ENTERTAINMENT COMPUTING
Technologies and Applications
IFIP was founded in 1960 under the auspices of UNESCO, following the First World Computer Congress held in Paris the previous year. An umbrella organization for societies working in information processing, IFIP's aim is two-fold: to support information processing within its member countries and to encourage technology transfer to developing nations. As its mission statement clearly states,

IFIP's mission is to be the leading, truly international, apolitical organization which encourages and assists in the development, exploitation and application of information technology for the benefit of all people.

IFIP is a non-profitmaking organization, run almost solely by 2500 volunteers. It operates through a number of technical committees, which organize events and publications. IFIP's events range from an international congress to local seminars, but the most important are:

- The IFIP World Computer Congress, held every second year;
- open conferences;
- working conferences.

The flagship event is the IFIP World Computer Congress, at which both invited and contributed papers are presented. Contributed papers are rigorously refereed and the rejection rate is high.

As with the Congress, participation in the open conferences is open to all and papers may be invited or submitted. Again, submitted papers are stringently refereed.

The working conferences are structured differently. They are usually run by a working group and attendance is small and by invitation only. Their purpose is to create an atmosphere conducive to innovation and development. Refereeing is less rigorous and papers are subjected to extensive group discussion.

Publications arising from IFIP events vary. The papers presented at the IFIP World Computer Congress and at open conferences are published as conference proceedings, while the results of the working conferences are often published as collections of selected and edited papers.

Any national society whose primary activity is in information may apply to become a full member of IFIP, although full membership is restricted to one society per country. Full members are entitled to vote at the annual General Assembly, National societies preferring a less committed involvement may apply for associate or corresponding membership. Associate members enjoy the same benefits as full members, but without voting rights. Corresponding members are not represented in IFIP bodies. Affiliated membership is open to non-national societies, and individual and honorary membership schemes are also offered.
ENTERTAINMENT COMPUTING

Technologies and Applications

IFIP First International Workshop on Entertainment Computing (IWECC 2002)
May 14-17, 2002, Makuhari, Japan

Organized in cooperation with the Information Processing Society of Japan (IPSJ)

Edited by

Ryohei Nakatsu
Kwansei Gakuin University/ATR
Japan

Junichi Hoshino
University of Tsukuba / PRESTO, JST
Japan

SPRINGER SCIENCE+BUSINESS MEDIA, LLC
The original version of the book frontmatter was revised: The copyright line was incorrect. The Erratum to the book frontmatter is available at DOI: 10.1007/978-0-387-35660-0_65
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREFACE</td>
<td>xv</td>
</tr>
<tr>
<td>PROCEEDINGS EDITORS</td>
<td>xvii</td>
</tr>
<tr>
<td>SUPPORTING ORGANIZATIONS</td>
<td>xvii</td>
</tr>
<tr>
<td>COMMITTEES</td>
<td>xix</td>
</tr>
<tr>
<td><strong>1. INVITED TALKS</strong></td>
<td></td>
</tr>
<tr>
<td>UNDER THE INFLUENCE: USING NATURAL LANGUAGE IN INTERACTIVE STORYTELLING</td>
<td></td>
</tr>
<tr>
<td><em>Marc Cavazza, Fred Charles, Steven J. Mead</em></td>
<td>3</td>
</tr>
<tr>
<td>INTERACTIVITY AND NON-LINEARITY: WHAT DO THEY REALLY MEAN?</td>
<td></td>
</tr>
<tr>
<td><em>Donald Marinelli</em></td>
<td>13</td>
</tr>
<tr>
<td><strong>2. COMPUTERS &amp; GAMES</strong></td>
<td></td>
</tr>
<tr>
<td>MULTI-GOAL PATH-FINDING FOR AUTONOMOUS AGENTS IN VIRTUAL WORLDS</td>
<td></td>
</tr>
<tr>
<td><em>Philippe Codognet</em></td>
<td>23</td>
</tr>
<tr>
<td>MULTIPLAYER GAME CHEATING PREVENTION WITH PIPELINED LOCKSTEP PROTOCOL</td>
<td></td>
</tr>
<tr>
<td><em>Ho Lee, Eric Kozlowski, Scott Lenker, Sugih Jamin</em></td>
<td>31</td>
</tr>
<tr>
<td>COMPLEX GAMES AND PALM COMPUTERS</td>
<td></td>
</tr>
<tr>
<td><em>Pieter Spronck, Jaap van den Herik</em></td>
<td>41</td>
</tr>
</tbody>
</table>
FACILITATING LEARNING IN A REAL TIME STRATEGY COMPUTER GAME
Penelope Sweetser, Simon Dennis ................................................................. 49

