When Close Doesn't Count

By Jeff Reinke, Editorial Director

With the help of customized motion control components, new surveillance and weapon aiming systems have achieved the accuracy levels their environment demands.

Efficiency is a common goal, whether the reference is manufacturing operations or energy consumption. But even more important than automation equipment or fuel mileage is the ability to more accurately and efficiently address hostile situations on the battlefield where performance really does carry life and death ramifications.

This schematic offers a closer look at the Nighthawk Surveillance System, which integrates the Galil DMC-1425 two-axis motion controller in providing greater accuracy and more durable operation.

PVP Advanced Electro-Optical Systems Inc. (PVPAEO) develops and integrates sensors and imaging systems for aeronautic, aviation, naval and land-based applications that incorporate advanced infrared cameras, lasers and laser rangefinders.

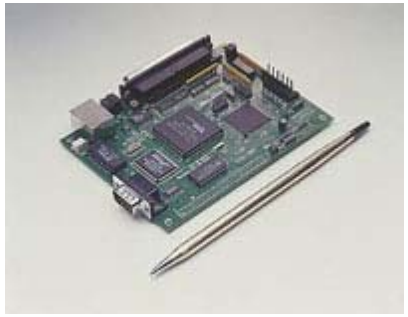
More specifically, for the U.S. Army's Stryker mobile gun system, an eight-wheeled, light-armored combat vehicle, PVPAEO provides the Commanders Pan Viewer (CPV) System. This gyro periscope system provides the vehicle commander with 360-degree surveillance of potential targets and threats without exposing him to outside danger.

Due to the varying range and intense operating environment, precise operation of this targeting system is obviously crucial. For this project, PVPAEO implemented Galil Motion Control's DMC-1425 two-axis motion controller. The unit offers a position mode that responds to user commands for specific elevation and azimuth angles, as well as a rate mode that is designed to close the loop around the gyro, allowing the sight

line to remain stable when the vehicle is driving over uneven or bumpy terrain. While these capabilities enhanced overall functionality, the development of this system was hardly an off-the-shelf selection.

In order to deliver both uncompromising results and a smaller footprint, the unit had to be customized with:

- A VME interface that could handle software capable of closing the servo loop around the gyro, while also implementing the required standard communication protocol. This involved adapting the controller to a special, ultra-high resolution encoder in order to achieve the necessary accuracy and to retain position memory during power-up.
- An interface that meshed with an existing VME chassis, which had already been developed.
- The ability to communicate with a custom dual-port RAM data structure through which all motor command signals could pass.
- A physical layout for the motion control card that allowed it to accept a specialized metal frame well-suited for the high-vibration environments associated with military operations. The card was also designed to interface with leading-edge absolute positioning devices, a dual-mode gyroscopic rate sensor and other external I/Os.
- The motion control card, which additionally interfaced with a small PROM containing unit-specific calibration data. This called for special firmware that can read and write data to the DPRAM, decode the position and velocity data from the special sensors, and drive the motors in either rate mode or position mode based on DPRAM data.



Galil Motion Control's DMC-1425 two-axis motion controller offers a position mode that responds to user commands for specific elevation and azimuth angles, as well as a rate mode that is designed to close the loop around the gyro, allowing the sight line to remain stable when the vehicle is driving over uneven terrain.

The controller also had to be able to write system snapshot information (motor positions, torques, I/Os, etc.) to specific VME registers.

More Than Just A Shot In The Dark

Another application developed by PVPAEO that called upon similar, if not identical, motion control considerations is the Night Hawk Surveillance Platform. It incorporates a high-performance, flexible pan and tilt gimbal that accommodates a wide range of sensors and video tracker configurations. The Night Hawk's pan and tilt gimbal operates on the same servo motor-based drive train as the CPV system.

Combining proven design elements with the servo motor-based drive train on the CPV also stabilized the sight. This resulted in greater accuracy and a lighter weight unit that consumes both less power and space.

Although the implementation of these customized motion control elements hit the proverbial target, it wasn't without some challenges. Robin Riley, the senior application engineer at Galil who worked with PVPAEO on the Stryker Mobile Gun System explains:

"The largest challenge was developing an algorithm for initializing and decoding position data from the absolute encoder. The selected encoder was a pre-production unit, and several technical discussions between Galil, PVPAEO and the supplier were needed before the design could be finalized. In the end, the algorithm provided very precise position data using a military-specified device that was accurate to within 0.005 degrees via information that was obtained at up to 300 degrees per second."

Because of the special DPRAM interface, tuning the controller's servo axes with typical Galil commands was also more difficult. Therefore, a special communication port was needed in order to tune the unit with standard Galil software. Additionally, these units rotate 360 degrees, so special shortest-path algorithms had to be developed in order for the user to change between targets as quickly as necessary, without waiting for previous position commands to be completed.

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Product Design & Development

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