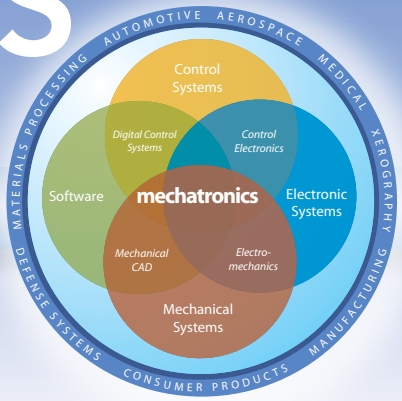
MECHATRONICS IN DESIGN

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



Mechatronics Engineers Know How to Balance

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/mechatronicszone

BY KEVIN CRAIG

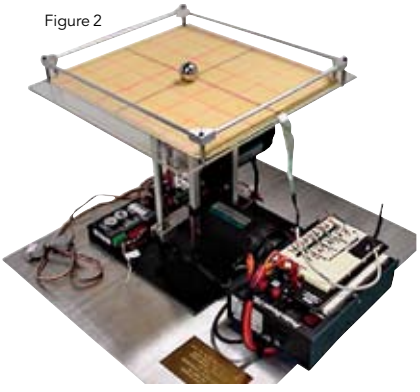
Whatever athletic activity you participate in, balance is an essential element to success. Throwing a baseball, riding a horse, hitting a golf ball, blocking and tackling in football, running a 100-m dash or even just physical conditioning — all require balance for peak performance, balance in preparation and balance in execution. Staying in balance requires concentration and tremendous effort — getting out of balance is easy! As an engineering educator, I often meet with freshman students and their parents. I always stress the fact the main reason these young women and men were successful till now was because of a balance in their lives — a balance among the intellectual, social, spiritual and physical aspects of their lives. When they start college, if they get out of balance and focus too much on intellectual pursuits at the expense of the other aspects of their lives, they will be less productive and efficient and certainly less happy.

Figure 1

A rotary inverted pendulum.

Mechatronics engineers also need that balance in their lives, but they also need a balance between two different sets of professional engineering skills — theoretical and experimental or, to put it another way, modeling/analysis skills and hardware-implementation skills. In the 21st century nothing less will do! Only a mechatronics engineer with a balanced set of skills can design and build the optimum multidisciplinary engineering system to solve a problem. In 1999, as a professor at RPI, I supervised four teams of students in senior-level design experiences with a focus on balance, i.e., stabilizing an inherently unstable system. The systems were a rotary inverted pendulum (Figure 1, top), a ball-on-plate balancing system (Figure 2, left), a hydraulically balanced beam system and a ball-on-beam balancing system.

Figure 2



Ball-on-plate balancing system.

These systems were exciting for the students to work on and exciting for all to view. While they seem to have little practical significance, they served to exercise all the skills required by the modern mechatronics engineer and I felt confident I was sending these students off well-prepared to practice mechatronics engineering in the real world. One student who led the effort on the ball-on-plate balancing system was Shorya Awtar. He went on to receive a Master of Science at RPI with me and a Ph.D. at MIT studying with Alex Slocum, the internationally known precision mechanical design professor. After gaining valuable industrial experience at GE R&D, he chose to become a teacher and is now a professor at the University of Michigan in Ann Arbor teaching, you guessed it, mechatronics. He is an outstanding example of the modern-day engineering professor who demonstrates in all he does the necessary balance between engineering theory and engineering practice.

In 2006 a team of students from RPI, under my direction, designed and built a Segway-like Balancing Human Transporter and were selected to be part of keynote presentations at the yearly event held by National Instruments' NI Week. This was quite an honor for all involved and showed what engineering students balanced in both their education and performance can accomplish. These balancing human transporters embody the key elements of a modern product, machine or system, with integrated machine elements, motors, sensors, electronics and intelligent controls running on a microcomputer. As is well known, this scooter remains balanced on two wheels by means of feedback controls and responds to a forward and backward leaning of a person standing on it by moving forward or backward, respectively.

To introduce students to the field of mechatronics at the University of Michigan, Professor Awtar had his students successfully build their own version of the balancing human transporter in fall 2007. Even though the operating principles of this system are well known, to complete this project in a short amount of time, starting with a blank sheet of paper, required many design decisions and an integrated, model-based, mechatronic approach to design. The success of these students is a testimony to what our young engineers can accomplish with a balanced approach to engineering design. With the right balance in our lives and in our engineering educational system, the technological future of our nation will flourish.

Stay in balance and learn from other state-of-the-art mechatronics' applications at the Mechatronics Zone: http://rbi.ims.ca/5704-522