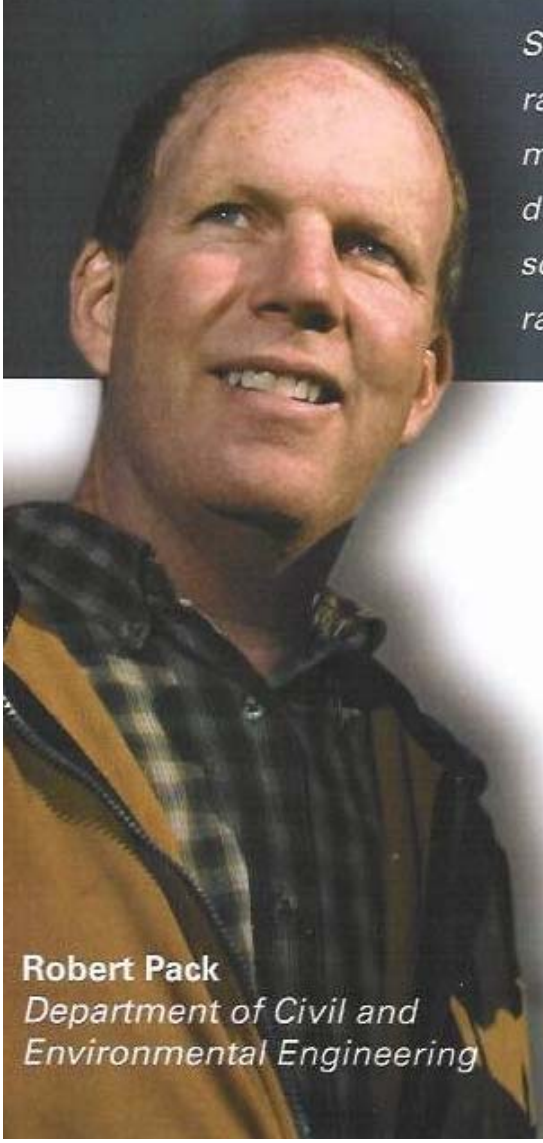
# walking through a photo

***Three-dimensional photography offers worlds of new possibilities.***

*Since World War II, the U.S. military has relied on radar—a system of bounced radio signals—to detect moving objects and targets. The simplistic radar depiction of planes, boats and submarines has left something to be desired by the military in accurately determining the distance and size of targets.*



**Robert Pack**
*Department of Civil and Environmental Engineering*

But, Utah State University researcher Robert Pack is using this same technology to develop survey instruments that are light years ahead of current military reconnaissance. Pack's research, however, has the potential to revolutionize myriad industries, including engineering, medicine, architecture and entertainment.

Pack and his team of USU engineers have been working on the development of advanced 3-D multispectral imaging, a technology that is able to produce complex 3-D images in the same time it takes to snap a photo. It is based on lidar technology, which is similar to radar, but uses light in place of radio waves.

This approach to 3-D photography started out as a small idea by Pack and his brother, Brent,

a retired electrical engineer. As they pursued it, they were amazed to find out no one else had come up with the idea before.

"Three-dimensional photography solves the problem of being able to characterize natural objects," says Pack. "[It] enables people to analyze, measure and better understand them using a computer."

The camera created by Pack, called Texel™, is composed of three common technologies: lidar, digital photography, and a global positioning system (GPS). The camera takes a normal digital photo of the scene in front of it, while the lidar and GPS are used at the same time to collect additional information. Once the 3-D photographic image is captured, it shows up on the screen, like a normal digital photo. Unlike traditional digital photography, however, the scene is automatically embedded with distance, area and volume information.

When multiple Texel™ photos are combined, a complete 3-D scene is formed with views from every desirable position, says Pack. At this point, users can "walk-through" the photo, viewing it from a first-person perspective and seeing in 3-D.

