DIGITAL DESIGN USING VHDL

a systems approach

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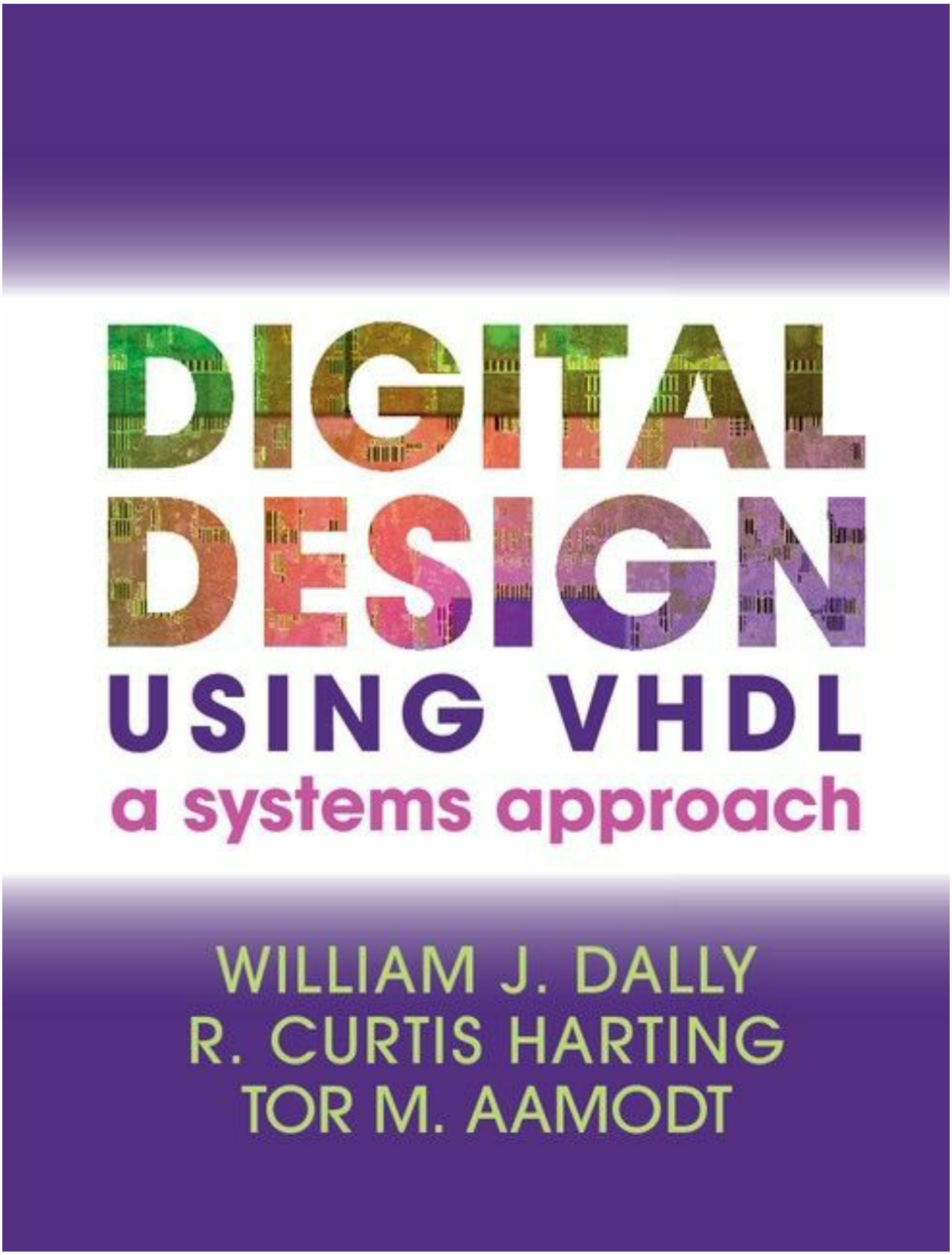
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Digital Design Using VHDL

A Systems Approach

This introductory textbook provides students with a system-level perspective and the tools they need to understand, analyze, and design digital systems. It goes beyond the design of simple combinational and sequential modules to show how such modules are used to build complete systems.

- All the essential topics needed to understand modern design practice are covered, including:
    - Design and analysis of combinational and sequential modules
    - Composition of combinational and sequential modules
    - Data and control partitioning
    - Factoring and composition of finite-state machines
    - Interface specification
    - System timing
    - Synchronization
- Teaches how to write VHDL-2008 HDL in a productive and maintainable style that enables CAD tools to do much of the tedious work.
- Covers the fundamentals of logic design, describing an efficient method to design combinational logic and state machines both manually and using modern CAD tools.

