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Linda Candy · Ernest Edmonds
Fabrizio Poltronieri

Explorations in Art and Technology

Second Edition

 Springer

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ISSN 2195-9056 ISSN 2195-9064 (electronic)
Springer Series on Cultural Computing
ISBN 978-1-4471-7366-3 ISBN 978-1-4471-7367-0 (eBook)
<https://doi.org/10.1007/978-1-4471-7367-0>

Library of Congress Control Number: 2018942931

1st edition: © Springer-Verlag London 2002

2nd edition: © Springer-Verlag London Ltd., part of Springer Nature 2018, corrected publication 2019
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The registered company address is: The Campus, 4 Crinan Street, London, N1 9XW, United Kingdom

In Memory of Emma Candy and Roy Stringer

Foreword to the Second Edition

The field of art, science and technology has matured significantly in the 16 years since this book was first published. It now has its own acronym—STEAM: Science, Technology, Engineering, Art and Mathematics—which bestows a new academic credibility and dawning acceptance. The ‘lumbering dinosaurs with their fortress faculties’ are slowly and I suspect reluctantly changing. The commitment and contributions of Linda Candy and Ernest Edmonds have been instrumental in enabling this change. Not only have they championed the value of the field but they have also pioneered the development of art as research, or practice-based action research. It’s an activity that has lent a new and necessary credibility to the arts as the traditional, studio-based, art schools merged with their more academically focussed university neighbours.

In 2002, when I wrote the original foreword, the field was on the cusp of emerging from decades of neglect. The same year the CACHE research project: Computer Arts, Contexts, Histories, etc. began at Birkbeck College in London led by Charlie Gere and myself. We were funded by the then relatively new Arts and Humanities Research Board, and the aims of the project were to research, document, preserve and contextualize the early development of the computational arts in the UK from the 1960s to the 1980s. The project re-energized the Computer Arts Society—CAS—that had been founded in 1968, just after the Cybernetic Serendipity exhibition, curated by Jasia Reichardt, was held at London’s ICA. CACHE built up a valuable and ongoing relationship between the CAS and the Victoria & Albert Museum and helped the V&A acquire two important archives of early computer art which established their reputation amongst the main international institutions collecting work in the area.

So it is a great pleasure for me to revisit my foreword for this revised edition of *Explorations in Art and Technology*. The original publication fulfilled its promise to be a ‘keystone reference’, and it has made a noteworthy contribution to the

development of the field over the years. This new edition with significant new and revised content should continue this influence and consolidate the book's reputation as one of our field's canonical texts.

Paul Brown

Ocean Shores, Australia

February 2018

Foreword to the First Edition

I was born in 1947, the year before American artist Charles Biederman published *Art as the Evolution of Visual Knowledge*. In that central year of the twentieth century, he gave art a focal place in the new scholarship of consciousness and cognition. Now, at the dawn of a new millennium, some scientists suggest that art is one of the few activities that distinguish homo sapiens from our hominid ancestors. It would seem that art is not only a powerful and uniquely human language that helps us engage with and comprehend and communicate our universe: perhaps, it is art amongst all human endeavours that defines who we are.

With the advent of the computer and in the context of the twentieth-century international art and technology movement, many artists began to explore the boundaries of cybernetics, cognition and artificial intelligence. In the late 1960s and 1970s, some were amongst the pioneers who defined an entirely new field of study now known as artificial life. By the end of the century, we were using terms like computational paradigm to describe the proliferating knowledge base that had been uniquely enabled by digital technology.

And now, some 50 years after Biederman's pioneering publication, it is possible to bring together some of the key practitioners whose work has helped define the intersection of art and technology. All have been associated in some way with the Creativity and Cognition Research Studio (C&CRS) programme at Loughborough University.

It is perhaps apt that a university that was founded in the 1960s in a small English market town should have provided the venue for one of the world's most dynamic interdisciplinary research programmes addressing this exciting area. I grow ever disenchanted by the traditional universities—those lumbering dinosaurs with their fortress faculties designed only to defend discipline against discipline whose economic rationalism both undermines and actively discourages collaboration whilst simultaneously ossifying the past at the expense of the future.

The dualism invoked by CP Snow's 'two cultures' is at last being eroded. A new synthesis is emerging, slowly to be sure, but wasn't it Kuhn himself who suggested that 'disciplines change when old men die'? But disciplines are changing: science is accommodating the qualitative and art the quantitative. We can no longer hold dear

to the modernist and simplistic grand narratives of science as the logical ‘left brain’ expression of human endeavour and of art as the lateral ‘right lobe’ activity.

In their introductory chapters, Linda Candy and Ernest Edmonds provide a valuable background and introduction to the book’s themes. They plot a history of art and science collaborations and trace the origins and context of the C&CRS. Much of the work of the centre has investigated the technological needs of artists and how to meet them. Several of the chapters describe projects they have undertaken. These are complemented by essays by pioneers and practitioners whose work has helped define the field and its achievements and needs.

Art and technology were associated with the period of late modernism in the twentieth century. The field suffered when it was rejected by the youthful and aggressive post-modernists who, like all children, deny their heritage. However, I am glad to see that this important historical contribution is being re-addressed and re-contextualized by a more mature generation who can now acknowledge the continuity of history and the connectivity of ideas.

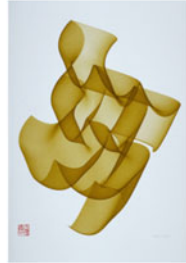
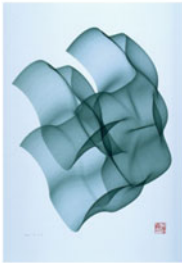
These essays make an exceptional and essential publication. I am grateful to the authors whose commitment and effort over several decades has made such a book possible. It comes at an important time and will provide a valuable keystone reference. The historical contributions are especially welcome. Some of the pioneers have already returned their elements to the matrix. Soon it will no longer be possible to write about this period in the first person singular.

Paul Brown

The Sunshine Coast

February 2002

"Any sufficiently advanced technology is indistinguishable from magic."
Arthur C. Clarke, 1962: Profiles of the Future



"I did not want
answers that might
show up on the
monitor seemingly
by magic."
Michael Kidner, 1996



"Art does not reproduce the visible:
rather, it makes visible."
Paul Klee, 1958: Inward Vision

"Digital Technology
may enable what is
already there to
be seen."
Michael Quantil, 1999



Preface to the Second Edition

The first edition of this book was published in the very early years of the twenty-first century and by now in 2018, the technologies have advanced enormously and expanded in their influence. Smartphones and tablets abound and social media seems to dominate our lives. Not surprisingly, the exploration of these technologies by artists has kept pace with this expansion. However, it is interesting to notice that many of the conceptual issues that were significant and challenging in 2002 remain so in 2018. The traditional art world, the big galleries, the fairs, have still to catch up with the cutting edge of art that seriously explores computer code, communications and the new world that computers have created. Perhaps when we are approaching 2040, a different story can be told. However, the practice of and the research into art and technology have flourished and we do have new art forms and a better understanding of the field. Today, we see that there is still much to explore and no shortage of new challenges. This second edition of the book acknowledges these changes and explores the current challenges.

