Sensing for augmented and virtual reality and for advanced manufacturing

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Brian Anthony. Credit: Massachusetts Institute of Technology

Sensors are everywhere today, from our homes and vehicles to medical devices, smart phones, and other useful tech. More and more, sensors help detect our interactions with the environment around us—and shape

our understanding of the world.

SENSE.nano is an MIT.nano Center of Excellence, with a focus on sensors, sensing systems, and sensing technologies. The 2019 SENSE.nano Symposium, taking place on Sept. 30 at MIT, will dive deep into the impact of sensors on two topics: sensing for augmented and virtual reality (AR/VR) and sensing for advanced manufacturing.

MIT Principal Research Scientist Brian W. Anthony is the associate director of MIT.nano and faculty director of the Industry Immersion Program in Mechanical Engineering. He weighs in on why sensing is ubiquitous and how advancements in sensing technologies are linked to the challenges and opportunities of big data.

Q: What do you see as the next frontier for sensing as it relates to augmented and virtual reality?

A: Sensors are an enabling technology for AR/VR. When you slip on a VR headset and enter an immersive environment, sensors map your movements and gestures to create a convincing virtual experience.

But sensors have a role beyond the headset. When we're interacting with the real world we're constrained by our own senses—seeing, hearing, touching, and feeling. But imagine sensors providing data within AR/VR to enhance your understanding of the physical environment, such as allowing you to see air currents, thermal gradients, or the electricity flowing through wires superimposed on top of the real physical structure. That's not something you could do any place else other than a virtual environment.

Another example: MIT.nano is a massive generator of data. Could AR/VR provide a more intuitive and powerful way to study information

coming from the metrology instruments in the basement, or the fabrication tools in the clean room? Could it allow you to look at data on a massive scale, instead of always having to look under a microscope or on a flat screen that's the size of your laptop? Sensors are also critical for haptics, which are interactions related to the sensation of touch. As I apply pressure to a device or pick up an object—real or virtual—can I receive physical feedback that conveys that state of interaction to me?

You can't be an engineer or a scientist without being involved with sensing instrumentation in some way. Recognizing the widespread presence of sensing on campus, SENSE.nano and MIT.nano—with MIT.nano's new Immersion Lab providing the tools and facility—are trying to bring together researchers on both the hardware and software sides to explore the future of these technologies.

Q: Why is SENSE.nano focusing on sensing for advanced manufacturing?

A: In this era of big data, we sometimes forget that data comes from someplace: sensors and instruments. As soon as the data industry as a whole has solved the big data challenges we have now with the data that's coming from current sensors—wearable physiological monitors, or from factories, or from your automobiles—it is going to be starved for new sensors with improved functionality.

Coupled with that, there are a large number of manufacturing technologies—in the U.S. and worldwide—that are either coming to maturity or receiving a lot of investment. For example, researchers are looking at novel ways to make integrated photonics devices combining electronics and optics for on-chip sensors; exploring novel fiber manufacturing approaches to embed sensors into your clothing or composites; and developing flexible materials that mold to the body or to

the shape of an automobile as the substrate for integrated circuits or as a sensor. These various manufacturing technologies enable us to think of new, innovative ways to create sensors that are lower in cost and more readily immersed into our environment.

Q: You've said that a factory is not just a place that produces products, but also a machine that produces information. What does that mean?

A: Today's manufacturers have to approach a factory not just as a physical place, but also as a data center. Seeing physical operation and data as interconnected can improve quality, drive down costs, and increase the rate of production. And sensors and sensing systems are the tools to collect this data and improve the manufacturing process.

Communications technologies now make it easy to transmit data from a machine to a central location. For example, we can apply sensing techniques to individual machines and then collect data across an entire factory so that information on how to debug one computer-controlled machine can be used to improve another in the same facility. Or, suppose I'm the producer of those machines and I've deployed them to any number of manufacturers. If I can get a little bit of information from each of my customers to optimize the machine's operating performance, I can turn around and share improvements with all the companies who purchase my equipment. When information is shared amongst manufacturers, it helps all of them drive down their costs and improve quality.