AI-powered smart medicine meets smart microchips

ASU researcher’s tools from health care get a high-tech makeover for semiconductors

By Kelly deVos, ASU News
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As the largest U.S. supplier of semiconductor equipment, Applied Materials is at the forefront of microchip innovation. Now it’s bringing its energy to impactful research at Arizona State University. Through a series of grants, the company is teaming up with ASU faculty to tackle big challenges in the microelectronics world.

These projects blend the company’s expertise with ASU’s engineering muscle to spark breakthroughs that could shape the future of chip manufacturing.

Baoxin Li is a professor of computer science and engineering in the School of Computing and Augmented Intelligence, part of the Ira A. Fulton Schools of Engineering at ASU. Through a series of multiyear grants, he and his team are collaborating with Applied Materials to create new artificial intelligence systems to make sense of complex microelectronics manufacturing data. The new technology builds on Li’s similar, successful projects in the medical sector.

“We’re developing smart systems that can learn from complex, often unlabeled data — whether it’s detecting faults in semiconductor recipes, enhancing electron microscope images or fusing multiple data types into one powerful model,” Li says. “This work has the potential to make manufacturing faster, more reliable and more efficient.”

A smarter way to read the recipe

For one phase of the project, Li and the team are focusing on improving how to understand and control the manufacturing processes used in semiconductor production. These processes involve instructions, called recipes, that include varied types of data such as images, sensor readings and machine configurations. Normally, these processes are analyzed separately, which misses how they relate to each other.

The goal of Li’s work is to combine many kinds of data into one powerful model using a method called graph representation. His team will use AI to create graphs that can be read by machines to help them better understand the overall manufacturing system so they can detect problems, recognize patterns and make predictions.

First, the team will build a basic version of this system using a public dataset, then move on to collecting real-world data from Applied Materials. They will also build tools to measure how well the system works on tasks like spotting unusual patterns in the data.

Once the system has been fine-tuned and tested, all code, data and reports will be packaged for use by the experts at the semiconductor giant.

Catching chip errors with a doctor’s touch

A good cook needs a good recipe. Add a bit too much of the wrong spice or leave your salmon on the grill for an extra minute, and you’ll have a mess of a meal.

Semiconductor engineers want their recipes to be perfect, too. But spotting problems usually requires lots of labeled data showing what’s “normal” and what’s “faulty.” In manufacturing, that kind of labeled data is hard to get.

To work around this, Li’s team is using advanced AI techniques called unsupervised and semi-supervised learning, which can work with mostly unlabeled data. The goal is to build a system that can automatically flag unusual recipe behavior, known as anomalies, without needing a huge pile of pre-labeled examples.

The exciting part? This system is built on technology originally developed for the medical field. Li previously created powerful AI models to help detect diseases like Alzheimer’s using medical images with little or no labeled data. Now, his team is adapting that same tech for semiconductor data, tasking machines to learn what “normal” looks like and then identify anything that doesn’t match.

From grainy to game-changing

As microchips become smaller and production processes more intricate, even tiny errors or undetected faults can lead to costly failures. Images taken by electron microscopes are essential tools for inspecting, analyzing and verifying the tiny structures on chips at the nanoscale level. But these images often come with a lot of noise, such as grains or speckles, making it hard to see important details.

The team is using AI to build a powerful and flexible denoising technology to clean up these images without losing any valuable information. They will create a smart system that focuses on key areas of an image and enhances them while removing noise. Here, again, Li will repurpose his prior work creating deep machine learning systems to optimize medical images, especially MRIs.

Anthony Tam, business development director for the Fulton Schools, says that Li’s projects exemplify the impact of ASU’s partnership with Applied Materials.

“Whether it’s sharper imaging, earlier fault detection or more intelligent data insights, our goal is to harness research expertise to empower Applied Materials teams to work faster, smarter and more effectively,” Tam says.

Through AI-powered systems that learn from limited data, detect subtle anomalies and sharpen microscopic images, Li and his team are translating breakthroughs from medicine to manufacturing. These projects not only showcase the strength of academic-industry collaboration but also point toward a future where more efficient chip production is driven by intelligent, flexible technologies.

