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Preface

1 Introduction

Imagine a virtual world with digital creatures that looks like real life, sounds like real life, and even feels like real life. Imagine a virtual world not only with nice three-dimensional graphics and animations, but also with realistic physical laws and forces. This virtual world could be familiar, reproducing some parts of our reality, or unfamiliar, with strange "physical" laws and artificial life forms.

As a researcher interested in the sciences of complexity, the idea of a conference about virtual worlds emerged from frustration. In the last few years, there has been an increasing interest in the design of artificial environments using image synthesis and virtual reality. The emergence of industry standards such as VRML [1] is an illustration of this growing interest. At the same time, the field of Artificial Life has addressed and modeled complex phenomena such as self-organization, reproduction, development, and evolution of artificial life-like systems [2]. One of the most popular works in this field has been Tierra designed by Tom Ray: an environment producing synthetic organisms based on a computer metaphor of organic life in which CPU time is the "energy" resource and memory is the "material" resource [3]. Memory is organized into informational patterns that exploit CPU time for self-replication. Mutation generates new forms, and evolution proceeds by natural selection as different creatures compete for CPU time and memory space.

However, very few works have used an Artificial Life approach together with Virtual Reality, or at least with advanced three-dimensional graphics. Karl Sims was probably one of the first researchers working in this direction. He designed a flexible genetic system to specify solutions to the problem of being a "creature" built of collections of blocks, linked by flexible joints powered by "muscles" controlled by circuits based on an evolvable network of functions [4]. Sims embedded these "block creatures" in simulations of real physics, such as in water or on a surface. These experiments produced a bewildering and fascinating array of creatures, like the swimming "snake" or the walking "crab". Demetri Terzopoulos and his colleagues have also created a virtual marine world inhabited by realistic artificial fishes [5]. They have emulated not only the appearance, movement, and behavior of individual animals, but also the complex group behaviors evident in many aquatic ecosystems. Each animal was modeled holistically as an autonomous agent situated in a simulated physical world.

Considering recent advances in both Artificial Life and Virtual Reality, catalyzed by the development of Internet , a unified approach seemed to be one of the most promising trend for the synthesis of realistic and imaginary virtual worlds. Thus, the primary goal of this conference was to set up an opportunity for researchers from both fields to meet and exchange ideas.

In July 1998, the first international conference on virtual worlds was held at the International Institute of Multimedia. It brought together scientists involved in Virtual Reality, Artificial Life, Multi-agent Systems, and other fields of computer science and electronic art, all of whom share a common interest in the synthesis of digital worlds

on computers. The diversity and quality of the work reported herein reflects the impact that this new trend of research has had on the scientific community.

2 The Proceedings

The production of these proceedings was a major task, involving all the authors and reviewers. As the editor, I have managed the proceedings in a classical way. Every contribution that was accepted for presentation at the conference is in the proceedings. The program committee felt that these papers represented mature work of a level suitable for being recorded, most of them without modification, some of them requiring modifications to be definitively accepted. Besides the classical goal of a proceedings volume, the idea was to recapture in print the stimulating mix of ideas and works that were presented. Therefore, the papers are organized to reflect their presentation at the conference. There were three invited plenary speakers: Nadia Thalmann, Jeffrey Ventrella, and Yaneer Bar-Yam. Two of them choose to provide a printed version of their lecture. There were nine sessions, most of them in parallel, for a total of 36 papers in all, recorded here roughly in the order in which they were presented.

The material covered in these proceedings is diverse and falls naturally into a number of categories: Virtual Reality, Artificial Life, Multi-agent Systems, Complexity, Applications of Virtual Worlds, and last but not least, Virtual Worlds and Art. This collection of papers constitutes a good sample of works that appear necessary if we want to design large and realistic virtual worlds on the Internet in the near future.

3 Acknowledgments

Many people and groups contributed to the success of the conference. My sincere thanks go out to all of them. I would like to thank first all the distinguished authors who contributed to this volume for their willingness to share the excitement of a new enterprise. The committee which selected the papers included the editor along with :

Michael *Best* (MIT Media Lab., USA),
Yaneer *Bar-Yam* (NECSI, USA),
Bruce *Blumberg* (MIT Media Lab., USA),
Eric *Bonabeau* (Santa Fe Institute, USA),
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Jeffrey *Ventrella* (Rocket Science Games, USA),
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Chris *Winter* (British Telecom, UK).

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I had a significant help for organizing and running this conference. Most of the staff of the International Institute of Multimedia fall under this category. First and foremost, I have to thank Claude Vogel who was encouraging and supporting me at every step of the project. Monika Siejka performed an enormous amount of work. She was effectively my co-organizer. It was a pleasure to work with Monika. Olga Kisseleva was another co-organizer. Olga was in charge of the artistic part of the conference. Thanks are also due to Sophie Dussault and Sylvie Perret for their help. Finally, all the staff of the Pôle Universitaire Léonard de Vinci were once again a pleasure to work with.

4 Conclusion

The terms “virtual worlds” generally refer to Virtual Reality applications or experiences. In this volume, I have extended the use of these terms to describe experiments that deal with the idea of synthesizing digital worlds on computers. Thus, Virtual Worlds (VW) could be defined as the study of computer programs that implement digital worlds with their own “physical” and “biological” laws. Constructing such complex artificial worlds seems to be extremely difficult to do in any sort of complete and realistic manner. Such a new discipline must benefit from a large amount of work in various fields: Virtual Reality, Artificial life, Cellular Automata, Evolutionary Computation, Simulation of Physical Systems, and more. Whereas Virtual Reality has largely concerned itself with the design of three-dimensional graphical spaces and Artificial Life with the simulation of living organisms, VW is concerned with the simulation of worlds and the synthesis of digital universes.

