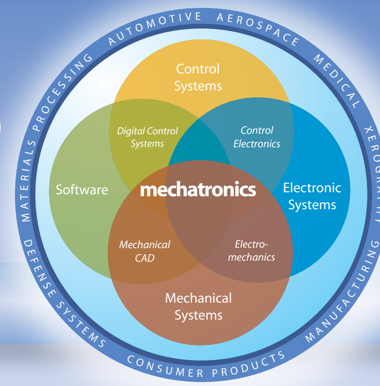
MECHATRONICS IN DESIGN

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



Where Is a Slide Rule When You Need One?

BY KEVIN CRAIG

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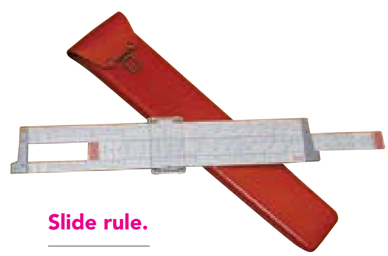
In 1969, when I was a plebe (freshman) at West Point, engineering was the required course of study and a slide rule was standard issue. In my first engineering class there was a 10-ft-long working slide rule hanging from the ceiling to aid in instruction. I never once thought my slide rule was going to solve an engineering problem I was facing; it would just make my calculations easier. I also never thought my handheld calculator was going to solve my engineering problems, but now I could more easily solve many more types of engineering problems without having to resort to punch cards and mainframe computers. However, my ability to estimate orders of magnitude was diminished. The early 1980s saw the rise of the personal computer and now every entering engineering student at most universities has a laptop computer fully loaded with the latest technical software. When confronted with a problem before the desktop/laptop computer era, the engineering student would develop the problem solution by hand with pencil, paper and much thought and only then was the slide rule or calculator taken out of its case or, if needed, a computer program written and cards punched. Today, entering freshmen have the perception that the solutions to engineering problems are somewhere in the computer and just have to be found, when in fact the solutions are where they have always been — in the minds of the engineers!



Slide rule.

Freshman engineering students in all disciplines usually take some computing class — usually C, Java or MATLAB programming — hopefully learn about pseudo code and flowcharting and then solve some simple problems developed primarily to make use of some features of the programming language just learned. In engineering practice today, only in special situations will an engineer write a computer program to solve a problem. Even in real-time computer applications, code generation programs are widely available. Most engineering problems today are solved using pre-written programs in MATLAB or LabVIEW, for example. Wouldn't it be most valuable if freshman engineering students were exposed to the types of engineering problems real engineers in any discipline face 90 percent of the time and appreciate the software used to solve these problems and how to use that as a tool? It certainly would put their laptop computer, computer software and computer programming in proper context. Aside from e-mail, word processing, presentation development, website creation and Internet use, what are the main types of problems practicing engineers in all disciplines solve using their computers, either with pre-programmed software or by writing their own code? The answer should help identify what our students should see in their freshman year.

My list starts with a basic assumption. All engineers must be able to model multidisciplinary engineering physical systems; predict how they will behave when built; optimize their design; validate their predictions and designs with engineering measurements; and see a design through to prototyping and manufacturing, with sustainability considerations paramount throughout. Based on this assumption, my list includes:

1. Solving linear and nonlinear algebraic equations.
2. Numerical simulation of time-dependent ordinary differential equations.
3. Numerical simulation of partial differential equations using MATLAB or some finite-element analysis software.
4. Basic computer programming skills, e.g., flowcharting, pseudo code generation, MATLAB or LabVIEW programming.
5. Design optimization.
6. Engineering graphics: sketching, detailed drawings, graphing, curve fitting and statistical analysis of data.
7. Real-time computer use for measurement and control of real physical systems.
8. Data management.
9. Project management including software, hardware, people and tasks.
10. Quality evaluation and control.

What is on your list? Please let me know and I will compile your responses and write about the results. You can send your comments to kevin.craig@marquette.edu.

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