technical lead in a research lab. Being President of my local Chapter showed me how much I enjoy leading a team to a common goal. Eventually I would like to be a teacher at a community college to pay forward the excellent education I received from one.

What made you interested in public policy/volunteer work?

As someone who's benefited from food pantries run by volunteers, I feel it's important to give back to the community.

What is the next BIG advance in engineering?

The next big advancement I hope for is more efficient power storage. This would enable far more advanced portable technology.

What is the most important thing you've learned in school?

Make connections. Make sure your professors know who you are (in a good way). Always be willing to work with your classmates on homework and in study groups. The group projects that you'll have to do during your senior year will be much smoother if you already know everyone. Being able to communicate your knowledge to others is what makes you an engineer instead of a walking encyclopedia.

What advice would you give to other students entering college and considering studying your major?

Start with community college if you don't want to make the immediate commitment to a university. Don't worry if you're not going to finish an EE degree in four years. It took me seven years to get mine. When you get your diploma it doesn't have how long it took stamped on there.

Georgia Tech Lab Kits Program

by Ethan Frommer, Vice President, Beta Mu Chapter, Georgia Institute of Technology

The Beta Mu Chapter at Georgia Institute of Technology celebrated last fall 15 years of success with its Lab Kits Program, through which necessary lab items are packaged and sold at reduced costs to all ECE students at the university.

The program was the brainchild of Tom Hanley, a Graduate Student Member of the Chapter, who wanted to begin a service project at the university. The program began on a small scale in 2005, and has undergone fine-tuning every year. It has "cornered the market" on the sales of these supplies. The Chapter constantly works with professors to ensure that the lab kits sold are the most updated for their students' needs. The Chapter also continues to increase the number of classes it sells lab supplies kits for.

Students line the halls to purchase lab kits

Purchasing opportunities also have been expanded over the years: Sales are held in the lab on the first day of class as well as in the ECE building for the remaining students.

During the pandemic, students lined up in the hallway to purchase their kits. From 19 to 22 January 2021 alone, more than 500 lab supply kits, manuals, and breadboard accessories were sold with COVID safety precautions in place to students of six different courses. The Chapter also sells lab kits to aerospace and mechanical engineering majors, so its impact reached beyond the scope of the ECE Department.

The success of the program has borne even more fruit: By 2008 the Chapter raised and saved enough from the Lab Kit sales to start an endowment for scholarships. The "Eta Kappa Nu/ECE Scholarship Endowment" was created within the Georgia Tech Foundation on March 1, 2008 with a gift of US $15,000 from the Student HKN Chapter.

Sales continued through the pandemic with COVID-19 precautions in place

With steady contributions over the years and with Foundation management of the fund, the endowment grew to over US $55,000 by 2020. The interest from the endowment funds supports two US $1,000 scholarships each year: one for an outstanding junior electrical engineering or computer engineering student, and one to recognize early innovation shown by an electrical engineering or computer engineering student.

The Chapter continues to grow the HKN endowment each semester through contributions of US $2,000 each year. The Chapter announced last fall that it will increase each scholarship to US $1,500, for a new total of US $3,000 awarded annually to students.

In celebration of the 15th anniversary of the Lab Kits Program, the Chapter produced a YouTube video highlighting details of the program. You can watch it here: https://youtu.be/glnG2tBrGPg

The Beta Mu Chapter at Georgia Tech has an active membership of more than 100 students and most recently received the Outstanding Chapter Award in 2019.

For First Time Ever, Chapters from 3 Different Nations Host Joint Founders Day Celebration

Submitted by Luz María Sánchez Reyes, Mu Psi Chapter, Universidad Autonoma de Queretaro (Mexico), Jiakang Yang, Mu Kappa Chapter, The University of Queensland (Australia) and Ibrahim Izdhan, Mu Alpha Chapter, UCSI University-Kuala Lumpur, Malaysia

The Mu Alpha, Mu Kappa and Mu Psi IEEE-HKN chapters held the first-ever multi-national HKN Founders Day Celebration on 13 November 2020. The chapters from Mexico, Australia and Malaysia gathered via Zoom to meet one another and share ideas.

