Volume 20 Number 1 2004 ISSN 0949-149X

The International Journal of Engineering Education

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Part 1

Isotopic Engineering (IE) refers to use of the diversity of stable isotopes of chemical elements for a range of technological applications, including such areas as microelectronics, optoelectronics and quantum informatics. In a more extended version, it also includes technological applications of radioactive isotopes. The author argues that the incorporation of IE in university courses on electronics, informatics and general engineering provides a convenient and unifying tool for introductory exposure of students to a broad range of novel scientific and engineering concepts and ideas. Among them are quantum well structures and superlattices, random number generators, quantum computing, as well as ideas of chaos theory and nanoscale information storage. While most of these topics are scientifically quite involved and educationally challenging, their presentation in the context of isotopic examples allows for some reduction of the 'threshold of difficulty' for a typical engineering student. For the in-depth understanding of most of these topics the educational background requires only a base knowledge at the level of introductory courses in physics, chemistry and mathematics.

Many recent web-based teaching and learning environments that involve the use of fixed sets of problems are unable to accurately measure a student's understanding about the subject matter. Such systems do not contribute significantly to the learning process. A good pedagogical framework is needed to develop effective web-based teaching and learning systems. This paper presents just such an effective system, which is designed for a specific engineering subject, Digital Logic Systems Design. Our system is called Web-based Intelligent Learning Environment for Digital System or WILEDS. WILEDS has been built on a robust framework of intelligent tutoring systems realised on a three-tier Java client-server architecture. It comprises five components: a communications module, a pedagogical module, a student model, an expert model and the domain knowledge. WILEDS incorporates the entire process needed to assess students, starting from automatically generating problems to checking the students' solutions and keeping track of their progress.

Data acquisition (DAQ) systems play an increasingly important role in science and technology school laboratory practice at all levels of education. Laboratory exercises employing DAQ systems supported by a variety of sensors and actuators have brought modern electronics to science and technology teaching. As a key device in microcomputer-based laboratories (MBL), a DAQ system needs to fulfil some specific requirements in order to be used successfully in an educational environment. Deriving from more then ten years of experience in MBL development, we promoted an EU project, one of the final products of which is a USB-based multifunction DAQ system designed for educational laboratory use. The architecture, characteristics and features of that system are presented in this paper.

This paper describes a semi-distance learning method applied to a technical degree which requires a significant amount of laboratory work. Their aim is to achieve for students that combine professional activities with scholarship a similar level of theoretical and experimental training to full-time students while reducing their physical presence at the university. Another objective is to reach a success rate for this kind of student comparable to the rate obtained by other full-time students. The methodology for this academic project is described, as well as their implementation in several subjects. The whole experience is evaluated and compared with the traditional organisation.

This paper presents a practical, economical, and useful way of enhancing an existing real-time digital signal processing (DSP) learning kit, the Texas Instruments TMS320C3x DSK, towards the development of adaptive signal processing (ADSP) algorithms. Many DSP educators use this kit to provide a basic platform for learning the real-time implementation of DSP algorithms. The kit includes an assembler and a debugger for software development. In its original configuration, the kit can be connected to just one signal source and provides a single analog output, which is sufficient for the prototype implementation of basic DSP algorithms. In the last few years, however, the sub-field of adaptive digital signal processing has become increasingly important in scientific and industrial applications. As such, real-time implementation of these algorithms, which typically require more than one independent input and output, is highly desirable. This paper outlines how to develop such a training platform by enhancing the popular TMS320C3x DSK with a stereo input/output module, and provides a software template and an example to aid in the software development for this enhanced training platform.

The paper introduces an innovative approach for teaching design with logic control. The proposed approach is based on: (a) a representation of the controlled system in a form of its control and operational interacting portions; (b) atomic requirement (ATR) specifications of the system. The ATR-based approach can be supported by a formal notation of transition formulae. Each of the ATRs corresponds to its specific formula. ATRs with the algebra of transition formulae can be considered as a theoretical basis in teaching logic control. While ATRs have been successfully used in large, commercial software development projects, they have never been applied to logic control teaching. In this paper we propose using ATRs for specifying logic control. This paper exposes specific

properties of ATRs. Owing to these properties, the ATRs will guide students to partition specifications between control and operation, and to correctly identify control signals. As a direct result, students will apply information hiding between the control unit and the operational components.

