Water strategist addresses questions on managing our precious water resources

December 22 2020

Junhong Chen, Argonne's lead water strategist. Credit: Argonne National Laboratory

Many questions surround how to best solve the numerous problems involving efficient management of our precious water resources. We asked a few questions regarding water science and engineering of Junhong Chen, lead water strategist at the U.S. Department of Energy's (DOE) Argonne National Laboratory and a professor of molecular

engineering at the University of Chicago's Pritzker School of Molecular Engineering. Prior to coming to Chicago, Chen served as a program director for the Engineering Research Centers program of the U.S. National Science Foundation.

Q: In what way is water research important to the nation's needs for sustainable energy, economic prosperity and security?

A: Water is an indispensable resource of our society as it is required for sustaining life and economic prosperity. For example, water is needed for manufacturing nearly everything, ranging from energy to food, clothes, cars and electronics. It is, thus, an integral part of our life beyond simply quenching thirst. Our future economy and national security highly depend on the availability of clean water. However, there is a limited supply of renewable freshwater with no substitute. Population and economic growth, climate change and urbanization further exacerbate the growing water stress globally. As such, we urgently need scientific and engineering solutions to achieve more efficient management of our precious water resources. Research and innovation around water conservation, recycling, reclamation and reuse are critical to meeting the national needs. In response to the looming water crisis, the White House initiated a Water Security Grand Challenge, led by DOE. Its goal is to advance transformational technology and innovation to meet the global need for safe, secure and affordable water.

Q: What is Argonne's strategy for contributing to water science in the near future?

A: We have named Argonne's water effort "Water + AI." Our mission is to pursue water science and engineering empowered by artificial

intelligence (AI). Our basic strategy is to leverage the power of AI to tackle the DOE Water Security Grand Challenge and the many scientific challenges relevant to the nexus between energy and water. This will involve bridging the AI and water research communities. Argonne's Water + AI strategy is available online.

Q: What unique capabilities does Argonne bring to Water + AI?

A: Argonne has three main capabilities that uniquely position us to take on the nation's pressing water challenges. First, Argonne offers a wide range of expertise under one roof, including materials science, chemistry, physics, biology, engineering, manufacturing, artificial intelligence/machine learning, high-performance computing, sustainability analysis and quantum science and engineering. This extraordinarily wide-ranging expertise can be harnessed to address the most complex societal challenges related to water.

Second, Argonne has launched its "AI for Science" initiative and is taking a leading role across DOE national labs in developing the mathematical foundations, hardware, software, data, partnerships and infrastructure needed to advance AI. Argonne's long history of pioneering advances in AI will enable transformational solutions for water that would otherwise be impossible.

Finally, Argonne has at its disposal world-class research facilities, such as the Advanced Photon Source (APS), Center for Nanoscale Materials (CNM), Argonne Leadership Computing Facility (ALCF) and Materials Engineering Research Facility (MERF). The APS, CNM and ALCF are all DOE Office of Science User Facilities. The APS offers ultrabright, high-energy X-rays applicable for probing water-material interfaces and even watching chemical processes that happen on the nanoscale. The

CNM is a premier user facility for interdisciplinary nanoscience and nanotechnology research that addresses national grand challenges such as those posed by water. In 2022, the ALCF will add as a computing resource the new Aurora exascale supercomputer, which will provide an unprecedented capability for simulating water-material interfaces with the smallest spatial and temporal resolutions. Argonne is already home to the fastest AI computer in the world, the Cerebras CS-1 system. The MERF applies advanced synthesis and processing technologies to develop scalable manufacturing processes for newly invented experimental materials, including water materials, so that they can become available for industrial evaluation, prototyping and further research.

Q: What are some of the significant accomplishments of Argonne in the water research space?

A: Argonne researchers have made numerous pioneering contributions to water science. One recent example is the observation of the fastest chemical processes in the decomposition of water molecules caused by radiation, understanding of which is of fundamental importance in diverse areas such as water-cooled nuclear reactors and medical research on radiation-induced genomic damage. Another example is the use of artificial neural network models combined with machine learning (ML) to predict key water properties. Argonne has also developed important licensable technologies, including the Oleo Sponge. This reusable sponge can recover oil and other petroleum products from bodies of water after spills and leaks, surpassing industry-standard technologies in multiple ways.

Also worth mentioning is that in recognition of Argonne's capabilities in the water research space, DOE selected Argonne National Laboratory in 2018 to lead the Advanced Materials for Energy-Water Systems Center

(AMEWS), a DOE Energy Frontier Research Center.

Q: In which research areas in Water + AI do you see Argonne growing in the next decade?

A: With the Water + AI strategy, Argonne will make major strides in development of three kinds of intelligent water systems over the next decade. These are fit-for-purpose water systems, water-enabled energy systems, and water management systems. Success will require growth in six areas: water materials, water sensors and controls, selective separation, modeling and AI/ML, manufacturing, and sustainability.

One of the growth areas in sustainability now being addressed with AI at Argonne is the challenge around a contaminant, per- and polyfluoroalkyl substances (PFAS). There are thousands of PFAS compounds. They are in food, commercial household products, cookware, the workplace, living organisms, drinking water, and groundwater. They pose a significant national challenge in terms of detrimental health effects and water reuse, and the estimated cost of national cleanup is in the billions of dollars. Solving this challenge would have important implications for water recycling, since we need to extract any PFAS before water reuse.

Q: What is the one key thing you want people to know about Water + AI at Argonne?

A: Argonne's Water + AI strategy will potentially transform the water industry by offering cost-effective and socially responsible solutions to the many challenges. We will accomplish this vision through partnerships with our stakeholders, including local, state and federal government, academic and national lab collaborators, industrial partners, nonprofit organizations, and regional economic development hubs. Therefore, we look forward to growing partnerships with current

collaborators as well as building partnership with new ones.

Provided by Argonne National Laboratory

Citation: Water strategist addresses questions on managing our precious water resources (2020, December 22) retrieved 21 June 2024 from https://phys.org/news/2020-12-strategist-precious-resources.html