A complete introduction to digital design is given through clear explanations, extensive examples, and online VHDL files. The teaching package is completed with lecture slides, labs, and a solutions manual for instructors (available via www.cambridge.org/dallyvhdl). Assuming no previous digital knowledge, this textbook is ideal for undergraduate digital design courses that will prepare students for modern digital practice.

WILLIAM J. DALLY is the Willard R. and Inez Kerr Bell Professor of Engineering at Stanford University and Chief Scientist at NVIDIA Corporation. He and his group have developed system architecture, network architecture, signaling, routing, and synchronization technology that can be found in most large parallel computers today. He is a Member of the National Academy of Engineering, a Fellow of the IEEE, a Fellow of the ACM, and a Fellow of the American Academy of Arts and Sciences. He has received numerous honors, including the ACM Eckert-Mauchly Award, the IEEE Seymour Cray Award, and the ACM Maurice Wilkes Award.

R. CURTIS HARTING is a Software Engineer at Google and holds a Ph.D. from Stanford University. He graduated with honors in 2007 from Duke University with a B.S.E., majoring in Electrical & Computer Engineering and Computer Science. He received his M.S. in 2009 from Stanford University.

TOR M. AAMODT is an Associate Professor in the Department of Electrical and Computer Engineering at the University of British Columbia. Alongside his graduate students, he developed the GPGPU-Sim simulator. Three of his papers related to the architecture of general purpose GPUs have been selected as “Top Picks” by *IEEE Micro Magazine* and one as a “Research Highlight” by *Communications of the ACM magazine*. He was a Visiting Associate Professor in the Computer Science Department at Stanford University during his 2012–2013 sabbatical, and from 2004 to 2006 he worked at NVIDIA on the memory system architecture (“framebuffer”) of the GeForce 8 Series GPU.

“Dally and Harting blend circuit and architecture design in a clear and constructive manner on the basis of their exceptional experience in digital design.”
“Students will discover a modern and effective way to understand the fundamental underpinning of digital design, by being exposed to the different

abstraction levels and views of computing systems."

Giovanni De Micheli, *EPFL Switzerland*

"Bill and Curt have combined decades of academic and industry experience to produce a textbook that teaches digital system design from a very practical perspective without sacrificing the theoretical understanding needed to train tomorrow's engineers. Their approach pushes students to understand not just what they are designing, but also what they are building. By presenting key advanced topics, such as synthesis, delay and logical effort, and synchronization, at the introductory level, this book is in the rare position of providing both practical advice and deep understanding. In doing so, this book will prepare students well even as technology, tools, and techniques change in the future."

David Black-Schaffer, *Uppsala University*

"Everything you would expect from a book on digital design from Professor Dally. Decades of practical experience are distilled to provide the tools necessary to design and compose complete digital systems. A clear and well-written text that covers the basics and system-level issues equally well. An ideal starting point for the microprocessor and SoC designers of the future!"

Robert Mullins, *University of Cambridge and the Raspberry Pi Foundation*

"This textbook sets a new standard for how digital system design is taught to undergraduates. The practical approach and concrete examples provide a solid foundation for anyone who wants to understand or design modern complex digital systems."

Steve Keckler, *The University of Texas at Austin*

"This book not only teaches how to do digital design, but more importantly shows how to do *good* design. It stresses the importance of modularization with clean interfaces, and the importance of producing digital artifacts that not only meet their specifications, but which can also be easily understood by others. It uses an aptly chosen set of examples and the Verilog code used to implement them."

"It includes a section on the design of asynchronous logic, a topic that is likely to become increasingly important as energy consumption becomes a primary concern in digital systems."

"The final appendix on Verilog coding style is particularly useful. This book

will be valuable not only to students, but also to practitioners in the area. I recommend it highly."

Chuck Thacker, *Microsoft*

"A terrific book with a terrific point-of-view of systems. Everything interesting – and awful – that happens in digital design happens because engineers must integrate ideas from bits to blocks, from signals to CPUs. The book does a great job of focusing on the important stuff, moving from foundations to systems, with the right amount of HDL (Verilog) focus to make everything practical and relevant."

Rob A. Rutenbar, *University of Illinois at Urbana-Champaign*

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