Microcontrollers and field programmable gate arrays (FPGAs) both are widely used in digital system design. Microcontroller-based instruments are becoming increasingly widespread. On one hand, their high speed, power and falling prices make them an obvious choice. On the other hand, the fast growing popularity of FPGAs, the availability of powerful development tools, and the increase in speed and high density have made FPGA-based systems an alternative choice. Due to the importance of both technologies to undergraduate students, this paper discusses the importance of both technologies and presents the experience in teaching both. The design, implementation and testing of a typical project completed, based on both a microcontroller and a FPGA is presented. Students' reactions, encountered problems and skills gained are also reported.

VFSS is an example of a mechatronics system which involves data acquisition and analysis using LabVIEW-based virtual instrument technology. This system can serve as teaching equipment for mechatronics students in the area of data acquisition, sensors and actuators, signal processing and vibration monitoring to aid students' understanding on these subjects. Since vibration fault signals and their causes are important for fault detection and diagnosis, a vibration faults simulation system is developed to gain good understanding of such signals. To achieve this a vibration faults simulation rig (VFSR) is designed and developed to simulate and study most common vibration fault signatures encountered in rotating machines. A LabVIEW-based data acquisition system is used to acquire and analyze the fault signals. The complete system has been developed and tested and the fault signals were compared with normal signals so as to ascertain the condition of the machine under investigation. VFSS has been successfully used to demonstrate some vital concepts in the teaching of DSP, sensor and actuators and mechanical vibration since data are acquired from the physical system and are analyzed to derive information on the system under investigation. This approach further allows students to gain insight into effects of noise on measurements and how such effects can be combated.

Finite difference is a method of choice for educators to demonstrate and compute potential field of two-dimensional geometries, such as integrated circuit planar resistors. It is simple and can be readily programmed by undergraduate students. It is also very accurate and its accuracy can be easily controlled by changing the grid size. Finite difference method (FDM), however, has two serious limitations. One, it can not be easily applied to unbounded regions such as integrated circuit (IC) microstrip lines. And two, the FDM computes potentials at predetermined grid points only. Unlike the finite element method (FEM), it does not generate potential functions that can be used to interpolate for potentials at the points that are not located at the grid, or to use these functions in determining other quantities based upon the computed potential such as the field intensity. This paper describes a hybrid method based upon conformal transformations, including the Schwarz-Christoffel (S-C) transformation (without having to compute the transformation functions) to map the original boundaries, including those at infinity, to a bounded region and only then applies a numerical method based on finite differences. This paper also describes a method that is a combination of the FDM and the FEM to generate the potential functions after the FDM has been applied. The combined method retains the simplicity and accuracy of the FDM. Yet it, like the FEM, provides potential functions that can be used for interpolation as well as post-processing of potential. Testing theses approaches by means of an example for which exact solution is obtainable, the hybrid method and the combination of the FDM-FEM are applied to determine the electrical potential at a specific point in the field of an IC microstrip line. In both cases the results are in agreement with analytically derived results. The approach we have developed is simple, readily applied by undergraduate students, yet accurate and thus of use in professional engineering work.

Preparing for ABET accreditation involved a set of changes in various aspects of the Electrical and Electronic Engineering program at Eastern Mediterranean University. Curriculum redesign was the most difficult component of the efforts. The curricular content was modified with more emphasis on design and practice, more humanities and social sciences; ethics courses were introduced as important components of a global profession. Many procedures were standardized to make the process of evaluation more transparent. A web site was designed to make students' academic status available to parents. Students' performance, before and after graduation, became a subject of concern and statistical methods were developed to monitor the outcome. In general, the preparation for ABET accreditation led to reorganization to improve service to students. The process of preparation has already induced a positive effect in the student body.

Through the years, electronics engineering has been undergoing changes in a variety of aspects. An analysis of these changes is carried out, relating separately to five dimensions: (1) availability of information; (2) scope of knowledge; (3) engineering entity; (4) information handling; (5) human-machine interface. Implications of these changes on electronics education curricula are presented. The transfer of a classic Electronics Engineering Technology BS program into an Information Technology BS program (integrating electronics hardware with software) is described and its implementation issues are discussed. This illustrates the issue of dealing with change. The new programs reflect similar foundations of math and science as to conventional programs but moves students and institution in directions reflected by trends in industry.

