

# Remote and Virtual Instrumentation Platform for Distance Learning

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**Abstract**—This journal presents distance learning using the National Instruments ELVIS II and how Multisim can be combined with ELVIS II for distance learning. National Instrument's ELVIS II is a new version that can easily be used for e-learning. It features 12 of the commonly used instruments in engineering and science laboratories, including an oscilloscope, a function generator, a variable power supply, and an isolated digital multi-meter in a low-cost and easy-to-use platform and completes integration with Multisim software for SPICE simulation, which simplifies the teaching of circuit design. As NI ELVIS II is based on LabView, designers can easily customize the 12 instruments or can create their own using the provided source code for the instruments.

**Index Terms**—Multisim, ELVIS, Virtual, LabView

## I. INTRODUCTION

Distance Learning, commonly known as e-learning, is a term used where student and teachers use online technology to interact and participate. The information is sent online and can be accessed by a student anywhere, thus making it easy to demonstrate concepts and perform experiments in a distance learning setting.

The use of Multisim 10.1 with NI ELVIS II can provide uniform switching between simulated and acquired data, overlay simulated and measured data in the same instrument and use a single platform when simulating or testing to provide an overall view of the circuit design process - from designing and prototyping to implementation.

## II. MULTISIM

Multisim provides users with the unique ability to capture and simulate from within the very same integrated environment. The advantages of this approach are many. New users to Multisim need not worry about sophisticated SPICE (Simulation Program with Integrated Circuit Emphasis) syntax and commands, while advanced users have easy access to all SPICE details. Multisim makes capturing schematics easier and more intuitive than ever.

The spreadsheet view in Multisim allows users to easily modify characteristics of any number of components simultaneously from a PCB footprint to a SPICE model. Working with both analog and digital multi-section components is intuitive and simple. In addition to traditional SPICE analyses, Multisim allows users to intuitively connect virtual instruments to their schematics. Virtual instruments make it fast and easy to view interactive simulation results by replicating the real-world environment.

Multisim also provides special components known as interactive parts, which can be modified while a simulation is running. Interactive parts such as switches and potentiometers will immediately and accurately affect the results of simulation. When the need arises for more advanced analysis, Multisim delivers over 15 sophisticated analyses. Some examples of analyses include AC, Fourier.

The Multisim environment is a powerful Grapher, which allows the customized viewing of simulation data and analyses. The integrated capture and simulation environment provided by Multisim is a natural fit for any circuit designer and will save both time and frustration throughout the entire circuit design process.

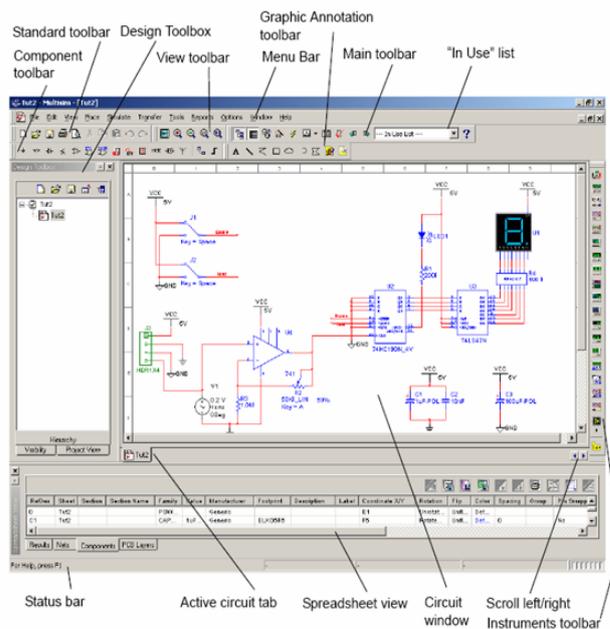


Figure 1. Display of Multisim Environment

NI Multisim also provides a number of measurement instruments that you can use to interactively measure the behavior of circuits. These instruments behave like their real-world equivalents as the user sets, uses and reads the simulated measurements. Using measurement instruments provides an easy way to examine a circuit's behavior through the simulation results.

All the measurement instruments in the NI Multisim environment share some common features as:

- Can change settings while the simulation is running.
- Can re-wire terminals while the simulation is running.

- Can use multiple instances of the same instrument in one circuit.
- Can save instrument settings and displaying data with the circuit file.
- Populating data displayed in the measurement instruments in the Grapher View.
- Can resize the measurement instrument panel to account for screen resolution or presentation mode.
- Can easily exporting displayed data to DAT, TXT, LVM and TDM format.

Multisim data saved in .LVM or .TDM format can be easily loaded into Lab VIEW using express Virtual Instrument (VI) technology. Simulation data can then be overlaid on top of measured results to quickly and easily verify designs.

