Zoological Studies 34, Supplement I (1995)

Zoological Studies

# NORAN Odyssey XL/Super Video Rate Confocal System

Bruce E. Batten
*Noran Instruments, Inc., 2551 West Beltline Hwy, Middleton, WI 53562, USA*

In late 1993 NORAN introduced a new version of the Odysey, called the Odyssey XL which added variable rate scan control features and fast digital image processing hardware. While the Odyssey XL is based on the same optical layout used in the Odyssey, the XL's new Dynamic Scan Control hardware was added to provide greater control over the Odyssey's point scanning mechanism as incroporate important video rate image processing features like background subtraction and averaging. Image scan rates, resolution, and pixel dwell time can be controlled to tailor the Odyssey XL's image capture and preprocessing facilities for later acquisition and analysis one the host computer scan parameter options available with the Odyssey XL.

The pixel dwell time is defined as the period of time during which excitation and detection occur for each point scanned in the active scan area (Odyssey field of view). The Odyssey XL pixel dwell time can vary from 100 nanoseconds up to 6.4 microseconds whereas the original Odyssey has a fixed pixel dwell time of 100 nanoseconds. ADC sample rates are adjusted according to the pixel dwell time. For slower dwell time (greater than 800 nanoseconds) the PMT signal is directed to an integrator stage prior to the ADC to accumulate over the entire dwell time; ie. lossless data acquisition.

In the Odyssey the analog signal generated by the PMTs is fed immediately to an output stage where it is translated into a RS-170 compatible video signal for output to a framegrabber in a host computer or to a video monitor for direct viewing. The Odyssey XL operated differently in that it digitized the PMT signal and can optionally perform arithmetic functions directly on the image data at video rates prior to sending the image to an output stage. The Odyssey XL video output stage includes both a CCIR 601 compatible digital video output and a RS-170 analog video output. The Dynamic Scan Control hardware embeds control information into each video frame that describes key scanning parameters and data organization. Acquisition software executed on the host computer interprets this control information and then as a results decides how to process, display, and store the ac-

**Table 1.**

| Image Size | Frame Rate | Scan Time Per Image | Pixel Dwell Time |
|---|---|---|---|
| 320×120 | 240 | 4.1 milliseconds | 100 nanoseconds |
| 320×240 | 120 | 8.3 milliseconds | 100 nanoseconds |
| 320×240 | 30 | 33.3 milliseconds | 400 nanoseconds |
| 640×480 | 30 | 33.3 milliseconds | 100 nanoseconds |
| 640×480 | 15 | 66.7 milliseconds | 200 nanoseconds |
| 640×480 | 7.5 | 133.3 milliseconds | 400 nanoseconds |
| 640×480 | 3.7 | 266.7 milliseconds | 800 nanoseconds |
| 640×480 | 1.8 | 533.3 milliseconds | 1600 nanoseconds |
| 1280×960 | 1 | 1.0 seconds | 800 nanoseconds |
| 1280×960 | 0.5 | 2.1 seconds | 1600 nanoseconds |
| 1280×960 | 0.2 | 4.3 seconds | 3200 nanoseconds |

quired data.

The Dynamic Scan Control hardware is based on a dual TMS34020 graphics system processor (GSP) architectur which also includes a separate fast arithmetic logic unit (ALU). Acquisition memory is 512×512×16 bits deep and is used to store data digitized by 10 MHz 8-bit ADC. The ALU can do background subtraction, accumulation (summing), and averaging operations on data in the acquisition memory at video rate. Results from an ALU operation are stored in display memory at video rate. Results from an ALU operation are stored in display memory at video rate. Results from an ALU operation are stored in display where it is staged for eventual output in either digital or analog video formats.

The display memory is controlled by a dedicated TMS34020 GSP which enables the Dynamic Scan Control hardware to decouple acquisition timing requirements from display and RS-170 video synchronization requirements. Thus even if the Odyssey XL is scanning at the slowest possible rate it is still maintaining an RS-170 compatible video output.

References (e.g. background) images can be captured and stored locally for subsequent ALU operations. Like acquisition memory, data stored in the background memory can be transferred to the display memory for output. This makes it possible for the Odyssey XL operator to switch between different displayed (output) images interactively.

This pressention will focus on how this new hardware can be utilized for diverse biological applications. Further the issue of dwell time and photo damage will also be addressed.