Part 2

Engineering Education Research and Policy

This paper describes the experiences of introducing ISO 9000 into Taiwan's higher education systems. Based on an empirical investigation and a case study, the authors argue that the implementation of ISO 9000 quality systems has a positive impact on the education quality. The benefits of ISO 9000 certification are further depicted for those interested in complying with the Standard. We also justify the current progress of the ISO 9000 implementation in Taiwan with recommendations for improvement.

The need to design structures for ever harsher environments, to greater heights and spans, with greater controllability and durability, and of greater economy and safety, calls for creative solutions by today's structural engineers. This paper examines the issue of fostering structural engineering creativity in students, which does not appear to have been discussed in the open literature. The paper

begins with a brief discussion of creativity followed by an analysis of the design process as a creative process. This analysis identifies the deficiencies in the current approach of teaching structural analysis which emphasises the mastery of skills for quantitative analysis but neglects the development of structural insight and an ability for divergent thinking. A number of measures which may be able to rectify these deficiencies are then discussed. These include the imparting of qualitative-analysis skills in students, the use of structural paradoxes to develop problem-solving skills, and a stronger emphasis in teaching on links between structural forms and functional attributes and between different structural forms.

Engineering Mechanics

A semester-long team design project was implemented in an advanced mechanics of materials course for both undergraduate and graduate students. The project involved the mechanics of a bicycle crank arm and built on earlier coursework. Student teams developed specifications and design criteria, performed analysis and design, developed validation experiments, compared experimental results with predictions, and reviewed finite element model predictions from students in a different course. Students completed an anonymous survey at the end of the project, which indicated that learning experiences obtained from the project were valued as much as listening to lectures and working homework problems. The survey results also indicate that undergraduate and graduate students have different attitudes about learning methods; with graduate students valuing a much wider range of learning methods.

Environmental Engineering

The need to introduce green engineering concepts to undergraduate students has become recognized to be increasingly important by industry and the general populace. Green engineering can be considered as the way engineering should be done, in that it results in products and processes that have a reduced risk of harm to both the environment and to humans. The use of green engineering practices is a method to reach sustainable development. In many engineering disciplines, aspects of environmental engineering are only taught in an optional senior year course. By placing this subject at the end of their university preparation, this tends to leave an impression with students that environmental concepts are added on after the engineering work is completed. Since one of the precepts of green engineering is that it should be conducted at all levels of engineering practice and design, we believe that it should be taught at all levels. Instead of having only an optional course in environmental or green engineering, we believe that it is more appropriate to integrate green engineering concepts in a range of courses within an engineering discipline. In 1998 the US Environmental Protection Agency initiated a program in green engineering to develop a text book on green engineering, to disseminate these materials and assist university faculties in using these materials through national and regional workshops. This program has developed teaching aides that include: presentation graphics, lecture notes, example problems, homework problems, case studies and experiments. These tools have been tailored to fit specific engineering classes, such as freshmen and sophomore engineering, mass and energy balances, separations, reaction engineering, process design. Using green engineering principles at the start of the design process can lead to processes and products of a sustainable future.

Civil and Construction Engineering

For educators at university level, acquiring new information to prepare and design creative courses is a key to ensure the attractiveness and effectiveness of academic programmes. Nevertheless, educators are also expected to participate in value-added training such as education conferences, workshops, language and interpersonal skills seminars, and other continuing professional development-related activities. Furthermore, much time is also needed for research and administrative works. As such, less time is now available for discussion with students and out-classroom interactions. Indeed, effective learning requires active participation, peer supports and interactions. The diminishing traditional face-to-face interactions make it less contributive towards the provision of an active learning environment. This deficiency can be improved by using Web-based teaching/learning. This paper presents a Web-based learning package, called the Construction Contracts Information Service (CCIS), for the teaching of construction contracts for Construction Engineering students. The design and contents of the website was based on Mishra's on-line course framework which has been successful applied in Post-Graduate management courses. The three key elements of the on-line course framework are Active Participation, Support, and Course Content. The Web-based learning package contains four learning ingredients: Hong Kong Standard Forms of Construction Contract, Construction Cases, Common Contractual Problems, and Reference Standard Documents. The World Wide Web provides the learning platform. Active participation is achieved through e-mail and on-line discussion forum. The design and uses of the CCIS are described in the paper. Although the contents of CCIS focus mainly on the Hong Kong Construction Engineering studies, the design concept and the tools used can be applied without geographical and disciplinary barriers.