# National Health Symposium 2020

PLIED PHYSICS ATORY

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## ACKNOWLEDGEMENTS

We thank the symposium speakers for their insightful presentations and the participants for their thoughtful discussions. We are grateful to the APL National Health Mission Area staff members for their support of the event, including assistance with planning, graphics design, and documentation.


The views expressed in this document are those of the authors and do not necessarily represent official views of their respective organizations.

## SAVE THE DATE 2021

The third annual National Health Symposium is scheduled for November 9–10, 2021. The symposium will bring together civilian, military, and government leaders from diverse organizations in health research to discuss the most pressing topics in the field.

Please look for updates regarding plans and logistics as the environment continues to evolve. We hope to see you there!

On September 14–15, 2020, nearly 300 civilian, military, and government leaders attended the second annual Johns Hopkins Applied Physics Laboratory (APL) National Health Symposium. The theme of the symposium was "Operationalizing Artificial Intelligence (AI) in Health." Presenters and attendees from more than 40 organizations in health care delivery, health research, and industry shared early successes and lessons learned, and left energized by the promise of a smarter, safer, and more equitable health system.

## Symposium Summary

The 2020 National Health Symposium convened leaders in health care technology to explore emerging applications of artificial intelligence (AI) across the health care continuum. The speakers discussed applications ranging from disease prevention, disease detection, case triage, and patient treatment to health

Ashley Llorens advocated for a focus on developing intelligent systems where machines are "empowered by AI to act on our behalf [and] be our agent, [...] always part of a human-machine team."

The panelists and presenters o□ered multiple examples of AI enhancing human workflows. The proliferation of health analytics illustrated that machines may outperform humans in recognizing complex patterns in data, such as laboratory and imaging results. For example, Fred Streitz described how cancer researchers use high-performance computing to iteratively explore the distribution of mutated proteins on multiple scales of size and time simultaneously, as well as with precision down to microseconds and n(a)-7 (r)25s 10 (e)-10 (t)4 (i)-1cing Its shared how AI components aid us by evaluating a vast space of possible actions, such as complex treatment decisions, and recommending the one th(a)-7 (1.9 (t)-10 ( )]TJ0 -1.261 Td[(bes)8 (t)-10 ( ach)-5 (i)-4.9 (e)15 applying quantitative imaging approaches in which AI auto5s ously adjusts intraoperative imaging to improve quality of screw placement during sensitive spinal fusion procedures. And to have impact, helps to build trust with the physicians using them, as well as non-physician stakeholders and patients themselves.

Beyond overgeneralizing results and applicability, Weinstein summarized community concerns for risks of ML algorithms encoding racial bias and AI exacerbating current health inequities as an unintended consequence of hasty implementation. Many other speakers chimed in on this challenge extending to the integration of education to traditional health providers. Weinstein raised the suggestion of a revised Hippocratic Oath for AI Practitioners saying, “It’s a different space that we didn’t learn about in medical school.”

## *Conclusions*

*On balance, the contributions from symposium presenters supported an optimistic view that human knowledge and AI can be effectively combined to enhance health outcomes if we develop solutions thoughtfully and take a systems approach. Participants were offered frameworks and strategies for expanding the art of the possible while responsibly opera-e [illegible]*

## Date: Sept. 14, 2020

| | |
|---|---|
| Location: | Online via ZoomGov |
| 1:00–1:10 p.m. | Welcome and Introductory Remarks<br>Sezin Palmer, Mission Area Executive, National Health Mission Area, Johns Hopkins Applied Physics Laboratory |
| 1:10–1:45 p.m. | |

