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Enduring Text Offers Complete Compendium Of Motor And Drive Concepts

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Electric Drives: Third Edition, Ion Boldea, S. A. Nasar, CRC Press (www.crcpress.com), ISBN-13: 978-1-4987-9, glossy hardback, 650 pages, 2016.

The leading author of this book, Ion Boldea, is an engineer at the University Politechnica and Romanian Academy in Timisoara, Romania, and an IEEE Life Fellow. The book is in its third edition, ten years after the second, and includes some new material, notably "sensorless" control. The subject of the book is motor drives, which is mainly about electronic power circuits and control theory as applied to electric machines including various mechanical loads.

Naturally, as most authors on the subject have discovered, some theoretical background on electric machines is unavoidable. This book is no exception; the first half pertains to brush and induction motors, and the second half mainly to synchronous and reluctance motors, including permanent-magnet synchronous (PMS) motors. Overall, *Electric Drives* is a compendium of knowledge on the subject with an emphasis on larger, industrial motors. The book is somewhat theoretically oriented, and equations appear throughout it, though not in overwhelming amounts. (One peculiarity of the equations is that the variables are unitalicized.) Examples are provided, and a summary, problems, and references are given at the ends of chapters.

For power-circuit engineers, circuit diagrams appear throughout the book, but they are given at a conceptual level; do not expect much in the way of detailed examples of motor-drive circuits. The discussion of circuits is more from a system-level standpoint than circuit elements, though occasionally such detail appears. Various control schemes are introduced and explained to a far greater extent.

The book is not, however, short on completeness in that all kinds of considerations for drive design are included: modes of motor operation, various complications caused by undesirable (non-ideal) aspects of motors, and above all, numerous control aspects which include not only motion control—that is, control of mechanical variables such as torque, speed and position—but also circuit-related control such as "Space-Vector PWM" including six-step phase resolution, overmodulation, and PWM current control.

In the old days, steady-state control of motors was the only concern, but with more demanding mechanical control applications such as are found in robotics and mechanical automation, transient response is also included for total-response control. This book covers total control and also does not overlook schemes for sensing feedback variables, including winding-sensed, or "sensorless," control. (There is a sensor: the motor itself, which feeds back through itself the induced voltage related to speed.) The added complications of induction motors are included, and the book is a worthy companion to Paul Krause's classic, *Analysis of Electric Machinery*, McGraw-Hill, 1986.

Chapter 10 starting on page 291 enters the realm of synchronous motors and immediately presents PMS motors, which as smaller (<500 W) motors are prolific, found in automobiles, consumer household, office, and medical equipment, and in factories. The third edition includes explanation of *d-q* (torque-flux) axes, which is found in "classic" introductory electric-machine textbooks based on steady-state motor theory. Synchronous reluctance motors (which the author calls RSMs) are not omitted, nor is the single-phase PMS motor.

The author has a predilection for modeling transient motor behavior, and simulated plots appear, sometimes in color. (The book is printed on semi-glossy paper with a sewn binding. No corners were cut in book manufacture.) PMSM and RSM drive control are covered together. Two chapters later, another popular topic appears: switched-reluctance (SR) motor drives.

Further on, practical problems with PWM motor drives are discussed, such as line harmonics, currents through motor bearings, EMI, audible noise, then (chapter 15) control of electric generators, more induction-motor control, then a final chapter (17) on multi-phase drives (such as five-phase) and the additional sensing and control schemes that can be applied with the extra degrees of freedom. The book ends with a fairly complete index.

What does this book have going for it? Topical completeness! The authors include every control scheme, every nuance in electric-machine behavior that can affect drive design, every machine type and mode of operation.

While the book has its emphases, it serves as a kind of motor-drive encyclopedia and is a worthy inclusion in the design engineer's motor-drives library.

About The Author

Dennis Feucht has been involved in power electronics for 32 years, designing motor-drives and power converters. He has an instrument background from Tektronix, where he designed test and measurement equipment and did research in Tek Labs. He has lately been working on projects in theoretical magnetics and power converter research.

To read Dennis' reviews of other texts on power supply design, magnetics design and related topics, see How2Power's Power Electronics Book Reviews.