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'I Can See Clearly Now'

University of Dayton, Ohio (url: http://www.udayton.edu/index.php)

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University of Dayton researchers have developed a program that allows surveillance systems to quickly transmit very large, high quality images — a breakthrough in image processing technology that will allow those monitoring the systems to clearly see and react to what's happening in real time.

Funded by the Air Force Research Laboratory, the program is designed to provide better images faster from surveillance aircraft to personnel on the ground

"Having fast access to information in the form of clear, high-quality photos will allow analysts and decision-makers to take action more quickly," said Bill Turri, group leader for remote sensing at the University of Dayton Research Institute.

The need for improved image processing has become more critical in recent years with the increased use of "layered imaging" in surveillance, Turri said. Multiple images taken by a variety of cameras — including traditional and infrared — are digitally "fused" together to create photographs that depict the landscape in rich dimensional and thermal detail. But at hundreds of megapixels each, layered images are extremely large and require significant computer storage space and transmission time.

"Current technologies create a dilemma for those operating surveillance aircraft, who want to collect high-resolution images that clearly show what's happening on the ground. But high-resolution images are 'weighty' and take too long to transmit to the analysts who need to see them," Turri said. "So the choice has always been between fast and clear."

Compressing images reduces file size for speedier transmission, but using the typical JPEG compression standard — which digital cameras use — means some image information is lost during compression, Turri added.

When an image is reopened for viewing after compression, it will return to its original size, minus the information lost during compression — which reduces its quality. A newer compression standard — JPEG 2000 — sacrifices far less information during compression, so image quality is maintained. But this standard requires a much longer processing time.

To address the speed-quality conundrum, Turri and his team turned to hardware acceleration technology. Rather than relying on standard pre-programmed computer chips, the researchers experimented with a specialized class of processing hardware called Field Programmable Gate Arrays (FPGAs) — integrated circuits that act like "digital blank slates" that can be customized to the needs of the user and application.

"FPGA technology allowed us to create a high-performance system that harnesses the quality compression performance of JPEG 2000 in files that are small enough for rapid transmission," Turri said. "In other words, we're putting large, high quality photographs in the hands of analysts quickly enough that they can exploit that information in real time."

The research team has successfully processed hundreds of hours of live camera data using their new system, which is also being integrated into a prototype commercial system for use in law enforcement applications. As the technology continues to become more affordable, the system could be adapted for other markets, including medical imaging or consumer electronics.

"This is likely to become another great example of a government-funded research and development program that will ultimately bring about benefits for the commercial sector," Turri said.

Turri and his group worked on the project with researchers at the Air Force Research Laboratory's Reconfigurable Computing Lab. University of Dayton electrical and computer engineering graduate students, under the direction of assistant professor Eric Balster, also assisted on the project.

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