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Damith Herath · Christian Kroos · Stelarc  
Editors

# Robots and Art

Exploring an Unlikely Symbiosis

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*To Amma and Thattha*

Damith Herath

*To my parents*

Christian Kroos

*For my partner, Nina Sellars*

Stelarc

# Preface

This is an unusual book.

It brings together perspectives of human activity and thinking that seemingly could not be further apart: science, engineering and technology on the one side, the arts and critical culture studies on the other. Yet, in contemporary robotic art they have been intertwined from the start, living off and nurturing each other. The current book follows this symbiotic relationship. It takes a path that meanders between the territories of the unlikely partners, along the fault lines of the areas, changing its style and viewpoint on the run as the narrative of robotic art makes inevitable.

For this book to come into being it took an unexpected collaboration. About seven years ago, a multidisciplinary, multi-university research project with funding from the Australian Research Council and the National Health and Medical Research Council was initiated at the MARCS Institute at Western Sydney University, Sydney, Australia. Titled the ‘Thinking Head Project’, it aimed to develop a sophisticated embodied conversational agent: a virtual, autonomous talking head that could generate appropriate and intelligent responses.

Unlike most other research projects, this project included an artist—an oddity indeed. In the beginning, there were no robots. As the research project progressed, the need for physical embodiment emerged from the desire to make the conversational agent more interactive and engaging. The new ‘Articulated Head’ was designed as a mixed-reality system, part virtual and part physical: An industrial robot arm moving the monitor that displayed the virtual agent. A robotics engineer was hired and a cognitive scientist already in the project switched from researching virtual human–computer interaction to handling the AI controlling the new robotic chimera. It may not come as a surprise then to readers that it is these three individuals who are the editors of the current book.

Such interdisciplinary collaborations are not without difficulties. Replicability and measurability required by science and engineering are at odds with the integrity of a work of art which transcends these norms: Not to be repeated, not to be measured. In implementing the Articulated Head, it became quickly apparent that the enfolding head-on collision of mindsets and methods was neither pragmatic

in nature nor project-specific. It is inscribed in the historical development of disciplines and despite encouragement of interdisciplinarity by universities, funding bodies and government programs in many countries, anyone working at the intersection of very diverse disciplines has experienced these apparent incommensurabilities. In academia especially, the organisational structures and evaluation processes often impede work attempting to bridge the gap between science and art.

It became our ambition to lower the disciplinary boundaries between robotics and art. We started with full-day workshops at international robotic conferences and discovered a rich culture of collaborations in robotic art, sometimes reaching back several decades. However, these collaborations had seldom entered mainstream robotics. The current book is an attempt to mend fences—not by ignoring established requirements and practices of the involved disciplines, but by opening the view to other perspectives.

As you will discover, the artists included in this book—either in their own account or as topic of analysis—have created some of the most iconic and seminal works in robotic art. The contributors to this book were invited for their diverse approaches and viewpoints and the quality of their work. Each contribution has undergone a thorough peer review process. The result is an informed and insightful look at the concepts, the technology, the history and the philosophy of robots in contemporary art and the notable influence it has had on the discussion of robot-related issues in society. The result is also a very readable book, accessible to a wider readership beyond disciplinary boundaries and beyond academic scholarship and education.

# Acknowledgment

We are indebted to the authors for their contributions amidst busy schedules and work commitments, gracefully accepting our relentless reminders, additional questions and revise requests. We also acknowledge the fertile landscape that was the Thinking Head Project, which provided the necessary support and the framework for us to collaborate and explore this unlikely union of robotics and art and between roboticists and artists. Especially, Denis Burnham and Kate Stevens at the MARCS Institute, Western Sydney University, along with other investigators of the Thinking Head project. We also acknowledge the many other organisers of the Robots and Art workshop series at ICRA for facilitating and promoting the cross-disciplinary dialogue over the years.

Many colleagues including some of the authors themselves have lent considerable personal time to review the draft chapters. Specifically, we acknowledge the contributions from the following reviewers: Bhante Sujato, Chris Drane, David St-Onge, Eleanor Sandry, Elizabeth Ann Jochum, Elizabeth Stephens, Guy Ben-Ary, Heidi Dokulil, Janise Farrel, Jayasinghe Herath, Jean-Paul Laumond, Jeni Thornley, Leonel Moura, Lesley Christen, Matthew Connell, Nicolas Reeves and Paddy Murray.

