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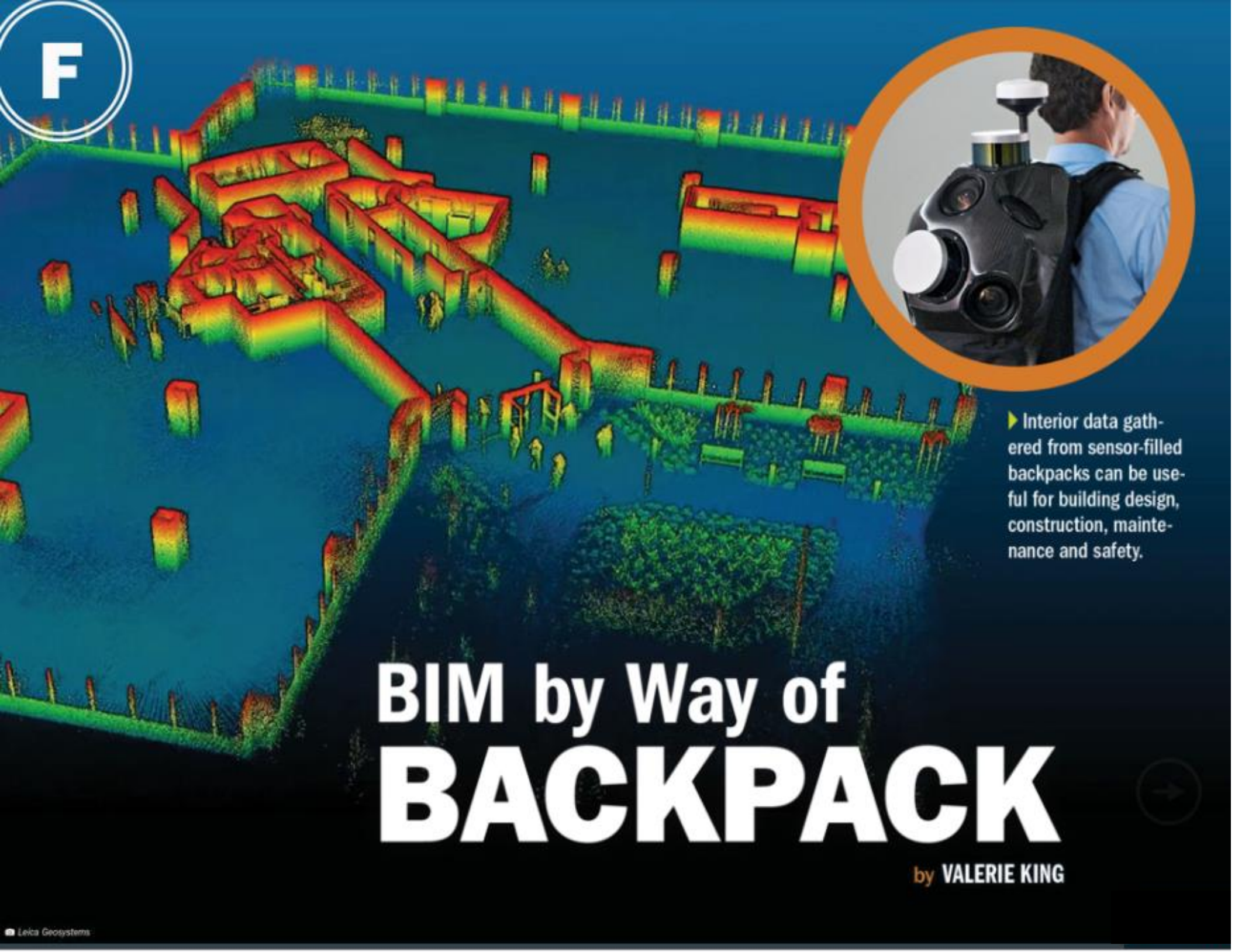


Interior data gathered from sensor-filled backpacks can be useful for building design, construction, maintenance and safety.

BIM by Way of BACKPACK

by VALERIE KING

Leica Geosystems

Building information modeling (BIM) is here to stay; it's not up and coming anymore, according to John Russo, president of the U.S. Institute of Building Documentation (USIBD), and president and CEO of Architectural Resource Consultants (ARC) in Irvine, Calif.

As BIM grows in popularity, developers are creating new tools for indoor data acquisition that more efficiently collect information through increased mobility.

A BETTER WAY

The most common way to capture a building in 3D right now is through static scanning, Russo says, which involves taking a tripod-based scanner, positioning it, taking a scan, moving it to another position, taking another scan and so on. Russo says repositioning is necessary because scanners are line-of-site instruments and that the data acquisition and processing steps are extended with each additional scan.

"For example, if you've got a 100,000-square-foot warehouse building, it may take a handful of scans to capture it because it's wide open inside. But if you have a 100,000-square-foot office space, you could have hundreds of scans because there are obstructions you have to scan around," he says.