For this second edition, we have been joined by Fabrizio Poltronieri, who both adds his own perspective and brings his knowledge of the work of South America into the mix. The book has been reorganized in certain ways, and the core chapters have been updated in the light of recent developments. We have taken a hard look at the collection of contributions from artists and those who collaborate with them. We have added a range of new contributors, often younger artists, and grouped the contributions to relate to relevant chapters. These new texts add life and an up-to-date perspective on the core concern of the book, the provision of a picture of the fast changing world in which artists are exploring the potential and the meaning of new and emerging digital technologies.

In the first edition of the book, we included a Note of Thanks, reprinted, with our thanks repeated, in this edition. Sadly, four important people have passed away since 2002: we remain grateful for our invaluable conversations with the late Marvin Minsky; Michael Kidner's unflinching encouragement continues to inspire

us beyond his lifetime; Harold Cohen, who passed away in 2016, was a pioneer and leader in this field whose contribution cannot be over-estimated. Finally, the memory of our late daughter, Emma Candy who supported us and contributed to the design of the book, influences everything that we do and write.

Linda Candy and Ernest Edmonds

Sydney, Australia

February 2018

Preface to the First Edition

Imagine a scene: in a darkened room a moving image is projected onto a large screen. In front of it, several people are moving rapidly in different directions, waving their arms and simultaneously watching the screen. They might be laughing or chatting with one another or quietly observing the shapes, colours and sounds that are continually changing as if in reaction to the movements of those present. As a matter of fact that is exactly what is happening. In today's world of art and technology, this is an interactive or 'participatory' art experience. Together, artists and technologists have created spaces in which infrared sensors detect people's movements and by detecting the movements in the space, a computer generates visual images and sounds which are displayed so that everyone can see the artwork as it evolves.

Experiments in art that involve audience participation have been taking place for some time and, because they subvert conventional expectations about the nature of art, they can appear in unexpected quarters and sometimes in disguise. The Millennium Dome of the Year 2000 in London received extensive media coverage and was the butt of many jokes. Some things, however, escaped press attention. One, in particular, is an interesting reflection on our current ideas of what is art and what is play. Few of the thousands who crowded into the Play Zone realized that the games they were enjoying were originally experiments in art. The innovative art and technology projects that gave rise to the Iamascope were direct descendants of Cybernetic Serendipity, the groundbreaking computer art show of 1968.

Interest in play and games is now a common theme in art. It might take the form of a sculpture that invites touching or climbing, as well as viewing, or a community project initiated by an artist, but created by people living in the same building who record their daily experiences in text and images. There are even computer games designed by artists. The link between play and art is participation. Participation in interactive art brings with it the kind of engagement in the creative process that is normally denied the art viewing public. Interaction is central to art practice today but is not part of conventional gallery culture. The new art and technology experiences do not necessarily fit comfortably into familiar cultural contexts. Being in interactive spaces is engaging and interesting. Children and adults too can have fun

with this kind of experimental art. It is one example of the new forms and the new audience relationships that are developing at the intersection of art and technology.

This book is an exploration of creative practice in art and technology. It brings together artists, technologists and researchers who have written about emerging correspondences between virtual and physical worlds, between human and machine processes, between abstract concepts and their physical realizations, between music and visualization and between film and painting. It is a story of new visions and new forms.

Digital art is not always recognized by the conventions of traditional art culture. It has a different character and form that means it is not necessarily reliant upon the usual outlets for artworks such as the public and commercial gallery system. The digital world lends itself to new modes of dissemination and, indeed, many of the practitioners are attracted to it for that very reason. The Internet, the vast system of computers that form a communicating network throughout the world, has opened up many access and delivery options for art.

The book arose from research into the intersection of art and technology through a series of artist-in-residence projects. Artists worked with technologists to develop new artworks, whilst researchers gathered information in order to learn as much as possible about the creative processes involved. A practice-based action research approach was used to investigate the creative process in a real context and as it takes place. One aim was to learn how to evolve strategies for developing responsive environments for art and technology innovation. We learn that creative practice offers new challenges and inspirations for the technologist as well as the artist and that artist and technologist need to find imaginative ways forward together if they are to realize their ambitions and gain mutual benefit. Most important, successful collaboration involves developing effective and personal partnerships that sustain creativity over time.

There are significant changes in art practice taking place as a result of the potential that digital technology offers. Artists are facing considerable demands upon artistic concepts and art-making skills alike. It is those very challenges that make it exciting. Digital technology can perform a number of roles in art practice: it can act as an aid to the artist by making multidimensional visualizations of an image; it can perform a direct role in the artwork itself by controlling movement or sound or a combination of elements; it can carry out instructions to create the contours and configuration of a work by generating instructions for laser cuttings or high-quality screen printing. Some of the artists represented in this book combine all these roles of the technology in their work. All are using the unique characteristics of digital technology to advance their art practice. This collection of experiences and viewpoints provides a picture of this changing world as it is taking place at the start of the twenty-first century.

A Note of Thanks First Edition

The contributors to this book are associated with Creativity and Cognition Research Studios either as artist-in-residents, speakers or exhibitors. We wish to thank them for their participation in those events and for their cooperation in the production of this book. We would also like to acknowledge many other people who could not make a written contribution but who, nevertheless, played significant roles in the work that gave rise to the book: thank you to Helmut Bez, Rob Doyle, Pip Greasely, Antonia Kelly, Peter Lowe, Simon Nee, Mike North, Kip Sahnsi, Sarah Tierney, Greg Turner, Paul Wormald and Bill Marshall. We would also like to mention the people active in the fields of art, technology and human–computer interaction whose support we have enjoyed over the years. The lively exchanges of views and, of course, the personal friendships that have developed, have contributed to our work in so many ways: with thanks to Ken Baynes, Steve Bell, Maggie Boden, Paul Brown, Nigel Cross, Anita Cross, Ben Shneiderman, Bronac Ferran, Gerhard Fischer, John Gero, Bryan Lawson, Kenji Mase, Marvin Minsky, Kumiyo Nakakoji, Patricia Railing, Doug Riecken, Steve Scrivener and Steve Willats. Finally, we are most grateful to Meroë Candy, Judith Mottram, Tom Hewett and Ingrid Holt whose thoughtful comments and useful tips helped us hone the ideas and the writing.

Funding support was provided from the following organizations:

Loughborough University: The School of Art and Design, Department of Computer Science and Department of Design and Technology

The Arts Council of England

East Midlands Regional Arts, UK

National Association for Fine Art Education in collaboration with the National Arts Association: Access to Art Colleges Scheme (AA2A)

Year of the Artist (YOTA) National Lottery Scheme, UK

Higher Education Funding Council of England and Wales (HEFCE)

Engineering and Physical Sciences Research Council, UK (EPSRC)

Silicon Graphics Ltd.

Drexel University USA: Department of Psychology and Department of
Mathematics and Computer Science.