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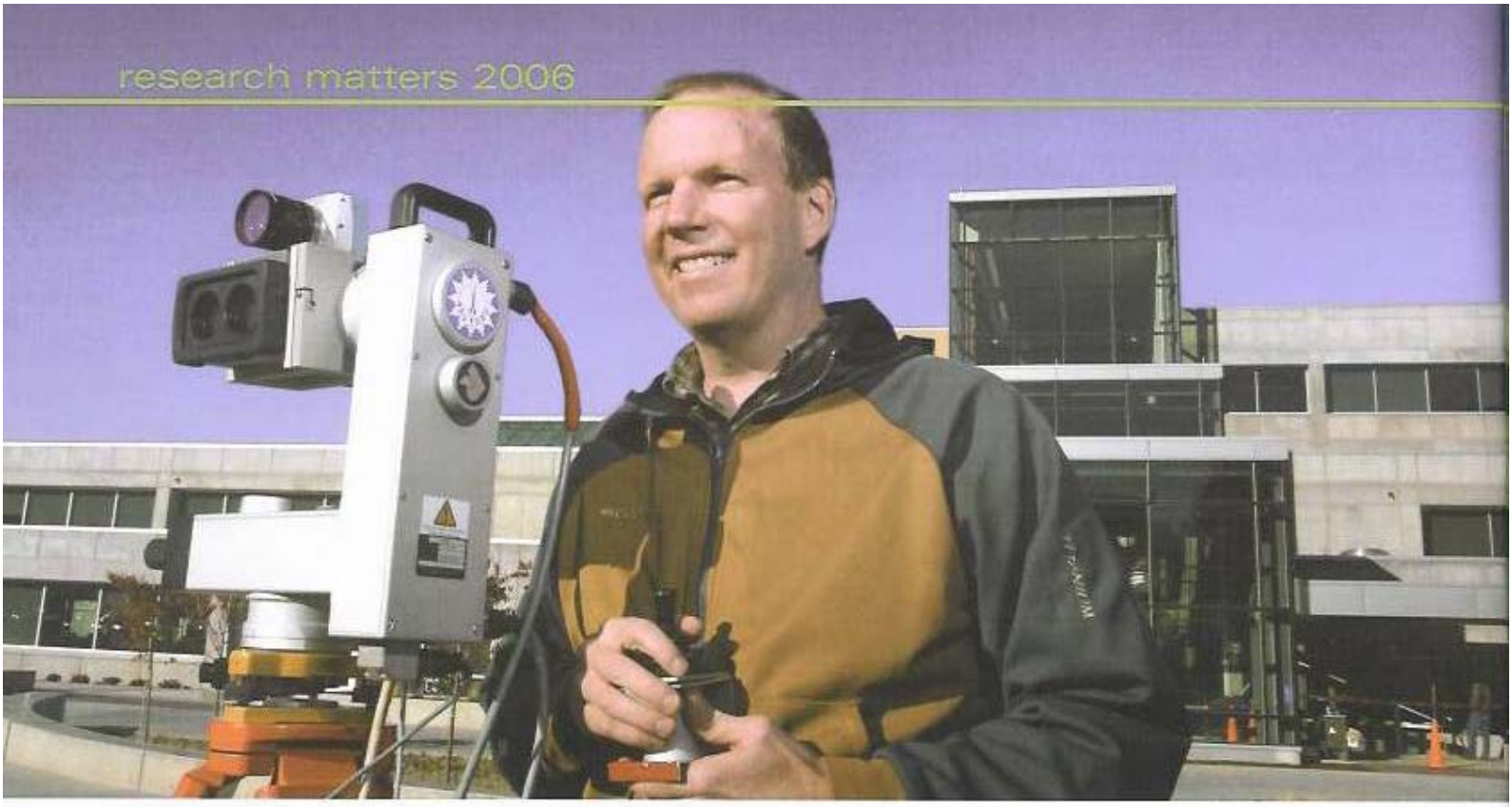

*Pack demonstrates the Texel™ prototype at USU. RappidMapper, a Salt Lake City company, has licensed the technology.*

Current 3-D processes use many of the same technologies as Pack's, but each one must be integrated with the others manually after the photos are taken and the information is collected. This takes a great deal of time and processing power. The Texel™ image, on the other hand, "comes out of the box in 3-D when it is downloaded onto a computer," says Pack. No configuration is needed, and the file is small enough to email, while achieving 10 times more accuracy than other techniques.

