Pentek Equipment Improves Performance of the Sea Lite Beam Director

[Written in the Winter of 1997]

The Sea Lite Beam Director is a state-of-the-art high-energy laser pointing and tracking system. Its key elements are a large aperture gimbal-mounted telescope with a 1.8 meter uncooled glass primary mirror, eight water-cooled metal mirrors, a precision tracking system that employs visible-light and infrared sensors, alignment and stabilization subsystems and a computer-based functional controller employing real-time software for automatic operation. It was named Sea Lite because it was developed for the Navy (Sea) and because it includes a laser (Lite).

Developed by Hughes in El Segundo, California, the Sea Lite Beam Director (SLBD) shown in Figure 1 was installed at the White Sands Missile Range in New Mexico and was integrated with a TRW mid-infrared chemical laser. The system has successfully demonstrated that it can acquire and track a target, such as aircraft or missile at extended ranges, by focusing the laser beam on the moving target and maintaining the focused beam on it long enough to destroy or disable it.

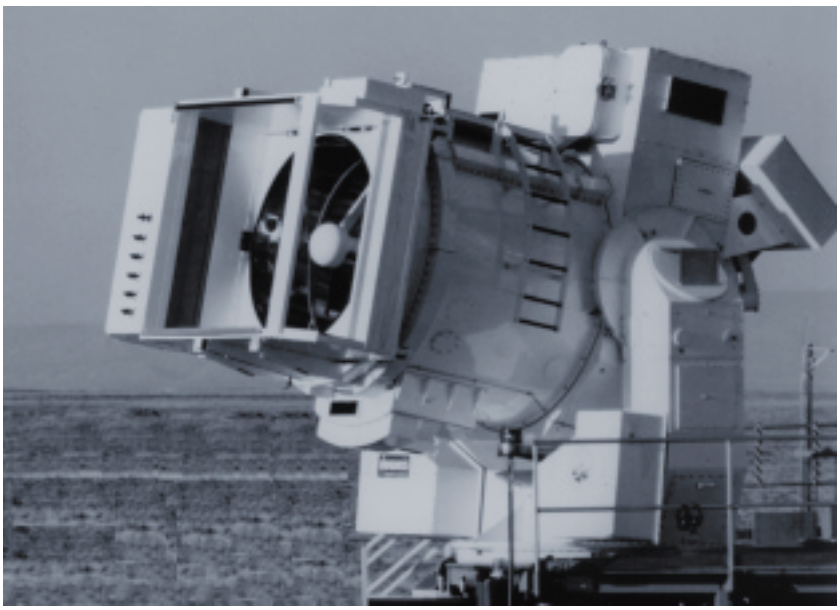

Figure 1. The Sea Light Beam Director installed at the White Sands Missile Range is about 25 ft. high. (Courtesy of Hughes Aircraft, now Raytheon Systems)

Pointing and Tracking

The SLBD system performs its precision pointing and tracking based on a stabilized line-of-sight concept. The line of sight of the 1.8-m telescope is controlled by an inner gimbal reference mirror, which is inertially stabilized. Optical sensors report any alignment errors between the coarse gimbals and the reference mirror to the beam steering mirrors. These, in turn, servo the line of sight of the high-energy laser beam and the tracking sensors to the line of sight of the stabilized reference mirror. This scheme allows for precision pointing without having to move the 18,000-lb telescope.

White Sands Missile Range radars provide the initial target coordinates to the SLBD functional controller which points the line of sight of the SLBD gimbal and tracking sensors to the target coordinates. The target sensors consist of a television camera and a TV-compatible infrared imaging sensor. Both sensors have fields of view of 4 milliradians elevation and 5 milliradians azimuth. The video signal from these sensors is sent to a track image processor for track error calculations. The track errors are then sent to an analog unit, which applies the proper control function. The output signals of this unit are used by the gyros on the stabilized platform to control the SLBD's line-of-sight pointing.

System Upgrades

In use for several years, the system has recently been upgraded to improve performance, flexibility and future expandability. These improvements have made it possible to not only improve tracking and pointing accuracy, but also enabled the SLBD to perform complex control algorithms not possible with prior technology. Making extensive use of off-the-shelf Pentek equipment, the upgrades also allow for the addition of new sensors to the tracker suite in days rather than weeks.

Tracker Interface Electronics

Several Pentek boards were used to upgrade the Tracker Interface Electronics (TIE) into a full VMEbus system. The main function of the TIE is to receive tracking and pointing errors, apply the appropriate control algorithm and drive the stabilized platform's rate-integrating gyros. As shown in Figure 2, four Pentek 6102 eight-channel A/D and D/A Converters handle the analog I/O functions. Analog inputs consisting of tracking errors, steering commands and reference signals are digitized to 16-bit accuracy and sent to three Pentek 4284 'C40 DSP Processors running at 50 MHz. Equipped with 16 MB of dual-access RAM and 512 kB of flash memory, these boards perform all the TIE calculations.