A TOOLKIT FOR DEVELOPING PROGRAMS OF CARD GAME PLAYED ON THE INTERNET
Masato Koide, Jingde Cheng ........................................................................... 57

A METRIC FOR ENTERTAINMENT OF BOARDGAMES: ITS IMPLICATION FOR EVOLUTION OF CHESS VARIANTS
Hiroyuki Iida, Nobuo Takeshita, Jin Yoshimura ..................................................... 65

THREAT STACKS TO GUIDE PRUNING AND SEARCH EXTENSIONS IN SHOGI
Reijer Grimbergen ........................................................................................................ 73

THE EVOLUTION OF STRONG OTHELLO PROGRAMS
Michael Buro .................................................................................................................. 81

3. HOME/ARCADE GAMES AND INTERACTIVE MOVIES

DIGITAL STORYTELLING WITH DINAH: DYNAMIC, INTERACTIVE, NARRATIVE AUTHORING HEURISTIC
David Ventura, David Brogan .................................................................................. 91

REAL-TIME CHARACTER ANIMATION USING PUPPET METAPHOR
Yoshihiro Okada ....................................................................................................... 101

FLY THROUGH VIEW VIDEO GENERATION OF SOCCER SCENE
Naho Inamoto, Hideo Saito .................................................................................... 109

PROTOTYPING MOBILE GAME APPLICATIONS
Johan Sanneblad, Lars Erik-Holmquist .................................................................. 117

A METHOD FOR REAL-TIME RENDERING OF WATER DROPLETS TAKING INTO ACCOUNT INTERACTIVE DEPTH OF FIELD EFFECTS
Tomoya Sato, Yoshinori Dobashi, Tsuyoshi Yamamoto ........................................ 125
KIRIFUKI: INHALING AND EXHALING INTERACTION WITH VISUAL OBJECTS
Soichiro Iga, Fumito Higuchi ................................................................. 133

VIRTUAL HORSEBACK ARCHERY-KIBAKIBA MUSHAMUSHA
Masataka Imura, Jun Kozuka, Koichi Minami, Yoshito Tabata,
Tatsuya Shizui, Kunihiro Chihara ....................................................... 141

CREATING UBIQUITOUS INTERACTIVE GAMES USING EVERYWHERE DISPLAY PROJECTORS
Claudio Pinhanez .................................................................................. 149

FACE ANALYSIS AND SYNTHESIS FOR INTERACTIVE ENTERTAINMENT
Shoichiro Iwasawa, Tatsuo Yotsukura, Shigeo Morishima ....................... 157

HUMAN BODY TRACKING FOR DIGITAL ACTORS
Atsushi Nakano, Junichi Hoshino .......................................................... 165

COMPUTER VISION BASED RECOGNITION OF INTERACTIONS BETWEEN HUMAN AND OBJECTS
Masumi Kobana, Jun Ohya ..................................................................... 173

REAL-TIME MANIPULATION OF MOTION-CAPTURE DATA WITH PATTERN GENERATOR
Shigeru Kuriyama, Yusuke Irino, Toyohisa Kaneko .................................. 181

4. ENTERTAINMENT ROBOTS & PHYSICAL SYSTEMS

DEVELOPMENT OF AUTONOMOUS BLIMP ROBOT WITH INTELLIGENT CONTROL
Keiko Motoyama, Hidenori Kawamura, Masahito Yamamoto,
Azuma Ohuchi ......................................................................................... 191

LEGO MINDSTORMS CHEERLEADING ROBOTS
Naohiro Matsunami, Kumiko Tanaka-Ishii, Ian Frank, Hitoshi Matsubara ................................................................. 199

ELECTRONICALLY ENHANCED BOARD GAMES BY INTEGRATING PHYSICAL AND VIRTUAL SPACES
Fusako Kusunoki, Masanori Sugimoto, Hiromichi Hashizume .................. 207
A DISTRIBUTED CONTROL SYSTEM AND SCRIPTING LANGUAGE FOR "INTERACTIVITY" IN LIVE PERFORMANCE
Eitan Mendelowitz, Jeff Burke ................................................................. 215

RECOGNITION OF HUMAN HAND GESTURE FROM A MONOCULAR IMAGE SEQUENCE FOR HUMAN-MACHINE COMMUNICATION SYSTEM
Satoru Odo, Kiyoshi Hoshino ................................................................. 223

