3DM: A Three Dimensional Modeler Using a Head-Mounted Display

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Abstract

3dm is a three dimensional (3D) surface modeling program that draws techniques of model manipulation from both CAD and drawing programs and applies them to modeling in an intuitive way. 3dm uses a head-mounted display (HMD) to simplify the problem of 3D model manipulation and understanding. A HMD places the user in the modeling space, making three dimensional relationships more understandable. As a result, 3dm is easy to learn how to use and encourages experimentation with model shapes.

1 Introduction

The use of interactive 3D environments has increased the demand for complex 3D models.[9] The 3D environments that provide a sense of telepresence or "virtual reality" require a large number of models in order to give the user the illusion of being in a specific place. This demand for more models has highlighted the fact that most modeling systems are difficult to use for all but a small number of experts.[9] Through identification and removal of some of the fundamental obstacles to modeling we hope to make it accessible to more users.

Typical techniques used to select and display objects are a major hindrance to 3D modeling.[3] To place an object in 3D requires six parameters: the position (three) and the orientation (three). Most modeling systems (modelers) must settle for a 2D mouse augmented by a keyboard for this purpose. This mismatch results in difficult placement and picking of objects in modeling space. The display of models usually takes the form of a projection onto a 2D monitor. This has the effect of making spatial relationships unclear. Technological improvements to 3D model display and manipulation hardware can remove these barriers to model creation and understanding.

Current virtual reality technology provides one solution to more intuitive modeling. A HMD system gives the ability to understand complex spatial relationships of models by placing the user in the model's world. Within this type of system, a hand-held pointing device supplies users with the ability to specify 3D relationships through direct

3D manipulation. As a result, the user can build the virtual world from *within* the virtual world.

Our source of inspiration for designing a user interface for a HMD-based modeler is the current software used for 2D modeling. At one time, creating 2D models required cumbersome CAD programs. This software took a long time to learn and often did not provide real-time interaction. Now, however, 2D drawings can be manipulated by even the most casual users of personal computers. This revolution is in part the result of intuitive drawing programs like MacDraw. One of the keys to MacDraw's success is its inherent simplicity. Most work done with it requires no reading or use of the keyboard. Rather, it provides a palette of tools which is always available next to the model. To change modes, the user simply selects the tool from the palette using the mouse. The process of 3D modeling can become more accessible if some of the lessons learned from this evaluation of 2D modeling can be applied to 3D modeling systems.

This paper presents a HMD-based system called **3dm** which simplifies the task of 3D modeling by implementing the concepts introduced above. Basic techniques for working within 3dm's virtual world are described to show how users access the various features. The implementation of 3dm is described through a presentation of its most useful commands. Finally, the results of actually using 3dm are presented with an emphasis on new techniques that can be applied within other virtual worlds.

2 Prior Work

A large body of work has been done on 3D modeling. Although 3D *input* devices have been used to enhance modelers, very little modeling has been done with a HMD. Some examples of modeling with six degree-of-freedom input devices are [1] and [8], but both of those used traditional 2D displays. Previous uses of HMD systems have concentrated more on exploration of virtual worlds rather than creating or modifying them. Some examples of this work with HMD's can be found in [5].

Modeling using a HMD system has been explored by Clark.[4] Users of Clark's system created parametric surfaces by manipulating control points on a wire-frame grid. This system highlighted the utility of using a HMD for improved understanding and interaction with models. Like Clark's system, 3dm relies on a HMD to help simplify modeling, but 3dm's intuitive user interface design also makes it easy to learn and use.

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Proceedings {of The} 1992 Symposium on INteractive 3D Graphics, Cambridge, Massachusetts, 29 March-1 April 1992 ,1992   **Proceedings of the 1992 Symposium on Interactive 3D Graphics** ,1999   **Proceedings** David Zeltzer,1992   *Proceedings* ,1992   **Proceedings** Association for Computing Machinery,1992-01-01   Smart Graphics Andreas Butz,2006-07-06 This book constitutes the refereed proceedings of the 6th International Symposium on Smart Graphics SG 2006 held in Vancouver Canada July 2006 The book presents 19 revised full papers and 8 revised short papers The papers are organized in topical sections on intelligent text processing perceptive systems smart visualization visual features sketching and graphical abstraction intelligent image and film composing as well as smart interaction   *Proceedings of the Conference on Experimental Research in Computer Systems* Lawrence Snyder,1997   *Virtual Environments '95* Martin Göbel,2012-12-06 Virtual Environments VE the new dimension in man machine communication have been developed and experienced in Europe since 1990 In early 1993 the Eurographics Association decided to establish a working group on Virtual Environments with the aim to communicate advances in this fascinating area on a scientific and technical level In September 1993 the first workshop on VEs was held in Barcelona Spain in conjunction with the annual Eurographics conference The workshop brought together about 35 researchers from Europe and the US The second workshop was held together with Imagina 95 in Monte Carlo Monaco This time around 40 researchers from Europe the US but also from Asia met for a 2 day exchange of experience Needless to say as in all Eurographics workshops we found the atmosphere very open and refreshing The workshops were sponsored by ONR Office of Naval Research UK US Army Research Institute UK University of Catalonia Spain EDF France CAE France INA France and IGD Germany and locally organized by Daniele Tost and Jaques David While in the first workshop in 1993 many concepts in VE were presented the 95 workshop showed up various applications in different areas and demonstrated quite clearly that Virtual Environments are now used in interactive applications   **Visualization in Scientific Computing '95** Riccardo Scateni,Jarke J.van Wijk,Pietro Zanarini,2012-12-06 Visualization is nowadays indispensable to get insight into the huge amounts of data pro duced by large scale simulations or advanced measurement devices The use of com puter graphics for scientific purposes has become a well established discipline known as Scientific Visualization Many problems still have to be solved and hence the field is a very active area for research and development This book represents results of the sixth in a well established series of international workshops on Visualization in Scien tific Computing organized by the EUROGRAPHICS Association in collaboration with CRS4 Center for Advanced Studies Research and Development in Sardinia held from May 3 to May 5 1995 in Chia Italy The thirteen contributions selected for this volume cover a wide range of topics ranging from detailed algorithmic studies to searches for new metaphors A rough di vision can be made into the parts interaction irregular meshes volume rendering and applications Interaction in three dimensions is a challenging area for research The use of three dimensional user interfaces for more