We collectively wish to acknowledge the support received from the MARCS Institute at the Western Sydney University, Brunel University, London, Alternate Anatomies Lab at Curtin University, SMaRT Centre at the University of New South Wales, Sydney, Human-Centred Technology Research Centre at the University of Canberra, and the Powerhouse Museum (Museum of Applied Art and Science), Sydney—the proving ground for our adventures in robotic art. We want to thank our long-standing colleague and friend Zhengzhi Zhang and Robological Pty Ltd for the many contributions made to the projects.

We are grateful to Springer for commissioning this important work and to the whole editorial and production team, especially Loyola (Loy) D’Silva, our publishing editor for patiently guiding this project through.

Finally, we thank our next of kin, friends and colleagues who played a key role in shaping this book over the years.



We would like to invite you, the reader, to embark on an exploratory journey with us and the contributors, travel through conflicting fields of studies and witness how they come together to form an unlikely symbiosis in the creation of robotic art. We hope you will enjoy this unusual journey as much as we did over the last five years while designing, editing and contributing to this book.

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Stelarc

# Editors and Contributors

## About the Editors

**Damith Herath** Human Centred Technology Research Centre, University of Canberra, Australia

Damith Herath received his Ph.D. in Robotics from the University of Technology, Sydney in 2008 while at the ARC Centre of Excellence for Autonomous Systems (CAS) and has a B.Sc. (Hons) in Production Engineering, University of Peradeniya, Sri Lanka in 2001. He held a doctoral fellowship at CAS prior to joining MARCS Institute on the Thinking Head Project as the Research Engineer. At MARCS, he led several robotic projects that explore various nuances of Human–Robot Interaction including reciprocal influences between the arts and robotics. His interests include autonomous robot navigation, localization and mapping, human–robot interaction and robotic art. Over the last 4 years, he has contributed to a number of robotic art projects as the lead roboticist. He is also the convener and program co-chair of the 2011 International Conference on Robotics and Automation—Workshop on Robots and Art.

**Christian Kroos** Alternate Anatomies Laboratory, School of Design & Art, Curtin University, Perth, Australia

Christian Kroos received his M.A. and Ph.D. in Phonetics and Theatre Studies from the Ludwigs-Maximilians-Universität, München, Germany. His work on speech articulator movements and face motion during spoken language led to interdisciplinary research covering computer vision, cognitive sciences and robotics conducted internationally at the Institute of Phonetics and Speech Processing at Ludwigs-Maximilians-Universität (Germany), at ATR International (Japan) and at Haskins Laboratories (USA). At MARCS Institute, University of Western Sydney, Australia, he explored non-verbal human–machine interaction in the Thinking Head project. Besides his interest in robotic agents, he is still fascinated by human speech production and the evolution of language.

**Stelarc** Performance Artist, Distinguished Research Fellow, Director Alternate Anatomies Lab, School of Design & Art, Curtin University Perth

Stelarc explores alternate anatomical architectures, using prosthetics, robotics, medical imaging, biotechnology and the Internet. He has performed with a Third Hand, a Virtual Body, an Extended Arm, a Stomach Sculpture, Exoskeleton and a Prosthetic Head. He is surgically constructing and stem-cell growing an ear on his arm that will be Internet enabled. Publications include *Stelarc: The Monograph*, Edited by Marquard Smith, Forward by William Gibson (MIT Press 2005). In 1996 he was made an Honorary Professor of Art and Robotics at Carnegie Mellon University, Pittsburgh and in 2002 was awarded an Honorary Doctorate of Laws by Monash University, Melbourne. In 2010, he received the Ars Electronica Hybrid Arts Prize. He has recently been presented with the inaugural Australia Council Award for Outstanding Achievement in Emerging and Experimental Arts. Stelarc is currently a Distinguished Research Fellow and Director of the Alternate Anatomies Lab, School of Design and Art (SODA) at Curtin University. His artwork is represented by the Scott Livesey Galleries, Melbourne.

## Contributors

**Gemma Ben-Ary** Gemma is an independent art curator, writer and visual artist who works on public arts projects and exhibitions, and is the Curator of the contemporary art collection of the City of Joondalup, West Australia, a collection featuring the work of Western Australian contemporary artists. She is currently completing a BA (Writing Minor, Visual Art Major) at ECU and sits on the Board of the Mundaring Arts Centre. Since graduating from TAFE in 2007 with an Advanced Diploma of Visual Art, she has worked in various cultural development roles and her artistic practice combines feminist theory and contemporary craft.

