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# Book Reviews

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**COMPUTATIONAL VISION – INFORMATION PROCESSING IN PERCEPTION AND VISUAL BEHAVIOR**, by H. A. Mallot (translated from German by J. S. Allen), Bradford Book, MIT Press, Cambridge, MA, 296 pp., 2001, ISBN 0-262-13381-4, 2001 (Hardback, £34.50)

This book focuses on information processing in early vision which is the stage of visual processing not requiring top-down inferences from higher levels. The book also covers aspects of behaviour-orientated vision such as eye movements and visual navigation.

The book comprises eleven chapters grouped into four parts: Part 1 introduces the conceptual framework of visual information processing and reviews the process of image generation. Part 2 discusses image processing techniques, concentrating on edge detection and the processing of colour information. Part 3 concerns depth perception and presents techniques for extracting depth information from single images and pairs of images using shading, texture and parallax data. Part 4 is devoted to the detection of motion and the spatial structure of the environment using a field of local displacement vectors computed from a sequence of images obtained, for example, by moving the observer's eyes.

The final chapter in Part 4 describes the application of such optical flow techniques to robot navigation control.

The book also includes a concise glossary of the mathematical terms used.

As the topics of many of the chapters are those of complete books in their own right, the treatment is understandably superficial in places. The lack of end-of-chapter exercises reduces the usefulness of the book as a text.

Despite these slight deficiencies and despite being a translation with the occasional unusual technical term (for example, HSB instead of HSI), the book can be recommended as a lucid introduction to a very important area of work for students of computer science, psychology and the neurosciences, as well as anyone with an interest in computer vision.

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**INTRODUCTION TO AI ROBOTICS**, by R. R. Murphy, Bradford Book, MIT Press, Cambridge, MA, 466 pp., 2001, ISBN 0-262-13383-0, 2001 (Hardback, £34.50)

This book is an introductory text on the principles underlying intelligent robots. The book aims to cover all the topics needed to program such robots for applications involving sensing, navigation and path planning.

The book comprises twelve chapters grouped into two parts. Part 1, which constitutes approximately two-thirds of the book, covers the main paradigms of intelligent robotics. The hierarchical, reactive, hybrid and distributed control models are discussed, with the emphasis placed on the implementation of reactive systems. Part 2 discusses robot navigation and describes qualitative and metric-based techniques of path planning and methods of map building using uncertain observations. A chapter concludes Part 2 by giving pointers to future developments.

The book is well organised. Each chapter clearly lists its objectives and includes review questions and exercises, some aimed at the more advanced student, and end notes which add interesting background information to the material covered.

To benefit fully from the discussions on implementation issues, the reader should have some knowledge of object-oriented programming although a background in artificial intelligence or digital circuitry is not required. If such a reader is willing to pursue the practical programming tasks set in the book, she/he should find that it can achieve its stated aim of preparing her/him for embarking on a serious project or competition in the area of intelligent robotics.

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**EVOLUTIONARY ROBOTICS: THE BIOLOGY, INTELLIGENCE AND TECHNOLOGY OF SELF-ORGANIZING MACHINES**, by S. Nolfi and D. Floreano, Bradford Book, MIT Press, Cambridge, MA, 320 pp., 2001, ISBN 0-262-14070-5, 2001 (Hardback, £34.50)

Evolutionary robotics is concerned with the automatic creation of autonomous robots and is inspired by the principle of natural selection and survival of the fittest. The basic idea is to generate a random population of robots, allow them to perform some specified tasks and select those that exhibit the best performances to form new and fitter populations. Robots in a new population might be direct replicas or modified forms of existing robots. Modified robots are obtained by applying genetic operators to an existing system.

This book presents the basic concepts and methodologies of evolutionary robotics, focusing on commonly used techniques such as genetic algorithms and neural networks. The eleven chapters of the book cover the evolution of a variety systems: neural networks (presumably as robot controllers), a controller for obstacle avoidance in navigation, a controller for a garbage collection task, as well as control circuits and complex robot structures. The book also discusses reactive intelligence, adaptation, learning and competitive co-evolution.

The field of evolutionary robotics is very much at the research stage. The techniques presented in the book generally would take too long for real-time application. They are best used in an off-line mode for design rather than operational optimisation.

The book is clearly written and, apart from not having a detailed table of contents, should serve as a good reference for an emerging subject. There are no end-of-chapter exercises. However, the book jacket mentions software that can be obtained freely from a Web page for readers to gain experience with the ideas presented in the book. Although the reviewer has not attempted to locate and use the software, it can be assumed that its availability would enhance the practical value of the book.

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**RESEARCH METHODS FOR POSTGRADUATES, SECOND EDITION**, by Tony Greenfield, Arnold, London, 2002, xiv+370 pp., ISBN 0-340-80656-7 (Pbk,, £19.99)

The front cover of this book carries a quotation from a review of the first edition by John Gribben in the *New Scientist*, calling this "the most useful book any new postgraduate could ever buy" and this accolade seems to be fully warranted. The book has been produced under auspices that ought to ensure high quality. It is explained in the preface written for the first edition that in 1994 the British government, in a white paper called *Realising our Potential*, recommended that all graduates wishing to study for doctorates should first take a one-year master's course in research methods. Several universities have introduced such courses and more are planned. This book has been written as a response to that development, and is meant to serve as a textbook, though without rigidly dictating course content.

The total of contributors is no less than twenty-eight, and the 42 chapters, most of them the work of a single author, are grouped into ten Parts. The first Part, headed Introduction, has six chapters that give useful initial orientation, and the next with three chapters discusses ways of obtaining support. The final Part, headed Future, has a chapter on Protecting and Exploiting Technology and one on Career Opportunities. In between there is an enormous amount of information about the conduct of research, including tools and methods of collecting and analysing data and of presenting the results. There are hints about making the best use of library facilities, and of course the Internet, and about using word processors and spreadsheets and computer packages for statistical analysis and modelling and some less obvious purposes such as guiding 1nnovation.