natural manipulation of three dimensional data and their visualization is natural but is far from trivial to realize Pang et al investigate the use of common objects such as spray cans and carving knives as metaphors for visualiza tion tools in order to provide an intuitive and natural three dimensional user interface Gibson uses a voxel based data representation not only for visualization but also for physical modeling of objects A prototype system under development for haptic explo ration is discussed **Smart Sensing and Context** Gerd Kortuem,Joe Finney,Rodger Lea,Vasughi Sundramoorthy,2007-10-05 This book constitutes the refereed proceedings of the Second European Conference on Smart Sensing and Context EuroSSC 2007 held in Kendal England October 2007 The 16 revised full papers and one invited paper were carefully reviewed and selected from over 51 submissions The papers are organized in topical sections on spatial and motion context human behavior as context context frameworks and platforms and sensing technologies and case studies *Algorithmic Foundations of Robotics VI* Michael Erdmann,David Hsu,Mark Overmars,A. Frank van der Stappen,2005-06-23 Robot algorithms are abstractions of computational processes that control or reason about motion and perception in the physical world Because actions in the physical world are subject to physical laws and geometric constraints the design and analysis of robot algorithms raise a unique combination of questions in control theory computational and differential geometry and computer science Algorithms serve as a unifying theme in the multi disciplinary field of robotics This volume consists of selected contributions to the sixth Workshop on the Algorithmic Foundations of Robotics This is a highly competitive meeting of experts in the field of algorithmic issues related to robotics and automation Advances in Multimedia Information Processing - PCM 2005 Yo-Sung Ho,Hyoung Joong Kim,2005-10-19 We are delighted to welcome readers to the proceedings of the 6th Pacific Rim Conference on Multimedia PCM The first PCM was held in Sydney Australia in 2000 Since then it has been hosted successfully by Beijing China in 2001 Hsinchu Taiwan in 2002 Singapore in 2003 and Tokyo Japan in 2004 and finally Jeju one of the most beautiful and fantastic islands in Korea This year we accepted 181 papers out of 570 submissions including regular and special session papers The acceptance rate of 32% indicates our commitment to ensuring a very high quality conference This would not be possible without the full support of the excellent Technical Committee and anonymous reviewers that provided timely and insightful reviews We would therefore like to thank the Program Committee and all reviewers The program of this year reflects the current interests of the PCM s The accepted papers cover a range of topics including all aspects of multimedia both technical and artistic perspectives and both theoretical and practical issues The PCM 2005 program covers tutorial sessions and plenary lectures as well as regular presentations in three tracks of oral sessions and a poster session in a single track We have tried to expand the scope of PCM to the artistic papers which need not to be strictly technical **Fundamentals of Wearable Computers and Augmented Reality** Woodrow Barfield,Thomas Caudell,2001-01-01 Fundamentals of Wearable Computers and Augmented Reality presents a broad coverage of the technologies and interface design issues associated with wearable computers and augmented reality displays

both rapidly developing fields in computer science engineering and human interface design This book presents concepts related to the use and underlying technologies of augmented reality and wearable computer systems There are many application areas for this technology such as medicine manufacturing training and recreation Wearable computers will allow a much closer association of information with the user than is possible with traditional desktop computers This book addresses an important aspect of wearable computers and augmented reality either from the conceptual or from an application framework Given the wide coverage of topics on issues related to the display of computer generated images in the environment this book can be used as a text for computer science computer engineering and interface design courses

