Data Acquisition

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Abstract:

The use of digital oscilloscopes having print/plot capability is discussed in reference to data acquisition in the undergraduate laboratory. These instruments can increase productivity in the laboratory while keeping the data acquisitions system almost transparent to the user.

Equipment:

1) Agilent 54600B Oscilloscope with RS-232/centronics module

The current availability of inexpensive, yet powerful, computers, has increased use of computers/controllers in the undergraduate laboratory. Although most computers have been applied to laboratories related to computer and digital systems, computers are well suited for data acquisition and automated measurements in most undergraduate laboratories [1-3]. Changes in laboratory instruction which incorporate computers may increase student productivity in the laboratory [4-5]; however, the laboratory experience may suffer if computers replace "hands-on" experiences by the student. Problems may also arise when the introduction of desk top computers and peripherals into the laboratory requires additional bench and laboratory space.

Modern instruments increasingly incorporate functions which provide an alternative to stand-alone computers. For example, digital sampling oscilloscopes (DSO's) provide enhanced laboratory productivity without increased space requirements and without diminishing the "hands-on" laboratory experience. Recent price reductions in DSO's make this an attractive alternative.

A unique feature of DSO's is the ability to produce a hard copy of an output waveform on a printer or plotter with the simple push of a button. This feature of newer DSO's is a direct result of the microprocessor based architecture of these oscilloscopes. The plot/print capability allows the student to record data displayed on an oscilloscope much more quickly and accurately than manual point-by-point sketches. An additional benefit is that data is acquired and recorded in a form ready for computer analysis. Laboratory data acquisition is greatly improved: students are introduced to the latest technology; while the "hands-on" experience in equipment setup and measurement is retained. Some educators believe that the use of more complex instruments in the undergraduate laboratory can obscure the actual experimental results. This has not been observed to be a problem in our laboratories using DSOs over the past three years. Modern DSO's have been designed to be user-friendly with controls that are very similar to the analog oscilloscopes, so that a student's attention remains concentrated on the experiment.

An example of a plot obtained on a printer/DSO system showing the bandpass characteristics of a micro-strip filter is shown in Figure 1. This figure was printed in slightly less than sixty (60) seconds in low resolution using an Agilent 54600A DSO and a ThinkJet Printer using GPIB. An Agilent 54600A DSO and an Epson printer with parallel interface took approximately the same time. Although better curve definition can be obtained by plotting, plotting took almost 7 minutes with an Agilent 7475A plotter.

Equipment setup is very easy and straightforward, requiring only a DSO-to-printer/plotter cable connection and the DSO's printer/utility menu selections for printing or plotting.

For students making a transition from analog oscilloscopes, the new class of digital oscilloscopes, the new class of digital oscilloscopes offers an analog-like interactive display with familiar names and controls, with menus are used for advanced features. DSO's offer features not available on comparably priced conventional scopes such as negative time display, waveforms storage and retrieval, automatic setup, glitch detection, on-screen cursors, measure/calculate/math functions, and effective bandwidths over 100 Mhz.

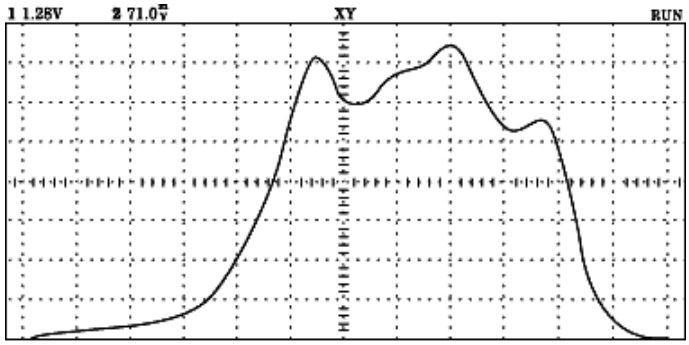

Figure 1. Bandpass Filter Characteristics Obtained with Printer/DSO Using X-Y Mode. (Amplitude versus Frequency)

In summary, using digital sampling oscilloscopes in the undergraduate laboratory increases student productivity because the DSO/printer/plotter provides all signal conditioning, transmission, display, and recording for data acquisition, while adding only the printer. Also, a DSO/printer system approach to data acquisition can be used in any laboratory where the measured quantities can be displayed on an oscilloscope, in both time and the X-Y modes, and data is acquired in a form ready for computer analysis and characterization. DSO's may not be the system of choice for all applications, but DSO's should be seriously considered in applications where increased laboratory productivity is desirable and the actual data acquisition system should be transparent to the user-requirements often present in undergraduate laboratories.

References:

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