Linda Candy and Ernest Edmonds

Loughborough

February 2002

Contents

Part I History

Theme: History	3
Fabrizio Poltronieri, Linda Candy and Ernest Edmonds	
Between Worshipers, Priests and the Nuke: An Introduction to the Cultural and Social History of Early Computer Art	31
German Alfonso Nunez	
A Million Millennial Medicis	39
Harold Cohen	
Structure in Art Practice	51
Ernest Edmonds	
From Zombies to Cyborg Bodies: Extra Ear, Exoskeleton and Avatars	59
Stelarc	
Tears in the Connective Tissue	71
Joan Truckenbrod	
Algorithmic Fine Art: Composing a Visual Arts Score	77
Roman Verostko	
The Computer: An Intrusive Influence	85
Michael Kidner	
Digital Art in Brazil	93
Priscila Arantes	

Part II Environments

Theme: Environments 103
Ernest Edmonds, Linda Candy and Fabrizio Poltronieri

New Directions for Art and Technology 121
George Whale

An Observer’s Reflections: The Artist Considered as Expert 133
Thomas Hewett

Realizing Digital Artworks 141
Colin Machin

Being Supportive 149
Andre Schappo

Working with Artists 157
Manumaya Uniyal

Demaking the High Heeled Shoe 163
Alex Murray-Leslie

Art as Digital Exploration (Vectors and Nodes) 173
Dave Everitt

Part III Research

Theme: Research 185
Linda Candy, Ernest Edmonds and Fabrizio Poltronieri

Creating Graspable Water in Three-Dimensional Space 203
Joan Ashworth

Contemporary Totemism 211
Jean-Pierre Husquinet

Integrating Computers as Explorers in Art Practice 217
Michael Quantrill

Hybrid to Simulated Invention 223
Beverley Hood

Playing with Rhythm and Technology 233
Brigid Mary Costello

Differentiating Interaction 241
Jennifer Seevinck

The Illusion and Simulation of Complex Motion 251
Fré Ilgen

LocalStyle > Forward 259
 Marlena Novak and Jay Alan Yim

Chance, Poetry and Computational Art: The Visual Theogonies 269
 Fabrizio Poltronieri

Self-portraying an Absence 279
 Grazielle Lautenschlaeger

Part IV Collaboration

Theme: Collaboration 289
 Linda Candy, Ernest Edmonds and Fabrizio Poltronieri

**Making Light Sculptures in Suspended Space:
 A Creative Collaboration** 309
 Linda Candy

Drawing Spaces 319
 Esther Rolinson

Collaborative Practice in Systems Art 327
 Sean Clark

**Creativity, Technology and Collaboration Towards Hoped-for
 and Unexpected Serendipities** 333
 Anthony Rowe

Collaborative Creation in Interactive Theatre 341
 Andrew Johnston and Andrew Bluff

Collaboration, the Color Organ, and *Gridjam* 353
 Jack Ox

**Creating Interactive Art—Conceptual and
 Technological Considerations** 363
 Christa Sommerer and Laurent Mignonneau

Post Fail: IOCOSE Collaborative Failures 371
 Paolo Ruffino, Matteo Cremonesi, Filippo Cuttica and Davide Prati

Speculative Apparatuses: Notes on an Artistic Project 379
 Cesar Baio

Correction to: LocalStyle > Forward C1
 Marlena Novak and Jay Alan Yim

Index 387

Authors and Contributors

About the Authors

Linda Candy is a writer and researcher who lives and works in Australia and England. Linda has Bachelor of Arts (B.A.), a Masters by research (M.Phil.) in computer-aided learning and a Ph.D. in Computer Science. She was senior researcher on leading interdisciplinary projects including the COSTART project: Artists and Technologists in Collaboration. Her main research areas are creative practice, interaction design and evaluation. She has conducted studies of creative people including the designer of the Lotus bicycle and has published widely. She is a member of several international conference programme committees and has carried out many projects in collaboration with industry. She was founding co-chair of the international symposia on Creativity and Cognition and Strategic Knowledge and Concept Formation and has over 25 years' experience in research into creativity, design and digital art. She has written over 100 papers and articles about the creative process, the role of computers and the methodologies for investigating these areas of research. Edited books include *Interacting: Art, Research and the Creative Practitioner* and *Interactive Experience in the Digital Age: Evaluating New Art Practice*. For further details, see: <http://www.lindacandy.com>.

Ernest Edmonds is an artist researcher who pioneered the field of computational art from the late 1960s. In 2017, he received the ACM SIGGRAPH Distinguished Artist Award for Lifetime Achievement in Digital Art. His recent exhibitions include retrospectives at Tsinghua University, Beijing, and De Montfort University, Leicester. He also recently exhibited with four other computer art pioneers in *Algorithmic Signs* at the Fondazione Bevilacqua La Masa, San Marco, Venice. Edmonds' skills are transdisciplinary and in 2017 he won the SIGCHI Lifetime Achievement Award for the Practice of Computer Human Interaction. He has been Head of a University Computer Science Department and a Dean. In the 1970s, he pioneered the supervision of practice-based Ph.Ds and has over 300 publications on human-computer interaction, creativity and computer-based art. He is currently

Professor of Computational Art at De Montfort University, Chair of the Board of ISEA International and Editor-in-Chief of the Springer Cultural Computing book series. His work was recently described in the book by Francesca Franco, *Generative Systems Art: The Work of Ernest Edmonds*, Routledge, 2017. For further details, see: <http://www.ernstedmonds.com>.

Fabrizio Poltronieri (b. 1976) is a computer artist, researcher and curator with a special interest in the relationships between Art, Digital Media, Design and Technology. His expertise is in the development of creative coding and its exchanges with philosophical questions. He is a member of IOCT (Institute of Creative Technologies) at De Montfort University, Leicester and holds a Ph.D. in Semiotics from the Pontifical Catholic University of São Paulo (PUC/SP), Brazil. In 2011–2012, he was awarded a fellowship to develop a Postdoctoral research project on the early days of computer art at the Royal College of Art in London. One of the outcomes of this research was a major exhibition with four pioneer computer artists. This exhibition entitled ‘Primary Codes’ featured artworks and talks by Ernest Edmonds, Frieder Nake, Harold Cohen and Paul Brown and took place in Rio de Janeiro in 2015. His second Postdoctoral research was at Leuphana Universität’s Gamification Lab, in Lüneburg, Germany on how the video games’ universe, the notions of gamification and post-history affect language production mediated by digital apparatuses. This research led to the chapter Communicology, apparatus, and post-history: Vilém Flusser’s concepts applied to video games and gamification, published in *Rethinking gamification*. For further details <http://www.fabriziopoltronieri.com>.

Contributors

Priscila Arantes is a researcher, curator and professor based in São Paulo. She is the director and curator of the Paço das Artes since 2007. She developed post-doctoral research at Penn State University (USA) and currently teaches in the graduate programme in Design at the Universidade Anhembi Morumbi. Between 2007 and 2011, she was the Programme Director of the Museu da Imagem e Som. In 2010, she was a member of the editorial board of the Bienal de São Paulo’s *Revista Polo de Arte Contemporânea*. She has served a juror at Capes/MEC and was member of the history, theory and criticism committee of the ANPAP. Among her publications are the books *Arte@Mídia: perspectivas da estética digital* (Senac, 2005); and *Re/escrituras da arte contemporânea: história, arquivo e mídia* (Sulinas, 2015).

