Ultra Sonic Weld Inspection

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Category:
Manufacturing

Products Used:
LabVIEW 8.2.1,
VXI 3.5.1,
DAQmx 8.7.1

The Challenge:
Develop an interface and control system that would display complex pipe weld inspection data, and allow user communication to a USB VXI chassis and USB DIO module, custom DSP communication and interface with existing control programs.

The Solution:
The solution used the easy to use LabVIEW display capabilities, along with flexible USB connectivity to perform the rapid DSP communication of very large data sets. LabVIEW's parallel architecture allowed data acquisition, display, alarm checking and data logging to all occur simultaneously.

Abstract:
A manufacturer of VXI-based ultrasonic inspection systems but wanted to leverage the visual display and communications ability of LabVIEW. DSA was able to use the user friendly device communication of LabVIEW over USB to obtain data and communicate with the other plant devices digitally. The modularity and reusability of LabVIEW enabled a new customizable user interface, superior to the original display capabilities of the control program, while limiting the user interface to a sleek design without excess system-level access. LabVIEW was also able to perform system self-adjustment and customization of the operator display, dynamically utilizing all screen space.

Background:
Ultrasonic weld inspection is performed on seamless welded pipes shortly after receiving a longitudinal weld. The pipes are examined in two ways:

- Scarf inspection checks for proper removal of the weld bead.
- Flaw inspection checks for weld flaws internal to the pipe.

Scarf and Flaw could be independently deployed in any combination. The speed of the pipe, as well as the high data density of the ultrasonic system, led to the data interpretation performed on a proprietary VXI DSP board. A core LabVIEW program existed previously and handled the data communications and configuration of the USB-VXI system. The GUI interfaces with this core, and allows several user-friendly interactions with the program.

Graphing:
The program needed to present several simultaneous plots to allow proper interpretation of the integrity of the pipe weld. First, the actual inside and outside profiles of the pipe were presented to the user, in order to see any irregularity in the surface (Figure 1). Due to the precise nature of this measurement, the display could be emphasized in the vertical direction, using slider controls, to better interpret the surface. The graph also scaled with the type of probe, always filling the display area, regardless of number of ultrasonic elements.

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Second, the recent thickness trend was displayed in a chart display. This allowed the visualization of a tool break, tool skip or transient error, to compare with a marked area. Third, the Flaw-only strip charts showed alarm conditions and flaw detection over the length of the test. These items were important to display for post-test analysis, but were only displayed in those tests that incorporated Flaw measurement.

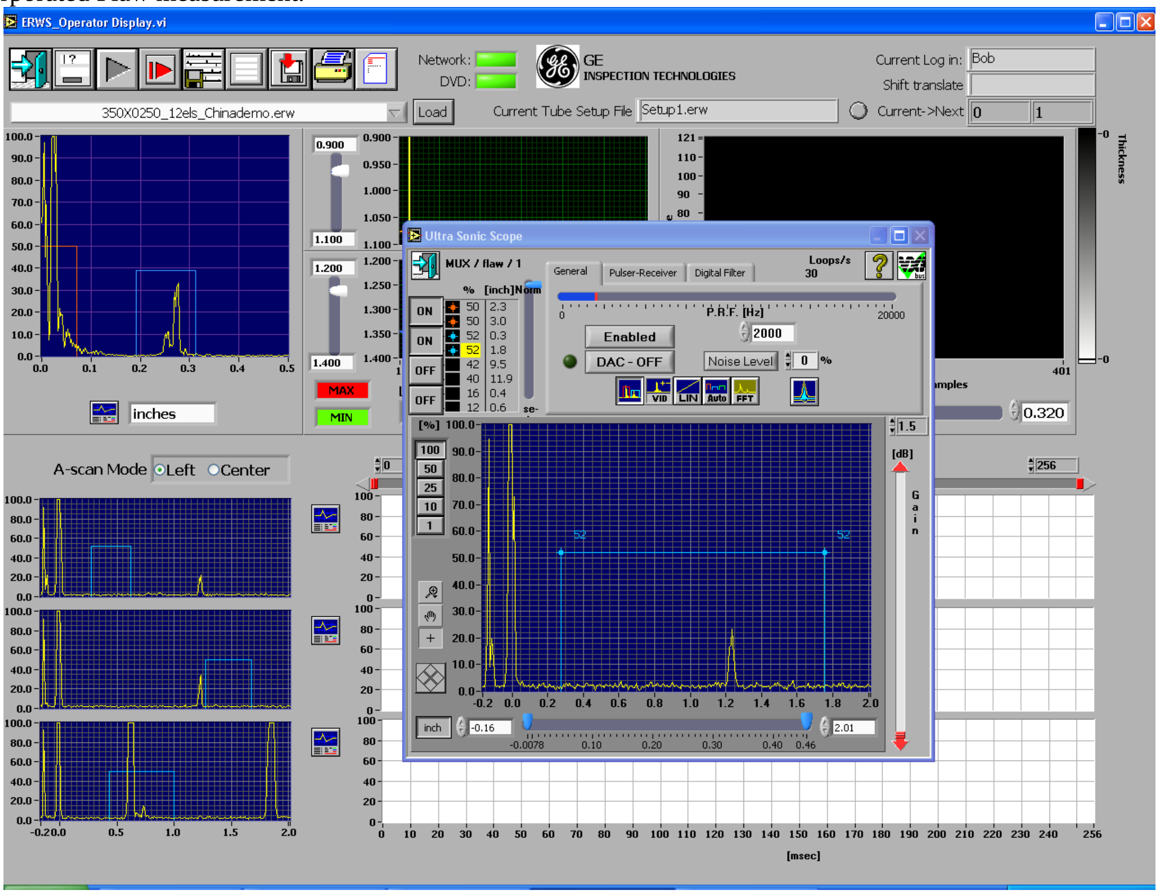

Figure 1 Operator GUI, including parallel displays, logging charts and pop-up central core functions, all shown in real-time

Save and Retrieve Settings:
The program was able to set and retrieve many types of settings, all tied to a single profile. Included in these settings are the actual control files downloaded to the DSP. The program had to appropriately stop data gathering and communication, deploy settings and restart the system. Also included were settings for alarm limits, discussed below, as well as data interpretation: whether to sample the data based on a system timer or attached rotary encoder. Logging setup was also included here, to allow logging of specific channels of thickness to text file.

Alarm conditions:
The alarm conditions for the Flaw system were calculated by the DSP itself, but all thickness measurements were compared, at acquisition time, to user-defined thickness limits. These limits included a tolerance, which was calculated at plus or minus the left or right edge measured thickness, as well as an absolute thickness limit which would allow alarming in case of overall thickness drift, rather than deviation of the nominal thickness. In addition to these limits, there were “ignore” limits, which allowed exclusion of exceptionally large or small thickness measurements, normally causes by transient loss of continuity or other measurement errors.

System Display:
As mentioned above, the system could have several deployments, using or excluding the Flaw or Scarf components individually. Rather than having unused screen area, the screen would re-size the plots and controls in order to fill it with Flaw or Scarf items only.

Summary:
Overall, LabVIEW provided the means by which a flexible, customizable user interface was developed as an upgrade to a legacy inspection system through the reuse of previously developed core modules.

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