Editorial

There is certainly nothing new about the creation of sophisticated devices, modules and systems by subtly blending highly diverse and yet complementary technologies, but rarely does such a fusion have such a profound revolutionary effect on the way we teach as the one now known as 'mechatronics'. Mechatronics, the theme of this *IJEEE* special issue, encapsulates one of the most important technological marriages made in the last fifty years, joining solid state electronics and software to the already established union of electromechanical systems. Despite the connotative similarity, mechatronics has served to fill the interdisciplinary chasm that has developed between the traditional electrical engineering and mechanical engineering academic disciplines to a level not hitherto achieved by electromechanical engineering alone. At the heart of this revolution, the advent of embedded microcomputer systems has allowed sensors, actuators and mechanical components to be seamlessly joined through real-time software, allowing the formation of products having unprecedented levels of performance, functionality, flexibility and reconfigurability, all at phenomenally low relative cost.

The current *IJEEE* issue focuses on a fairly diverse cross-section of mechatronics, with several recurring themes throughout, which are now discussed.

Next to analysis and specification, the issue of system verification is possibly one of the most important aspects of design and manufacture. There is, after all, no point in specifying a super-deluxe 'gizmo' if it is impossible to prove all features specified. As devices and systems become increasingly more complex, then so does the challenge of verification through analysis, simulation and test. Over the years, many ingenious techniques have been developed in order to facilitate verification; however, there still remains the challenge of how people can be trained in the methods and practical use of such vital skills.

The possibility of the inclusion of sophisticated dynamic control systems within mechatronic systems has allowed a complete break from traditional design approaches where components would have been designed for individual dynamic stability where possible. In the case of a mechatronic system however, only the stability and performance of the complete system is of concern, i.e. the mechanical system with the control system combined. This has brought great freedom to the designer, allowing hitherto unprecedented benefits in improved dynamic performance, energy efficiency and reduced overall hardware cost. A good example of this is the common desk-top printer, which now contains incredibly little in the way of mechanical hardware and yet easily outperforms older mechanically oriented printers.

These benefits do not, however, come without associated difficulties, and engineers must now have a wider knowledge and actual decision input into all aspects of a design. For example: 'Can a less rigid lever be employed while maintaining performance by changing the software?' Mechatronic engineers must therefore be trained in a range of skills, including multiple domain dynamic system modelling, control algorithm design and control parameter tuning. Training in each of these skill areas may generally be enhanced by the use of graphical or visual methods, which allow the student to gain an intuitive feel for model and system structures and operating surfaces.

It is all very well training students using software simulation packages and techniques based on hypothetical systems, however, at some point the student must enter the real world and be given the opportunity to learn the practical benefits, problems and limitations. A combination of real project case studies and set project problem-solving work can provide such invaluable experience while also providing potential sources for great inspiration and fun.

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