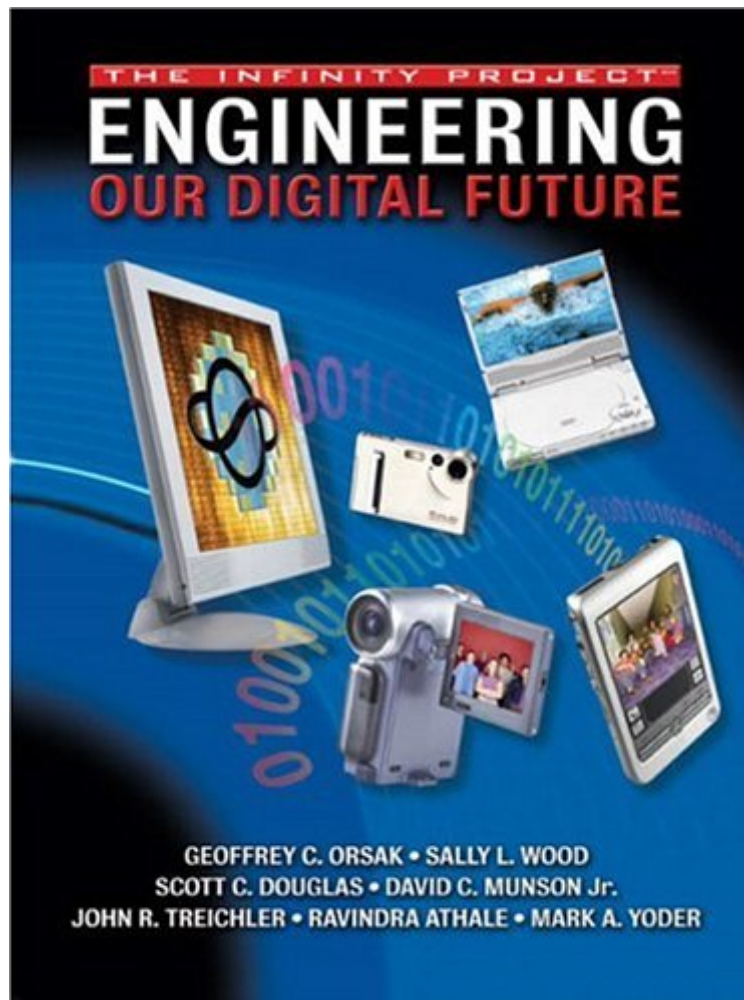


Engineering Our Digital Future: The Infinity Project

Geoffrey C. Orsak, Sally L. Wood, Scott C. Douglas, David C. Munson Jr., John R. Treichler, Ravindra A. Athale, Mark W. Yoder

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Geoffrey C. Orsak, Sally L. Wood, Scott C. Douglas, David C. Munson Jr., John R. Treichler, Ravindra A. Athale, Mark W. Yoder : Engineering Our Digital Future: The Infinity Project before purchasing it in order to gage whether or not it would be worth my time, and all praised Engineering Our Digital Future: The Infinity Project:

0 of 0 people found the following review helpful. As an older book, this is a depressing indicator of the current status of textbook companies. By J. Cronin Props for this book being well constructed (from a physical standpoint) and not being re-hashed as a required \$200 cost every other year. If students are paying \$100+ for a rehashed copy of the last edition every 2 years, it should at least be hardcover like this! I'm sick of paying through the teeth for exorbitantly priced paperbacks with cruddy print quality and insanely thin pages! 0 of 0 people found the following review helpful. good book By pumpkiny the book is in quite good condition and i bought it at a really cheap price. it's useful and easy to

understand. 11 of 13 people found the following review helpful. Excellent book
By A Customer
I think it is a great book. DSP education has suffered by not having this level of material presented and understood before diving into the blizzard of equations that characterises most peoples first exposure to DSP education. Also, its goal of reaching high school students is filling the need of providing a basic literacy in the digital nature of daily life that is sorely needed. The presentation is clear. It uses aspects of technology that touch peoples lives, so they aren't remote or unapproachable. I think it is very positive in promoting electronics as an area where females as well as males can be comfortable participating. The topic areas were selected to peak interest, the first step toward learning. And although the book intended to lay basic groundwork, it does it with a clear eye toward paving the way to more advanced investigations, and strikes good compromises about the depth to go into, so that introductions are made to techniques that will be major themes in later study. It is also an attractive book. It is colorful and inviting. I disagree with another reviewer that it is has hype for engineering. It is compelling and elicits enthusiasm. How can that be a flaw in a textbook?!