5. MUSIC INFORMATICS

DEVELOPMENT OF MIDI ENCODER "AUTO-F" FOR CREATING MIDI CONTROLLABLE GENERAL AUDIO CONTENTS
Toshio Modegi .......................................................................................... 233

"IMPROVISESSION-II" - A PERFORMING/COMPOSING SYSTEM FOR IMPROVISATIONAL SESSIONS WITH NETWORKS
Yoichi Nagashima .................................................................................. 241

AN ACCOMMODATING PIANO WHICH AUGMENTS INTENTION OF INEXPERIENCED PLAYERS
Akio Yatsui, Haruhiro Katayose ............................................................. 249

TWO-STEP INPUT METHOD FOR SUPPORTING CONSTRUCTION OF MIDI SEQUENCE DATA
Chika Oshima, Yohei Miyagawa, Kazushi Nishimoto, Takashi Shirosaki ........ 257

A MELODY RETRIEVAL SYSTEM ON PARALLELIZED COMPUTERS
Tomonari Sonoda, Toshiya Ikenaga, Kana Shimizu, Yoichi Muraoka .......... 265

SOUND COMPASS™ - A FAST QUERY-BY-HUMMING SYSTEM USING MULTI-DIMENSIONAL FEATURE VECTORS
Hidenobu Nagata, Naoko Kosugi, Ryoji Kataoka, Takashi Honishi .......... 273

STATISTICAL PHRASE EXTRACTION AND INDEXING FOR MUSIC RETRIEVAL
Atsuhiro Takasu, Teruhito Kanazawa, Jun Adachi .................................. 281

A PORTABLE ELECTRONIC BASS USING TWO PDAS
Tsutomu Terada, Masahiko Tsukamoto, Shojiro Nishio ............................ 289
MUSIC COMPOSITION BY ONOMATOPOEIA
Toshiyuki Masui……………………………………………………………………………………………297

6. SOCIOCY AND PSYCHOLOGY OF ENTERTAINMENT

THE TECHNOLUMDIC FILM: IMAGES OF VIDEO GAMES IN MOVIES (1973-2001)
Matteo Bittanti …………………………………………………………………………………………………307

DETERMINANTES FOR COLLABORATION IN NETWORKED MULTI-USER GAMES
Matthias Rauterberg ………………………………………………………………………………………….313

POLITICS IN MOTION – SOME REFLECTIONS ON POLITICAL BIAS IN SIMULATION GAMING
Nicklas Lundblad, Anders Frank ……………………………………………………………………………323

AWARENESS COMMUNICATIONS BY ENTERTAINING TOY DOLL AGENTS
Kazuyuki Saitoh, Tomoko Yonezawa, Kenji Mase ………………………………………………………331

CGA SYNTHESIZER INTERPOLATING AND EXTRAPOLATING MOTION DATA
Kiyoshi Hoshino………………………………………………………………………………………………339

LEAVING FANTASY BEHIND IN VIDEOGAMES: THE LIMITS OF THE NARRATIVE PARADIGM
Gonzalo Frasca………………………………………………………………………………………………347

RESPONSES IN LIGHT, SOUND AND SCENT: A THERAPEUTIC INTERACTIVE YOGA SYSTEM
Sidney Fels, James Gauthier, Patricia Smith………………………………………………………………355

THE NEW ROLE OF GAMING — HOW GAMES MOVE OUTSIDE ENTERTAINMENT
Anders Frank, Nicklas Lundblad ……………………………………………………………………………363
### 7. VIRTUAL REALITY TECHNOLOGIES FOR ENTERTAINMENT

**A NEW ECONOMICAL FLUORESCENT LAMP INFORMATION TRANSMISSION SYSTEM FOR INDOOR TRACKING WITH APPLICATIONS FOR INDOOR GAMES**  
Yue Li, Adrian David Cheok .......................................................... 381

**SKILL TRAINING SYSTEM OF MANUAL ARC WELDING**  
Kazuhiko Kobayashi, Shinobu Ishigame, Hideo Kato ............................... 389

**INTERACTION FOR ENTERTAINMENT CONTENTS BASED ON DIRECT MANIPULATION WITH BARE HANDS**  
Kenji Oka, Imari Sato, Yasuto Nakanishi, Yoichi Sato, Hideki Koike ................ 397

**AUTHORING MIXED REALITY — A COMPONENT AND FRAMEWORK-BASED APPROACH**  
Ralf Doerner, Christian Geiger, Michael Haller, Volker Paelke ....................... 405