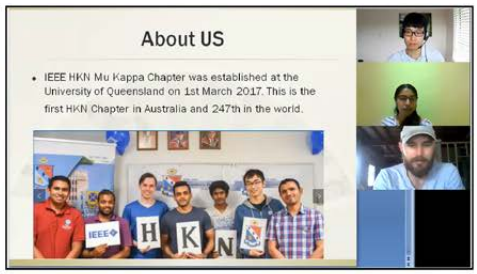
The event was divided into five stages: a welcome message given by Aobo Zhou, President of the Mu Kappa Chapter; presentations from each Chapter on their experiences, strategies and opportunities during the pandemic; several games to break the ice, and a closing message. Eighteen IEEE-HKN members, including students and faculty members, participated in the event.

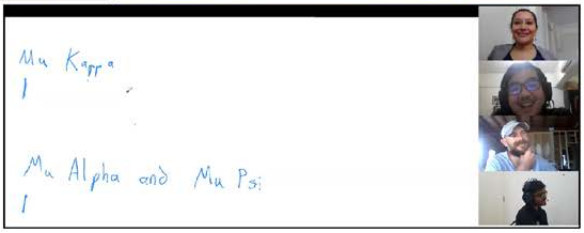
The event coordinators reported that this was a great event because the shared experiences help strengthen a newly created chapter like Mu Psi, while also enabling each member help each other through sharing ideas for workshops and conferences. It also proved to be a successful networking event.

Jiakang Yang of the Mu Kappa Chapter wrote: "This was a wholesome networking activity, which will motivate the members from the Mu Alpha Chapter, Mu Psi Chapter and Mu Kappa Chapter of HKN to make acquaintances with and reach out to each other. Shared experience with pandemic challenges will enlighten the Chapters to better seize the opportunities during this time and make more contributions."

"The importance of collaborating with other chapters lies in the bonds that are formed, friendships, colleagues who later can continue to collaborate, extending the scope of the activities, and benefiting more members," wrote Luz María Sánchez Reyes, Mu Psi Chapter. "HKN helps us to network, an example was this successful event, it expands horizons and strengthens soft skills. HKN is more than a society, it's a family."

Has your Chapter held a successful activity that you would like to share with the HKN community? Please submit an Activity Report and nominate it as a successful practice.





Check out These New E-Books and Audio Books from IEEE-USA

by Georgia C. Stelluto

Topics include Idea-to-Product Information; First Steps in Career Transitioning; Electrical Engineering Activities for the Classroom; and Emerging World Trends

IEEE-USA has some excellent new e-books and audiobooks for students, members and educators–all free to all IEEE members.

Following is a list of the latest new IEEE-USA E-Books.

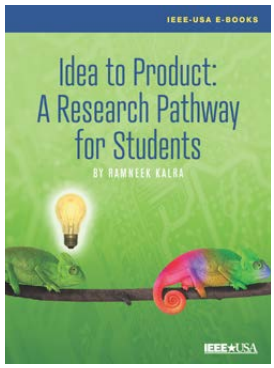
Career Transitioning 101–Book 1: First Steps

Is there a professional who, at some point in their career, has not sensed it is time to make a change? Career transitioning is almost inevitable today–whether it begins with feelings of stagnation in a current role or company, changes in career goals or interests, or simply an unplanned change in employment.

In fact, according to Dr. Robert Danielle, an expert in professional and career development and career transitioning, a person will change jobs an average of 12 times.

"The January 2018 report from the U.S. Bureau of Labor Statistics observed that many workers spend five years or less in every job," Danielle says. "It means they devote more time and energy transitioning from one job to another, and because of the economic impact of the COVID-19 pandemic, those numbers could be even higher."

Danielle is a consultant, whose work also includes leading large, successful change initiatives and improving individual and team performances. He has just written *Career Transitioning 101–Book 1: First Steps*, the first volume in this timely, new e-book series from IEEE-USA. IEEE-USA has introduced the e-book this month at no charge to members and for $2.99 to non-members. Go to https://ieeeusa.org/shop.



Idea to Product: A Research Pathway for Students

A purely random assignment to write a very simple program calculating simple interest, from a then-high school IT instructor triggered a breakthrough for author Ramneek Kalra. Kalra began thinking from the perspective of a customer/user. He also found a new passion–inspiring other students to understand the process of transforming an idea into a product.

Now a project engineer at Wipro Limited in New Delhi, India, this IEEE Member has written the IEEE-USA E-Book, *Idea to Product–A Research Pathway for Students.*

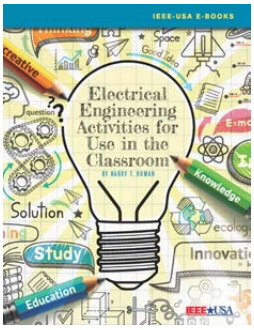
"I feel it is very important for students around the world, studying in secondary schools and universities, to understand the process of transforming an idea into a product," he writes.