3:20–3:25 p.m. Closing Remarks

3:25–3:30 p.m. 5-Minute Break

3:30–4:30 p.m. Demo and Poster Session: Unlocking the Power of AI for Health Care

| | ROOM 1<br>Moderator: Ashley Llorens | ROOM 2<br>Moderator: Adam Cohen | ROOM 3<br>Moderator: Erin Hahn |
|---|---|---|---|
| 3:30–3:45 p.m. | Bioinspired Touch Sensor for Intelligent Robots in Health Care (Luke Osborn, Ph.D. and Jared Wormley, APL) | Technology for Automated Feedback on Intraoperative Surgical Care (S. Swaroop Vedula, Ph.D., JHU) | Concept for Real-time Feed-back to Prevent Overuse Injuries of the Human Mus-culoskeletal System (Connor Pyles, APL) |
| 3:45– | | | |
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## Date: Sept. 15, 2020

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|---|---|
| Location: | Online via ZoomGov |
| 1:00–1:10 p.m. | Welcome and Introductory Remarks<br><br>Sezin Palmer, Mission Area Executive, National Health Mission Area<br>Johns Hopkins Applied Physics Laboratory |
| 1:10–1:45 p.m. | Keynote Address<br><br>Jim Weinstein, D.O., Senior Vice President, Microsoft Healthcare<br><br>Keynote Discussion Moderated by Adam Cohen, M.D., Army Medical Response Program Manager, Johns Hopkins Applied Physics Laboratory |
| 1:45–1:50 p.m. | Technical Talk: Medical Machine Learning in Difficult Clinical Settings with Biased/Unbalanced/Limited Data<br><br>Philippe Burlina, Ph.D., Johns Hopkins Applied Physics Laboratory |
| 1:50–3:20 p.m. | Panel: Ensuring Responsible Implementation of AI in Health Care<br><br>Led by Erin Hahn, Group Supervisor, Concepts and Assessments,<br>Johns Hopkins Applied Physics Laboratory<br><br>Efthimios Parasidis, Professor of Law and Public Health, Moritz College of Law and the College of Public Health, Ohio State University<br><br>Oscar C. Marroquin, M.D., FACC, Chief Healthcare Data and Analytics Officer, University of Pittsburgh Medical Center, Associate Professor of Medicine, Epidemiology, and Clinical and Translational Science<br><br>M. Khair ElZarrad, Ph.D., MPH, Deputy Director of the Office of Medical Policy, Center for Drug Evaluation and Research, U.S. Food and Drug Administration |

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|---|---|
| 3:20–3:25 p.m. | Closing Remarks |
| 3:25–3:30 p.m. | 5-Minute Break |
| 3:30–4:30 p.m. | Demo and Poster Session: Ensuring Responsible Implementation and Explaining the Performance of AI in Health Care |

| | ROOM 1<br>Moderator: Ashley Llorens | ROOM 2<br>Moderator: Adam Cohen | ROOM 3<br>Moderator: Erin Hahn |
|---|---|---|---|
| 3:30–3:45 p.m. | Guidance and Tools to Build Regulatory Research Environment Using Data and AI (Bill Campman and John Brown, Microsoft) | Autonomous Data Operations for COVID-19 Dashboard (Tamara Goyea, Ph.D., Ryan Lau, and Tim Ng, APL) | Newton: A Fairness Case Approach for Justified Confidence in Health Care Machine Learning (Chuck Howell, Mitre) |
| 3:45–4:00 p.m. | Towards Benchmarking Intelligent Algorithms Against Existing Medical Device Alarms (David O. Nahmias, Ph.D., FDA) | APL Active Sensing Testbed (Lee Stearns, Ph.D., Mary Luongo, and Neil Fendely, APL) | Big Data Neuroscience and Applications to Health Care (Will Gray-Roncal, Ph.D., APL) |
| 4:00–4:15 p.m. | Data-Driven Predictive Analytics (Hannah Cowley, APL) | Intelligent Unmanned Systems to Address Health Care Delivery in Challenged Environments (Bob Chalmers, APL) | Nanoscale Connectomics for Robust, Adaptable AI (Erik Johnson, Ph.D., APL) |

## Operationalizing AI in Health Framework

At the beginning of the symposium, event organizers presented a framework to consider the topics covered to guide the exploration of operationalizing AI. The “Operationalizing AI in Health Framework” organizes the symposium content across Health Applications and AI Capabilities continuums to contextualize the breadth of how artificial intelligence can be applied to health care.