**Guy Ben-Ary** SymbioticA: The Center for Excellence in Biological Arts, the University of Western Australia

Guy Ben-Ary is an artist and researcher at SymbioticA at the University of Western Australia. Recognised internationally as a major artist and innovator working across science and media arts, Guy specialises in biotechnological artwork, which aims to question our understanding of life. Guy's work has been shown across the globe at prestigious venues and festivals from the Beijing National Art Museum to San Paulo Biennale to the Moscow Biennale (to name a few). In 2009, his work was awarded an Honorary Mention in Ars Electronica and also won first prize at VIDA, an international competition for Art and Artificial Life.

**Louis-Philippe Demers** School of Art, Design and Media, Nanyang Technological University

Louis-Philippe Demers makes large-scale installations and performances building more than 375 machine performers over the past two decades. His projects

can be found in theatre, opera, subway stations, art museums, science museums, music events and trade shows. Demers' works have been primed at Ars Electronica, VIDA, Japan Media Arts Festival, Lightforms and at the Helpmann Awards. Demers was Professor at the Hochschule fuer Gestaltung Karlsruhe, affiliated to the world-renowned Zentrum fuer Kunst und Medientechnologie (ZKM, Germany). Since he joined the School of Art, Design and Media at the Nanyang Technological University (Singapore).

**Stefan Doepner** He studied experimental film and intermedia arts at the University of Arts Bremen. Doepner primarily works in the field of technology-based art, robotics and sound. He cofounded several art groups and initiatives, e.g. f18institute in Hamburg, Obrat and Cirkulacija2 in Ljubljana. Since 1997 he collaborates with Stelarc. Doepner participated at the documenta9 project VanGogh TV (1992); exhibited at Steirischer Herbst, (2006); Synthetic Times: Media Art China, Beijing (2008); Ars Electronica, (2008); MedienKunstLabor, Graz (with Cirkulacija2, 2009), f18institut's Playground Robotics project, Switzerland and Slovenia (2004). The NanoŠmano project with Dusseiller and Leskovšek—nano-scale material, life-forms and tools (2010–2012) at Kapelica Gallery. The “Total Art Platform” (2010–2013) and “The Noise is Us” festival (2014/15) with Cirkulacija2.

**Ken Goldberg** University of California Berkeley

Goldberg is an Artist and Professor of Engineering at UC Berkeley. He explores the intersection of the digital and the natural worlds. His artworks include a living garden tended by a robot via the Internet and the award-winning film “Why We Love Robots”. His works have appeared at the Whitney Biennial, Venice Biennale, Pompidou Center, Walker Art Center, Ars Electronica, ZKM, ICC Biennale, Kwangju Biennale, Artists Space and the Kitchen. He is the Founding Director of Berkeley's Art, Technology, and Culture Colloquium.

**Tara Heffernan** Tara Heffernan is a Melbourne-based independent art writer. Contributing to numerous Australian art magazines, such as Artlink, Eyeline, and un Magazine, Heffernan's research concerns performance, technology and video in contemporary art. She received a Bachelor of Fine Art (with an honours in Art History) from Griffith University in 2012.

**Hiroshi Ishiguro** Graduate School of Engineering Science at Osaka University; Hiroshi Ishiguro Laboratories at the Advanced Telecommunications Research Institute

Hiroshi Ishiguro received a D.Eng. in Systems Engineering from the Osaka University, Japan in 1991. He is currently Professor of Department of Systems Innovation in the Graduate School of Engineering Science at Osaka University (2009–) and Distinguished Professor of Osaka University (2013–). He is also visiting Director (2014–) (group leader: 2002–2013) of Hiroshi Ishiguro Laboratories at the Advanced Telecommunications Research Institute and an ATR fellow. His research interests include sensor networks, interactive robotics, and android science.

**Elizabeth Jochum** Aalborg University

Elizabeth Jochum (BA Wellesley College; MA, Ph.D. University of Colorado) is an Assistant Professor of Robot Aesthetics at Aalborg University (Denmark) and the co-founder of Robot Culture and Aesthetics (ROCA) research group at the University of Copenhagen. Her research focuses on the intersection of robotics, art and performance.

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Urška Jurman graduated 2002 in Art History and Cultural Studies from the Faculty of Arts, University of Ljubljana. She works as editor, writer, curator and producer. Her field is contemporary art and its social context. Collaborations in Slovenia: Škuc Gallery, '95–'97; SCCA-Center for Contemporary Art, '99–'02, '05–'06; hEXPO festival 2000; festival Break 2.2, '03; Gallery P74, '05–'08. Since 2012, she is Program Manager of the Igor Zabel Association. She is Co-founder of Obrat Association.

