DARPA "AWARE - Wide Field of View Camera"

Recent advances in imaging technology coupled with an increasing demand in defense and security control have made it possible to deploy camera sensors in target tracking applications where a wide Field of View (FOV) is required to monitor an entire landscape in the field. In the AWARE program (Advanced Wide FOV Architectures for Image Reconstruction and Exploitation) by the US Defense Advanced Research Projects Agency (DARPA), researchers continue to invent the new imaging techniques that push the limitations of camera sensor performance through improved design and test methodology. As the ability to see multiple events unfolding simultaneously over a broad FOV is crucial in the new target tracking system, an advanced camera system is developed with an astonishing 2 gigapixel resolution and 120 degree FOV, including a central objective lens and 300 micro-cameras with 14 megapixels each, linked in a geodesic pattern around the central lens. The micro cameras, each of them recording a small portion of the field of view, are set up in an overlapping pattern with the goal to capture a wide field of view using combined images, producing 0.5 terabytes of data per second after compression.

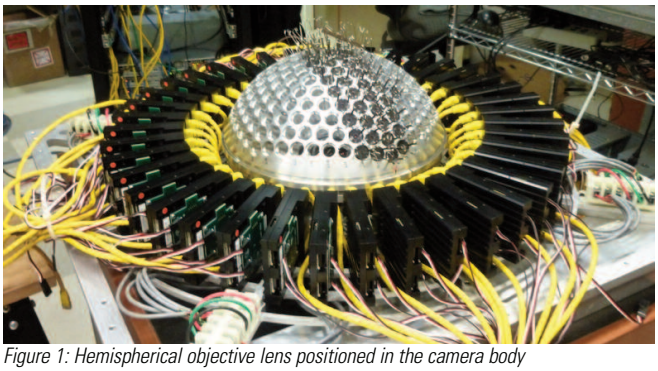

Figure 1: Hemispherical objective lens positioned in the camera body

"How do you stitch the images from 300 cameras together and register the overlapping images?"

To answer this challenging question, the researchers approached Newport to build a high precision motion system platform that will meet the special test requirements. A Newport custom XZ system, combined with an Azimuth-Elevation gimbal mirror mount enables the projection of DLP chip images through a telescope, registering each sensor input over a 120 degree range. (Figure 2) Looking at the images combined with the absolute position of the motion system allows the researchers to determine the overlap of each camera, construct the overall image and calculate the actual field position of the image.

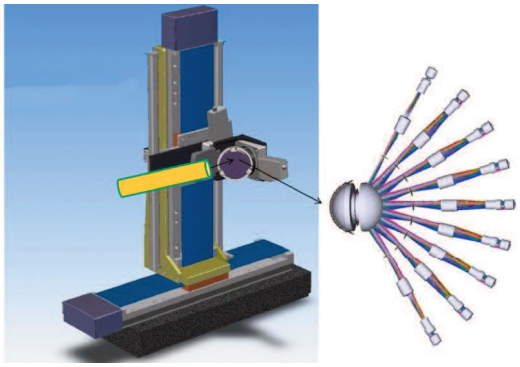

Figure 2: Gimbal mirror mount on XZ system, projecting images over 120° FOV

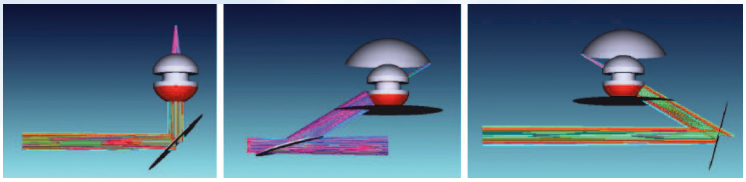

Figure 3: Ray tracing simulation of gimbal translation into optics

The XZ system is assembled with two IMS600CCHA High Performance Linear Stages, featuring 600mm travel, 0.1µm resolution from a linear scale encoder and 600N load capacity to support the 6" diameter mirror and gimbal assembly. The Azimuth-Elevation gimbal is configured with two custom URS100BCCHAs using high accuracy direct read encoders from Renishaw that provide 0.001° accuracy after error mapping.

The XPS-C4 Universal High Performance Controller enables monitoring the motion of the system from a remote facility via TCP/IP communication interface. A special software algorithm is used to remove the distortion, compile each segment and form the full image from the field.

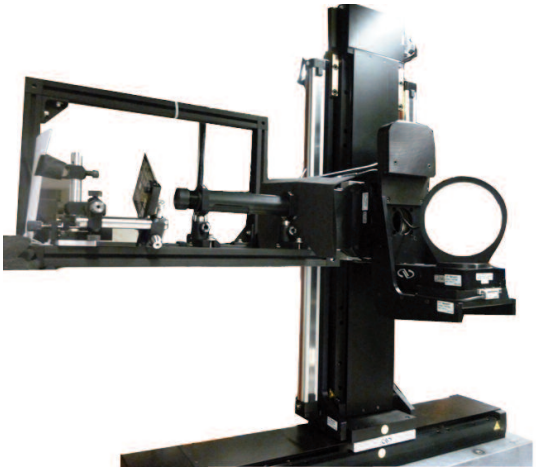

Figure 4: Motion system installed with telescope and LCD projector

Upon completion of the current camera system with 2 gigapixel resolution, a new system with 10 gigapixel is planned for the next implementation. With Newport's 4-axis motion system, the imaging technique from the AWARE program continues the breakthroughs in high resolution, wide field of view camera performance, providing increased visibility for broader view and higher clarity in the target tracking application.

For more information, please contact Newport sales and applications engineer at tech@newport.com

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