Fine-tuning robotic positioning systems

When every millisecond matters

Application Note

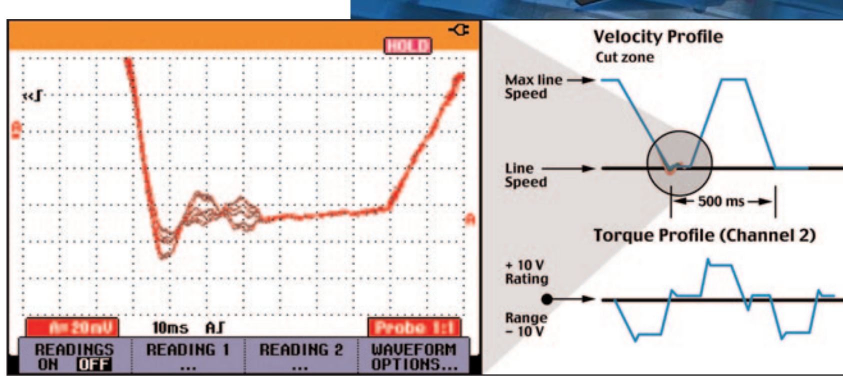
When Dennis Teague, a field service engineer with Rockwell Automation, stopped by the Fluke Corporation booth at a recent trade show, he brought a tough challenge that turned out to have a simple solution.

Teague had been searching for a way, using Fluke products, to more easily display the results of tuning high-response positioning systems. These types of systems are typically used to cut product to length in the metals, paper converting and plastics industries.

"For example, in the box board industry the production line moves an eight to nine foot wide web of continuous corrugated board at speeds up to 850 feet per minute." he said. "The web is slit and creased at several widths and then cut to length by two and sometimes three rotary shears, each responsible for a different cut length. This allows the line to produce two or three different size blanks from one stream of boxboard. The blanks are used in downstream operations and are expected to be accurate within plus or minus 0.01 inches. With cut lengths usually between 18 and 80 inches, the approximate repeat cycle for each cut ends up to be from 0.25 to 0.75 seconds."

In this example, the knife blades are required to be line speed matched and the system at zero position error for about five inches of the product travel during each cut. To determine the capability of the system to meet the accuracy required, position error and torque feedback signals need to be carefully examined as the blades settle back at line speed and just begin to enter the cut zone. Depending on line speed, this requires capturing about 60 milliseconds of data for each cut cycle of 250 to 750 millisecond duration.

"These are typical requirements for starting up and maintaining these and other positioning system applications." Teague said. What was *not* typical was his quest for a test tool that could reflect in near real-time what was happening during the process of adjustment so that technicians could perform the fine-tuning more accurately and efficiently. "The goal is to have at least two captures on the screen at the same time. In the foreground, the first capture would represent the current cycle and, in the background, the second would represent the data from the previous cycle. This would allow the technician to compare the tuning from one cycle to the next," he said.



Older phosphorus storage oscilloscope display tubes had this capability as they could be adjusted so that the trace could remain "burned" on the display for a short adjustable amount of time after the trace had completed. This allowed the next trace to overwrite the first with a brighter trace and gave the person tuning the drive enough time to make intuitive judgments on the adjustments being applied.

But the older oscilloscopes were very expensive, limited in functionality, low in frequency response, heavy, bulky and are no longer available. In recent years the replacement tubes, being increasingly more difficult to

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source, now cost far more to purchase than the original price of the scope.

Some approaches to digitally capturing data have been to collect the whole waveform before displaying it. This hinders the technician's ability to combine peripheral vision and sound with the image on the scope to resolve problems. "You don't want to be sampling something and then having to wait for it to be displayed." he said. "You always need to see data as it is being collected. And," he went on, "to quantify your progress, you need to have at least one comparison waveform. Ideally, I would like a real-time trace that I could compare with the previous trace and, even better, a third waveform, representing the ideal you're shooting for, all displayed at the same time."

Even positioning systems equipped with automatic position tuning need periodic troubleshooting and adjusting.

"Many systems have 20 or 30 sections. Today auto-tuning allows the original commissioning to be completed quickly and efficiently and everybody's happy," Teague said. "But over time or sometimes even during commissioning, mechanical or electrical problems arise that require the technician to dig out a scope."

Teague indicated some of the earlier digital scopes, when viewing data with low repeat rates, forced the user into displaying the results in "roll" or "scroll mode", like viewing a chart recorder. While this is useful for resolving some issues, it fails to allow the technician the ability to easily compare one stroke or cycle of the machine to the next. "This makes it very difficult to quantify the technician's tuning efforts," said Al Feldman, a Fluke field representative who met with Teague. "Most of these positioning system applications will produce a positive or negative trigger somewhere within each cycle. The challenge is to find a scope that will allow the effects of "tuning" to be displayed in an intuitive form. The Fluke ScopeMeter® 190C Series Test Tools are a perfect fit for this application. They can trigger on each new pulse at a fast-time base, and the Persistence mode allows the user to view the previous waveform in the background along with a third reference waveform. That way the effect of tuning can easily be determined."

The Fluke ScopeMeter 190C Series test tools are powerful, full-function scopes that offer the power and speed of a bench oscilloscope with the portability of a handheld. These are multifunction test tools that engineers and technicians in industrial, electrical and electronic applications rely on to get the job done.

The ScopeMeter 190C Series tools include everything needed, from high-performance 2.5 GS/s oscilloscope capabilities to a 5000-count digital multimeter and paperless recording. With functions such as cursors, zoom, advanced triggering and a unique ability to capture 100 screens, ScopeMeter test tools are designed to find very difficult intermittent and hard-to-diagnose problems — all in an easy-to-use, intuitive operational format. The 190C Series offers a full-color display that makes identification of individual waveforms easier, particularly when displaying large amplitude or multiple overlapping waveforms on screen. The bright, high-contrast display allows for clear reading under varying light conditions.

Particularly important to the resolution of Teague's question, the 190C Series' new Digital Persistence mode allows users to see dynamic signal behavior instantaneously. It helps you find anomalies and analyze complex dynamic signals by showing the waveforms' amplitude distribution over various time settings using multiple intensity levels and user-selectable decay rates. And its fast display update rate reveals signal changes instantaneously.

With a maximum real-time sampling rate of 2.5 GS/s per input, you can see what really is happening with 400 ps resolution. Independently floating, fully isolated inputs have their own digitizer, so you can simultaneously acquire two waveforms and analyze them with the highest resolution and detail.

The high-resolution screen – together with the deeper memory of 1200 samples per input in Scope mode or 27,000 samples per input in ScopeRecord mode – reveals minute signal detail. A complete video line can be displayed with more detail in one screen of 12 divisions.

"That's the beauty of the ScopeMeter 190C Series," said Hilton Hammond, Fluke ScopeMeter U.S. Marketing Manager. "If you can find an oscilloscope challenge, the 190C Series likely can solve it."

By the time Teague left the Fluke booth that day, he had seen the 190C at work and was impressed with the easy, intuitive and accurate resolution to his question with the added benefit of being able to upload and download the digitally stored waveforms. For your own online demonstration of Fluke ScopeMeters at work, visit www.fluke.com/scopemeters.

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