This book, *Engineering Our Digital Future*, plus a broad spectrum of supplemental materials, classroom technology, and a comprehensive instructor training programwork in concert to motivate users to learn about the infinite possibilities of technology and engineering in today's world. Developed by a national team led by Southern Methodist University and Texas Instruments, this book is the first of its kind in the country. Chapter topics include: The World of Modern Engineering; Creating Digital Music; Making Digital Images; Math You Can See; Digitizing the World; Coding Information for Storage and Secrecy; Communicating with Ones and Zeros; Networks from the Telegraph to the Internet; and The Big Picture. A new outlook into the possibilities of technology and engineering for beginner engineers.

From the Back Cover
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About the Author
Geoffrey C. Orsak is Associate Dean for Research and Development and a Professor with the Department of Electrical Engineering, Southern Methodist University. He also serves as the Executive Director of the federally supported Institute for Engineering Education at SMU and Director of the Infinity Project. Dr. Orsak is widely regarded as one of the nation's leaders in K-12 engineering education. In addition to these activities, he has served as an advisor on matters associated with the science and technology of national defense to the U.S. Department of Defense; the National Academy of Engineering; the Institute for Defense Analysis, among others. Dr. Orsak received the B.S.E.E., M.E.E., and Ph.D. degrees in electrical and computer engineering from Rice University, Houston, TX. Sally L. Wood is a Professor with the Department of Electrical Engineering, Santa Clara University, the oldest university in California. For the past six years, she has also been the head of the department. She was born in Swansea MA, raised in Georgia, and graduated from high school in Washington state. After she received the B.S. degree from Columbia University, she worked for five years in the northeast and in Europe designing systems to automatically read printed text. She then returned to graduate school at Stanford University and earned a Ph.D. degree for research on medical imaging. She enjoys teaching classes from the freshman level to the graduate level in digital logic and signal processing and continues her research on video and image processing. She is a past vice president of the IEEE Signal Processing Society. Scott C. Douglas is an Associate Professor with the Department of Electrical Engineering, Southern Methodist University. He is also the Associate Director for the Institute for Engineering Education at SMU. Before attending college, he was drawn to engineering through his love of music and the arts, and he has performed in numerous orchestras, bands, and musical groups as a saxophonist and singer throughout his life. He received the B.S., M.S., and Ph.D. degrees from Stanford University. Afterward, he became a professor, educator, and engineering researcher. He regularly consults with companies all over the world on topics related to his research interests, which focus on the processing of acoustic signals for sound and vibration control, speech enhancement, and spatial understanding. David C. Munson, Jr. is both the Chairman and a Professor with the Department of Electrical and Computer Engineering, University of Michigan. Prior to this, he was a Professor with the Department of Electrical and Computer Engineering, University of Illinois, Urbana-Champaign. His research focuses on computer algorithms for tomography and synthetic aperture radar. In addition to his research, Dr. Munson particularly enjoys being in the classroom, where he has taught thousands of students their first course in digital signal processing. He received the B.S. degree from the University of Delaware and the M.S., M.A., and Ph.D. degrees from Princeton University, all in electrical engineering. Dr. Munson is a past-president of the IEEE Signal Processing Society and the founding editor-in-chief of the IEEE Transactions on Image Processing. John R. Treichler