One use of the book will be simply as a source of recommendations for such things as statistical packages and addresses of websites, but it offers very much more. The contributors have not been afraid to depart from the strictly factual and to give general advice based on their own experience. There is consequently some material that may not be directly applicable to all types of research or research situations, or personalities of researcher, or even known idiosyncrasies of examiners, but all of it is well worth reading and pondering.

Part Four has the title "Creativity" and consists of four chapters whose authors give their views on how creativity can be encouraged. The first discusses the life of Charles Darwin as a supreme innovator and suggests ways of profiting from his example. The last of the chapters brings even this elusive topic down to earth by reviewing websites that provide systematic aids to creativity.

The book certainly merits its acceptance as essential reading for postgraduates and will be valuable to anyone associated in any way with research or with presentation of technical or scientific information of any kind.

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**BEYOND WEBCAMS: AN INTRODUCTION TO ONLINE ROBOTS**, by Ken Goldberg and Roland Siegwart, MIT Press, Cambridge, Mass., 2002, xxi+331 pp., ISBN 0-262-07225-4 (Hbk, £30.95)

It was remarked in an early paper on machine pattern recognition, recalled by Andrew,[1] that the intelligence of computers had an elusive, unnatural quality. The usual inputs and outputs, as bit streams representing numbers or character strings, correspond to only a part of the sensory inputs and motor outputs of humans. At a later stage the Internet was initially a means of transmitting mainly text and numbers but took on a different character when webcams were introduced, especially when commands to direct the webcam were also transmitted. Now, in the same way as robotics altered the character of computing and *AI*, it also alters that of the Internet by letting it interact with the real 3D world.

As the editors recall in their Introduction to the present book, remote-controlled robots were first imagined in science fiction, then were put into practice in the 1940s for the remote handling of radioactive material. Since then they have come to be used to explore the depths of the ocean and surfaces of planets, as well as to defuse bombs and clean up hazardous waste. In these applications the robots were usually accessible only to specialists, but now there is the possibility of having robots freely accessible through the Internet. The book contains detailed descriptions of eighteen systems allowing this.

A distinction is made between remote-controlled robots (telerobots) and simpler devices for remote operation, though it may be difficult to say just where the line should be drawn. A degree of autonomy and hence intelligence built into the robot can allow effective operation despite transmission delays and limited bandwidth of the two-way communication channels linking the robot to its controller. Transmission delays are inevitable in planetary exploration, and the Internet brings the added complication that delays are variable and unpredictable. One of the schemes described in the book is said to operate satisfactorily at times of the day when Internet traffic is light but to be unworkable at other times.

The situation can also be helped by incorporating "intelligence" or sophistication at the controlling end of the link. A facility allowing prediction can help to give effective control despite transmission delays. It can also be useful to have the controller operate on a simulation of the robot environment rather than having all inforamtion about the environment continuously signalled back. The operator's viewpoint can also be adjusted automatically. These measures not only overcome limitations imposed by the links between controller and robot but also those due to the operator's own processing capacity. It is of course expected that as the Internet develops the problems will become less because transmission delays will reduce and bandwidths will increase.

Towards the end of the Introduction by the editors, it is mentioned that as their work went to press there was an announcement that an American company had marketed an off-the-shelf online robot along with all necessary software. The website *www.irobot.com* is quoted, and it gives the information that the company is called the iRobot Corporation and has as its cofounder and chairman Rodney A. Brooks who is also director of the MIT AI Laboratory. A recent book[2] is associated with the project.

The eighteen chapters following the Introduction all describe particular implementations, and are grouped into four Parts according to the aspect that they mainly illustrate. The four papers in the first Part are concerned mainly with problems of manipulation. The first of them describes an underwater robot that was used in exploring the Titanic, and the next refers to two robots that are essentially toys, but nevertheless are instructive as demonstrations, one of them being the robot-tended garden described in an earlier publication by Goldberg.[3] In another chapter a true domestic robot is described that can be instructed remotely to do such things as loading laundry, and checking that doors are locked.

The five papers in Part Two describe applications where robot mobility is a feature. One is about Xavier, a mobile robot that has been in operation at Carnegie Mellon University since 1995, and accepts commands to visit classrooms and offices to deliver messages and jokes. Its link to the Internet is by radio. Another chapter describes the use of helium balloons driven by fans and fully equipped with cameras and microphones so as to constitute Personal Roving Presences that can visit laboratories or listen-in on conferences.

In Part Three the focus is on issues related to control and time-delay, including concrete proposals for a new architecture and detailed mathematical techniques. Plans for control of a vehicle on Mars are discussed, as well as a device that allows a realistic human handshake to be transmitted despite variable time delays. Part Four then reviews some other novel applications including a scheme whereby a user produces a painting remotely, with the painting then delivered by post, and means of remotely examining a solid object in a museum. The final paper is particularly intriguing as it is about a proposal for remote control of micromanipulation of protein crystals as part of a procedure that requires microgravity and has been carried out in the space station. Remote control would obviate the need for a member of the space station crew to acquire the necessary skill and to have an extra demand on his time in orbit. Remote access to scientific equipment could be useful in various other circumstances.

The book is the first to cover the important topic of online robotics and deals with it admirably. In places mathematical treatment is needed, especially in Chapter 11 in Part Three where a means of achieving stability despite variable time delay is explained, but on the whole the presentation is clear and readable.

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