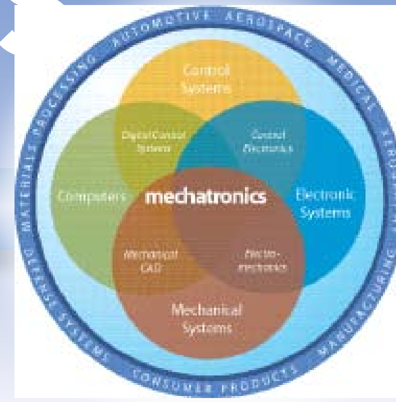
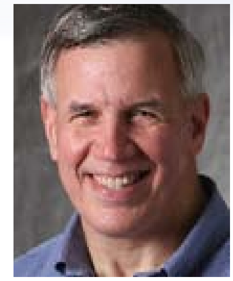
MECHATRONICS IN DESIGN

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



Get Your Passport to 21st Century Design

BY KEVIN CRAIG

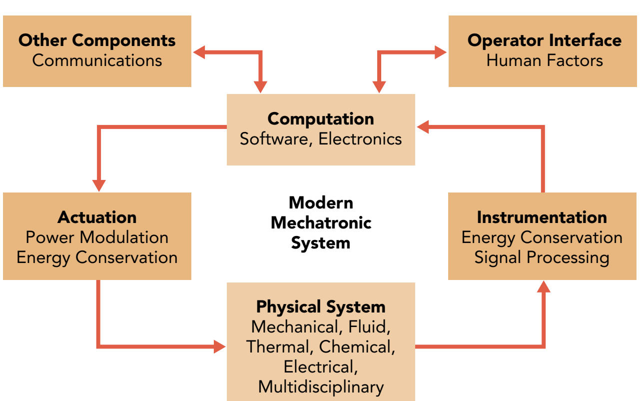


Kevin Craig, Ph.D. is a professor of mechanical engineering at Rensselaer Polytechnic Institute in Troy, NY. Check out his blog at www.designnews.com/mechatronics

How can today's engineers be successful when faced with the tough job of integrating electronics, computers and control systems in design? Add to that challenge the ongoing demands for high performance, reliability, low cost and robustness. The answer is learning to master the essentials of mechatronics, which is fast becoming the 21st century approach to engineering design for an increasingly wide range of products.

At its core, mechatronics is the synergistic integration of physical systems, electronics, controls and computers throughout the entire design process. Integration is the key, since complexity has been transferred from the mechanical domain to the electronic and computer software domains. Mechatronics also demands horizontal integration among the various engineering disciplines, as well as vertical integration between design and manufacturing.

The diagram below shows a modern mechatronic system and its four key elements: physical system, actuation, instrumentation and computation. As Professors Dave Auslander and Masayoshi Tomizuka of UC Berkeley point out, these components are energetically isolated, with computation playing the central role. Engineers can exploit this real-time computation to create systems that are qualitatively different from any that came before. Real-time computation, unlike conventional computation, must deliver correct results at the correct time. It also embodies the concept of duration, involves asynchronous operations and frequently must include safety-critical factors.



A modern mechatronics system includes four key elements: physical system, actuation, instrumentation and computation.

Why should a company adopt a mechatronic design culture? As David Bradley and his colleagues note in their book, *Mechatronics and the Design of Intelligent Machines and Systems*, 21st century companies must use technology to increase the competitiveness of their products and must respond rapidly and effectively to changes in the marketplace. A mechatronic approach to engineering provides a company with a competitive advantage through the development of innovative products and through enhancement of existing products. In the automotive world, for example, many mechatronic features have become commonplace, including engine-management systems, traction control and ABS. Other examples now just emerging include: drive-by-wire, collision-avoidance systems, lane tracking and navigational control. Jay Leno jokes that a new self-parking feature is so realistic, it not only parks your car, but also changes the presets on your radio, steals the spare change out of your ashtray and leaves the seat all the way back.

How does a company achieve the transformation to mechatronics? Much of it depends on the ability of the design team to communicate, collaborate and integrate. Indeed, a major role of the mechatronics engineer is to bridge the communication gaps that can exist between more specialized colleagues.

In the past dozen years, I have conducted numerous mechatronics workshops for practicing engineers at companies such as Xerox and Procter & Gamble. What I hear from engineers at these companies is that several practices need to be remedied before a mechatronics culture can take hold. Control design and implementation, for instance, is still the domain of specialists. Indeed, controls and electronics are often viewed as afterthought add-ons. Among other problems, very few engineers perform any kind of physical and mathematical modeling. In fact, many engineers view mathematics as a subject that does not enhance engineering skills and is therefore an obstacle to avoid. What's more, very few engineers have achieved the balance between analysis and hardware that is essential for success in mechatronics.

In my next column, I'll look at how engineering teams are coping with these shortcomings in the design of new computer magnetic hard-disk drives. This is a great example of a mechatronics product, a complex system made up of elements from a variety of engineering disciplines. The computer industry is striving for greater data-storage density and higher data-transfer rates — at a lower cost. Mechatronics will provide many of the answers.

Stamp your passport for synergistic system integration at the Mechatronics Zone: http://rbi.ims.ca/5381-515