**PLAYING RUBIK’S CUBE IN MIXED REALITY**  
Makoto Sato, Yasuharu Koike .......................................................... 415

**INSIDE THE SCORE: MUSIC AND AUGMENTED REALITY**  
Rodney Berry, Ivan Poupyrev, Makoto Tadenuma, Nobuji Tetsutani,  
Shigeo Imura ............................................................................. 423

**MAGIC MUSIC DESK: A MULTI-MODAL EMBODIED INTERACTIVE DESK**  
Zhou Zhiying, Farzam Farbiz, Chen Xiangdong, Adrian David Cheok,  
Liu Wei .................................................................................. 431

**SENSES OF SPACES THROUGH TRANSFICTION**  
Alok Nandi, Xavier Marichal ................................................................ 439
PENGUIN HOCKEY: A VIRTUAL REALITY GAME SYSTEM FOR CHILDREN
Akihiko Shirai, Shouichi Hasegawa, Yasuhiro Koike, Makoto Sato .................. 447

USABILITY AND PLAYABILITY ISSUES FOR ARQUAKE
Bruce Thomas, Nicholas Krul, Benjamin Close, Wayne Piekarski ..................... 455

TOUCH SPACE: AN EMBODIED COMPUTING MIXED REALITY GAME SPACE
Wang Weihua, Xubo Yang, Adrian David Cheok, Mark Billinghurst, Hirokazu Kato .................................................. 463

USING AUGMENTED REALITY FOR ENTERTAINMENT
Blair MacIntyre, Brendan Hannigan ........................................................... 471

RAPID PROTOTYPING OF MIXED REALITY APPLICATIONS THAT ENTERTAIN AND INFORM
Christian Geiger, Christian Reimann, Waldemar Rosenbach, Joerg Stoecklein .......................................................... 479

AN AUTHORING TOOLKIT FOR MIXED REALITY EXPERIENCES
Scott S. Fisher ..................................................................................... 487

A DISTRIBUTED MR TRANSPORTER FOR NETWORKED COLLABORATION
Koichi Minami, Tomi Korpiä, Masataka Imura, Yoshihiro Yasumuro, Tomohiro Kuroda, Yoshitsugu Manabe, Kunihiro Chihara ......................... 495

3D LIVE HUMANS IN MIXED REALITY ENTERTAINMENT
Simon J.D. Prince, Adrian David Cheok, Farzam Farbiz, Todd Williamson, Nik Johnson, Mark Billinghurst, Hirokazu Kato ........................................... 503

IMMERSIVE ENVIRONMENT TECHNOLOGIES FOR PLANETARY EXPLORATION WITH APPLICATIONS FOR MIXED REALITY
John Wright, Frank Hartman, Brian Cooper .................................................. 511

CONTENT MANAGEMENT IN MIXED REALITY SYSTEMS CONSIDERATIONS FROM AN APPLIED SCIENCE PERSPECTIVE
Martin Kurze ........................................................................................... 519

MIXED REALITY IN TRAFFIC SCENES
A.B. Martínez, J.P. Arboleda, E.X. Martín, C. Torrens .................................. 527

ERRATUM TO: ENTERTAINMENT COMPUTING
Ryohei Nakatsu, Junichi Hoshino ............................................................... E1
Preface

This volume is the Proceedings of the First International Workshop on Entertainment Computing (IWEC 2002). Entertainment has been taking very important parts in our life by refreshing us and activating our creativity. Recently by the advancement of computers and networks new types of entertainment have been emerging such as video games, entertainment robots, and network games. As these new games have a strong power to change our lives, it is good time for people who work in this area to discuss various aspects of entertainment and to promote entertainment related researches. Based on these considerations, we have organized a first workshop on entertainment computing.

This workshop brings together researchers, developers, and practitioners working in the area of entertainment computing. It covers wide range of entertainment computing such as theoretical issues, hardware/software issues, systems, human interfaces, and applications. The particular areas covered by the workshop are:

1. Computers & Games

Computer game algorithms, modeling of players, web technologies for networked games, human interface technologies for game applications.

