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- Jay R. Porter and Sanjay Tumati** 11–18 Using Simulation Tools to Verify Laboratory Measurements
- The Electronics Engineering Technology (EET) program at Texas A&M University is currently working with industry to incorporate both digital and analog testing techniques into the curriculum. One area that has been identified as important by industry is helping future engineers understand the concept of integrating simulation into the design verification and testing process. To this end, the EET faculty is working to develop tools that allow the measurement process to be automated and compared directly to simulated results. For example, the faculty has already developed a LabVIEW™ tool that imports simulation data calculated using Altera's MaxPlusII and automatically creates a comparison between simulated and measured results on digital logic circuits. This paper presents a similar tool that was created recently for analog measurements allowing the comparison of Cadence's PSpice simulations to benchtop measurement data.*
- Dale H. Litwhiler** 19–25 Listening to PSpice Simulations with LabVIEW
- Engineering technology students at Penn State University are using LabVIEW Virtual Instruments (VI) to actually listen to the signals of PSpice simulations. A text parser VI is used to scan the PSpice simulation output file for the desired data. This text data is then formatted into the required audio format for playback via the computer's sound card. LabVIEW contains many functions to easily facilitate text file manipulation and sound card interfacing. By listening to various signals throughout the circuit, the students get an added dimension not typically experienced during circuit simulation. Students have developed a greater understanding of the operation of several circuits through the experience of being able to hear their circuit simulation results.*
- Jack Denton and Elaine Cooney** 26–32 Power Measurements: Simulations and Measurement
- A laboratory exercise was developed employing RMS voltage and power measurements for non-standard waveforms. The purpose was to educate the student in the method of RMS and power measurement calculations beyond the common sinusoidal waveforms and to reinforce the practice of 'know your equipment'. The waveform used was a damped sinusoid and was implemented in a LABVIEW VI developed for generating output voltage signals from input formulas using a data acquisition module. The RMS measurements were investigated using MATLAB, oscilloscopes, digital multi-meters and a second LABVIEW VI. The student analyzed the resulting data and a discussion of various discrepancies ensued.*
- Devdas Shetty, Suresh K. Ramasamy and Seong Joo Choi** 33–40 A Non-Contact Visual Measurement System Integrating LabVIEW with Matlab
- The recent trend in the field of on-line inspection has shown a growing need for a non-contact visual-based measurement system. A systematic development of a real-time inspection system can bring about an increase in productivity and effectiveness during in-process monitoring. This paper discusses the development of a typical real-time measurement system used for different industrial applications, with a specific example of volumetric shrinkage measurement. The volume shrinkage measurement system described in this paper is based on a procedure of obtaining the cross-sectional information of the sample of the product (adhesive droplet) before and after the product is subjected to shrinkage. A specialized laser system, rotary mechanism, imaging system and virtual instrument are used to compute the shrinkage percentage of the droplet.*
- Gloria Mousalli-Kayat, Jesús Calderón-Vielma, Addison Ríos-Bolívar and Francklin Rivas-Echeverría** 41–48 Learning Faults Detection and Diagnostics Using a Virtual System
- The present work focuses on teaching fault detection and diagnostics in industrial processes, through a computational tool that integrates a virtual instrument developed in LabVIEW™ 6.0 and a computer application in MatLab 6.1 for simulating an industrial process. For integrating the applications, the dynamic data exchange (DDE) protocol has been used. The objective of this work has been to use the integration of the LabVIEW™ interface with the MatLab computational tool in order to allow students to interact with a process for detecting, by inspection or fault-detecting filters, the possible faults that can occur.*
- Nicolae Patrascoiu** 49–54 Modeling and Simulation of the DC Motor Using Matlab and LabVIEW
- One of the most used actuators in control systems is a direct current (DC) motor. The general output variable of this actuator can be angular speed or angular displacement motion, but, coupled with wheels or drums and cables, can provide translation motion. This paper proposes a state-space model of the DC motor built for constant flux and considering two inputs: supply voltage and resistive torque. The three states of the resulting model are represented by angular speed, angular displacement and current supply and any of these states can be an output variable for a simulation model. Consequently, the system's model has two inputs and three outputs. For the system's simulation a VI is built where the most important element is a Matlab script which contains the matrices A, B, C, D of the state-space model, the independent variable time and the Matlab simulation function lsim. The motor's parameters are given by digital controls on the panel so that these parameters can be interactively modified. To generate inputs, two CASE structures are used*

where the input variables can be set: impulse, step and ramp. Here it is also possible to set the signal amplitude and duration, either by knob or slide control. TRANSPOSE 2D ARRAY and INDEX ARRAY are used for setting the matrices' dimensions. The output signals are live display, either one by one or together, on the WAVEFORM GRAPH.