Joan Ashworth is an artist working in moving image with a background in stop-frame animation. While studying graphic design at Newport, Gwent, she was introduced to animation, both drawn and stop-frame. She immediately embraced animation as a means of expression and specialized in stop-frame animation for the majority of her degree, as it combined the study of many aspects of art, design and film. Later, studying film-making at the National Film and Television School,

Beaconsfield, Buckinghamshire, she also explored live action. She graduated in June 1987 with an 18-minute film *The Web*, based on Mervyn Peake's *Titus Groan*, the first book of the *Gormenghast* trilogy. This was made using stop-frame animation with puppets made of soft leather. *The Web* was shown at film festivals worldwide, winning the Mari Kuttna Prize for Best British Animation 1987 and broadcast on Channel 4. In September 1987, she set up a production company, 3 Peach Animation, with two partners, Martin Greaves (Producer, NFTS) and Andy Staveley (Director, Royal College of Art). The partners closed 3 Peach in 1997, and she and Greaves set up Seed Fold Films to pursue personal projects.

Cesar Baio is an artist, professor and researcher with background in electronics and media studies. He developed his Ph.D.'s at the *Pontifícia Universidade Católica de São Paulo* with a graduate internship at the *Vilém Flusser Archive* at the *Universität der Künste*, Berlin. During 2017 and 2018, he was visiting Artist–Researcher at *i-DAT*, at *Plymouth University*, UK. He is professor and co-founded of the Graduated Program in Arts of the *Federal University of Ceará*, Brazil, where he coordinates the *actLAB—Laboratório de Pesquisa em Arte, Ciência e Tecnologia*. His Ph.D. investigated how the emergent media technologies reshape the models of representations consolidated in traditional media. His hypothesis suggests the raising of a performative regime of the image, thought by the different forms of relation between bodies and technological interfaces. The series of videos, photos, interactive installations and urban interventions produced by him discuss the insertion of the technology into the cultural practices and power structures. Author of the book '*Máquinas de Imagem: Arte, Tecnologia e Pós-virtualidade*' (*Machines of Image: Art, Technology and Post-Virtuality*), he has published in academic journals and collections. He has participated in conferences, seminars and exhibitions in Brazil and abroad. For further details, see: <http://www.cesarbaio.net>.

Andrew Bluff is a digital artist, software engineer and researcher at the University of Technology Sydney. Following his Ph.D. research combining immersive technology, interactive art and live performance, he is currently investigating new methods for mixed reality storytelling as a Postdoctoral Research Fellow at the UTS Animal Logic Academy. His technology-based works commonly feature immersive virtual environments that interact with live musicians, dancers or audience members in a fluid and semi-abstract way to create a synesthetic interdependence of sound, vision and movement. In addition to collaborating on major performance works including Stalker Theatre's *Dot and the Kangaroo*, *Creature: Interactions* and Alon Ilisar's *The Hour*, he has created mobile music apps including *DrumStudio* and *Mobile Phone Orchestra*. He has also worked as a software engineer, creating award winning audiovisual software including *Vista2* by Jands, the *SmartConsole* by SmartAV and *Pixus* by Fairlight Media. For further details, see: <http://www.rollerchimp.com>.

Sean Clark was born in Eastbourne in 1965 and grew up in West Sussex. He studied Computer Science at Loughborough University before becoming a Researcher at the LUTCHI Research Centre there. He developed an interest in

computer-based arts in the mid-1990s and began exhibiting his own digital artwork in 2000. He has since gone on to show work nationally and internationally. He has an M.A. in Digital Arts from Camberwell College of Arts and is currently working towards a practice-based Ph.D. in systems theory and digital art at De Montfort University in Leicester. His core interests are the creative exploration of flow and connectedness and the application of systems thinking to arts practice. In 2016, he was the co-winner with Esther Rolinson, of the inaugural ArtCHI award in San Jose, CA and the Lumen Prize for 3D/Sculpture in London, UK. For further details, see: <http://www.seanclark.me.uk>.

Harold Cohen was an English painter with an established international reputation when he went to the University of California at San Diego (UCSD) in 1968 for a 1-year visiting professorship. His first experience with computing followed almost immediately, and he never returned to London. He is the author of the celebrated AARON programme, an ongoing research effort in autonomous machine (art-making) intelligence which began when he was a Visiting Scholar at Stanford University's Artificial Intelligence Laboratory in 1973. Together, he and AARON have exhibited at London's Tate Gallery, the Brooklyn Museum, the San Francisco Museum of Modern Art, Amsterdam's Stedelijk Museum and many more of the world's major art spaces. They have also been shown at science centres, including the Ontario Science Centre, the Boston Science Museum and the Los Angeles Museum of Science and Industry. He represented the US in the World Fair in Tsukuba, Japan, in 1985. He has a permanent exhibit in Boston's Computer Museum and has given invited papers on his work at major international conferences on artificial intelligence, computer graphics and art technologies. His work is widely cited, and it is the subject of Pamela McCorduck's *AARON's CODE: Meta-Art, Artificial Intelligence and the Work of Harold Cohen*. The painting machine with which AARON coloured real drawings was premiered at the Computer Museum in Boston in 1995. He died on April 27, 2016 at his home in Encinitas, California at the aged of 87 years. Further details <http://www.aaronhome.com/aaron/aaron/index.html>.

Brigid Mary Costello is an interactive artist and researcher. She began her career with a focus on the moving image and the practice of cinematography, working as cinematographer on award winning short films and documentaries. She now creates computer-based installations that work with current and past traditions of interactive moving images, exploring the powerful relationship between a body and an interface. In her practice, she has also focused on creating playful experiences, producing works that go beyond conventions of fun and explore the full affective possibilities of play. Her current research for the forthcoming Springer book *Rhythm, Play and Interaction Design* focuses on the bodily experience of rhythm within interaction design practice. She lectures in interaction design at the University of New South Wales in Sydney, Australia. She is also an Associate of the Creativity and Cognition Studios at the University of Technology, Sydney.

Dave Everitt's interests include the implications of the interdisciplinary sciences in creative work, integer patterns (especially magic squares and cubes), the history of number symbolism, order and disorder in mathematical and natural pattern, and computer programming culture. His early work at Nottingham Trent University involved music, visual images, photography, collaborative work and installation. From 1997 as an Artist–Researcher at Loughborough University's computer science department, he began to combine computing with creative activities. In 2000–2002, this spawned collaborative public projects with other artists working in the field. He has been a group and solo recipient of Arts Council England awards, and a member of several steering groups and arts advisory panels. He is currently an independent research fellow at the Institute of Creative Technologies, De Montfort University, Leicester, a lecturer in web technologies, and director of EcoVisum.com. He is active in experimental music, including a performance with the Royal Philharmonic 'Sharp Edge' group, and collaborations with digital and improvisational musicians. He has delivered presentations on emerging technology and usability, on the experience of being an artist collaborating with computer programmers, and has worked as a mediator between artists and programmers. For further details, see: <http://daveeveritt.org>.