Kalra sees the development of this concept as five specific phases:

1. Determining the problem, then developing problem statements and solutions
2. Choosing the right team and the right technology
3. Conducting in-depth research and a literature survey
4. Developing the prototype
5. Securing intellectual property rights

IEEE-USA is offering the book, Idea to Product: A Research Pathway for Students, at no charge to members and $2.99 to non-members at: https://ieeeusa.org/shop/careers/career-resources/idea-to-product-a-research-pathway-for-students/

Log in to your IEEE web account, add the book to your cart and checkout! No promo code necessary.



Electrical Engineering Activities for Use in the Classroom

For years, veteran engineer and educator Harry T. Roman has been assisting students of all ages discover the excitement of real-world engineering and problem solving in the classroom. Now, this IEEE Life Senior Member has written an e-book for teachers and working engineers. It shows them how to foster broad-based, useful knowledge among students about the myriad aspects of electrical engineering.

Roman's latest e-book is full of discussion topics and project ideas designed to challenge students in multiple areas of engineering. Whether it's to encourage interest in the many disciplines within electrical engineering, or simply to foster a deeper awareness of engineering technology, he includes abundant suggestions for getting students' attention and interest.

All IEEE members can download this free new e-book from IEEE-USA. Go to: https://ieeeusa.org/shop/policy/stem-education/electrical-engineering-activities-for-use-in-the-classroom/

Log into your IEEE web account, add the book to your cart, and checkout!

Women in Engineering–Book 23: From Semiconductor Physics to Sales & Marketing: My Perfect Career Path

Liang Xi Downey didn't see the inside of a classroom until she was almost 10. Born in 1965 – just as China's Cultural Revolution was starting – she was one of multitudes of children prohibited from starting their learning when China's leaders forced the country's schools and universities to close.

After the Cultural Revolution ended in 1976, relatives took her to Beijing. With the support of family and teachers, she persevered and excelled in her studies. Ultimately, despite her late start in a classroom, Downey graduated from the prestigious Tsinghua University with a degree in microelectronics.

Today, her 30-year career spans not only electrical engineering but also sales, marketing and business development. Downey is an IEEE Senior Member and a business strategist for DTE Energy, a Detroit, MI-based energy company. Using AI and other advanced technologies, Downey leads cross-functional teams to investigate, analyze and recommend current strategic and operational issues.

Her remarkable autobiography, *Women in Engineering –Book 23: From Semiconductor Physics to Sales & Marketing: My Perfect Career Path*, is the subject of the latest volume in the award-winning IEEE-USA Women in Engineering (WIE) e-book series.

All IEEE members can download their free new e-book from IEEE-USA. Go to: https://ieeeusa.org/shop/careers/workforce/women-in-engineering-book-23/

Log into your IEEE web account, add the book to your cart, and checkout!

Don't forget to download these free, new IEEE-USA Audiobooks:

Thomas Edison–Man of the Millennium: Volume 3: Observations

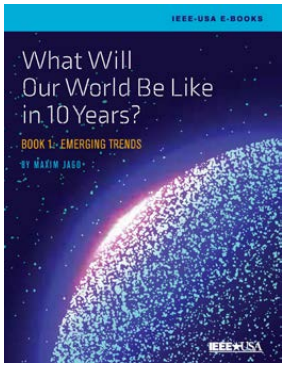
Members who eagerly snapped up the first two free audiobook volumes of Harry T. Roman's series on Thomas Edison are in for a post-holiday treat.

IEEE-USA is now offering listeners the third–and final–audiobook in the series, *Thomas Edison–Man of the Millennium: Volume 3: Observations.* The companion e-book from the series also is available to members at no charge.

In Volume 3, **Observations,** the author presents a strong, persuasive case for how Edison's innovative work more than a century ago became the basis for how engineers and other technologists are meeting the needs of contemporary society. The examples include electric automobiles, integrated circuits, and the digital economy.