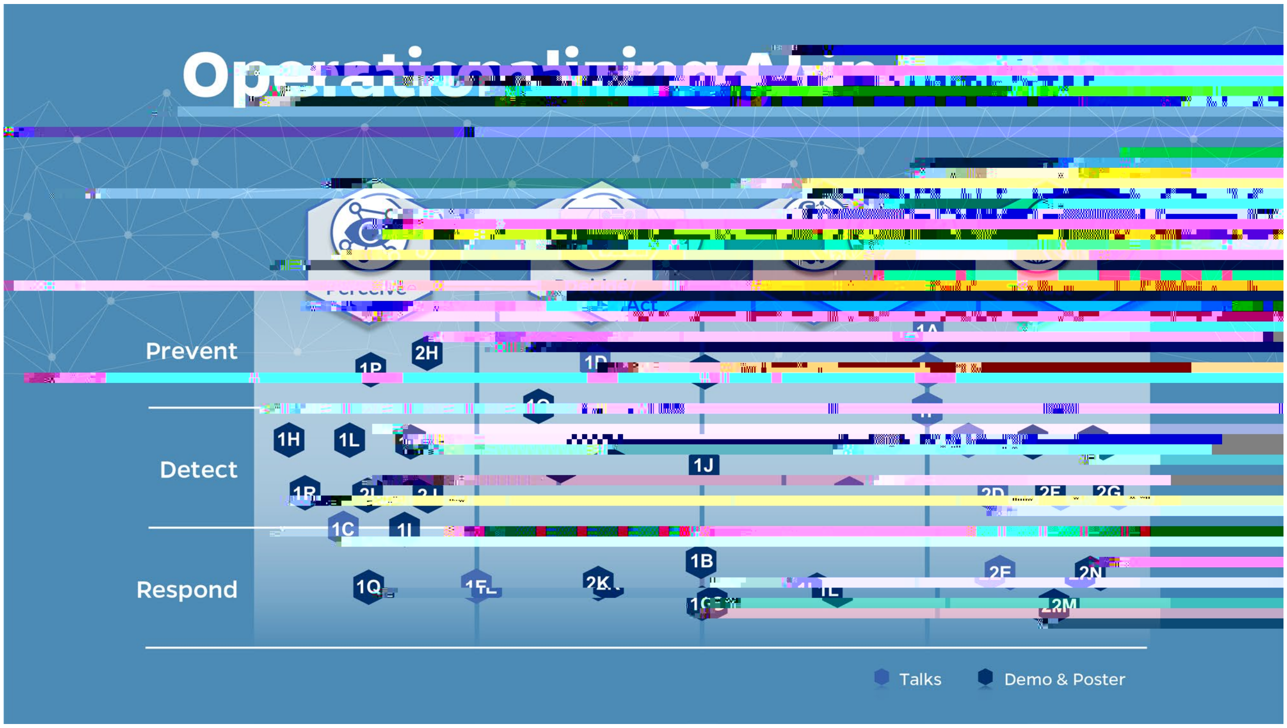
The framework is illustrated below and described in more detail on the following page. Health Applications are considered for **Prevent**, **Detect** and **Respond**. How intelligent systems contribute to these

**Pe ce e** its environment: AI will help predict, detect, and diagnose clinically significant deviations from a healthy baseline in individuals and populations. Driven by a diverse set of data, and combined with medical research, AI will help researchers discover new indicators and provide e□cient detection of changes to individual and population health. **Dec de** on a course of action: AI will be able to identify a range of options to respond to the perceived environment, supported by data-informed predictions of application-specific e□cacy and risk. In some cases, these options can be automatically acted on to make a preventative adjustment or provide immediate care anywhere. **Ac** within a framework of acceptable actions: In some cases, AI will assist individuals and providers with health and disease tracking, as well as care reinforcement and feedback. AI will team with providers to combine data-driven insights with human intuition and empathy to provide the best available courses of care. **Tea** with humans and other agents to accomplish a human-specified mission. Adaptive human-robotic teams will provide robotic medical and surgical assistance. Brain-computer interfaces will combine man and machine to teleoperate prosthetics and enhance vision to provide amputees and those that are vision impaired capabilities once thought impossible. Achieve its objectives with an appropriate level of **T**

# SUMMARY OF PRESENTATIONS

The content presented at this symposium has been summarized for ease of future reference.