In addition to improving detection technology, Pack's camera could be used for a wide variety of other military applications, such as surveying a battlefield in real time and identifying tanks and artillery hidden under the cover of trees. Not only does 3-D visualization improve accuracy, but it is also more cost efficient. The Department of Defense has granted a three-year contract to Pack to develop this camera for use in a cruise missile.

Three-dimensional visualization, however, isn't valuable for just the military. The technology is being investigated for use in many fields, including space exploration, crime investigation, engineering, architecture and entertainment.

"We want to revolutionize the 3-D camera market and put these in the hands of photographers of all sorts who care about the dimensions and shapes of objects," says Pack.

In one possible use, a surveyor would be able to fly over a forest with the Texel™ camera and measure the height and species of trees, as well as the dimension and density of the forest.

The camera could also be used to document crime scenes in three dimensions, allowing investigators and jurors to "walk through" them long after critical evidence has been moved or cleaned up. Several federal and state agencies

***Entertainment is one industry that could benefit from 3-D technology. Instead of spending millions of dollars to create digital scenes of physical sets, animators for movies and games could photograph the locations and import them into a computer.***

## It Takes a Village: Texel™ Camera Contributors


*Above: An RMI composite image shows a 3-D mountainside.*

*The following people have contributed significantly to USU's 3-D photo technology:*

- ***Paul Israelsen,** Center for Advanced Imaging LADAR: Control and synchronization electronics.*
- ***Scott Budge,** associate professor in electrical engineering: Image and signal processing.*
- ***Tom Wilkerson,** physicist at Space Dynamics Laboratory: Ladar system design and development and atmospheric physics.*
- ***Christopher Neale,** biological and irrigation engineering professor: Support for deployment of the Texel™ camera on his remote sensing aircraft.*
- ***Rees Fullmer,** associate professor in mechanical and aerospace engineering: High-speed, large aperture scanning mechanisms for future Texel™ Camera development on aircraft and space platforms.*
- ***Ky Sealy,** electrical engineering research assistant and graduate student: Electronics and software design.*

have already expressed interest in testing the technology for this purpose.

Other industries that do extensive surveying, such as engineering and architecture, also stand to gain much from this technology. Buildings, construction sites and landscape designs could all be pre-visualized before they are completed.

The entertainment industry could also benefit from 3-D photography. Instead of spending millions of dollars to create digital scenes of physical sets, animators for movies and games could easily photograph the sets and locations and import them into a computer.

NASA's Jet Propulsion Laboratory is interested in taking the camera to space by integrating the Texel™ camera into future Mars rovers, as well as in devices for more distant expeditions.

These possibilities have made Pack's technology a shining star among start-up companies. After moving his research to the USU Center for Advanced Imaging Ladar, a Utah Center of Excellence, he was awarded a patent for the basic technology and expects to have several more within the next few years.

USU has also licensed Pack's camera to a Salt Lake City-based company, RappidMapper, Inc. (RMI) (see page 39).

In the meantime, Pack says there are "a lot of avenues to explore" and he hopes to work on making the tripod more easily airborne and eventually put the technology in unmanned aerial vehicles.

Pack is also working to increase the shots that can be taken per second from 600 to 200,000. (To compare, a typical digital camera can take four to six shots per second.) Pack also wants to improve the accuracy and range of the camera so that it could take pictures of objects up to five kilometers away.

Pack says pictures are worth a thousand words, but an RMI image is worth a thousand pictures.

"I am really excited to see where this technology can take us," says Pack. "People have always needed to know what's out there. They need to know what sizes and shapes things are. This technology provides a new observation for us. Perhaps it allows us to discover things that have never been discovered." ■