Download your free audiobook from IEEE-USA, *Thomas Edison–Man of the Millennium: Volume 3: Observations*

Members: You can also download the companion e-books of Volumes 1 and 2 of this series for free! Go to: https://ieeeusa.org/?s=thomas+edison+e-book&post_type=product



What Will Our World Be Like in 10 Years? Emerging Trends

Emerging Trends is the first in a projected series of five volumes that Maxim Jago is writing especially for IEEE-USA. The overall title of the series is *What Will Our World Be Like in 10 Years?*

British-born Jago's work spans multiple industries–from Artificial Intelligence (AI) and Extended Reality (XR)–to education and the creative arts. The author of numerous books and online courses, Jago's volume on video editing with Adobe Premiere Pro is the standard text most film schools use. In addition, millions of people worldwide have viewed his more than 1,800 online tutorials that teach the subject.

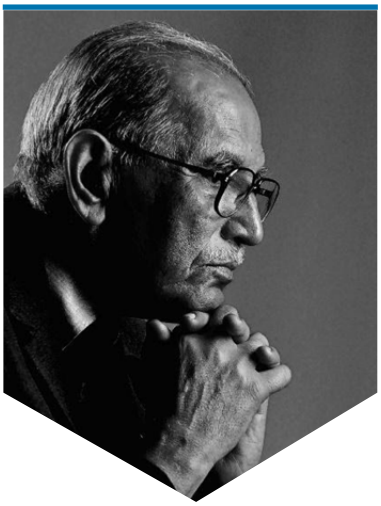
With *Emerging Trends,* IEEE members and other technical professionals need to look no further for reliable predictions about how social developments will likely affect contemporary technologies over the next decade. The audiobook offers Jago's views on about 31 developments he defines as "impactful for several important facets of our lives, in the next ten years." He goes on to pinpoint them as themes that are "the most compelling and worthy of attention."

IEEE-USA is now offering this new, free audiobook, *What Will Our World Be Like in 10 Years? Emerging Trends*

To download the new audiobook, go to: https://ieeeusa.org/wp-content/uploads/ebooks/audio/WWTWBL.mp3 or https://ieeeusa.org/shop/audiobooks/

The companion e-book from the series is also available to members at no charge. Go to: http://shop.ieeeusa.org

Georgia C. Stelluto is IEEE-USA's Publishing Manager; Manager/Editor of IEEE-USA E-BOOKS; InFocus Department Editor for IEEE-USA InSight; and Co-Editor of the IEEE-USA Conference Brief.



Faqir Chand Kohli

1924-2020
Founder of
IEEE Founders Medal

A pioneer and a visionary 1924-2020

Sourced from Engineering and Technology History Wiki

Regarded as the "father" of India's IT revolution, Faqir Chand Kohli helped drive India's IT industry from a handful of computer professionals to a multibillion dollar industry with over 2 million highly trained professionals. Kohil, an HKN Eminent Member, IEEE Founders Medal recipient and the founder of Tata Consultancy Services, died 26 November 2020.

Kohli helped improve and develop the human resources required for successful computer hardware and software engineering growth in India and modernize India's engineering curricula and facilities to support the IT industry's growth.

As Tata Consultancy Services' first general manager, Kohli saw the potential software engineering held for utilizing India's growing engineering talent. However, India did not have the necessary hardware to support such a vision early on. Kohli worked hard to develop deep technical strength at Tata by settling for nothing less than the state-of-the-art computer technology, which was crucial to offering quality IT services. Through his efforts, India's world-class IT services industry has become the country's signature. Tata is the largest IT Company in India, employing more than 350,000 people in 75 countries.

Kohli championed the use of technology to address social challenges. He designed a multimedia computing system to aid illiterate adults in Indian languages, which has been adopted by the Government of India. The system improves literacy within 30 hours of lessons, and its success led to interest from South Africa in addressing several African languages. Kohli also applied the benefits of technology to advancing India's engineering curricula and facilities to support the engineering and IT industry's growth. He spurred a new generation of corporate social responsibility initiatives through which professionals use their technological competencies to improve society.

Dr. Kohli was born in Peshawar, India. He earned a bachelor's of science in electrical engineering from Queen's University in Canada in 1948 and his master's of science in Mechanical Engineering from the Massachusetts Institute of Technology in 1950.

An IEEE Life Fellow, Kohli received the 2012 IEEE Founders Medal "for early vision and pioneering contributions to the development of the IT industry in India." He was an active IEEE Volunteer, serving as founding Chair of the IEEE India Section, and then of the IEEE India Council when it became a Council of three Sections. Ultimately he served as Director of IEEE Region 10.

IEEE-Eta Kappa Nu Launches IEEE-HKN Career Center

IEEE-Eta Kappa Nu

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