Thomas Hewett is Professor Emeritus of Psychology and Computer Science at Drexel University where for many years he taught courses on Cognitive Psychology, The Psychology of Human Computer Interaction (HCI), The Psychology of HCI Design and Problem Solving and Creativity. He has been Visiting Fellow, Visiting Professor or Visiting Researcher at the University of Vienna, Vienna, Austria, Tampere University, Tampere, Finland, Twente University, Hengelo, The Netherlands, Loughborough University, Loughborough, UK, University of the Aegean, Syros, Greece, and the Battelle Pacific Northwest National Laboratory, Richland, WA, USA. More recently, he was Visiting Professor at the Creativity and Cognition Studios, Faculty of Information Technology, University of Technology Sydney, Australia, and Cognos Distinguished Visiting Scientist at The Human Oriented Technology Laboratory, Carleton University, Ottawa, Canada. For several years, he regularly offered a professional development tutorial on cognitive aspects of interactive system design to interaction designers at both conferences and in-house training sessions. In some of those years, he also taught a weeklong course on Human Problem Solving for the User System Interaction programme at the Technical University of Eindhoven, The Netherlands. Research interests have included identifying areas in which computers can facilitate creative knowledge work, scientific problem-solving environments and networked engineering design.

Beverley Hood is an artist and lecturer in Design at Edinburgh College of Art, University of Edinburgh. She studied Sculpture and Electronic Imaging at Duncan of Jordanstone College of Art, Dundee and Nova Scotia College of Art & Design, Halifax, Canada. Her creative practice interrogates the impact of technology on relationships, the body and human experience, through the creation of practice-based projects and writing. A longstanding research interest is live performance

using technology and interdisciplinary collaboration. She is a member of the RAFT and DISIGN research groups at Edinburgh College of Art, and the Centre for Creative and Relational Enquiry, at the University of Edinburgh. She is also a member of the Art & Ethics Research Group (AERG), a Mason Institute research project, at the University of Edinburgh, that draws upon diverse approaches and methodologies from the arts and humanities in conversation with scientific and medical practitioners. For further details, see: <http://www.bhood.co.uk> and <http://www.eca.ed.ac.uk/profile/beverley-hood>.

Jean-Pierre Husquinet was born in Ougrée, Belgium and studied art at the Royal Academy for Arts in Liège between 1973 and 1979. He is a painter, a musician, a sculptor, a printer and an editor. In 1979, he began to specialize in silk screen printing and in 1982 began to work in a geometric way. He is co-founder and co-editor of the magazine *Mesures Art International*. His first works using rope as a material date from 1993 with an installation in the woods of Horion-Hozémont in Belgium. In 1995, he began teaching at the art school of Valenciennes in France. He exhibits regularly, mainly making installations in different sites, natural and industrial, throughout Europe, and in Korea, Russia, Estonia, and Senegal, where he also takes part in musical performances. In 1998, he realized his first audio CD with four musicians and is preparing another one which includes musical and visual correspondence work. He participated in the making of two books with the poets Julien Blaine and Dominique Sampiero and created many portfolios with various artists. He is now working on a new kind of catalogue which is concerned with a subject between anthropology and modernity.

Fré Ilgen (b. 1956, The Netherlands), based in Berlin, is a sculptor, painter and a theorist and curator. His paintings, sculptures and mobiles depict a reality that is not a solid mass but a swirling movement of shifting relationships, using abstract as well as figurative forms. He combines features from Western and Eastern cultures and philosophies, like from the Baroque and Indian sunyata. His extensive interest in visual perception and his interest in neuroscience motivate him exploring artworks that are visually powerful, appealing in dynamic compositions, defying gravity and simulating continuous change. These purposely cause a pleasant bewilderment in the viewer, because his works do not offer any singular narrative besides a fusion of the positive and negative in life. His interests and knowledge span across times and cultures. Exhibitions include more than 45 solo exhibitions and more than 150 group exhibitions in galleries, museums, corporations, foundations and at art fairs and biennials (incl. the 56th Venice Biennial). He moderates the award winning 'Checkpoint Ilgen' idealistic art salon, which he and his wife Jacqueline host in Berlin. He lectures widely at universities, fine art academies, galleries and international conferences, like in Europe, USA, East Asia. For further details, see: <http://www.freilgen.com>.

INCOSE Paolo Ruffino, Matteo Cremonesi, Davide Prati and Filippo Cuttica have been working together since 2006 as the art collective IOCOSE. IOCOSE's art investigates the after-failure moment of the teleological narratives of technological

and cultural development, in regards to both their enthusiastic and pessimistic visions. They have been exhibiting internationally at several art institutions and festivals, including Venice Biennale (2011, 2013), Tate Modern (London, 2011), Science Gallery (Dublin, 2012), Jeu de Paume (Paris, 2011), FACT (Liverpool, 2012), Transmediale (Berlin, 2013, 2015), Fotomuseum Winterthur (Switzerland, 2017), iMAL (Brussels, 2018), MAMbo (Bologna, 2018) and featured in publications such as Wired magazine, The Creators Project, Flash Art, Neural, Liberation, Der Spiegel, El Pais. For further details, see: <http://iocose.org>.

Andrew Johnston is a researcher and interaction/software designer based in Sydney, Australia. His work focuses on the design of systems that support experimental, exploratory approaches to interaction, and the experiences and practices of the people who use them. In recent years, he has created large-scale interactive projection systems for dance and physical theatre performances in collaboration with Stalker Theatre. Productions featuring his work have toured internationally and been attended by more than 30,000 people to date. He is Associate Professor at the University of Technology Sydney, where he works as the Research and Course Director of the UTS Animal Logic Academy, a unique, professionally equipped studio focusing on the creative application and design of digital technologies. He also co-directs the Creativity and Cognition Studios, an interdisciplinary research group working at the intersection of performance, art and technology. For further details, see: andrewjohnston.net.

Michael Kidner was born in 1917 in the UK. He received an honours degree in history and anthropology at Cambridge University in 1939 and from 1940 to 1946 served in the Canadian Army. He studied art in London and Paris between 1947 and 1953. In 1957, his work was included in Metavisual, Tachiste and Abstract Art in England, the first post-war exhibition of British abstract art. From 1957, he began his search for the objective use of colour leading to stripe and wave paintings emphasizing colour interaction. From 1966, he began to use colour as a code in conjunction with shape and his Columns work reflected the relationship between two and three dimensions. In the 1970s and 1980s, he explored wavy grid lines in which the area in between the lines become the structural elements of a space expressing infinity and the use of elastic cloth and fiberglass rods express spatial tension where the rods define the contour. From 1996, his imagery incorporated pentagon shapes and tulle material where the purpose is to undermine the gestalt. His distinguished career included many honours, prizes and international shows. He taught at Bath Academy of Art, Corsham from 1962–82 and was Visiting Lecturer at The Slade School of Fine Art from 1975–1979 and Chelsea School of Art from 1981–85. He co-founded the Systems Group with Jeffrey Steele and others in 1969. His work is in many important collections including those of Tate Britain, The Royal Academy, The British Arts Council, as well as in Portugal, Germany, Poland, Hungary, Vienna, Tokyo Russia and America. In 2004, he was elected as a senior Royal Academician. Latterly, he was to see a considerable revival of interest in his work, as general critical interest returned to the abstract painting of the 1960s and early 70s. He continued to work in his studio until his death in 2009.

