Book Reviews

edited by Graeme Hirst

Visual Reconstruction

Blake, Andrew; and Zisserman, Andrew
[University of Edinburgh]

(The MIT Press series in artificial intelligence)
Cambridge, MA: The MIT Press, 1987, xi+225 pp
Hardbound, ISBN 0-262-02271-0, US$25.00

Reviewed by
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Understanding how the visual process operates, either in the context of human or machine, remains a formidable problem. In particular, drawing a conclusion about what the three-dimensional world looks like from only a two-dimensional projection (on the image) implies "making up" for an entire lost spatial dimension. In fact, there are many hypothetical three-dimensional scenes that could give rise to any single two-dimensional image. One popular hypothesis regarding how the visual system selects a three-dimensional interpretation is that it constructs the one that is most consistent with certain assumptions about the smooth cohesive properties of matter. This is the core of the approach eloquently espoused by Blake and Zisserman.

The recurring theme in many recent approaches to low-level bottom-up vision has been the use of "smoothness constraints"; that is, the preference for world models whose physical properties tend to vary gradually across space and time. Typical examples of such constraints are those on surface depth or derivatives — reasonable surfaces have surface depth values that vary continuously across the object. Such constraints can be elegantly expressed in the language of variational calculus. Differing formalisms for the concept of gradual change thus produce differing classes of surface model.

Blake and Zisserman painlessly introduce the conceptual basis for such constraints and derive the consequent conclusions about the performance of surface fitting algorithms. By relegating the actual solutions of the variational forms to the appendices, they produce a running dialogue outlining the significant conclusions without incurring excessive mathematical overhead. Although the details of the technique require a certain mathematical sophistication, the essential concepts should be accessible to readers with the barest familiarity with the concepts of calculus.

Their approach provides a very readable introduction to the basic concepts (and some shortcomings) of surface reconstruction using "energy" minimization. The penalty functions they use for smoothness are on the first and second spatial derivatives and correspond to surface models that behave like membranes and plates, respectively.

In the later part of the book, the problem of discontinuity detection is dealt with and several approaches to the inherent convexity of this problem are discussed. By the time this discussion culminates in the authors' own "GNC" algorithm — a continuation method for the problem of surface fitting with discontinuities — the level of description has become substantially more mathematically sophisticated than in the early part of the book. The utility of relegating parts of the analysis to the appendices at this stage is rather questionable. A reader comfortable with the later chapters will probably find himself flipping back to the appendices.

Blake and Zisserman manage to introduce the problems of surface reconstruction through functional minimization in a way that is readily digestible and even fascinating for novices in the field. At the same time they present enough detail to make the book interesting to more sophisticated readers. In reconciling the needs of readers across the spectrum of sophistication, they make the book somewhat less than ideal for either. Many readers will be left feeling the discussions are both simplistic in parts as well as too difficult in others. More important, however, is the fact that they succeed in making a potentially difficult subject area accessible to a broad range of readers.

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Logics for Artificial Intelligence

Turner, Raymond
[University of Essex]

(Ellis Horwood series in artificial intelligence)
Chichester: Ellis Horwood, 1984, 120 pp
Distributed in Canada by John Wiley, Cdn$43.95

Reviewed by
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This short (120 pp) book is intended, apparently, as a supplementary text or reference for a graduate AI course that emphasizes logical approaches to the subject. It gives concise introductions to dynamic logic, many-valued logic, temporal logic, non-monotonic logic, type theory, and fuzzy logic. As can be seen from this diverse list of topics, each is given only a cursory treatment; and to get much out of the author's short discussions, some general sophistication in logic is expected of the reader. (The author's remark, p.16, that his two-page summary of classical logic is all that is required, is seriously misleading.)

Besides the worth of the concise introductions to different areas of logic which an AI student should become aware, the book contains much to recommend it. For one thing, Turner emphasizes the formal semantics of these systems of logic — something which is much too rare in AI texts. In various of the areas he gives good critical assessments of proposals that have been put forth in the literature, and his proposal in Chapter 5 for a semantics of non-monotonic logic based on partial models is especially interesting. And to top it off, the writing is generally quite lucid.