### III. USING THE NI ELVIS-MULTISIM PLATFORM

The Electronics Education Platform is composed of the Multisim circuit simulation environment, industry standard Lab VIEW measurement software, and the brand-new NI ELVIS II design and prototyping platform now completely integrated to form an unparalleled platform for circuit's education [1-5] i.e., the new NI ELVIS II measurement instruments can be opened inside the Multisim 10.1 environment, and the same instrument can be used to analyze simulated and real measurements. National Instruments' ELVIS is an ideal companion to any electronics lab that uses Multisim.

ELVIS provides a breadboard prototyping environment, with built-in instruments including a Function Generator, a Digital Multimeter (DMM), an Oscilloscope, and a Variable Power Supplies. The breadboard is detachable, allowing students to work on their projects and labs independently of the ELVIS unit. ELVIS provides LabView-based software for interacting with the virtual Instruments. These instruments can be modified to load Multisim data for rapid comparison of simulated and measured data.

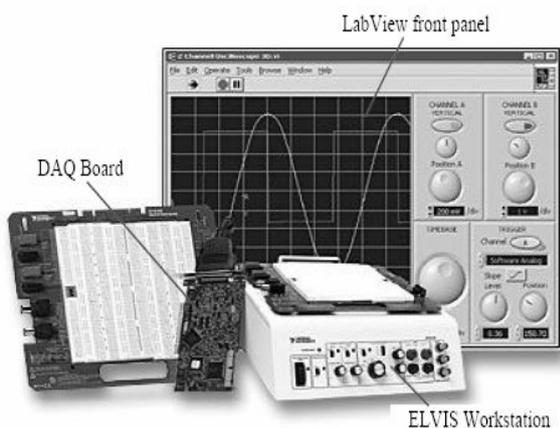


Figure 2. ELVIS board trainer kit

NI ELVIS consists of LabView-based virtual instruments, a multifunction data acquisition device, and a custom-designed bench top workstation and prototyping board. This combination provides a ready-to-use suite of instruments found in all educational laboratories. Because it is based on LabView and provides complete data acquisition and prototyping capabilities, the system is ideal for

academic coursework, from lower-division classes to advanced project-based curricula. Curriculum applications include electronics design, communications, controls, Mechatronics, instrumentation, and data acquisition. NI ELVIS II, LabView graphical system design software and the tight integration with Multisim 10.1 brings together cutting-edge hardware and software to create a hands-on platform for science and engineering labs.

The ETCB (electronics training circuit board), a custom-built trainer board that works in concert with National Instruments NI ELVIS (Electronics Laboratory Virtual Instrumentation Suite) and a personal computer, is a solution for students who need to perform laboratory experiments, whether at a distance or on campus. This offers students the convenience of purchasing a laboratory manual and a custom-built eTCB, which are designed to offer a complete set of laboratory experiments in DC and AC circuit analysis and design courses.

### IV. DISTANCE LABORATORIES

One significant hurdle of distance education in the fields of engineering and technology is how to provide a meaningful substitute for the traditional onsite laboratory. Rather than take on this challenge, we chose to develop a distance laboratory platform that would supplement the 'hands-on' experience using a system with 24x7 access to experiments via the Internet. Known as ALTE (Automated Laboratory Test Environment), the system allows users to control test and measurement equipment remotely and thereby run the same experiments normally performed by coming onsite.

Much of the early work that used the Internet to remotely deliver experiments began in 1998 with Esche and Chassapis [6]. It was followed by a series of work reported in 2000 by both Esche and Gurocak [7, 8, 9]. Each year, a growing body of work has appeared that has further validated both the technological viability of distance laboratories, and their effectiveness in delivering a worthwhile laboratory experience [10-15].

The quality of the architectures and designs has shown steady improvement, and there appears to be ample evidence that this form of experimentation delivers a valuable learning experience for students [16-19]. The technical architecture of ALTE consists of two elements: (1) a web-based management system that governs online access and (2) multiple lab station PCs attached to pre-built circuit breadboards. Users are required to log in, identify the specific course/section and then select an experiment to run. After being re-directed to the appropriate lab station PC, LabVIEW virtual instrument panels (VIPs) provide a familiar interface to acquire test data directly from the circuit breadboard. ALTE has been pilot tested over several semesters with great success as a supplement to the online laboratory.

### V. CONCLUSIONS

The brand new integration between Multisim and NI ELVIS II overcomes the hurdle of transitioning students from theory to laboratory. The 3D NI ELVIS II view in Multisim allows students to practice prototyping in a virtual environment.

Once the circuit is built, the BUILT-IN NI ELVIS II instruments in Multisim allow the student to simulate the

design, measure the prototype and compare in the same instrument.

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