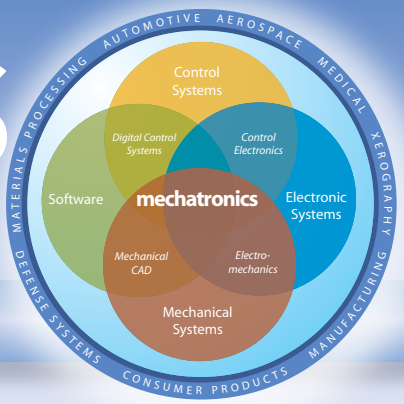
MECHATRONICS IN DESIGN

FRESH IDEAS ON INTEGRATING MECHANICAL SYSTEMS, ELECTRONICS, CONTROL SYSTEMS AND SOFTWARE IN DESIGN



Dumbing down the Engineer

BY KEVIN CRAIG

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Over the past four columns, I have talked about modeling and analysis techniques for multidisciplinary systems: block diagrams, linear graphs and bond graphs. I had planned in this column to compare these approaches and discuss their appropriate use in mechatronic design. But instead, let me put that off to deal with an urgent issue that affects the very basis of this column: a disturbing trend toward "dumbing down" what engineers need to know.

Over the past several months, through my work at the university, with companies and at conferences, I detected confusion over expectations for the 21st century engineer. Is the modern engineer a Tool User or a Tool Master? Are there two types of engineers — those who model and those who don't? These questions go right to the importance of modeling, and hence science and mathematics, in the practice of engineering.

I believe there are two compelling questions facing the engineering profession: How can engineering educators best transform students to become engineers prepared to solve mankind's problems in the 21st century? And how can a company transform itself to successfully design multidisciplinary engineering systems? Much is at stake here, because successful multidisciplinary engineering not only triggers innovation but it also meets the key requirements of modern-day design: performance, reliability, low cost, robustness and sustainability.

One of the great failures in engineering education has been the inability of graduating students to integrate all they have learned — science, mathematics, engineering fundamentals — in the solution of real-world engineering problems. The cartoon on this page highlights this dilemma. We give students tools for their engineering toolbox — knowledge, hardware, software — but fail to teach them how to integrate and master these tools to solve an engineering problem. This shortcoming is exacerbated in industry as practicing engineers are pressured to deliver hardware quickly and cheaply. Result: They fall back on trial-and-error design.

It may initially take longer to solve an engineering problem by using science and mathematics in the modeling process. However, it has been shown over and over again that the gains in understanding and cost control are overwhelmingly worth the initial investment in time. Unfortunately, there are too few engineers capable of making this investment. Being able to just operate a tool, such as inputting data to a computer program and getting some results, is woefully inadequate. Engineers need to master the tools of their trade. They need to know what tool to use for a particular situation, the role it will play in the entire design process and the meaning of the results obtained from use of the tool. In other words, the process demands a true engineer.

But I have even recently heard speakers at engineering conferences, as well as industry managers, belittle the mathematics and science that forms the basis of engineering practice. Is there a crisis in engineering? Yes. Is engineering being dumbed down in universities and in industry? Yes. It's a crisis that must be addressed.

As they take on the challenge of designing multidisciplinary systems, engineers can call on a tremendous library of modeling tools — MATLAB, LabVIEW, 20-Sim and more. In the hands of the right person, all these tools hold enormous potential to aid in the design, prototyping and deployment of mechatronics-based products. And the right person is the engineer well grounded in all aspects of the problem-solving process, especially the fundamentals of physical and mathematical modeling.

Engineering educators, together with engineering industry leaders, must ensure the engineering problem-solving process, in its entirety, receives the emphasis it deserves. Which type of engineer are you, a Tool User or a Tool Master?

Mechatronics demands a multidisciplinary approach to engineering systems and multidisciplinary engineering systems have as integral parts electronics, computers and controls. These are enabling, and often hidden, technologies that foster innovation. Performance, reliability, low cost and robustness are absolutely essential in any modern design. Add to this the goal of sustainability — the ability of the present generation to meet its needs without compromising the ability of future generations to meet their needs.

Move from Tool User to Tool Master.
Learn the Fundamentals at the Mechatronics Zone:
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