**Jean-Paul Laumond** LAAS-CNRS, Toulouse, France

J.P. Laumond, IEEE Fellow, is a roboticist. He is Directeur de Recherche at LAAS-CNRS. His research is devoted to robot motion. He has published more than 150 papers in international journals in Robotics, Computer Science, Control and Neurosciences. He has been the 2011–2012 recipient of the Chaire Innovation technologique Liliane Bettencourt at Collège de France in Paris. His current project Actanthrope (ERC-ADG 340050) is devoted to the computational foundations of anthropomorphic action.

**Chico MacMurtrie** Amorphic Robot Works

Chico MacMurtrie is internationally recognised for his large-scale, interactive public sculpture, performances and robotic installations. After graduating from UCLA in 1987, he has received various awards and grants including from the Rockefeller and Daniel Langlois Foundation. In 1991 he founded Amorphic Robot Works/ARW, a collective of artists, engineers, and scientists dedicated to the creation of anthropomorphic, organic, and abstract robotic forms. ARW has exhibited in major museums and institutions worldwide, including: Reina Sofia Museum, Madrid; NAMOC, Beijing; MUAC, Mexico City; Beall Center for Art and Technology; Shanghai Biennale, Pioneer Works, (NY); SESC, Sao Paulo; Cité des Sciences, Paris.

**Leonel Moura** is a European artist born in Lisbon who works with AI and robotics. In 2003, he created his first swarm of 'Painting Robots', able to produce original artworks based on emergent behaviour. Robotic Action Painter (RAP), produced for the American Museum of Natural History in New York and ISU (The Poet Robot), both from 2006, are able to generate highly creative and original art works. In 2007, the Robotarium, the first zoo dedicated to robots and artificial life, opened near Lisbon. In 2009, Moura was appointed as the European Ambassador for Creativity and Innovation.

**Kohei Ogawa** Graduate School of Engineering Science at Osaka University

Kohei Ogawa received a Ph.D. in Future University-Hakodate, Japan in 2010. He is currently an Assistant Professor in the Department of Systems Innovation in the Graduate School of Engineering Science at Osaka University (2012–) His research interests include interactive robotics, and human agent interaction.

**Simon Penny** University of California Irvine

Simon Penny is an interactive media artist, teacher and theorist with a long-standing concern for embodied and situated aspects of artistic practice. He explores—in both artistic and scholarly work—problems encountered when computational technologies are interfaced with cultural practices whose first commitment is to the engineering of persuasive perceptual immediacy and affect. Currently, a Professor of Electronic Art and Design, he teaches Mechatronic Art, Gizmology and related practices. He is also the Founding Director of Arts Computation Engineering graduate program, UCI; Labex International Professor, Paris8 and ENSAD 2014; visiting professor, Cognitive Systems and Interactive Media masters, University Pompeu Fabra Barcelona, 2006–2013, Professor of Art and Robotics Carnegie Mellon, 1993–2000. See [simonpenny.net](http://simonpenny.net).

**Nicolas Reeves** NXI GESTATIO Design lab—University of Quebec in Montreal

Trained in architecture and physics, a graduate of MIT, Nicolas Reeves is an artist and researcher at the School of Design at University of Quebec in Montreal (UQAM). His work is characterised by a highly poetic use of sciences and technologies. A founder member and, later, Scientific and Research-Creation Director of the Hexagram Institute from 2001 to 2009, Vice-President of the Société des Arts Technologiques from 1998 to 2008, he directs the NXI GESTATIO design lab, which explores the formal impact of digital information in all creative fields. He has produced a number of acclaimed works, such as *Harpe à Nuages* (Cloud Harp) and triggered the *Aerostabiles* research programme, which studies the potential of flying automata able to develop autonomous behaviour. The winner of several prizes and grants, he has shown work and given talks on four continents.

**Ken Rinaldo** The Ohio State University

Ken Rinaldo is internationally recognised for his interactive installations blurring the boundaries between the organic and inorganic and speaking to the co-evolution between living and evolving technological cultures. His work interrogates fuzzy boundaries where hybrids arise. Biological, machine and algorithmic species and their unique intelligences are mixing in unexpected ways and we need to better understand the complex intertwined ecologies that these semi-living species create. Rinaldo is focused on trans-species communication and researching methods to understand animal, insect and bacterial cultures as models for emergent machine intelligences, as they interact, self organise and co-inhabit the earth. Rinaldo's works have shown and commissioned by museums, festivals and galleries internationally.

