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Engineering Design Optimization Using Calculus Level Methods: A Casebook Approach: Math Modeling, Simulation, & Optimization



Synopsis

How to teach new problem solving technology to engineers and scientists? Problem solving requires a broad based knowledge in both math and science as well as discernment and flexibility to challenge the way it has always been done before. Generally, an objective driven design will yield the best design in the least amount of time. Companies need engineers trained in setting objectives before they begin the time- consuming process of formulating and testing new concepts and designs. This textbook considers design from the pragmatic concerns of industry. It utilizes casebook studies of math problems with their solutions in real life situations. Because it encourages students to view themselves as part of the design team, this text is the next best thing to an on-the-job training. It shows how setting objectives to problem solving assignments can help students complete work quickly and efficiently. But it also stresses that while every situation is different, the approach remains the same: objective-driven engineers state a math model and an objective function for a given problem while leaving the solving to a calculus-based computer language. The text attempts to fill a gap in educational material in the mathematical problem solving arena. Traditional texts leave students in a simulation thinking mode. Simulations require many computer runs causing delays in solution and little gain, if any, in problem understanding. Simulations require a numerical algorithm to be meshed with their math model. In such form, math models are hard to recognize and discuss. Besides slowing their understanding, users lose confidence in program solutions. In contrast, an objective function coupled with a simulation program model will move a problem from a simulation to an optimization problem. An optimization problem with a good numerical algorithm can reduce the number of computer runs to one, a nice time saver which results in increased productivity for industry. The textbook itself is the centerpiece to a comprehensive teaching and learning package that targets a single goal: to successfully demonstrate how identifying and setting objectives works in the real world, thus helping students to understand the concepts that motivate industrial designs.

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