Each keynote, presentation, demonstration, and poster discussion has been assigned an alphanumeric code and plotted within the AI in Health Framework in alignment with the Health Applications and AI Capabilities it addressed. A graphic of that mapping and short text summaries are provided here.




### 1A: "Operationalizing AI for Health Care," Keynote (Christine Fox, Johns Hopkins Applied Physics Laboratory)

Artificial intelligence is one of the most exciting aspects of health care research today, inextricably linking people (through their personal health) and math. Innovation in this space can be directed with bold envisioned futures in which health care is available everywhere, health interventions are precise and proactive, and health threats are preempted. These powerful visions are much needed as shifting population demographics, priorities, and distribution of health knowledge and resources exacerbate current gaps. AI enables realization of those visions through levers such as telemedicine, precision health, wearables, and new methods for data and pattern analysis. The introduction of AI also presents risks to privacy, security, health disparities, and bias. We must "develop thoughtfully" — to go full speed after the "good" while anticipating the "bad" that could happen and building in mitigations. This will involve requirement-driven thinking, risk management, and partnership with clinicians and subject matter expert communities within health and health care. To get this right — and it is essential that we do — operationalizing AI for health must be aligned with our vision and our values.

### 1B: "Achieving Thought-Based Control of a Prosthetic Limb," (Francesco Tenore, Ph.D., Luke Osborn, Ph.D., and Matthew Fifer, Ph.D., Johns Hopkins Applied Physics Laboratory)

Researchers at APL have developed state-of-the-art robotic systems and advanced ML techniques that have pushed the boundaries of what is possible. Using signals from the body and brain, individuals who have lost their limbs or suffered spinal cord injuries are now able to regain function and independence.

### 1C: "Overcoming Data Scarcity," (Peter McCaffrey, M.D., VastBiome)

Despite a popular perception that health care AI leverages nearly unbounded datasets, developing health care AI is often limited by a lack of sufficiently large sample sizes or a lack of samples that are similar enough to the problem at hand to be useful for training. An example of this phenomenon from genomics showed that, despite the large size of genomes, many studies actually have few samples. McCaffrey discussed the "virtuous cycle" in health care AI wherein models can be matched to data generation or collection platforms to help address issues of data scarcity.

### 1E: "Towards Patient-Specific Imaging to Advance Clinical Decision Making," (Mathias Unberath, Ph.D., Johns Hopkins University)

Medical imaging modalities combined with powerful image processing algorithms are emerging as an essential component of clinical routine to enable effective triage or guide minimally invasive treatment. Unberath highlighted how recent advances in computer vision, including leaps in ML, enable patient-specific image acquisition to better inform clinical decision making.

### 1F: "Interpretable Machine Learning for Health Care," (Cynthia Rudin, Ph.D., Duke University)

With widespread use of ML, there have been serious societal consequences from using black box models for high-stakes decisions. Explanations for black box models are unreliable and can be misleading. Interpretable ML models come with their own explanations, which are faithful to what the model actually computes. Rudin provided examples of interpretable ML in health, including the 2HELPS2B model for predicting seizures in critically ill patients and interpretable neural networks for computer vision for the analysis of mammograms.

### 1G: "Bioinspired Touch Sensor for Intelligent Robots in Health Care," (Luke Osborn, Ph.D., and Jared Wormley, Johns Hopkins Applied Physics Laboratory)

As robotic manipulators become more dexterous and functional, providing the sense of touch becomes critical for enabling advanced systems such as prosthetic limbs and robotic medical assistants. Flexible materials are used to make an artificial electronic dermis (e-dermis) that conforms to robotic manipulators for capturing tactile information, which can be used as input to ML-based algorithms. Recently, the e-dermis was integrated with intelligent robotic systems for health care applications.