**David Rye** Australian Centre for Field Robotics, The University of Sydney, Australia; Adjunct Associate Professor, Creative Robotics Lab, UNSW Art & Design, The University of New South Wales, Australia.



Associate Professor David Rye is a co-founder of the Australian Centre for Field Robotics, which was established in the School of Aerospace, Mechanical and Mechatronic Engineering at the University of Sydney in 1999. He holds a Ph.D. in Mechanical Engineering from the University of Sydney. He has conducted extensive research in fields related to automation and control of machines, including applied nonlinear control, container handling cranes, excavation and autonomous vehicles. Since 2003, he has worked with Mari Velonaki in the field of social robotics, designing and implementing autonomous robots that can interact with people in social spaces. Rye is recognised as a pioneer in the university teaching of mechatronics, having instituted the first Australian BE in Mechatronic Engineering in 1990.

**Eleanor Sandry** Curtin University

Eleanor Sandry is a Lecturer in Internet Studies at Curtin University. Her research develops an ethical and pragmatic recognition of, and respect for, otherness in communication. She writes about communication theory and practice, using examples from science and technology, science fiction and creative arts to illustrate her ideas. She has a particular interest in human–robot interactions and her first book, *Robots and Communication*, was published by Palgrave Macmillan in 2015.

**David St-Onge** Département de Robotique, Université Laval, Québec

An engineer in arts trained as a mechanical engineer, David St-Onge then graduated in project management to acquire the skills required to work in a multidisciplinary environment. His Ph.D. in space robotics is conducted at the Department of Mechanical Engineering of Laval University in Quebec. He works with some of the most important artists of the Quebec technological arts scene, providing them with the tools needed to express their talent and vision.

**Elizabeth Stephens** Southern Cross University

Elizabeth Stephens is an Associate Professor in Cultural Studies and Director of Research in the School of Arts and Social Sciences at Southern Cross University. Her books include *Anatomy as Spectacle: Public Exhibitions of the Body from 1700 to the Present* (2011) and *Queer Writing: Homoeroticism in Jean Genet's Fiction* (2009). She is currently completing a new book, *A Critical Genealogy of Normality*, with Peter Cryle.

**Mari Velonaki** Director, Creative Robotics Lab, UNSW Art & Design, The University of New South Wales, Australia; Adjunct Associate Professor, Australian Centre for Field Robotics, The University of Sydney, Australia.

Mari is a researcher in the fields of social robotics and interactive art. Mari's research expanded to robotics when she initiated and led a major Australian Research Council (ARC) project 'Fish–Bird' (2004–2007) at the Australian Centre for Field Robotics. She founded the Centre for Social Robotics in 2006 within ACFR. In 2014, Mari was awarded an ARC grant for the creation of a National Facility dedicated to Human–Robot Interaction Research. Mari is the Director of

the Creative Robotics Lab at UNSW. In 2014, she was voted by Robohub as one of the world's 25 women in robotics you need to know about.

**Bill Vorn** Concordia University

Based in Montreal, Bill Vorn is working in the field of Robotic Art for more than 20 years. His installation and performance projects involve robotics and motion control, sound, lighting, video and cybernetic processes. He holds a Ph.D. degree in Communication Studies from UQAM (Montreal) for his thesis on Artificial Life as Media. He currently teaches Electronic Arts in the Department of Studio Arts at Concordia University (Intermedia program) where he is a Full Professor.

**Norman T. White** Norman White started his art career as a painter, but in the late 1960s he taught himself electronics and began to create electrical machines in order to better model the often unpredictable behaviour of dynamic systems, especially that of living organisms. White has exhibited his artwork throughout North America and Europe. Many of his works can be found in public collections, including those of the Art Gallery of Ontario, the Vancouver Art Gallery, the Canadian Art Bank and the National Gallery of Canada. Since 1978, he has taught electronics, mechanics and computer programming at both OCAD and Ryerson Universities in Toronto.

**Amy M. Youngs** The Ohio State University

Amy M. Youngs is an artist and creative researcher in the areas of eco art, interactive installation and socially-engaged practices. She has exhibited her work at venues such as the Te Papa Museum in New Zealand, the Trondheim Electronic Arts Centre in Norway, the National Art Museum of China and the Peabody Essex Museum in Salem, Massachusetts. She has published articles in *Leonardo* and *Antennae* and her artwork has been featured in many art and science publications. She co-developed the Art and Technology program at the Ohio State University, where she has been on faculty since 2001.