Graziele Lautenschlaeger is a Brazilian media artist and researcher interested in practices at the intersection between Art and Science, searching to potentialize the poetic and symbolic layers of technological artefacts. Since 2014, she has been Ph.D. candidate in the Institut für Kulturwissenschaft at Humboldt-Universität zu Berlin. She graduated in Image and Sound from the Federal University of São Carlos (2002–2005) and her Master's degree was conducted in the Architecture and Urbanism Department of the University of São Paulo, where she collaborated with Nomads.usp—Centre for Interactive Living Studies (2007–2010). In 2008, she was a master exchange student in the Interface Culture Department at Kunstuniversität Linz, Austria and in 2010 she lectured at the Digital Design course at Uniara (Centro Universitário de Araraquara) in Brazil. Between 2011 and 2013, she was a cultural agent at SESC SP (The Social Service of Commerce in São Paulo), curating and producing programmes in Media Art, Digital Culture and Dance. As a visiting researcher and resident artist, she has been to Laguear (Graphics Laboratory for Architecture Experience) at the Federal University of Minas Gerais (2010–2011), LabMIS (Museu da Imagem e Som) in São Paulo (2011) and Salzamt Atelierhaus in Linz (2012). For further details, see: <http://www.grazielelautenschlaeger.com>.

Jay Alan Yim and Marlena Novak The collaborative localStyle was founded in Amsterdam in 2000 by Marlena Novak and Jay Alan Yim. Their goal is to use the senses to trigger reassessment of existing situations, beginning in 2003 to address issues of climate change and resource extraction, and expanding since 2006 to focus on non-human others via themes as varied as the mating behaviour of hermaphroditic marine flatworms, the sonification of electric fish from the Amazon, experimental Eurasian blackbird grammar and the presumptive logic underlying human taxonomic systems. These intermedia works—a practice that includes experimental 3D media, video, sound, interactive installations, live performance with electronics, audience participation and resistance gardening—have been presented in museums, galleries and alternative venues in more than 40 cities worldwide. Novak studied at Carnegie Mellon University and Northwestern University; she is an Adjunct Assistant Professor at the School of the Art Institute of Chicago, in the Department of Film, Video, New Media and Animation. Yim studied music composition at the University of California Santa Barbara, the Royal College of Music, and Harvard, and computer music at Stanford and MIT. He currently teaches at Northwestern University. For further details, see: <http://www.localstyle.tv>.

Colin Machin graduated from Hatfield Polytechnic in 1971 with a first-class honours degree in computer science, and went on to study for a Ph.D. in computer science. His work investigated the relationship between the design of computer hardware and that of the operating system, culminating in the design and implementation of a novel variable micro-code computer system and accompanying operating system. He was awarded a Ph.D. in 1976. From 1974 to 1976, he remained at Hatfield Polytechnic as a lecturer before moving to Loughborough University, where he took up a post as lecturer in the Department of Computer Studies (now Computer Science), an appointment held to the present. A sometime member of the British Computer Society's Computer Art Special Interest Group,

his contribution to the current debate stems from his expertise in real-time, microprocessor-based control systems. This is just the kind of technology that is required to power digital artworks. One of his particular interests outside of work is photography. Rather than simply taking photographs for posterity, he participates in the activities of a local photographic society and enters local, regional and national photographic competitions and exhibitions.

Manfred Mohr born on 8 June, 1938 in Pforzheim, Germany, worked in Paris from 1963 to 1983 and has lived and worked in New York since 1981. In 1960, he was making Action paintings and in 1961 received the school prize for art of the city of Pforzheim. In 1962, he began the exclusive use of black and white as a means of visual and aesthetic expression. In 1965, he studied lithography at the Ecole des Beaux Arts, Paris and his geometric experiments led to hard-edge painting. In 1968, his first one-man exhibition took place at the Daniel Templon Gallery, Paris. In 1972, sequential computer drawings were introduced and he began to work on fixed structures. He received awards at the World Print Competition, 1973, San Francisco, and the 10th Biennial in Ljubljana. In 1977, he began to work with the 4D hypercube and graph theory and in 1987 renewed the work on the 4D hypercube and extended the work to the 5D and 6D hypercube rotation and their projection as generators of signs. In 1990, he received the Golden Nica at Prix Ars Electronica in Linz and the Camille Graeser Prize in Zürich. In 1994, the first comprehensive monograph on him was published by Waser-Verlag, Zürich and in 1997 he was elected a member of the group, American Abstract Artists. In 1998, he started to use colour, after using black and white for more than three decades to show the complexity of the work through differentiation.

Alex Murray-Leslie is an artist–researcher and co-founder of the art band Chicks on Speed. Her practice-based research focuses on the design and development of somatic wearable musical instruments with a focus on computer-enhanced foot devices for theatrical audiovisual expression. She has performed and exhibited solo and with Chicks on Speed internationally in key art & science institutes, foundations and Biennales, including MoMA New York, Centre Pompidou Paris, Tate Modern, London, 55th and 56th Venice Biennale, ZKM Centre for Art and Media, Karlsruhe, Thyssen-Bornemisza Art Contemporary 21, Vienna, Art Electronica, Linz, Milani Gallery Brisbane, Artspace Sydney, Deitch Projects, New York, Dundee Contemporary Arts and at The National Museum of Modern Art, Kyoto. She is currently adjunct faculty at Interface Cultures and Fashion & Technology, The University of Art and Design, Linz, Research Associate, (CRCDM) Centre for Research Creation in Digital Media, Sunway University, Kuala Lumpur, Research Affiliate at CCC (Critical Curatorial Cybernetic studies) HEAD, The University of Art and Design, Geneva and Artist Fellow at Pier 9, Autodesk, San Francisco.

Frieder Nake born on December 16, 1938 in Stuttgart, Germany, is a mathematician, computer scientist and pioneer of computer art. He is best known internationally for his contributions to the earliest manifestations of computer art. His first exhibition of computer art was in Stuttgart in 1965, with Georg Nees, and in

1968 he took part in the London exhibition *Cybernetic Serendipity*. He has been a professor of interactive computer graphics at the Department of Computer Science, Bremen, since 1972. After studying mathematics at the University of Stuttgart, where he earned his Diploma and doctoral degrees (in probability theory), he taught in Stuttgart, Toronto and Vancouver, before coming to Bremen. Since 2005, he has also been teaching at the University of the Arts, Bremen. He won the First Prize of the Computer Art Contest of Computers & Automation in 1966. His book *Ästhetik als Informationsverarbeitung* (1974) is one of the first to study connections between aesthetics, computing and information theory.