is the Chief Technical Officer of Applied Signal Technology, Inc., an engineering company that builds specialized electronic equipment for the U.S. government and its friends overseas. His research focuses on the application of advanced technology to communications systems. Dr. Treichler has been a professor at both Cornell University and Stanford University. He received the B.A. and Masters of Electrical Engineering degrees from Rice University and the Ph.D. degree from Stanford University. He served aboard ships as an officer in the U.S. Navy, and continues to work at the company he co-founded. Ravindra Athale is currently a Program Manager of Photonics at the Defense Advanced Research Projects Agency (DARPA), on leave from George Mason University. Prior to this, he has worked at various government research labs and in private industry. He has been fascinated by everything optical lasers, holography, liquid crystals, optical computers for his entire career. He is the co-inventor of HoloSpex glasses, which is the first mass scale consumer product based on the esoteric technology of far-field computer-generated holography. Dr. Athale received the B.Sc. and M.Sc. degrees in physics in India and the Ph.D. degree from the University of California, San Diego, in electrical engineering. During his career as a professor, he has developed and taught a course that teaches principles of information technology to non-science and engineering students. Mark A. Yoder is a Professor with the Department of Electrical and Computer Engineering, Rose-Hulman Institute of Technology, Terre Haute, IN. Dr. Yoder received the B.S. degree in 1980 and the Ph.D. degree in 1984, both in electrical engineering and both from Purdue University. While working as a research scientist, he discovered that teaching engineering was most enjoyable, prompting him to join Rose-Hulman Institute of Technology. He is a national leader in teaching digital signal processing to young college students, using symbolic algebra systems in electrical engineering education and in developing engineering curriculums for high school students. Excerpt. Reprinted by permission. All rights reserved.

ABOUT THE INFINITY PROJECT As we move into the 21st century, engineering and technology will have an ever-increasing impact on our daily activities. Yet as our lives have become more and more dependent on technology, public awareness and knowledge about technology-related issues has declined. All of this is compounded by the fact that young students today continue to see little relevance in traditional math and science curricula suggesting that this unfortunate trend may continue into the foreseeable future, resulting in a reduced ability of our population to deal with society's challenges. The Infinity Project was created to address just this problem by developing an innovative approach to applying fundamental science and mathematics concepts to solving contemporary engineering problems. This nationwide program, designed by leading college engineering professors in cooperation with education experts, is sponsored and run by the Institute for Engineering Education at SMU, with generous support from Texas Instruments, the National Science Foundation, and the Department of Education. The Infinity Project engineering and technology curriculum encourages students to be curious about math and science by connecting their relevance to prized personal technologies such as MP3, CD, and DVD players; cellular phones; pagers; and handheld video devices. The perennial question "Why do I need to learn this?" is answered in ways that are both relevant and fun. The Infinity Project curriculum sharpens math- and science-based problem-solving skills, and encourages students to be innovative, to go beyond what is, and to dream of what can be. The Infinity Project supplies schools and teachers with a complete turnkey solution that includes this first-of-its-kind engineering textbook. Engineering Our Digital Future covers a selection of topics and hands-on activities to inspire and excite students. The Infinity Project curriculum encourages young people to learn about engineering, inspires them to understand the relevance of technology and the importance of mathematics and science, and shows how these concepts can lead to rewarding, challenging, and creative career opportunities. And although we emphasize the current leading-edge digital technologies that are important and exciting to today's youth, the approach to problem solving emphasized throughout the book applies to all fields of engineering and many other professions as well. The Infinity Project provides a complete answer for effectively and easily incorporating engineering and technology into standard curricula today: stimulating, well-thought-out content; comprehensive teacher training; cutting-edge classroom technology; lab materials and lab activities; and an outstanding supplements package. On-line Web support guarantees that you are never alone.

CURRICULUM The Infinity Project curriculum is typically covered in a yearlong class. Students learn how to apply math and science concepts to design new technologies involving digital music and images, special effect" for films, personal communication devices such as cell phones, and the Internet all while clearly understanding how information in the digital era is collected, stored, processed, and moved around the globe. The curriculum is significantly enhanced by many hands-on experiments that are carefully integrated with the course materials. The classroom and lab equipment produced by the Infinity Project, in partnership with Texas Instruments and Hyperception, Inc., is based on new cutting-edge digital signal processing technology and has been made available by our industrial partners as the Infinity Technology Kit. This very low cost kit converts standard PCs found in classrooms and laboratories into a modern engineering design platform and allows instructors to clearly demonstrate engineering design in the digital era. The modern design tools that are part of the Infinity Technology Kit allow instructors and students to design and build remarkably capable and complex systems from simple function blocks. Engineering Our Digital Future is designed for students who have completed mathematics through a second course in algebra (Algebra II) and who have had at least one laboratory science course. This innovative engineering and technology course allows students to see firsthand the applications of math and science to engineering and technology

