New sensing platform deployed at controlled burn site, could help prevent forest fires

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Argonne scientists conduct a controlled burn on the Konza prairie in Kansas using the Sage monitoring system. Credit: Rajesh Sankaran/Argonne National Laboratory

Multichannel sensing could help in emergencies.

Smokey Bear has lots of great tips about preventing forest fires. But how do you stop one that's started before it gets out of control? The answer may lie in pairing multichannel sensing with advanced computing technologies provided by a new platform called Sage.

Sage offers a one-of-a-kind combination. This combination involves both multiple types of sensors with computing "at the edge," as well as embedded machine learning algorithms that enable scientists to process the enormous amounts of data generated in the field without having to transfer it all back to the laboratory. Computing "at the edge" means that data is processed where it is collected, in the field, while machine learning algorithms are computer programs that train themselves how to recognize patterns.

Researchers using Sage recently completed a demonstration as they successfully monitored a prescribed controlled burn—in which a piece of land is carefully burned as part of environmental management—of part of the Konza tallgrass prairie in Kansas. The advanced cyberinfrastructure deployed in Sage, which allows for on-the-spot detection, monitoring and analysis of the burned area, could offer scientists and natural resources officials the ability to get ahead of forest fires with quickly analyzed, multi-instrumented data.

"When it comes to forest fires, time is absolutely of the essence," said Argonne computational scientist and NAISE Fellow Rajesh (Raj) Sankaran. "Often, there's no time to move data from the field—where high-speed connectivity might be an issue—to the lab. With Sage, we're getting the pertinent information we need when we need it."

The controlled burn in the Konza prairie gave the researchers a large collection of data—almost 60 DVDs worth—full of information about the progression of smoke and fire. This data can be used to educate a machine learning algorithm that can make further determinations of the behavior of other fires in real time.

After the success of the Sage network in Kansas, future plans exist for the network to be deployed in California, Colorado, Illinois and Texas as part of a network led by the National Ecological Observatory Network

(NEON). Eventually, researchers hope to set up a continent-spanning network of smart sensors that could employ Sage technology. "NEON is developing a mobile deployment platform that can complement land-based and aquatic sites all over the country," Sankaran said. "Sage can play a supportive role in many different environments throughout the United States."

Technologically, Sage relies on an open-source wireless sensor platform called Waggle, developed and funded by Argonne. Waggle leverages emerging technology in low-power processors, sensors and cloud computing to build powerful and reliable sensor nodes that can actively analyze and respond to data. "Essentially, Waggle is the base that Sage uses," said Argonne computer scientist and NAISE co-director Pete Beckman, who helped to pioneer Waggle and Sage. "It's basically as if Waggle is a cell phone, and Sage is the network that the phone uses to communicate plus the apps that run on it."

According to Beckman, the team is also pursuing a further research partnership with a researcher at the University of Oregon, who is working with the Federal Emergency Management Agency to construct a series of monitoring stations in the Pacific Northwest. Beckman hopes that by including Sage, these monitoring stations can have added functionality in getting ahead of forest fires and other natural disasters by monitoring the environment.

Provided by Argonne National Laboratory

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