Unfortunately, there are also a number of shortcomings in the book. The main one is its brevity. It is just not possible to introduce classical logic in two pages or modal logic in two pages. It is only the student who already knows the basics of these areas, and of formal semantics generally, who will benefit much from this book. Furthermore, logic is treated in an axiomatic manner — probably the least common form used in AI — rather than in a resolution-based manner or in a natural deduction format. No treatment is accorded to equality, which is certainly central to AI applications. From this it would seem that the main use of the book would be as a guide to the literature of the areas covered. The presentations of the various logics generally stop at definitions with little indication of what the formal properties of the logics are or what they have done or might do for AI. An instructor planning to use the book as a text would have to elaborate considerably on the material. Furthermore, there are large gaps in the coverage. One would think that a book with this title would include a discussion of applications of *standard* logic to AI, such as resolution and answer extraction. And there is no mention of probabilistic logics, planning logics, inductive logics, intensional logics, relevance logics, paraconsistent logics, or applications of any logic to natural language processing. As a text it also falls short by having no exercises. Finally here, we remark on the truly astonishing number of typographical errors in the book, sometimes making text and formulas incomprehensible.

We close with one general remark on Turner's overall division of logics. Like many other authors, Turner divides "non-standard logics" into "rival logics" and "extensions of classical logic". The intent is to distinguish those logics with the same vocabulary as classical logic but with different theorems (usually fewer e.g., many-valued logics, intuitionist logic, relevance logic, fuzzy logic) from those that add new vocabulary and new rules so as to retain all classical theorems and add new ones (e.g., modal logics, intensional logics, temporal logics). Turner notes that the distinction is "not watertight"; but the real situation is much more muddied than that, and Turner should have indicated so. Whether a logic is a subsystem of, an extension of, or a rival to classical logic depends on how we formulate the systems and compare them. Consider, for example, a modal logic which is formulated with "—>" for "strict entailment" (rather than with a box for necessity). Such a system is a subsystem of classical logic in which the —> is interpreted truth-functionally (with appropriate axioms governing it). But now consider formulating classical logic with just {&,~} and the rule of inference: from A and ~(A&~B) conclude B. Given this formulation of classical logic, our modal logic emerges as an extension when we add —> (with appropriate axioms). Similar remarks can be made about many-valued logics (with "assertion operators", as in Turner's Chapter 3), about intuitionistic logics (as in his Chapter 4), or temporal logics (as in his Chapter 2). The alleged distinction between rival ("deviant") logics and extensions becomes vacuous, and only confusion is engendered in suggesting it without a restriction to a specific vocabulary and formulation of the rules.

In sum, we find Turner's book to be most useful as a guide to the literature in certain fields of logic-as-applied-to-AI. It would be more useful in this role if it had broader coverage. It is not suitable as an introduction to the fields themselves because of its lack of depth. And the instructor who attempts to employ it for any use would be wise to prepare errata sheets.

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Manufacturing Intelligence

Wright, Paul Kenneth; and Bourne, David Alan
[New York University and
Carnegie Mellon University]

Reading, MA: Addison-Wesley, 1988, ix+352 pp
Hardbound, ISBN 0-201-13576-0

Reviewed by
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If you are interested in the control of machine tools and how to apply artificial intelligence approaches to this problem you will find this book both interesting and useful. If you are interested in robotics, vision, or expert systems this book will only be worth consulting if you are involved in applications.

What do the authors mean by "manufacturing intelligence"? As indicated in the preface: 1) The goal of the emerging field of "manufacturing intelligence" is to model the skills and expertise of manufacturing craftsmen so that intelligent machines can make small batches of parts without human intervention. We believe that this goal will be accomplished by integrating the results of research in knowledge engineering, manufacturing software systems, robotic vision, and robotic manipulation. 2) It is the intention of this book to assess actual progress, in research and practice, towards full development and implementation of manufacturing intelligence in the factory. Further, we consider the rich promise that the book holds for bridging the two areas of manufacturing science and computer science.

The book contains lots of general discussions and comments regarding a wide range of aspects related to manufacturing intelligence. It also raises and discusses many important issues related to applying current research to practical industrial environments.

The book consists of four major parts. Part 1 has two chapters and deals with the machine tool industry. The authors set the tone for the book by specifying the desirability of automating craftsmanship, in particular that related to the operation of machine tools. This will clearly require an AI approach with particular emphasis on knowledge-based systems and machine perception of the environment. A discussion of manufacturing systems is presented and some desirable features for future systems are indicated.

Part 2 is a brief overview of intelligent machines for manufacturing from the point of view of design and contains four chapters. Chapter 3 is a general overview. Chapter 4 is concerned with the "manufacturing brain" and discusses software tools for building intelligent control systems. Software design is discussed in detail and the authors' Cell Management Language (CML) for programming manufacturing systems is presented. Chapter 5 provides a very restricted overview of the