early enough in their studies to encourage them to pursue more advanced math and science courses and to begin to consider future careers in technology and engineering. The book focuses squarely on the math and science fundamentals of engineering during the information revolution and teaches students how engineers create, design, test, and improve the technology around them. Applications are drawn from a wide array of modern devices and systems seen today. Scope and Focus of Content: Engineering is an exceptionally broad field—so broad, in fact, that no single course or book could adequately capture all the application areas that engineers are working in today. However, what makes *Engineering Our Digital Future* directly relevant to every area of engineering is the application of math and science concepts to the creative aspects of engineering design. The members of the Infinity Project had to make a number of difficult decisions in choosing which topical areas of engineering to emphasize in this book. Our choice was made all the easier by talking to students and teachers, who stated clearly that they love high technology, particularly those areas that touch students' everyday lives. So, the Infinity Project assembled one of the best teams in the country to create this innovative engineering textbook. The content within the book focuses on the engineering applications of basic math and science concepts used by engineers to dream up, design, and build many of the new high-tech innovations that are changing our world. While we wish we could have shared the full breadth of engineering applications with students, we believe that the material contained in this book shows clearly how engineers, armed with knowledge of math, science, and technology, have the ability to impact nearly every aspect of our lives. *Engineering Our Digital Future* is composed of nine separate chapters, each emphasizing different application areas of engineering and each losing different areas of math and science commonly seen in high school and early college. Chapter 1 introduces students to the engineering design process and the basics of modern technology, including integrated circuits, computer chips, and mathematical concepts such as Moore's Law, binary numbers, and simple exponential functions that describe constant growth rates. Chapter 2 exposes students to some of the most important engineering ideas associated with the creation of digital music. Students learn how basic ideas drawn from the right triangle, such as sines and cosines, are fundamental to making computer music. Chapter 3 develops the basic concepts behind digital imaging technologies, including capturing and storing digital pictures. Various mathematical concepts are developed, explored, and shown to be interesting and relevant to manipulating these images. Chapter 4 extends the ideas in Chapter 3 to using digital images and video in several interesting human applications. Additional mathematics are developed wherein images are treated as matrices, and operations to improve image quality or extract information from images are defined in terms of simple matrix operations. Chapter 5 focuses on the general ideas associated with the digitization of a wide range of information, from text in books and magazines, to speech and music, to images and video. Students learn the details of how all these types of information are captured and stored in digital form. They also learn about the various practical trade-offs when real-world, or "analog", information is converted to numbers and stored with finite precision. Chapter 6 focuses on some of the more interesting opportunities for coding information when the information is stored on a computer, using only bits. Problems in computer security and encryption as well as redundancy of numbers and data compression are both highly relevant and interesting to students. The basic concepts of detecting and correcting errors in digital data are discussed. This chapter gives students some very interesting applications of simple polynomials and random numbers. Chapter 7 exposes students to the basic ideas behind wireless and radio communications. Students see firsthand how sines and cosines enable all wireless communications. They learn such important fundamental concepts as bandwidth and data rate. Chapter 8 gives a very good overview of computer networks and the Internet from both a modern and an historical perspective. Students will be fascinated to learn how similar the Internet is to many other networks, including the U.S. Postal Service and the telegraph system. In this chapter, students have the opportunity to undertake some very interesting mathematical calculations involving simple economic tradeoffs in system and network design. Chapter 9 looks at the big picture of engineering. By examining the engineering concepts and social implications of ten important engineering feats throughout history, this chapter shows how these accomplishments changed the way people live, work, and play. Various fields within engineering are introduced, and certain myths and misconceptions of engineering are discussed and dispelled. Course Options A typical course using *Engineering Our Digital Future* begins with Chapter 1 and ends with Chapter 9, with the instructor judiciously selecting a subset of chapters from the book in accordance with the anticipated pace of the class. The well-paced classroom can expect to complete the entire book taken in order. Classrooms with a more conservative pace will want to select an appropriate subset of chapters that will ensure a high-impact course. In selecting chapters that will be of interest to students, the instructor should consider the mathematical level of the students taking the class. If the students have had a successful experience with mathematics up to a second course in algebra and have had reasonable exposure to the most basic ideas from geometry and trigonometry, then all of the chapters can be selected without any fear of the students not having the appropriate background. In this case, the selection criteria should then be based on the level of student interest in the various chapters. For classes with a high interest in music and video, the educator should focus on Chapters 1-5 and 9. For classes with an interest in cell phones and the Internet, the educator should focus on Chapters 1 and 5-9. For classes with larger percentages of students with little exposure to trigonometric ideas, some topics in Chapter 2 and in Chapter 7 might come across as a bit challenging. However, the material is relevant and the engineering designs are exciting,