2. Home/Arcade Games and Interactive Movies


3. Entertainment Robots & Physical Systems

Entertainment robot systems, toy robots and pet robots, entertainment robots for man-machine interfacing, physical games and mental games
4. Music Informatics
MIDI and its extensions, acoustic computation, computer music for home entertainment, new music instruments, sound and voice for entertainment

5. Sociology and Psychology of Entertainment
Modeling and representation of emotion; mind model for entertainment, psychological aspect of immersion, future of entertainment; social significance of entertainment

6. Virtual Reality Technologies for Entertainment
Generations of virtual entertainment environment, interactions in virtual environment, mixed reality technologies for entertainment

The program committee received more than 70 submissions from 12 different countries in Asia, Europe, North America and South America. Each submission was reviewed by at least three PC members. This volume contains 63 contributed papers and 2 invited papers presented at the conference. We are very grateful to these members who are listed on the following pages, for their time-consuming and hard work in the judging process. We also thank the invited speakers for sharing with us their vision of the future.

We hope that the reader will find in this volume many motivating and enlightening ideas. Also we wish that this volume would contribute to the development and further awareness of this new and interdisciplinary field of Entertainment Computing

July 2002

General Chair
Tak Kamae
Technical Program Chair
Ryohei Nakatsu
Proceedings Editors

Editor-in-Chief
Ryohei Nakatsu (Kwansei Gakuin University/ATR)

Managing Editor
Junichi Hoshino (University of Tsukuba/PRESTO, JST)

Vice Editors
Jaap van den Herik (University of Maastricht)
Hiro Iida (Shizuoka University)
Hitoshi Matsubara (Future University of Hakodate)
Masahiko Tsukamoto (Osaka University)
Adrian David Cheok (National University of Singapore)

Supporting Organizations

Japan Society for the Promotion of Science
Virtual Reality Society of Japan
Japanese Society of Artificial Intelligence
The Society for Art and Science
Institute of Electronics Engineers of Japan
The Institute of Electronics, Information and Communication Engineers (IEICE), Information and System Society (ISS)
The Institute of Electronics, Information and Communication Engineers (IEICE), Human Communication Group (HCG)
International Computer Chess Association (ICCA)
Committees

General Chair
Tak Kamae (LIST)

Technical Program Chair
Ryohei Nakatsu (Kwansei Gakuin University/ATR)

Technical Program Subcommittee Chairs

Computers & Games
Jaap van den Herik (University of Maastricht)

Home/Arcade Games and Interactive Movies
Kazuhiko Nishi (ASCII Corp.)
Junichi Hoshino (Univ. of Tsukuba/PRESTO, JST)

Entertainment Robots & Physical Systems
Hitoshi Matsubara (Future Univ. of Hakodate)

Music Informatics
Masahiko Tsukamoto (Osaka Univ.)

Sociology and Psychology of Entertainment
Ryohei Nakatsu (ATR)

Demo and Contest Co-chairs
Hitoshi Matsubara (Future Univ. of Hakodate)
Hiro Iida (Shizuoka University)

Special Session on “Mixed Reality Entertainment Computing” Co-chairs
Adrian David Cheok (National University of Singapore)
Hirokazu Kato (Hiroshima City University)
Mark Billinghurst (University of Washington)

Steering Committee
Donald Marinelli (CMU, Ent.Tech.Center)
Demetri Terzopoulos (NYU)
Marc Cavazza (University of Teesside)
Bluce Blumberg (MIT Media Laboratory)
Matthias Rauterberg (Technical University of Eindhoven)
Program Committee

Computer & Games
Michael Buro (NECI, USA)
Ernst Heinz (MIT, USA)
Hiroyuki Iida (Shizuoka University, Japan)
Tony Marsland (University of Alberta, Canada)

Home/Arcade Games and Interactive Movies
Marc Cavazza (University of Teesside, UK)
Demetri Terzopoulos (NYU)
Bruce Blumberg (MIT Media laboratory)
Gonzalo Frasca (Cartoon Network, USA)

Entertainment Robots & Physical Systems
Masayuki Inaba (University of Tokyo)

Music Informatics
Keiji Hirata (NTT Communication Science Laboratories)
Toshihiro Konno (Sony Music Entertainment)
Meiho Nagata (Daichi-kosho)
Kenzo Saeki (Musician)
Atsushi Yamaji (Osaka Electro-Communication University)

Sociology and Psychology of Entertainment
Sidney Fels (University of British Columbia, Canada)
Jeffrey Cohn (University of Pittsburgh, USA)
Claudio Pinhanez (IBM Thomas Watson, USA)
Rodney Berry (ATR, Japan)
Matthias Rauterberg (Technical University of Eindhoven)

Finance Chair
Takaya Ishida (Mitsubishi Electric)

Local Arrangement
Shigeru Chiba (Sharp Corp.)

Secretariat
Osamu Ayukawa (IPSJ)

Web Design
Yumi Hoshino