This approach is something broader and more fundamental. Throughout the natural world, at any scale, from particles to galaxies, one can observe phenomena of great complexity. Research done in traditional sciences such as biology and physics has

shown that the basic components of complex systems are quite simple. It is now a crucial problem to elucidate the universal principles by which large numbers of simple components, acting together, can self-organize and produce the complexity observed in our universe [6]. Therefore, VW is also concerned with the formal basis of synthetic universes. In this framework, the synthesis of virtual worlds offers a new approach for studying complexity.

I hope that the reader will find in this volume many motivating and enlightening ideas. My wish is that this book will contribute to the development and further awareness of the new and fascinating field of Virtual Worlds. As of now, the future looks bright.

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May 1998 Jean-Claude Heudin

Table of Contents

Invited Paper

Real Face Communication in a Virtual World 1
W.-S. Lee, E. Lee, and N. Magnenat Thalmann

Virtual Reality (1)

Animated Impostors for Real-Time Display of Numerous Virtual Humans 14
A. Aubel, R. Boulic, and D. Thalmann

Can We Define Virtual Reality ? The MRIC Model 29
D. Verna and A. Grumbach

Distortion in Distributed Virtual Environments 42
M.D. Ryan and P.M. Sharkey

VRML Based Behaviour Database Editor 49
J.F. Richardson

Virtual Reality (2)

The Scan&Track Virtual Environment 63
S.K. Semwal and J. Ohya

CyberGlass: Vision-Based VRML2 Navigator 81
C. Numaoka

Work Task Analysis and Selection of Interaction Devices
in Virtual Environments
T. Flaig 88

Effect of Stereoscopic Viewing on Human Tracking Performance
in Dynamic Virtual Environments 97
P. Richard, P. Hareux, P. Coiffet, and G. Burdea

Virtual Reality (3)

Interactive Movie: A Virtual World with Narratives 107
R. Nakatsu, N. Tosa, and T. Ochi

Real-Image-Based Virtual Studio 117
J.I. Park and S. Inoue

Pop-Out Videos 123
G.U. Carraro, J.T. Edmark, and J.R. Ensor

Color Segmentation and Color Correction Using Lighting and White Balance Shifts 129
P. Gerard, C.B. Philips, and R. Jain

Invited Paper

Designing Emergence in Animated Artificial Life Worlds 143
J. Ventrella

Artificial Life

ALife Meets the Web: Lessons Learned 156
L. Pagliarini, A. Dolan, F. Menczer, and H.H. Lund

Information Flocking: Data Visualisation in Virtual Worlds Using Emergent Behaviours 168
G. Proctor and C. Winter

Nerve Garden: A Public Terrarium in Cyberspace 177
B. Damer, K. Marcelo, and F. Revi

A Two-Dimensional Virtual World to Explain the Genetic Code Structure ? 186
J.L. Tyran

Multi-Agent

Grounding Agents in EMud Artificial Worlds 193
A. Robert, F. Chantemargue, and M. Courant

Towards Virtual Experiment Laboratories: How Multi-Agent Simulations Can Cope with Multiple Scales of Analysis and Viewpoints 205
D. Servat, E. Perrier, J.P. Treuil, and A. Drogoul

A Model for the Evolution of Environments 218
C. Lattaud and C. Cuenca

AReVi: A Virtual Reality Multi-Agent Platform 229
P. Reigner, F. Harrouet, S. Morvan, J. Tisseau, and T. Duval

Complexity

Investigating the Complex with Virtual Soccer 241
I. Noda and I. Frank

Webots: Symbiosis Between Virtual and Real Mobile Robots 254
O. Michel

Vision Sensors on the Webots Simulator 264
Y.L. de Meneses and O. Michel

Grounding Virtual Worlds in Reality 274
G. Hutzler, B. Gortais, and A. Drogoul

Applications (1)

Growing Virtual Communities in 3D Meeting Spaces 286
F. Kaplan, A. McIntyre, C. Numaoka, and S. Tajan

A Mixed 2D/3D Interface for Music Spatialization 298
F. Pachet and O. Delerue

Organizing Information in 3D 308
D. Doegl and C. Cavallar

Human Centered Virtual Interactive Image World for Image Retrieval 315
H. Kimoto

Applications (2)

Virtual Great Barrier Reef: A Theoretical Approach Towards an Evolving, Interactive VR Environment Using a Distributed DOME and CAVE System 323
S.T. Refsland, T. Ojika, T. Defanti, A. Johnson, J. Leigh, C. Loeffler, and X. Tu

The Developement of an Intelligent Haulage Truck Simulator for Improving the Safety of Operation in Surface Mines 337
M. Williams, D. Schofield, and B. Denby

Navigation in Large VR Urban Models 345
V. Bourdakis

Virtual Worlds and Art

Art and Virtual Worlds 357
O. Kisseleva

Las Meninas in VR: Storytelling and the Illusion in Art 360
H. Bizri, A. Johnson, and C. Vasilakis

Mitologies: Traveling in the Labyrinths of a Virtual World 373
M. Roussos and H. Bizri

Aggregate Worlds: Virtual Architecture Aftermath 384
V. Muzhesky

Zeuxis vs. Reality Engine: Digital Realism and Virtual Worlds 394
L. Manovich

Avatars: New Fields of Implication 406
R. Hayem, T. Fourmaintraux, K. Petit, N. Rauber, and O. Kisseleva

Author Index 411