“By the end of these projects, we’re hopeful that Applied Materials will have reliable, adaptable systems to enhance speed and quality in semiconductor production,” Li says.

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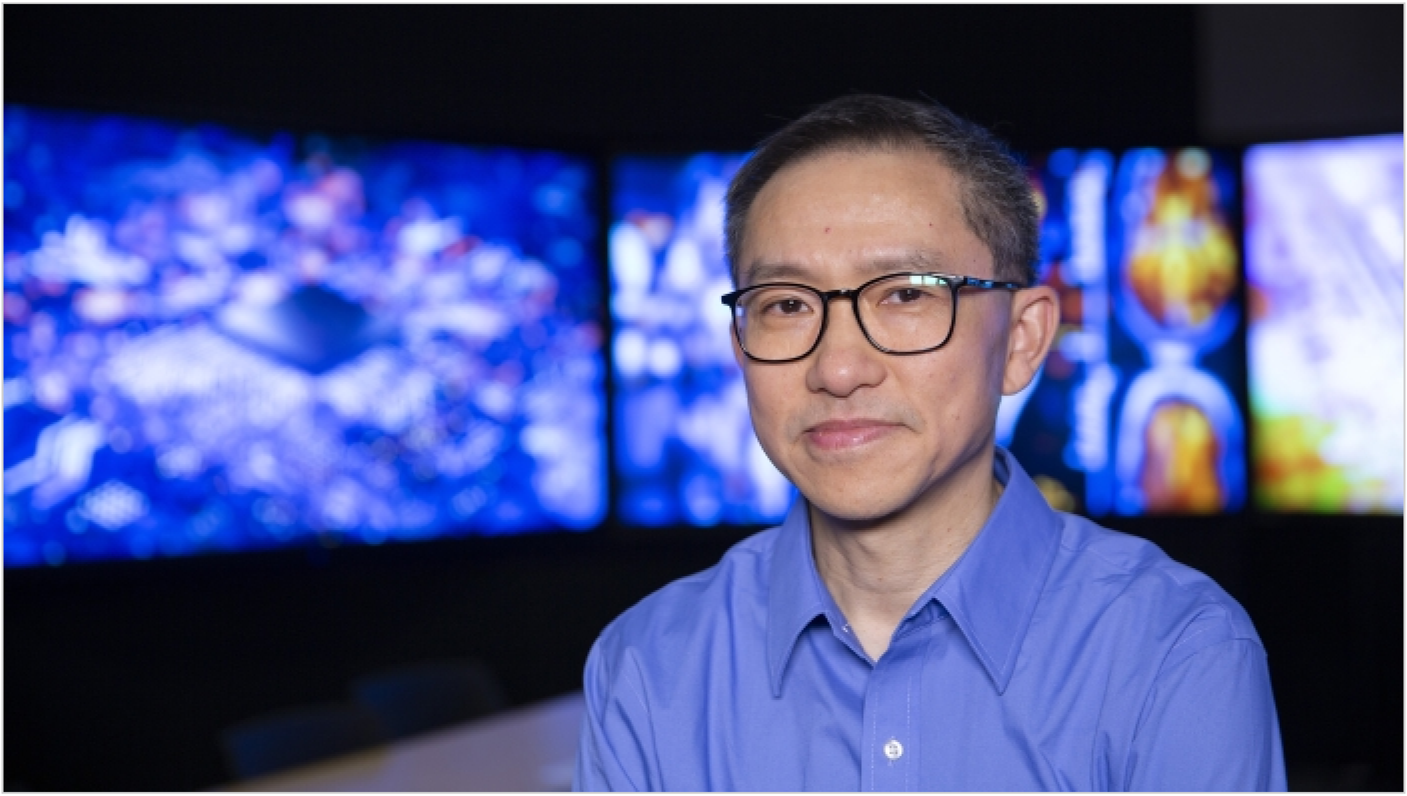
Main image



Baoxin Li (shown in ASU's Decision Theater) is a professor of computer science and engineering in the School of Computing and Augmented Intelligence, part of the Ira A. Fulton Schools of Engineering. He has received a research grant from global semiconductor giant Applied Materials to create new artificial intelligence systems to help improve microelectronics manufacturing. Photo by Erika Gronek/ASU