The more complicated the space is — whether densely packed, confined or divided into many sub-spaces — the more complicated the scanning and processing is and the more costly it ends up being for the client.

For that reason, Russo says he sees an interior mobile solution as a next big frontier for the building documentation industry. One platform in particular that developers are packaging their sensors into for better indoor mobility is the

This image of the Indoor Reality backpack, uncovered, shows the technology it comprises, including a camera, LiDAR sensor and thermal camera.

Indoor Reality

backpack. Other moveable options like rolling carts or trolleys exist, but they tend to have difficulty with stairs and sloped surfaces.

BACKPACK BOOM

"You wear the backpack, come inside the room, spin around, walk out and you're done," says Avideh Zakhor, CEO of Berkeley, Calif.-based Indoor Reality, a startup that specializes in indoor reality capture solutions.

The first backpack solution Russo came across for building documentation was developed by Indoor Reality. ARC used it for research and development purposes when it was just a research project around four years ago. Now the portable platform for sensors has been commercialized and is available for purchase.

Indoor reality capture by way of backpack takes much less time than tripod-based static scanning and isn't inhibited by stairs like cart-based scanning.

Leica Geosystems

Leica Geosystems has rolled out a wearable reality capture sensor platform as well. The Pegasus:Backpack, designed for indoor and outdoor use, combines five cameras that offer fully-calibrated 360-degree viewing and two LiDAR profilers. The Indoor Reality backpack is also bundled tight with technology, including a camera, LiDAR sensors, inertial measurement units and thermal cameras.

Both backpacks are between 25 and 30 pounds.

Zakhor says the backpack is about 100 times faster than traditional methods like static scanning. "As an example, we were asked to bid for an 800,000-square-foot campus, a bunch of buildings. We can pretty much cover 200,000 square feet in one day, so we could complete that job in four days. Our competitors that use tripod based scanning — their bid was 45 days. Because it's so quick to acquire the data and because it has automated processing,

it makes this whole process of reality capture and visual documentation much more affordable and much more feasible than it was in the past."

APPLICATIONS

The use of backpacks for building documentation opens up applications that very recently couldn't have even been conceived of, Zakhor says. She points out that construction projects might be scanned every three or six months using the static method, since it might take a week to scan an entire floor. But if the process can be reduced to a half day, construction sites might be scanned weekly and smaller areas may be scanned as often as every day.

The resulting 3D models can also increase construction efficiency by simplifying communication and coordination.

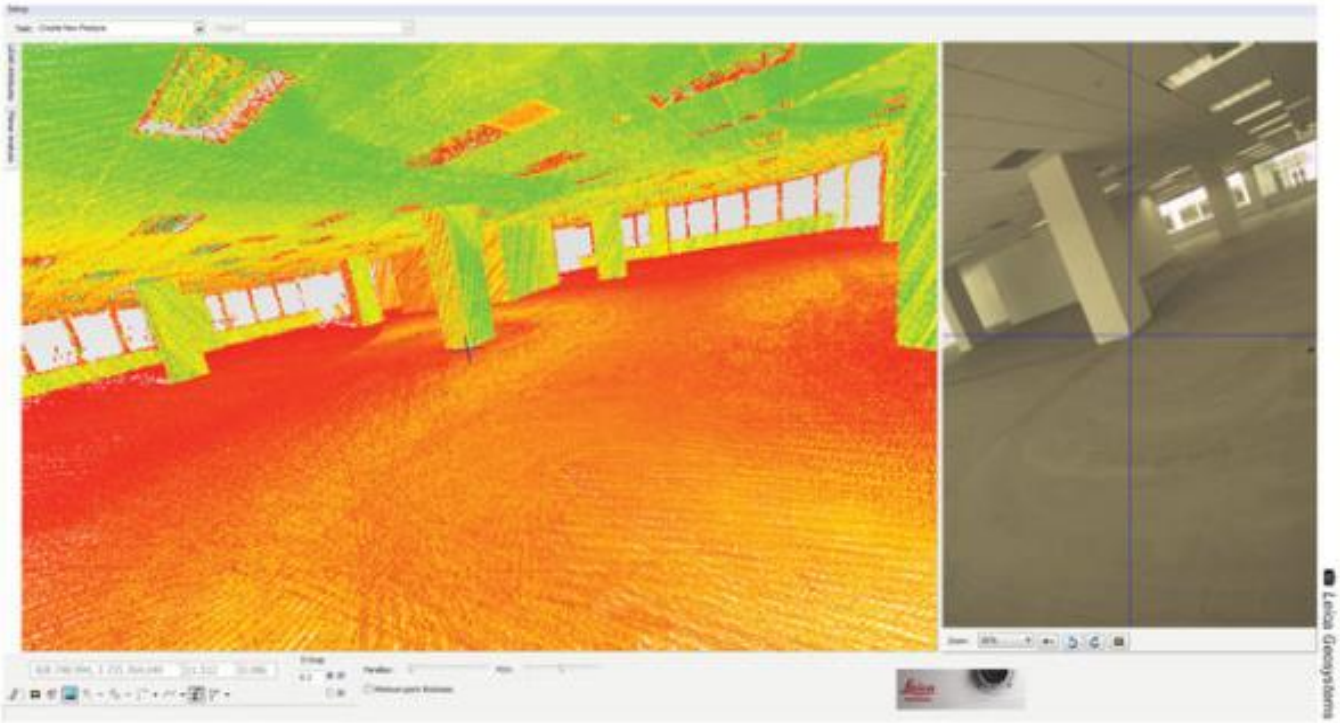
"You can think of it as different subcontractors can talk to each other with this visual tool because it has 3D spatial things inside it. So they might say, 'I am talking about this pipe,' and they can put a thumb tack on the pipe so we know exactly what pipe, or, 'A leak in the pipe is in this location.' It's very specific so you don't get tongue tied trying to say, 'OK. Go to the third floor, walk along the hallway for 100 meters, then make a left to get into the room, then it's in the northeast corner up,' " Zakhor says.