German Alfonso Nunez is a postdoctoral fellow at the University of São Paulo, Brazil. There he holds a grant from the São Paulo Research Foundation (FAPESP) for his research ‘From concretism to the amusement park? The course of technological art in the Brazilian artistic field’. Aiming a social history of the artistic practices concerned with the use and dissemination of electronic or digital technology, he contrasts the Brazilian case with its European and US counterparts. As a practitioner, since 2007 he is a member of the artistic collective known as [+zero], which has exhibited in countries such as Austria, Romania, UK and Brazil.

Jack Ox is creative director of the nonprofit Intermedia Projects Inc. She began as an artist who used research as the method behind her art works. Now she is taking the procedures developed as an artist to the scientific and engineering world of visualization. She presented a paper at IEEE VIZ conference in Paris and is a Ph.D. with a dissertation on ‘Manifestations of Conceptual Metaphor and Blending Theories in Science, Design and Art’ from Swinburne University of Technology, Melbourne, AU. She is also a longtime member of Leonardo Journal of the International Society for the Arts, Sciences and Technology’s editorial board, and has served as both a Research Assistant Professor in art and art history and Research Associate Professor of music at the University of New Mexico (UNM). She is presently a Research Associate with the Center for Advanced Research Computing (CARC) UNM and a Research Fellow at the Art/Sci Center in ATEC, at UTDallas. Her 30-year career of mapping musical scores to paintings such as Kurt Schwitters’s intermedia masterpiece, *Ursonate*, Debussy’s *Nuages*, *The Gridjam*, *J.S.Bach’s Ein feste Burg ist unser Gott, BWV 80*, *Bruckner’s Eighth Symphony*, and *Stravinsky’s Symphony in Three Movements* is here: intermediaprojects.org/pages/UrForSale.html.

Michael Quantrill is an artist whose work traverses scientific research and fine art. From 1987 to 1992, he worked as a programmer after which, he left the computing industry and began to formalize his interest in art practice. After studying art and design at Riley College, Hull in 1994, he studied fine art at Loughborough College of Art and Design in 1995. In 1997, he began an ongoing association with the Creativity and Cognition Research Studios at Loughborough University where he began to integrate his drawing practice with advanced computing technology. In 1998, he worked with Manu Uniyal on the ArtParty98 project. This involved a collaborative drawing tool that allowed a number of individuals from international locations to draw on a virtual whiteboard simultaneously. In 2000, he received

funding under the Year of the Artist scheme to continue his work. Also in 2000, he formed the Emergency Art Lab with Dave Everitt, culminating in a commission to present work at the Wired and Dangerous Conference in Leicester, UK. In 2001, the Emergency Art Lab was commissioned to perform Club Confessional in the UK and Holland. He has written a number of papers and presented his work and ideas at various international conferences.

Esther Rolinson is an award winning UK-based artist who makes light installations and sculptural works through drawing. Working since 1999, she has major permanent installations in the UK and exhibits her works internationally. Her drawings are exhibited in their own right, and examples of her two-dimensional works have been acquired for the Victoria and Albert Museum Digital Art Collection. She makes drawings in experimental ways to understand structures and sensations, often using simple systems to render overall complex forms. She extends her drawing techniques to develop physical forms and movement sequences that underpin the programming of light movements in her installations. *Her* intuitively built structures and light movements become extendable sculptural systems. They are rendered on various scales and in flexible compositions whilst retaining the same underlying principles of construction. She employs internationally recognized manufacturers and consultants to achieve her pieces and also makes sculptural components by hand in her creative studio practice. *Her* hand-folded acrylic and programmed light installation *Flown*, developed in collaboration with programmer *Sean Clark*, won the Lumen Global Digital Arts Prize, Sculptural and 3D Award 2016 and the inaugural ArtCHI Prize, San Jose, California, 2016. For further details, see: <http://www.estherrolinson.co.uk>.

Anthony Rowe (b. 1964) is an artist, designer and researcher. He founded digital arts group Squidsoup in 1997, with the aim of creating immersive, emotive and intuitive experiences that merge the physical and the virtual. Squidsoup's groundbreaking work has been seen by millions of people on five continents, at institutions and events as varied as Sydney Opera House (AUS), Salisbury Cathedral (UK), SIGGRAPH (USA) and Ars Electronica (AU). He was Associate Professor of Interaction Design at the Oslo School of Architecture and Design (2009–2014); the same institute that awarded his Ph.D. He received an honorary mention in the Ars Electronica Awards (2017), and previously worked as an illustrator, photographer and sailor, crossing the Atlantic solo (1988). For further details see: <http://www.squidsoup.org>.

Andre Schappo has engaged in diverse aspects of technology and human support functions through his employment as an IT manager. His working life started at the age of 16 as a farm worker followed by numerous jobs, including agricultural mechanic and barman. His first experience of computing was attending a course on Cobol programming as a mature student. This was followed by a Higher National Diploma and then a Degree Course at Leicester Polytechnic (now De Montfort University). Since then he has been involved in research in various areas, including graphics languages, image processing, colour perception and management and

computer supported co-operative work. In 1985, he joined Loughborough University as a member of the computer science technical team. Later, he took on a dual role in the support services for the department and the computing services function. He had responsibility for Apple Macintosh systems across the campus. This enabled him to extend an already strong network of contacts throughout the university which proved to be very important when he joined the COSTART project in 1998 as a technology coordinator. He fervently believes in the superiority of the Macintosh platform for both end users and systems people. He has found that most artists he has met also prefer the Macintosh and so, apart from his interest in art, it is also a common ground between him and the artists.

Jennifer Seevinck is an electronic artist and researcher who creates digital, interactive art systems. Her practice is driven by conceptual questioning and design for audience experience. Themes driving the work include emergence, landscape, data and novel, physical interfaces. Qualitative research into people's experience of interactive art systems is also conducted alongside the practice. The integration of research and practice are key to her approach as practice informs the directions of research enquiry while evaluation research also informs the practice. She has exhibited at conferences and contemporary art galleries in Beijing, Tokyo, Australia and the U.S.A. Research publications include the recent book 'Emergence in Interactive Art' (Springer, 2017). In creating art, she has collaborated with community artists on creative interactive visualizations for the physically disabled, through to working with scientists on their data and artistic visualizations. In the distant past, she was a research scientist in the USA, project managing and designing for virtual reality training applications; and she has developed many interactive arts and interactive applications using state-of-the-art interaction technologies and applied to data visualization, medicine, space and engineering, to date. Currently, she is an academic at the Creative Industries at Queensland University of Technology, Australia. For further details, see: <http://www.smartnoise.net>.