### 1H: "Uncovering Novel Patterns in Ovarian Cancer Using Tensor Decomposition Methods," (Anna Konstorum, Ph.D., University of Connecticut Health Center)

Ovarian cancer (OVC) is the most lethal of gynecological malignancies, with a 5-year survival rate of ~45%. High-grade serous ovarian cancer (HGSOC) is the most common and the deadliest subtype of OVC, and it has also been recognized as a highly heterogeneous disease, thereby requiring novel methods to categorize and classify the malignancy for differential treatment planning. The unfolding "omics" era provides clinicians and researchers unprecedented opportunity to probe tumors using genetic and epigenetic information, and can help lead the way to improve personalized treatment planning. Nevertheless, there exists a major challenge in the field regarding how to efficiently, and with maximal information retrieval, synthesize different omics datasets. This presentation summarized work that employed the technology of tensor decompositions to simultaneously incorporate multi-omics clinical data, including RNA-Seq gene expression and copy number variation, to detect novel patterns and distinguishing features of HGSOC. Konstorum showed that this approach holds potential to forward multi-omics integration of patient data for stratification and treatment planning.

### 1I: "PINE: PMAP Interface for NLP Experimentation," (Brant Chee, Ph.D., Johns Hopkins Applied

### 1L: “Butterfly Lung Ultrasound,” (Gioel Molinari, Butterfly Network, Inc.)

Butterfly is working at the intersection of ultrasound and innovative hardware technology and AI to make it easier and more reliable to stratify COVID-19 patients by lung ultrasound. Lung ultrasound is a new technology that has emerged over this year as European physicians started adopting it for stratification of patients as they were coming into care settings. There have been improvements in the quantity of patients that can be screened, as well as cost savings. A lung ultrasound makes it easy to identify the lung wetness associated with an infection such as that which happens with COVID. During a simple one- to two-minute examination, physicians can now stratify and determine whether a patient has a severe lung infection and needs to be admitted or if they can be treated at home. This technology is being used around the world; it is easy to use and can be brought to patients at point of care, at home, or at a clinical setting.

### 1M: “Environmental Localization and Guidance for Visual Prosthesis Users,” (Seth Billings, Ph.D., Johns Hopkins Applied Physics Laboratory)

Under NIH funding, APL is working with the Wilmer Eye Institute and Carnegie Mellon University to enhance the Argus II retinal prosthesis, which consists of a head-mounted camera, an electrode array, and a vision processing system. Researchers are leveraging the latest advances in sensors, processing, and computer vision algorithms to integrate an autonomous navigational aid that supports volitional action for independent navigation with minimal cognitive load.

### 1N: “A Data-Driven Framework for Identifying Intensive Care Unit Admissions Colonized with

### 2D “Ensuring Responsible Implementation of AI in Health Care,” (Oscar Marroquin, M.D., FACC, University of Pittsburgh Medical Center)

This presentation summarized principles employed in the systematic development of a growing toolkit that enables clinicians to more powerfully use the data in Electronic Medical Records to augment their

### 2F "Guidance and Tools to Build a Regulatory Research Environment Using Data and AI," (Bill Campman and John Brown, Microsoft)

Data and AI are the keys to unlocking scientific discoveries that will lead to accelerated medical therapies. This session offered guidance on how to build a secure research environment that meets today's regulatory compliance and provide researchers with scalable AI tools in the cloud and the architecture for their data models.