For recently completed buildings, 3D models generated with backpack-acquired data can make marketing easier. When house or commercial building hunting, interested buyers can virtually navigate a space before ever stepping foot inside. The data can also be useful for contractors that want to give bids for remodeling projects on existing build-

ings. If not all of the key stakeholders can make it to the location when it is open for viewing, the owner or the bidder can do a quick walkthrough with the backpack and create a virtual model. Then the rest of the team can look at the model back at the office and make a more informed decision on how to bid.

Manual energy audits can also be very time consuming when done the traditional way, Zakhor says. The process involves going into a building, measuring everything and counting all of the lights. Indoor Reality offers a layer of intelligence on top of the data acquired with the backpack. So in addition to generating the geometry of the building, things like windows, doors, lights and certain kinds of plug loads like computers are also calculated. The resulting data can be used to generate an energy model for the building and the energy model can be used for a simulation model. Thermal sensors also make it possible to detect moisture leaks or air leaks, where windows may not be tightly sealed.

"So you put the data collected from the backpack into these energy models and run it and then you can figure out what the energy cost savings are that save money in a big-picture, overall way, because you could save money on your lighting but lose money on something else," Zakhor says.



▲ BIM as a whole is expected to continue growing in popularity and the technology that supports it is expected to continue advancing.

In addition to applications related to building construction and maintenance, the data can be used for first responders. Exposing firefighters and paramedics to 3D maps of the buildings they rush to before and during an emergency can give them a better sense of the

building's layout, lead to more informed planning and ultimately make it possible to save more lives. From a preventative perspective, the detailed models can help occupants develop more informed evacuation plans.

END-TO-END

This is more than just a backpack and more than just making it easier to acquire data, Zakhor says; it's about creating an end-to-end solution that leads to a final useful model.

As an operator walks through a building, the data is collected and stored inside a compact computer in the backpack. When the walkthrough is over, the data is uploaded into the cloud and Indoor Reality processes it. A number of products can be generated, including point clouds, 3D mesh, 2D floor plans and 3D floor plans like Revit Architecture models. Indoor Reality also generates a web-based visualization tool that allows clients to virtually navigate inside a building by panning, zooming, matching, measuring and leaving annotations on 3D points.

The Leica:Pegasus Backpack is also tied to automated post-processing and utilizes Leica Pegasus Software, which is compatible with ESRI ArcGIS and Autodesk AutoCAD feature extraction.

LOOKING AHEAD

The challenge with the backpack, Russo says, is maintaining position while moving and accomplishing an acceptable level of accuracy.

"With static scanning you can get fairly high degrees of accuracy. The mobile methods that I've seen currently on the market are not as accurate as static scanning, but that doesn't mean they're not suitable for certain applications. Maybe less so for design applications and more so for asset management or general mapping of spaces and navigation," he says.

He points out that the demand for interior data is high, but that the acquisition method is not what end users are most concerned with. They care most about price, so the promise of mobile scanning inside buildings can dramatically reduce the data acquisition cost and make it fall within the price the market is willing to pay.

As for the end model, Russo says it isn't unusual for building owners to lack the level of sophistication to run a BIM program in house. He says there is a serious need for comprehensive BIM training within the building operations and maintenance space. In addition, many building owners don't own BIM software.

"So making modeled data available to the users who are performing maintenance and operation on the building is one of the stumbling blocks right now."

Overall, Russo says backpack BIM solutions are "certainly promising" and that BIM overall is moving in a very positive direction.

"It's going to continue to grow and flourish. I think it's going to get more sophisticated and hopefully easier to work with. It's a pretty robust tool." GDP