Y. Robinson and S. Dhandapani 55–62 Experimental Investigation on Electronic Fuel Injection in a Two-Stroke SI Engine by Virtual Instrumentation Technique

This paper presents the results of experimental work conducted on a two-stroke spark-ignited engine to reduce emissions and to enhance performance using electronic fuel injection. A virtual instrumentation program developed using LabVIEW software controls the fuel injection system. A comparative study was carried out with a base engine for determining the effect of electronic fuel injection. The injector was mounted on the inlet manifold to get a better mixing of the fuel and air. The in-cylinder pressures were recorded for 1,000 continuous cycles using a piezo-electric pressure pickup and PC-based data acquisition system. The results show that the accurate and precise control of fuel injection achieved by virtual instrumentation techniques results in improved engine performance, reduced emissions, and cycle-to-cycle variations.

N. Mkondweni, R. Tzoneva and S. Harisson 63–74 Integrating LabVIEW Capabilities for Monitoring and Supervisory Control with a B-Braun Biotech GmbH Unit for Fermentation Processing and Direct Control

The paper presents a control strategy and LabVIEW 6.1 computer program for the design and real-time implementation of an adaptive control system of a fed-batch fermentation process run in a Biostat[®] C fermentation unit. The methods used for modelling, parameter estimation, optimization and controller design are discussed. Algorithms for integration with the unit communication protocol through LabVIEW VIs are described and the VIs are given. The programs and control system are implemented on a standard PC, running Windows 98, and connected to the fermentation unit through a standard RS232/RS422 converter. The program is used to control a yeast production process.

Jay R. Porter and Michael R. Warren 75–83 Teaching Mixed-Signal Testing Concepts Using Low-Cost Test Equipment and LabVIEW[™]

As the number of transistors on an integrated circuit continues to grow, both analog and digital electronic systems are being built on a single chip. As the complexity of these chips increases, a firm grasp of mixed-signal test concepts is essential for the successful entry-level test or product engineer. This paper discusses a set of laboratory experiments being developed at Texas A&M University that introduces these concepts to students prior to graduation. The curriculum emphasizes the use of standard electronics bench equipment combined with additional low-cost personal computer technology to ensure that all interested academic institutions can afford to offer these labs. To demonstrate the type of experiments discussed, an example of one of the labs and its implementation using LabVIEW is also presented.

Jim Sibigroth and Eduardo Montañez 84–93 Motor Control Demonstration Lab

This paper presents an example laboratory exercise using a microcontroller to control a motor. NI ELVIS is used as a convenient platform to connect components, provide power, and analyze circuit operation. A small MCU module with required basic circuitry for crystal, serial I/O, and debugger connections is provided as a small module that plugs into the NI ELVIS breadboard. MCU program development and debug are done with Metrowerks CodeWarrior[™] software running on the same host PC as the NI ELVIS and LabVIEW[™] software.

Zhou Yi, Jiang Jian-Jun and Fan Shao-Chun 94–102 A LabVIEW-Based, Interactive Virtual Laboratory for Electronic Engineering Education

Virtual laboratories extend the application area of virtual instrumentation to the web, which leads to an openly integrated environment for sharing teaching and learning materials and hardware and software resources. An interactive Virtual Laboratory for Electronic Engineering Education (VLE) was implemented based on LabVIEW and other engineering education software such as MATLAB Simulink, MS Office and SQL Server. It consists of two sections: virtual simulation and real-time measurement. The system architecture, hardware configuration and system implementation are presented. Compared with existing virtual laboratories, VLE provides significant advantages and improvements in development efficiency, system expandability, flexibility for working independently, and multithreading safety.

Part II

Richard M. Felder and Joni Spurlin 103–112 Applications, Reliability and Validity of the Index of Learning Styles

The Index of Learning Styles[®] (ILS) is an instrument designed to assess preferences on the four dimensions of the Felder-Silverman learning style model. The Web-based version of the ILS is taken hundreds of thousands of times per year and has been used in a number of published studies, some of which include data reflecting on the reliability and validity of the instrument. This paper seeks to provide the first comprehensive examination of the ILS, including answers to several questions: (1) What are the dimensions and underlying assumptions of the model upon which the ILS is based? (2) How should the ILS be used and what misuses should be avoided? (3) What research studies have been conducted using the ILS and what conclusions regarding its reliability and validity may be inferred from the data?

D. M. O'Doherty 113–120 Working as Part of a Balanced Team

The importance of teamwork within undergraduate engineering degree schemes has been recognised for a number of years. However, the establishment of such teams has traditionally been based on a stochastic method or the whim of the academic supervisor. This study was therefore undertaken to determine whether the selection of teams based on the Belbin technique would result in 'better' teams. Overall the results obtained support the use of this technique in defining the teams, although great care has to be taken in ensuring their potential is met.

Johan Bankel, Karl-Fredrik Berggren, Madelaine Engström, Ingela Wiklund, Edward F. Crawley, Diane Soderholm, Khalid El Gaida and Sören Östlund 121–133 Benchmarking Engineering Curricula with the CDIO Syllabus

Four internationally-renowned universities—Chalmers University of Technology, Linköping University, Royal Institute of Technology (Sweden), and the Massachusetts Institute of Technology (USA)—developed a benchmark survey that may be used by any engineering school to benchmark curricula for teaching of personal, interpersonal and system building skills. These skills are enumerated in the CDIO Syllabus. Teaching activities were categorized as Introduce, Teach or Utilize, based on intent, time spent, and linkage to learning objectives, assignments and assessment criteria. Interviews were used to collect the data from instructors of the schools' engineering programs. The data was then reduced and analyzed to illuminate patterns of teaching. The results indicate that much effort is expended in covering these topics, but often in an inefficient, uncoordinated and unplanned manner. For example, there are often

frequent repetitions of introducing a topic, without ever teaching it. In other instances, students are expected to utilize knowledge without having been taught it. The results of the benchmark survey indicate that a consistent and deliberately designed curriculum in this area could demand no additional resources, yet provide a much more effective education. The survey gives useful indications of how to begin such a curriculum redesign process.