Christa Sommerer and Laurent Mignonneau are internationally renowned media artists working in the field of interactive computer installation. They are Professors at the University of Art and Design in Linz Austria where they head the Department for Interface Culture at the Institute for Media. Sommerer and Mignonneau previously held positions as Professors at the IAMAS International Academy of Media Arts and Sciences in Gifu, Japan and as Researchers and Artistic Directors at the ATR Media Integration and Communications Research Lab in Kyoto Japan. Sommerer originally studied biology (botany) at the University of Vienna and modern sculpture and art education at the Academy of Fine Arts in Vienna. Mignonneau studied modern Art and Video Art at the 'Ecole des Beaux Arts' in Angoulême, France where he received his masters' degree. They completed their Ph.D. degrees from CAiiA-STAR, University of Wales College of Art, Newport, UK and the University of Kobe Japan, respectively. They have won mayor international media awards, for example, the 'Golden Nica' Ars Electronica Award for Interactive Art 1994 (Linz, Austria), the 'Ovation Award' of the Interactive Media Festival 1995 (Los Angeles, USA), the 'Multi Media Award'95' of the Multimedia Association

Japan and the 'World Technology Award' in London (2001). For further details, see: <http://www.interface.ufg.ac.at/christa-laurent/BIOGRAPHY/Biography.html>.

Stelarc is an Australian artist who has performed extensively in Japan, Europe and the USA, including new music, dance festivals and experimental theatre. He was a keynote speaker at Creativity and Cognition 1996 and CHI2002. He has used medical imaging, prosthetics, robotics, virtual reality systems and the Internet to explore and extend the parameters of the body. In 1997, he was appointed Honorary Professor of Art and Robotics at Carnegie Mellon University, Pittsburgh. In 2000, he was awarded an Honorary Degree of Laws by Monash University. He has completed Visiting Artist positions in Art and Technology, at the Faculty of Art and Design at Ohio State University in Columbus in 2002, 2003 and 2004. He has been Principal Research Fellow in the Performance Arts Digital Research Unit and a Visiting Professor at The Nottingham Trent University, UK. Between 2006 and 2011, he was Senior Research Fellow and Visiting Artist at the MARCS Lab, University of Western Sydney, Australia and Chair in Performance Art, School of Arts, Brunel University, Uxbridge, UK. In 2010, he received a special projects grant from the Australia Council and was also awarded the Prix Ars Electronica Hybrid Arts Prize. In 2012, he was the recipient of the Michael Cook Performance and Body Artist Award. In 2015, he received the Australia Council's Emerging and Experimental Arts Award. He is presently a Distinguished Research Fellow in the School of Design and Art, Curtin University. His artwork is represented by the Scott Livesey Galleries Melbourne. For further details, see: <http://stelarc.org>.

Joan Truckenbrod has exhibited her artwork internationally, including the IBM Gallery in New York City, the Smithsonian Institution in Washington DC, Museu de Arte Moderna in Rio de Janeiro and Musee d'Art Modern de la ville de Paris. Her work has been shown in one person exhibits in Chicago, Berlin and London. In 2000 and 2001, she had one person exhibition in Paris and Wiesbaden, Germany. Collections such as Parade Publications in New York and ISA Holding in London include her work. She is a Professor in the Art and Technology Department at the School of the Art Institute of Chicago. Her artwork is represented by FLATFILE Gallery in Chicago, Galerie de Gegenwart in Wiesbaden, Germany, Colville Place Gallery in London, and the Williams Gallery in Princeton, New Jersey. She has received a Scandinavian American Foundation Fellowship and a Fulbright Fellowship, research scholar's award. Her work has been featured recently in an article, *Instantanés sur l'art électronique à Chicago*, *Computer Art@Chicago* in *artpress* #246, May 1999, as well as in *Computers in the Visual Arts* (1998), *Art in the Electronic Age* (1993), *Photographic Possibilities* (1991) and *Digital Visions* (1987). She published her book *Creative Computer Imaging* in 1988.

Manumaya Uniyal was a doctoral student in the department of computer science at Loughborough University at the time of the COSTART project. His areas of study involved economics, computer graphics, computer animation and virtual reality. In 1996, he completed his Masters' degree in computer visualization and animation at Bournemouth University, UK. From 1996 to 1997, he worked at the

National Institute of Design (NID), Ahmedabad, Gujarat in India. At NID, he was involved in planning and setting up a computer animation laboratory. In 1997, he received a postgraduate scholarship and joined the LUTCHI Research Centre, Loughborough University where he worked on a number of projects covering a wide range of areas. In 1998 with Michael Quantrill, he developed the ArtParty98 project. The project involved a collaborative drawing tool that allowed a number of individuals from international locations to draw on a virtual whiteboard simultaneously. The live artworks were projected on a wall in the nightclub of Loughborough university student's union. He also worked on the Gallery of Future project at Loughborough University. During his research, he has conducted workshops and projects in the UK, India and Sweden and has written papers examining the application of virtual reality in the areas of law, health and tourism.

Roman Verostko Professor Emeritus at Minneapolis College of Art and Design, trained as a painter and art historian and exhibited his first use of electronics in 1967, the Psalms in Sound and Image. With the advent of the personal computer, he gradually developed a personal expert system that includes his own software driving tech pens and paintbrushes mounted on pen plotters. Recipient of the Golden Plotter First Prize (1994, Gladbeck, Germany) and an Ars Electronica honourable mention (1993), his work has been shown in art and technology exhibitions on four continents including Genetic Art—Artificial Life in Linz, 1993 and the ARTEC'95 Biennial in Nagoya, Japan. A past board member of the Inter-Society for Electronic Art (ISEA) and Programme Director for the 4th International Symposium on Electronic Art, he has published articles and lectured internationally on the subject of Art and Algorithm. Recent works include an illuminated binary version of a universal Turing machine and a pen-plotted mural spanning 40 ft in the Frey Science and Engineering Centre at the University of St Thomas, St Paul, Minneapolis. For further details, see: <http://www.verostko.com>.

George Whale is an artist and software engineer with special interests in drawing, print and computer-mediated creative collaboration. He obtained an honours degree in fine art from Portsmouth Polytechnic in 1983 and a Masters' degree in computing in design from Middlesex Polytechnic in 1989. Previously he was a Research Associate at Loughborough University School of Art and Design, and he worked as a community artist, as a commercial designer and printer and as a graphics software developer. One of the original team members of the London Institute research project, The Integration of Computers, Print Technology and Printmaking (1994–1998), he has been involved in a number of digital collaborations, has exhibited prints internationally and is co-author of *Digital Printmaking* (A & C Black, London). His current research is directed towards modelling some of the cognitive processes underlying observational drawing activity. To the extent that this approach enables drawing strategies to be made explicit and their pictorial consequences to be understood, he believes that this research will have specific relevance to the future teaching and learning of observational drawing.



What fascinates me about a machine is the experience of a physical and intellectual extension of myself. Manfred Mohr

I want to refine my methods of working and find more ways of using the benefits with the pleasures of the tactile and physical. Joan Ashworth



The more than 150 years old history of the 'new medium' photography has already shown that a new technology definitely may add important creative possibilities, without ever really excluding painting or sculpture. Fré Ilgen



Using digital technology seems to give potential for creating a different type of relationship between object and viewer. Esther Rolinson

In digital art I want to go somewhere I have never imagined going in painting or performance. Ray Ward

