Reviews

Virtual Reality Technology (2nd Edition).
Grigore Burdea and Philippe Coiffet.
Wiley-Interscience. ISBN 0 471 36089 9. US$ 115.

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In 1994, amongst a tide of popular books on virtual reality, Grigore Burdea and Philippe Coiffet published a well researched review of the field. Their book, "Virtual Reality Technology," was notable because it was the first to contain detailed information on force and tactile feedback, areas in which both the authors have conducted extensive research. The book became a classic, and although not intended as such was adopted as the textbook of choice for many university classes in virtual reality. This was due in part to its broad review of the virtual reality technologies based on a strong engineering and scientific focus.

Almost ten years later and Burdea and Coiffet have returned with a second edition that builds on the success of the first. While the content of the second edition is largely the same as the first, with almost identical chapter headings, there is a change in focus towards making this more of an educational tool. From their introduction on, it is clear that the authors intend for this to be used as a textbook. Each chapter is filled with definitions, graphs and equations, and ends with a set of review questions. More significantly the book has an accompanying CD which contains a number of excellent video clips and a complete laboratory manual with instruction on how to build desktop VR interfaces using VRML and Java 3D libraries. The manual is a 120 page book with 18 programming assignments and further homework questions. This book provides the instructor with almost all the material they might need for a course in virtual reality.

The content itself is well written and researched. The authors have taken the material of the first book and updated much of it to reflect a decade of growth in the VR field. A strong theme running through the book is

the rising dominance of PC-based virtual reality platforms, particularly in the chapter on computing architectures. Readers will be exposed to discussion on graphics rendering pipelines, PC graphics architecture, and clusters. In the fast changing world of PC hardware some of the hardware mentioned has already become dated, but the content still gives an essential grounding in the technological principles.

Discussion of hardware architectures is also complemented by chapters on input and display devices, modeling, and programming toolkits. These were also in the original addition, but have been updated to reflect the invention of devices such as the Phantom force-feedback arm, or new software toolkits such as Java 3D. Interestingly, rather than having a whole chapter on force feedback, this now becomes part of a more general chapter on output devices. Burdea's own work on the Rutgers Master glove with force feedback is barely mentioned at all.

As with any book on a field as rich as virtual reality it is impossible to cover all possible topics in significant depth. The authors handle this by providing hundreds of references to the relevant technical literature, enabling readers to study topics in as much depth as they are interested in. In the first book a separate bibliography and list of VR companies and laboratories was provided at the end of the book. In the second edition, references are provided at the end of each chapter. This makes each chapter more self contained and suitable for studying in almost any order, once the introduction has been read. In this way the book provides an ideal introduction to a student or researcher who will want to know where to find out more.

Despite its considerable strengths there are a number of weaknesses the authors might want to address when they produce a third edition. Some of these are minor. For example, the first edition had a collection of color photographs showing a variety of VR technologies and environments. Unfortunately these are missing from the second edition, and although the many black and white pictures are excellent, there are aspects of the technology that can be best understood by seeing it in color. As a teaching tool, it would have been good for the authors to provide more code samples on the enclosed

CD. There are some examples of code for interfacing with a 5DT dataglove or Polhemus Fastrak, but little else. Unfortunately, students using the laboratory manual will have to type in most of the code samples themselves and find VRML resources and sample files on the web. Most students will be able to do this with no problem, but perhaps the authors will add this type of material, and source code for all the examples in the book, to the recently-launched companion website *www.vrtechnology.org*. This is common practice for engineering textbooks like this.

There are also areas that the text content could be improved. In general it is excellent, especially the chapters on virtual reality technology. However the authors could provide more information about the human-computer interface aspects of VR interface design. This is covered to some extent in a chapter on human factors, but this is focusing more on the mechanics of experimental design rather than interface metaphors and interaction techniques. There is a rich research literature on three dimensional user interface design and interaction that Burdea and Coiffet could draw on to fill in the gaps, much of it published or referred to in *Presence*.

A second area of possible improvement is the addition of material on future research directions. The book finishes with a chapter on emerging applications of virtual reality, including such topics as virtual prototyping, teleoperation and information visualization. It would also be good to provide an overview of important emerging research trends that could be significant in five to ten years time. For example, transitional interfaces which allow people to move smoothly between reality and virtuality, retinal scanning displays, tangible input metaphors, and large-scale collaborative virtual environments. Material that highlights the potential fertile areas for research would be of particular use to students who might be considering graduate work in VR.

In summary, Burdea and Coiffet have taken a strong book and made it even better. The second edition is tailored to the needs of students and would make an outstanding textbook for an introduction to virtual reality course. There are some limitations to the material and some improvements that could be made, but none so great that I would have any trouble endorsing this book as a must have for any student or researcher seriously interested in virtual reality.