Jeff Jawitz, Jennifer Case and Nazeema Ahmed 134–138 Smile Nicely, Make The Tea—But Will I Ever Be Taken Seriously? Engineering Students' Experiences of Vacation Work

This study investigates the vacation work experiences of a group of final-year civil and chemical engineering students at the University of Cape Town in South Africa. Situated cognition theory, with its conceptualization of learning as induction into a community of practice through the activity of legitimate peripheral participation, was used to analyze focus group and interview data. Issues of race and gender appeared prominently and spontaneously in students' accounts of their experiences. Access to legitimate peripheral participation was associated with positive identity formation in the role of engineer-to-be, while denial of this access severely affected learning and feelings of self-worth.

Edward J. Coyle, Leah H. Jamieson and William C. Oakes 139–150 EPICS: Engineering Projects in Community Service

Engineering Projects in Community Service, EPICS, is an engineering design program that operates in a service-learning context. EPICS students earn academic credit for their participation in design teams that solve technology-based problems for not-for-profit organizations in the local community. The teams are: multidisciplinary—drawing students from across engineering and around the university; vertically-integrated—maintaining a mix of freshman through seniors each semester; and long-term—each student participates in a project for up to seven semesters. The continuity, technical depth, and disciplinary breadth of these teams enable delivery of projects of significant benefit to the community.

Sandra Ingram 151–157 Making the Transition from Engineering Student to Practicing Professional: A Profile of Two Women

This paper presents follow-up interviews conducted with two women engineers who took part in a qualitative study by the author on gender and collaboration in an engineering classroom six years earlier. The women compare their student experiences with their emerging professional lives to highlight the barriers they have overcome as well as the obstacles remaining in this traditionally male-dominated profession. Pedagogical implications are drawn and the value of incorporating engineering work experience into the curriculum for women students in particular, is highlighted.

Abir Ziyad Qamhiyah 158–165 Internationalization of the Undergraduate Engineering Program, Part 1: The Need

The goal of this paper is to present the evidence for the need for international experience in engineering education. Data on engineering education and the practice of the engineering profession was compiled from multiple sources such as the United Nations Conference on Trade and Development World Investment Reports, the Institute of International Education's Open Doors Reports, and The National Information Center for Higher Education Policymaking and Analysis statistics. Analysis was then performed to present the magnitude of the challenge facing the engineering educational institutions in the United States in their attempt to prepare their undergraduate students for successful careers.

Nasir Bilal, Harold R. Kess and Douglas E. Adams 166–177 Reversing the Roles of Experiment and Theory in a Roving Laboratory for Undergraduate Students in Mechanical Vibrations

Product manufacturers are carrying out far fewer, more deliberate experiments than ever before to cut costs and compete in the marketplace; however, many undergraduate engineering students enter the workforce with the false perception that 'experiments are just data-taking.' The roving laboratory discussed here can be set up wherever interesting test specimens are found and aims: to give students more control of the learning process through inquiry-based, collaborative teaching; to provide a better introductory education in vibrations and experimental mechanics; to promote lifelong self-learning and an appreciation of experimentation; and to strengthen the link between industry and academia. By reversing the roles of theory and experiment, the new course lab and lecture empower students to discover theories on their own. Comparisons between formative and summative surveys indicate that: student perceptions of experimental practices changed as a result of the course; students were more engaged than in traditional laboratory courses; and students felt more prepared to enter the workforce. Other assessment results are also discussed.

M. D. Hurley, W. L. Xu and Glen Bright 178–186 Implementing Fuzzy Logic for Machine Intelligence: A Case Study

Intelligent machines are machines with microcontroller(s), actuators and sensors embedded and of reprogrammable intelligence. The Mechatronics course at Massey University, New Zealand, teaches students how to design intelligent machines in an integrated manner. The success of the teaching/learning would be achieved in a way that the students are able to apply what they have learnt from various courses to the design of an intelligent machine. To this end, each student is required to do a design project. This paper presents a sample project that deals with real-time implementation of fuzzy logic for machine intelligence on microcomputer. The objectives identified for the project were to modify Rug-Warrior Pro, an autonomous mobile robot platform, to have a long-ranging capability and to implement obstacle avoidance in an unmapped and changing environment as the machine intelligence. The hardware interfacing and software drivers of the sensors are given, and the techniques for coding the membership functions and defuzzification operation of fuzzy logic are discussed. The machine behaviours are formulated by an If-Then rule base that mimics human heuristic, and the resultant program offers an excellent alternative to more common vector-based navigation methods with a fraction of the processing requirements resulting in a fast-responding, reliable application.