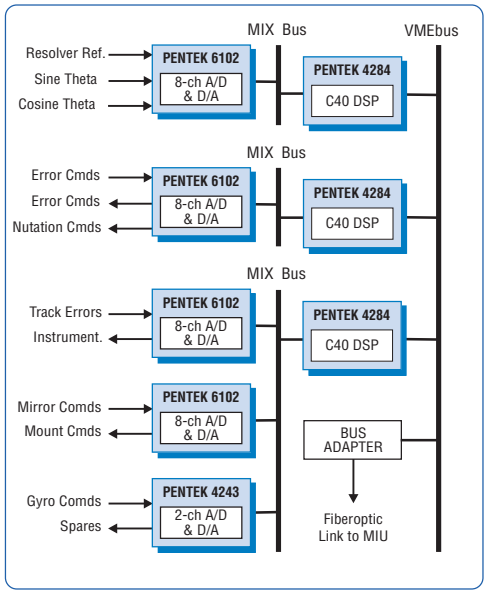

Figure 2. Tracker Interface Electronics

Analog output data from the D/A section of the 6102s contain feed forward commands, instrumentation and loop test outputs. The 6102s communicate with the 4284s over the MIX bus. Also attached to one of the processors through the MIX bus is a Pentek 4243 two-channel 18-bit A/D and D/A Converter, which is used primarily for generating tracking and pointing commands to a resolution of 15.25 mradian/sec.

The TIE software is being developed using Pentek's SwiftTools development environment. When finalized, the code will be written into the flash EPROM of the 4284s, so that it loads and runs automatically upon system reset.

Mount Interface Unit

This system's electronics were also replaced by a full VMEbus system to increase flexibility and expandability. The Mount Interface Unit (MIU) shown in Figure 3 performs: analog and digital interfacing between the Functional Controller System (FCS) and the SLBD mount; resolver to digital conversion; non-linear compensation algorithm calculations; control of the TIE system mode and calculation of trigonometric functions needed by the TIE. Also new in the system is a reflective memory for enhanced communications between the MIU and the SLBD

Again, a Pentek 4284 is used as the MIU processor and is configured with the same memory resources as the TIE processors.

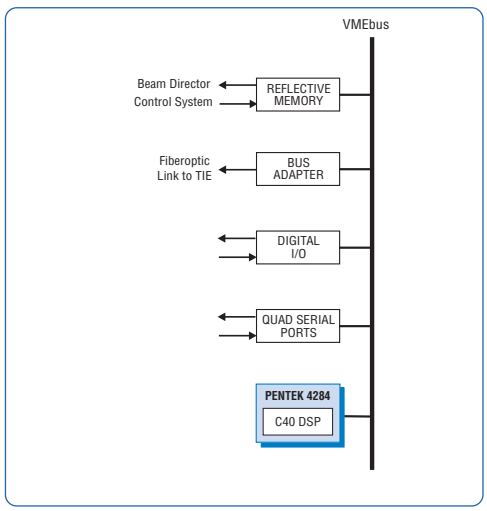

Figure 3. Mount Interface Unit

Mount Simulator

The Mount Simulator (MS) is a VMEbus unit, which simulates several functions of the SLBD. Among others, the functions include accepting commands from the TIE, executing mathematical models of the stabilized platform and gimbals, generating video with a target whose position is proportional to the pointing error and producing simulated resolver outputs that correspond to the gimbal's position. The unit has reduced test and integration times to 25% of the previous.

As shown in Figure 4, an external Pentium PC controls the Mount Simulator. Again, a Pentek 4284 DSP processor with the same memory resources is used as the main processor. As in the case of the TIE, two Pentek 6102s handle the analog I/O in the Track Error Processor section, while a Pentek 4243 handles the stabilized platform gyro commands from the TIE.

"We elected to go with Pentek for most of our VME boards, because of the breadth of the product line and because they met our system requirements and specifications," said Mike Gonzalez, SLBD Systems Engineer. "Pentek's MIX bus technology allows us to transfer data very fast into and out of the processor board without tying up the VMEbus," he added. ❑

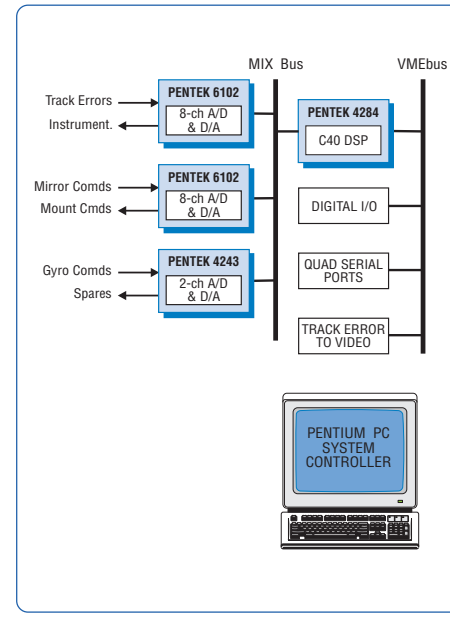

Figure 4. Mount Simulator

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