### 2G "Towards Benchmarking Intelligent Algorithms Against Existing Medical Device Alarms," (David O. Nahmias, Ph.D., U. S. Food and Drug Administration)

Current patient monitoring is known to have high false-alarm rates leading to alarm fatigue as well as a lack of interpretive and predictive functionality about a patient's clinical condition. Intelligent medical device algorithms that analyze physiologic data from multiple sources, using AI techniques from look-up tables to deep learning models, are being developed. These systems have the potential to identify and minimize false alarms while enabling predictive alarms about future physiologic events. The former raises risks about missing critical events, and the latter raises existing concerns with false alarm rates and alarm relevant to operational decision making; and collection and dissemination of U.S. county-level and sub-national data pertaining to the Coronavirus pandemic. Data are provided publicly through Github and can be viewed on the JHU Center for Systems Science and Engineering (CSSE) COVID-19 Global Dashboard.

### 2J: “APL Active Sensing Testbed,” (Lee Stearns, Ph.D., Mary Luongo, Neil Fendley, Johns Hopkins Applied Physics Laboratory)

Novel breakthroughs in machine vision and AI have expanded the way systems can build and maintain an internal model of the world and actively form hypotheses about that world model through active perception. The Active Sensing Testbed is an APL-developed framework and physical testbed for research into active perception combined with world-view reasoning. The system consists of three components: (1) a cloud server framework that handles the processing and data routing for customizable workflows, and which includes several prebuilt video analytics and transformations; (2) an Application Programming Interface (API) for accessing the server functions and operator station software that wraps the API and provides tools for visualization, controls, and recording capabilities; and (3) a physical testbed that can be reserved for data collection sessions.vrid mponents:, asnt( a)-72 Td[(l)-10 (n)-2 (t)1e (w)20.1 (a)-7 (r)25 (ed[(be

## National Health Virtual Speaker Series, Session II

### July 14, 2020

The second event in the 2020 National Health Speaker Series featured M. Khair ElZarrad, Ph.D., the Deputy Director of the Office of Medical Policy in the Center for Drug Evaluation and Research at the Food and Drug Administration (FDA). ElZarrad discussed the FDA's work in operationalizing AI in health. He touched on the evolving ecosystem of regulation and policy around health, the need for continued innovation, FDA's Real World Evidence Program, the potential of technology and digitization, and AI. This event also featured a discussion with ElZarrad on current events and their impact on operationalizing AI in health. The discussion was co-moderated by Erin Hahn, a senior national security analyst in the National Security Analysis Department at APL, and Henry Farrell, a professor of international studies at the Johns Hopkins Stavros Niarchos Foundation SNF Agora Institute. A video of this event is available at https://www.youtube.com/watch?v=Ifp9GgPGWoY&feature=youtu.be.

## National Health Virtual Speaker Series, Session III

### August 18, 2020

The August installment of the 2020 National Health Speaker Series featured Gil Alterovitz, Ph.D., Director, National Artificial Intelligence Institute at the U.S. Department of Veterans Affairs (VA). Alterovitz talked

to enable self-care or care by non-traditional providers. He works with military, academic, and industry partners to focus on high-impact innovations. Prior to Hopkins, he was the Inpatient Neurology Director and Teleneurology Director at Massachusetts General Hospital where he practiced inpatient neurology, neuro-ophthalmology, and neuroradiology. He has done extensive work in health care quality improvement and digital health.

## Nick Dalesio

*A i a P fe f A e he i l g a d C i ical Ca e Medici e*
Johns Hopkins University School of Medicine

Nicholas Michael Dalesio, M.D., is an assistant professor of anesthesiology and critical care medicine and otolaryngology-head and neck surgery at the Johns Hopkins University School of Medicine. His area of clinical expertise is pediatric anesthesiology. He received his undergraduate degree in cell biology/molecular genetics from the University of Maryland. He earned his medical degree from the Virginia Commonwealth University School of Medicine and completed his anesthesiology residency at Yale-New Haven Hospital. Dalesio performed a fellowship in pediatric anesthesiology at the Children's Hospital of Philadelphia before joining the faculty at Johns Hopkins. In addition to pediatric anesthesiology, Dalesio has a special interest in sleep-disordered breathing and obstructive sleep apnea in children, di□cult airway management in children, and craniofacial reconstructive surgery in children. He is a member of the Society of Pediatric Anesthesia, the American Society of Anesthesiologists, the American Board of Anesthesiology, and the Maryland Society of Anesthesiologists.