4th International Conference on Nanotechnologies and Biomedical Engineering Ion Tiginyanu,Victor Sontea,Serghei Railean,2019-09-17 This book gathers the proceedings of the 4th International Conference on Nanotechnologies and Biomedical Engineering held on September 18 21 2019 in Chisinau Republic of Moldova It continues the tradition of the previous conference proceedings thus reporting on both fundamental and applied research at the interface between nanotechnologies and biomedical engineering Topics include developments in bio micro nanotechnologies and devices biomedical signal processing biomedical imaging biomaterials for biomedical applications biomimetics bioinformatics and e health and advances in a number of related areas The book offers a timely snapshot of cutting edge multidisciplinary research and developments in the field of biomedical and nano engineering **Geometric Constraint Solving and Applications** Beat Brüderlin,Dieter Roller,2012-12-06 Geometric constraint programming increases flexibility in CAD design specifications and leads to new conceptual design paradigms This volume features a collection of work by leading researchers developing the various aspects of constraint based product modeling In an introductory chapter the role of constraints in CAD systems of the future and their implications for the STEP data exchange format are discussed The main part of the book deals with the application of constraints to conceptual and collaborative design as well as state of the art mathematical and algorithmic methods for constraint solving *Virtual Reality Software & Technology* Gurminder Singh,Steven K. Feiner,Daniel Thalmann,1994 Few technologies in recent years have attracted as much scientific media and public attention as Virtual Reality By providing a profoundly new paradigm for human computer interaction it is fundamentally changing the way people use and think about computers Despite being in its infancy Virtual Reality has found applications in such varied fields as entertainment interactive arts medicine architecture security education and financial analysis The articles collected here were selected after thorough review and describe the state of the art in Virtual Reality software and technology Included are the latest results in software architectures interaction techniques and devices modeling techniques and applications Advances in Ergonomics Modeling and Usability Evaluation Halimahtun Khalid,Alan Hedge,Tareq Z. Ahram,2010-06-23 Taking the field of human factors and ergonomics beyond state of the art this volume focuses on advances in the use of ergonomics modeling and on the evaluation of usability a critical aspect of any

human technology system The research described in the book s 70 chapters is an outcome of dedicated research by academics and practitioners from around the world and across disciplines It provides an invaluable resource for evaluating products and environments This volume is one of seven titles in the Advances in Human Factors and Ergonomics Series

Algorithms and Data Structures Frank Dehne,Jörg Rüdiger Sack,Michiel Smid,2003-10-02 The refereed proceedings of the 8th International Workshop on Algorithms and Data Structures WADS 2003 held in Ottawa Ontario Canada in July August 2003 The 40 revised full papers presented together with 4 invited papers were carefully reviewed and selected from 126 submissions A broad variety of current aspects in algorithmics and data structures is addressed *Texturing & Modeling* David S. Ebert,2003 The third edition of this classic tutorial and reference on procedural texturing and modeling is thoroughly updated to meet the needs of today s 3D graphics professionals and students New for this edition are chapters devoted to real time issues cellular texturing geometric instancing hardware acceleration futuristic environments and virtual universes In addition the familiar authoritative chapters on which readers have come to rely contain all new material covering L systems particle systems scene graphs spot geometry bump mapping cloud modeling and noise improvements There are many new spectacular color images to enjoy especially in this edition s full color format As in the previous editions the authors who are the creators of the methods they discuss provide extensive practical explanations of widely accepted techniques as well as insights into designing new ones New to the third edition are chapters by two well known contributors Bill Mark of NVIDIA and John Hart of the University of Illinois at Urbana Champaign on state of the art topics not covered in former editions An accompanying Web site www texturingandmodeling com contains all of the book s sample code in C code segments all updated to the ANSI C Standard or in RenderMan shading language plus files of many magnificent full color illustrations No other book on the market contains the breadth of theoretical and practical information necessary for applying procedural methods More than ever Texturing Modeling remains the chosen resource for professionals and advanced students in computer graphics and animation New chapters on procedural real time shading by Bill Mark procedural geometric instancing and real time solid texturing by John Hart hardware acceleration strategies by David Ebert cellular texturing by Steven Worley and procedural planets and virtual universes by Ken Musgrave New material on Perlin Noise by Ken Perlin Printed in full color throughout Companion Web site contains revised sample code and dozens of images

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Table of Contents 1992 Symposium On Interactive 3d Graphics

1. Understanding the eBook 1992 Symposium On Interactive 3d Graphics
    - The Rise of Digital Reading 1992 Symposium On Interactive 3d Graphics
    - Advantages of eBooks Over Traditional Books
2. Identifying 1992 Symposium On Interactive 3d Graphics
    - Exploring Different Genres
    - Considering Fiction vs. Non-Fiction
    - Determining Your Reading Goals
3. Choosing the Right eBook Platform
    - Popular eBook Platforms
    - Features to Look for in an 1992 Symposium On Interactive 3d Graphics
    - User-Friendly Interface
4. Exploring eBook Recommendations from 1992 Symposium On Interactive 3d Graphics
    - Personalized Recommendations
    - 1992 Symposium On Interactive 3d Graphics User Reviews and Ratings
    - 1992 Symposium On Interactive 3d Graphics and Bestseller Lists

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