Book Review

Virtual Reality Technology. By Grigore Burdea and Philippe Coiffet, Second Edition with CD-ROM, Wiley, New Jersey, 2003, ISBN 0471360899, \$115.00

Virtual reality (VR) is a very powerful and compelling computer application by which humans can interface and interact with computer-generated environments in a way that mimics real life and engages all the senses. Although its most widely known application is in the entertainment industry, the real promise of VR lies in such fields as medicine, engineering, oil exploration, and the military, to name just a few. Through VR scientists can triple the rate of oil discovery, pilots can dog-fight numerically superior "bandits," and surgeons can improve their skills on virtual (rather than real) patients. At a time when VR is experiencing something of a comeback, and is delivering real results and benefits, the expert authors Dr Grigore Burdea (Rutgers-State University of New Jersey) and Dr Philippe Coiffet (French National Scientific Research Center) have produced a timely tome that will be of immense value to practitioners and students alike. Although the authors wrote the first edition as a research review rather than a textbook, the second edition has tremendously enhanced the field. It has developed into a valuable textbook in terms of structuring and integrating VR technology and serving as a major resource reference for researchers and practitioners.

Turning to consider the book, its content and layout in some detail, we see that early in the book the authors identify what they consider to be the key aspects of a "VR system architecture." At the start of each chapter they then highlight the position of the chapter material within this architecture. This simple mechanism clearly shows where each aspect of the technology is located in the bigger picture. The introductory chapter deals primarily with a history of VR, showing some of the earliest systems, but also speculating on growth trends and the potential of the technology. This is an interesting but generally lightweight chapter and perhaps the only area with which I was a little disappointed.

Chapters 2, 3, and 4 consider the system hardware, with chapters 2 and 3 concentrating on input/output hardware, and chapter 4 focusing of the computer platforms. I found this logically written and presented, providing an excellent overview, and in most instances good detail of the hardware and its operation. Given the number of devices highlighted it could be argued that there is insufficient detail and while this may be true for the expert reader I feel that it is well rounded to suit the student reader. At this same time the extensive list of references available at the end of each chapter should satisfy many of the demands of the expert. In chapter 4, dealing with the platforms, I was pleased to see that considerable effort has been focused on the PC-based systems which are becoming increasingly powerful and acceptable both to the public and commercial/professional user. Although the technology at this end of the market changes and dates so quickly the importance of this format makes it a valuable addition.

In chapter 5, dealing with modeling, the authors explain the difference between, the use of, and advantages with different modeling techniques including polygon-based and NURBS-based models and the principles of physical modeling, behavioral modeling, and database management. There is no doubt that the content of this chapter will stretch those coming into the area with limited mathematical knowledge while perhaps falling short for those with specialist modeling requirements. Getting the right blend for the novice student and expert reader is always going to be difficult. Nonetheless, I believe that the blend achieved suits a wide (the widest) range of audience.

The sixth chapter considers programming and not a programmer's manual per se that offers excellent explanations of the key limitations, advantages and idiosyncrasies of some of the better known programming languages. Having studied this the reader is left in the position where they now possess the basic knowledge to consider some serious VR programming and this is no mean achievement given all the other content of the book. A user's perspective is presented in chapter 7 looking at the human factors. Unlike many texts which deal only with visual interaction quality, this book covers a wide range of effects including the nature of the input interface and multiple interactions with objects and other humans. This chapter not only explains the value of human factors studies, it actually gives a fairly complete explanation of how they are conducted. The chapter concludes with a discussion of health and safety issues including the causes and prevention of simulation sickness.

The final two chapters focus on the applications. Given the number of applications that are or have been developed and the natural bias of any reader, getting the right blend will never be easy or perhaps even possible. Nonetheless, the authors have tried and largely succeeded in identifying the key generic areas where VR is having or is likely to have an impact. It would be all easy to nit-pick over the exact choice which will never be to everyone's liking, but there is a good blend of current medical, entertainment, and military uses followed by a brief exploration of emerging application trends.

The organization of this edition is commendable, logically organized and presented with clarity. In general, this edition seems to cover most of the important topics in the field. It assumes a role of an impressive manual for the VRML/Java 3D Lab in helping organize the very necessary VR teaching laboratories as companions to teaching a VR class. The authors' writing style cleverly accommodates undergraduate readers and researchers from other fields. The materials in this edition are technically valuable and up-todate. The authors provide additional, appropriate diagrams and photographs, which allows a wider range of readers to grasp the concepts presented. Unlike previous texts, the authors also devote sections of the text to PC architectures as well as those underpinning their graphics "supercomputer" counterparts. The advent of low-cost, high-performance graphics capabilities for PC platforms has been a major stimulus in the resurrection of interest in VR, and these systems are given a satisfactory level of attention. Indeed, despite the fact that the graphic cards covered in the book have been superseded since publication, the authors have defined the key features and benchmarks to be aware of so well (e.g., graphics pipeline characteristics, rendering terminology, etc.) that the reader will be able to make his or her own judgments with regard to postpublication developments in this rapidly expanding field.

As has often been the case in VR texts, a bias towards the North American side of the Atlantic is evident, from both an historical perspective and in the applications examples quoted. True, VR was born in the US, but there are many international applications of the technology well worth covering that have been omitted from this book—particularly those that have "migrated" from the academic or corporate research labs into real world settings. Another location where I found deficiencies was Chapter 7—Human Factors in VR. Certainly, the collection of user performance studies is valuable, but the coverage of how to execute a human-centered approach to the design of VR systems for (for example) real-world applications needs more detailed attention, specially as it is now known that such an approach carries with it a high probability of success, not only in the development of meaningful VE content and the selection of appropriate display/interaction technologies, but also in postdelivery cost-benefit and human performance analyses.

Despite these minor criticisms, the overall Burdea and Coiffet partnership has done an excellent job at revising the first edition of their book. The inclusion of a CD with video excerpts of technologies and applications, not to mention the VRML/Java laboratory examples represents a major step towards bringing the concept of real-time interaction in VR to life—two-dimensional book pages (no matter how hard one tries!) always fail to achieve this.

Instructors in need of a textbook for undergraduate or graduate introductory courses, students looking for a guide to the field of VR, persons interested in knowing something about the current state of VR, and practitioners, researchers, and businesses involved in VR, will all find this a must-have book. A textbook of this caliber is a welcomed asset for researchers, universities, and others in the field.

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