## Khair ElZarrad

*De Di ec f he O ce f Medical P lic , Ce e f D g E al a i a d Re ea ch*
U.S. Food and Drug Administration

Khair ElZarrad, Ph.D., MPH, leads the development, coordination, and implementation of medical policy programs and strategic initiatives at FDA's Center for Drug Evaluation
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## Lauren Gardner

*A ciaeP fe , De a e f Ci il a d S e E gi ee i g*
Johns Hopkins University Whiting School of Engineering

Lauren Gardner, Ph.D., is the creator of the interactive web-based dashboard being used by public health authorities, researchers, and the general public around the globe to track the outbreak of the novel coronavirus. The dashboard, which debuted on January 22, 2020, became the authoritative source of global COVID-19 epidemiological data for public health policy makers and many major news outlets worldwide. Because of her expertise, Dr. Gardner was one of six Johns Hopkins experts who briefed congressional staff about the outbreak during a Capitol Hill event in early March 2020. She is co-director of the Center for Systems Science and Engineering and affiliated faculty in the Johns Hopkins Bloomberg School of Public Health. Prior to joining Johns Hopkins University in 2019, she was a senior lecturer in civil engineering at the University of New South Wales (UNSW) Sydney, in Australia. Her research expertise is in integrated transport and epidemiological modeling. She has previously led related interdisciplinary research projects which utilize network optimization and mathematical modeling to progress the state of the art in global epidemiological risk assessment. Beyond mobility, her work focuses more holistically on virus diffusion as a function of climate, land use, mobility, and other contributing risk factors. On these topics, Gardner has received research funding from organizations including NIH, the National Science Foundation, NASA, the Australian Government National Health and Medical Research Council, Australian Research Council, Commonwealth Scientific and Indusor normative issues in the context of operational or technology challenges. She serves as the co-chair for the International Panel on the Regulation of Autonomous Weapons, the work of which has been influential in shaping the ongoing discussions of the United Nations Group of Government Experts for Lethal Autonomous Weapons Systems. She has authored or co-authored several works, including a book chapter (with Jesse Kirkpatrick, et al.), “Trust and Human-Robot Interactions,” in *Robot Ethics 2.0*. Hahn was formerly the Associate Director of the University of Maryland Center for Health and Homeland Security in Baltimore, Maryland. Prior to that, she was an attorney in private practice doing complex civil litigation.

## Aaron Katz

*S e i , La ge Scale A al ic G*
Johns Hopkins Applied Physics Laboratory

Aaron Katz leads the Large-Scale Analytics Systems Group in the Asymmetric Operations Sector at the Johns Hopkins Applied Physics Laboratory. During his 20-year career

capability development. She earned a Bachelor of Science degree in electrical engineering from the University of Maryland and a Master of Science degree in electrical engineering from Johns Hopkins University.

## Jeremy C. Pamplin

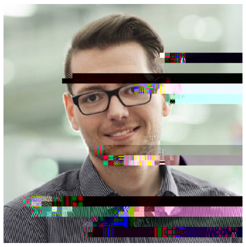
*Di ec , Tele edici e a d Ad a ced Tech l g Re ea ch Ce e*
U.S. Army Medical Research and Development Command
*A cia e P fe f Medici e a d A cia e P fe f Mili a /E e ge c Medici e*
Uniformed Services University of the Health Sciences

U.S. Army Col. Jeremy Pamplin, M.D., FCCM, FACP, has been the director of the Telemedicine and Advanced Technology Research Center since June 2019, a position he assumed following his role as deputy director starting in August 2018. Prior to this assignment, he was the director of Virtual Critical Care at Madigan Army Medical Center. During that assignment, he began the first Army Tele-Critical Care service and integrated it with the Navy's Tele-Critical Care service to form the Joint Tele-Critical Care Network. Prior to that assignment, he was the chief of Clinical Trials in Burns and Trauma and the medical director of the U.S. Army Burn Intensive Care Unit at the U.S. Army Institute of Surgical Research. He has served as medical director of the surgical and medical intensive care unit since completing his Critical Care

