

Guest Editorial

THE MID-1980s marked the beginnings of the Calculus Reform Movement. The Mathematical Association of America (MAA), National Science Foundation (NSF), National Academy of Science, National Academy of Engineering, and American Society of Engineering Education (ASEE) are just some of the many key organizations that have been involved in the ensuing university mathematics-related education reforms in the US. The European Society for Engineering Education (SEFI) Mathematics Working Group has had a similar involvement in Europe. The Calculus Reform Movement has spawned major curriculum changes in engineering, for example, see R. W. Soutas-Little and D. J. Inman, 'Calculus reform to mechanics reform', *IJEE*, **13**, (6), (1997) pp.442–447. The Calculus Reform Movement, developments in computers and technology, and the rapidly changing engineering workplace are just some of the driving forces that are redefining the mathematics/engineering education scene worldwide. It is in this setting that the contributors to this special issue present their views.

This special issue of the *International Journal of Engineering Education* focuses on the mathematics education of engineers. The papers included reflect just some of the many multifaceted issues that confront engineering educators. Space does not permit a comprehensive study. Thus, the papers presented in this issue represent a survey of some of the related contemporary pedagogical and technical issues.

The papers by Small; Allen, Herod, Holmes, Ervin, Lopez, Marlin, Meade and Sanchez; Sazhin; Taylor and Morgan, deal with pedagogical issues. Small gives an overview of some of the forces that are changing the engineering mathematics curriculum, shortcomings of the present curriculum, and suggestions for the future. Don Small is a leader in the Calculus Reform Movement and has organized over 100 NSF-supported workshops on the use of computer algebra systems and on calculus reform. Allen *et al.* provide a general overview of the use of computer algebra systems (CAS) in mathematics and engineering classrooms, results from a workshop sponsored by the NSF. Sazhin compares two assessment techniques for determining student understanding of the mathematics content of engineering and science subjects. Taylor and Morgan address the difficulties that many engineering students have in performing appropriate mathematics and report on an intervention strategy designed to address these difficulties.

Askarpour and Owens; Mustoe and Croft; Meade and Struthers; Marchand and McDevitt;

Maixner; Murphy, Goodman and White; Pleym, present technical issues. Askarpour and Owens derive rules that enable all possible distinct similarity transformations leading to the same Jordan form to be calculated, a result useful especially to controls engineers. Mustoe and Croft emphasize the importance of motivating engineering students with actual case studies of real-life engineering problems. Leslie Mustoe is the Chair of the SEFI Mathematics Working Group and has published extensively in the area of engineering mathematics education. These case studies are used to present and integrate mathematics applications in applied engineering contexts.

The papers by Meade and Struthers; Maixner; Marchand and McDevitt, demonstrate this idea of using case studies. Meade and Struthers introduce a specific case study, that of the kinematics of skydiving, as a means of integrating modeling and use of CAS technology (*Maple*) into the subject of engineering ordinary differential equations (ODEs). Maixner illustrates interdisciplinary applications of *Mathcad* in his course, 'Numerical and Computer Methods for Engineering Design', offered at the Maine Maritime Academy. Marchand and McDevitt exploit the versatility of the CAS, *Mathematica*, in order to illustrate the mathematics of ODEs and the usefulness of CAS in calculation and animation. The paper by Murphy, Goodman and White includes use of the Web for disseminating information (specifically for teaching) and the use of technology (*Mathematica*) as a visualization aid, especially helpful in multivariable calculus. Pleym's paper demonstrates uses of *Maple* in calculating and animating the responses of free and forced vibration systems. Additionally, Pleym's animations appear at the Journal's website (<http://www.ijee.dit.ie>).

One of the goals of this special issue is to help keep avenues of communication open between the partner disciplines of mathematics and engineering. It is hoped that the readers of the Journal find this special issue stimulating, enjoyable, and beneficial with respect to their own contributions to the mathematics education of the engineers of tomorrow.

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