PREFACE

Advances in communication technologies and interest by nations to upgrade their engineering education programs have helped to fuel the recent upturn in emphasis on international cooperation. Other factors include increasing trans-national parity for international cooperation created by heightened investments in science and engineering by many countries, and by the greater number of international students returning to their homelands to help build the national economies.

The purpose of this book is to chronicle the recent progress made by the global engineering education community. Papers selected for inclusion are based on abstracts submitted for the International Conference on Engineering Education held in 2001 in Oslo, Norway (ICEE-2001), augmented by additional invited papers.

Authors of 42 ICEE-2002 papers were invited to submit updated manuscripts for consideration for possible publication. Two additional invited papers supplemented these papers. All forty-four papers were subjected to a rigorous peer review process. Based on these reviews, nineteen papers were selected for publication in the present volume.

The countries of origin of the first authors of the papers are as follows: USA (6 papers); United Kingdom (4); Norway (2); Canada (2); Germany (1); Denmark (1); Singapore (1); Slovenia (1); Spain (1).

Authors in this volume include **Saul Fenster**, who writes about engineering education from twenty-four years of experience as the head of a major research university. Though speaking from an American perspective, his views are clearly universal. Pointing to the importance of the U.S. engineering education system to America's economic leadership, he argues that future progress will depend on a significant broadening of the "box," for both students and faculty. For students, he says, there is a need to engage in experiential learning outside of the classroom. For faculty, he suggests engagement with the K-12 pipeline to help young people develop a better appreciation of science- and mathematics-based professions.

Ernest Smerdon notes that engineering educators mostly attempt to make progress by finding solutions in a piecemeal fashion. He advocates falling back on the traditional strengths of the engineering method, using it to break down problems facing engineering education to its fundamental elements – and seeing how we might improve the process in each.

Jeff Froyd, a mathematician-cum-engineer, emphasizes the learning triangle built around faculty expectations from students; understanding the way students learn; and facilitating learning by students. He sees the benefit from a tighter connection between learning and teaching, just as a tighter connection between engineering and science has yielded benefit for engineering.

Tracing the recent up-and-down cycle in international cooperation in engineering education, **Win Aung** notes an apparent upturn taking place, driven by information technology and the interest on the part of nations in education reform, in Europe motivated in no small degree by the Bologna Declaration. He emphasizes the importance of international cooperation in producing the next generation of internationally sensitized and mobile engineers for the global economy. As an example of the recent increased emphasis on international cooperation, he describes the emergence and programs of iNEER, the International Network for Engineering Education and Research.

Several papers in this volume deal with advances in specific engineering disciplines. From Slovenia, **Hercog** reports on his experience in animations of electromagnetic wave propagation phenomena using MathCAD. He advocates the presentation of wave phenomena starting in time domain instead of frequency domain, showing several examples. **Macho-Stadler et al.** of Spain describe multimedia teaching tools for acoustics, focusing on basic principles, and on acoustics as applied to music, architecture, electroacoustics, noise, and physiology. They recommend a methodology based on classroom participation by and tutorials for students, combined with individual work outside of the classroom.

Several innovations concern web-based teaching and learning. **Tuttas and Wagner**, of the University of Hannover in Germany, describe the implementation and evaluation of a joint Hannover-Stanford distance learning experiment in process control for electrical engineering students. The education concept, online laboratory, experiment and evaluation approach, methods, and results are described. Their results show that distance-learning experiments can lead to the same learning results as physical laboratory experiments.

Two papers deal with new technological tools for distance operation of laboratory experiments through the Internet. From the Tele-Universite in Montreal, Canada, **Saliah-Hassane et al.** provide an overview of the design of an adaptable laboratory instrument measurement interface that allows geographically dispersed team members to collaborate and cooperate in carrying out laboratory tasks. In a related paper, **Saad et al.** of the Ecole de Technologie Superieure, also in Montreal, describe a synchronous remote access control laboratory. They present the laboratory architecture, and position and industrial process level control applications.

Exploiting the opportunities provided by the Internet for disseminating education materials to students in both local and distance education, **Fjeldy et al.** of the Norwegian University of Science and Technology report the creation of an efficient environment for interactive, on-line operation of laboratory experiments. They employed the LabVIEW 6i software, dedicating the current version of the laboratory to semiconductor device characterization. They state that these laboratory courses can be offered inexpensively to students worldwide.

Fink of Aalborg University in Denmark, on the other hand, examines the issue of work-based continuing professional development (CPD) for engineers. He notes the strong similarity between CPD and problem-based learning (PBL) in full-time education programs, and suggests the adaptation of the latter for CPD.

Reflecting the recent trend in which the international engineering education community is increasingly interested in the effectiveness of learning and teaching**, Sorby and Hamlin** examine student performance at Michigan Technological University prior to and immediately after implementation of a revamped first-year engineering program, in which mathematics, science and engineering courses are integrated and active collaborative learning (ACL) is emphasized. Cohort scheduling, a term assigned by the authors to ACL, and changes instituted in mathematics courses, are found to have a positive impact on student performance in calculus.

Also helping to improve performance and retention is the introduction of student "induction" sessions to help provide students with survival skills and identify with the engineering profession as they begin their engineering studies, as described by **Edward and Middleton** from the Robert Gordon University in Aberdeen, United Kingdom.

Other studies related to the assessment of teaching and learning include the one by **Royrvik and Hornaes** concerning a computer algebra system that is being implemented in Norwegian engineering colleges; and the study by **Alexander et al.** at the University of Ulster in Northern Ireland, United Kingdom, who find that the use of online assessment methods, adopted to cope with large classes, is an acceptable means of assessment as compared to the usual manual process.

In a thought-provoking thesis, **Khambadkone** deals with the use of criterion-based continuous assessment of student learning, with criteria derived from engineering functions. A case study on the method shows that the timing and type of assessment can be used to enhance learning patterns, but he cautions that too many tests can undermine the purpose of continuous assessment.

Writing from the University of York, in the United Kingdom, **Benest** argues that to have an impact, assessment of computer-based lecture modules must be carried out before they are used. He presents a method of measuring objectively many of the published characteristics for good lecturing, and offers predictive models for determining the quality of lectures and difficulty of contents, outlining approaches for improving the models' accuracy.

The need for the mobility of engineers around the world has led to an increasing concern about international accreditation and mutual recognition of engineering programs. **Sarin** of North Carolina A&T State University describes a model based on the organizational structure for the ISO-9000 global quality assurance standard. **Dodridge and Kassinopoulos**, respectively from the United Kingdom and Cyprus, describe the collaboration between their respective institutions that led to the formulation of a common set of generic program learning outcomes, and subsequent mapping of these into program modules.

In closing we thank all the authors for their contributions and for their patience in working with us during manuscript review and revision. In editing this volume, we have paid special attention to the writing style of the authors(s) of each chapter, including the usage of English, and have tried to preserve the original style as long as the meaning is clear.

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