## Cynthia Rudin

*P fe f C e Scie ce, Elec ical a d C e E gi ee i g,*
*a d S a i ical Scie ce; P i ci al I e iga , P edic i A al i Lab*
Duke University

Cynthia Rudin, Ph.D., is a professor of computer science, electrical and computer engineering, and statistical science at Duke University. Previously, Rudin held positions at Massachusetts Institute of Technology (MIT), Columbia University, and New York University. Her degrees are from the University at Buffalo and Princeton University. She is a three-time winner of the INstitute For Operations



## Mathias Unberath

*A i a P fe , De a e f C e Scie ce*
Johns Hopkins University

Mathias Unberath, Ph.D., is an assistant research professor in the Department of Computer Science at Johns Hopkins University, with affiliations to the university's Laboratory for Computational Sensing and Robotics and the Malone Center for Engineering in Healthcare. He created and is currently leading the research group on Advanced Robotics and Computationally AugmenteD Environments (ARCADE), which focuses on computer vision, ML, and augmented reality and their application to medical imaging, surgical robotics, and clinician-centric assistance systems. Previously, Unberath was a postdoctoral fellow in the Laboratory for Computational Sensing and Robotics at Hopkins and completed his Ph.D. in computer science at the Friedrich-Alexander-Universität (FAU) Erlagen-Nürnberg from which he graduated summa cum laude in 2017. While completing a bachelor's degree in physics and a master's degree in optical technologies at FAU Erlangen, he studied at the University of Eastern Finland as an Erasmus Scholar in 2011 and later joined Stanford University as a Deutscher Akademischer Austauschdienst (German Academic Exchange Service) Fellow throughout 2014.

## James Weinstein

*Se i Vice P e ide*
Microsoft Healthcare

James N. Weinstein, D.O., is the Senior Vice President for Microsoft Healthcare. He helps lead strategic partnerships across the health care ecosystem with a particular focus on innovation and health equity. Prior to joining Microsoft, he was the chief executive officer (CEO) and president of Dartmouth-Hitchcock Health. Prior to becoming CEO in 2011, he served as president of Dartmouth-Hitchcock Clinic, and was the director of The Dartmouth Institute for Health Policy and Clinical Practice.

Weinstein is a member of the National Academy of Medicine (NAM) and serves on the organization's Board for Population Health and Public Health Practice. He also serves on two NAM committees related to AI in health care and co-chairs — with NAM president Dr. Victor Dzau — the ongoing inequities in health care "call to action" meetings. He serves on several boards of trustees, including the Max Planck Florida Institute for Neuroscience, the BioFabUSA program (a public-private partnership between the Department of Defense and the Advanced Regenerative Manufacturing Institute), and the Intermountain Health System. He continues to serve as an appointee to the Special Medical Advisory Group of the Department of Veterans Affairs, which advises the Secretary of Veterans Affairs and the Under Secretary for Health on matters relating to the care and treatment of veterans.

In 2015, Weinstein was awarded the Ellis Island Medal of Honor by the National Ethnic Coalition of Organizations (now the Ellis Island Honors Society). In 2017 he was the recipient of the American Hospital Association's Justin Ford Kimball Innovator's Award. He has been named one of The 100 Most Influential People in Healthcare by Modern Healthcare magazine and one of the top 50 Physician Leaders to Know by Becker's Hospital Review. He is the longest standing Editor-in-Chief of a major journal, Spine, and the author of the highly acclaimed *U a eled: P e c i i Re ai a B ke Heal h Ca e S e*

## ABOUT APL:

For more than 75 years, the Johns Hopkins University Applied Physics Laboratory (APL) has provided critical contributions to critical challenges with systems engineering and integration, technology research