so the educator might want to consider covering only the first few sections of these chapters. Similarly, if a large percentage of the class has had little exposure to mathematical abstraction, some parts of Chapters 5 and 6 may be omitted without losing continuity. For classes that want to sample the entire book, but don't feel that they have the time to thoroughly cover the full scope of the material, teachers should feel comfortable covering the first few sections of each chapter without fear that they are leaving important material out that will be necessary for future chapters. Each chapter is fairly well contained, and important supporting material, if it is needed, is easy to find.

PEDAGOGICAL FEATURES Hundreds of four-color illustrations that demystify engineering and technology concepts Real-world examples that are actually fun Notes and facts in the margins that emphasize important points and interesting facts Definitions Interesting Facts Key Concepts Keep in Mind Infinity Project experiments fully integrated within the text that are designed specifically for use with the Infinity Technology Kit Infinity Technology Kita complete engineering design platform for today's most relevant and interesting new technologies Interesting applications presented in boxes within the text Exercises divided by pedagogical approach Mastering the Concepts Try This In the Laboratory Back of the Envelope Master Design Problems Chapter review and summary Big Ideas Math Science Concepts Learned Important Equations Building Your Knowledge Library Comprehensive glossary

INFINITY TECHNOLOGY KIT Engineering is about doing things. Therefore, throughout this book, students will have the opportunity to master engineering and technology concepts by building and testing new designs while using digital technologies, including video, audio, and graphics, that are engaging for students and teachers. To aid in the classroom or laboratory, the team behind the Infinity Project has created the cutting-edge Infinity Technology Kit, a multimedia hardware and software system for converting standard PCs into engineering design environments. The Infinity Technology Kit brings to life the engineering concepts taught in The Infinity Project engineering curriculum. The predesigned lab experiments and engineering designs allow students to experience firsthand the full range of the engineering design process of envisioning, designing, building, and testing modern technology. The technology used within the Infinity Technology Kit is based upon Texas Instruments' Digital Signal Processor (DSP) chips and a new and innovative graphical programming environment called Visual Application Builder, designed and developed by one of the Infinity Project partners, Hyperception, Inc. With the Infinity Technology Kit, students with limited experience can act like real engineers creating innovations that are relevant and exciting. No previous experience with any programming languages is required.

Components: Hardware: High-performance digital signal processing board based on TI DSP technology. Software: Easy-to-use, yet powerful, graphical computer programming software created and produced by Hyperception, Inc. Accessories include Web camera, PC powered speakers, PC microphone, and all the necessary cables for easy installation

SUPPLEMENTS The Infinity Project supplements offer comprehensive additional resources and classroom support: Instructor's manual containing Microsoft PowerPoint lecture notes Lab exercise handouts Extensive test-item file with complete solutions Laboratory manual

WEBSITE The Infinity Project website, at <http://www.infinity-project.org>, provides ongoing classroom support and resources: Curriculum updates, including additional on-line chapters related to new and exciting topics such as robotics and the physics of engineering Infinity Project engineering experiments and updates Discussion groups for teachers and educators, monitored and supported by the staff of the Infinity Project Training materials Installation instructions and support for the Infinity Technology Kit Links to interesting and related websites