

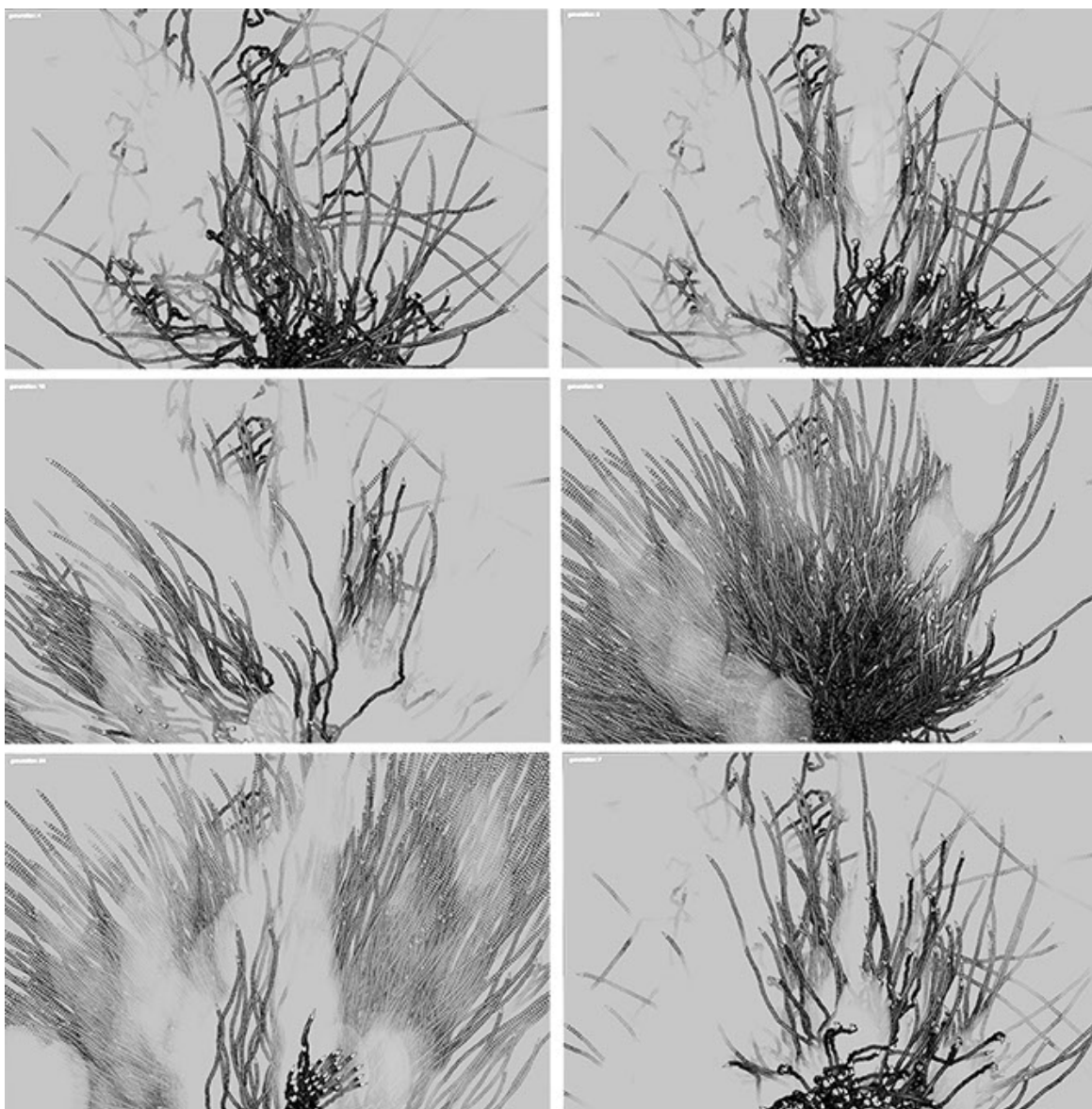
# Computer Graphics, Imaging & Visualization

— New Techniques and Trends —

— CGiV 2016 —

*Edited by*

Ebad Banissi, Muhammad Sarfraz, and Muhammad Fakir



29 March–1 April 2016 • Beni Mellal City, Morocco

PROCEEDINGS

# Computer Graphics, Imaging & Visualization

— New Techniques and Trends —

—— CGiV 2016 ——

29 March–1 April 2016  
Beni Mellal City, Morocco

*Edited by*

**Ebad Banissi, Muhammad Sarfraz, and Muhammad Fakir**



Copyright © 2016 by The Institute of Electrical and Electronics Engineers, Inc.  
All rights reserved.

*Copyright and Reprint Permissions:* Abstracting is permitted with credit to the source. Libraries may photocopy beyond the limits of US copyright law, for private use of patrons, those articles in this volume that carry a code at the bottom of the first page, provided that the per-copy fee indicated in the code is paid through the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

Other copying, reprint, or republication requests should be addressed to: IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, P.O. Box 133, Piscataway, NJ 08855-1331.

*The papers in this book comprise the proceedings of the meeting mentioned on the cover and title page. They reflect the authors' opinions and, in the interests of timely dissemination, are published as presented and without change. Their inclusion in this publication does not necessarily constitute endorsement by the editors, the IEEE Computer Society, or the Institute of Electrical and Electronics Engineers, Inc.*

IEEE Computer Society Order Number: E5814  
BMS Part Number: CFP16349-ART  
ISBN: 978-1-5090-0811-7

*Additional copies may be ordered from:*

IEEE Computer Society  
Customer Service Center  
10662 Los Vaqueros Circle  
P.O. Box 3014  
Los Alamitos, CA 90720-1314  
Tel: + 1 800 272 6657  
Fax: + 1 714 821 4641  
<http://computer.org/cspress>  
[csbooks@computer.org](mailto:csbooks@computer.org)

IEEE Service Center  
445 Hoes Lane  
P.O. Box 1331  
Piscataway, NJ 08855-1331  
Tel: + 1 732 981 0060  
Fax: + 1 732 981 9667  
[http://shop.ieee.org/store/  
customer-service@ieee.org](http://shop.ieee.org/store/customer-service@ieee.org)

IEEE Computer Society  
Asia/Pacific Office  
Watanabe Bldg., 1-4-2  
Minami-Aoyama  
Minato-ku, Tokyo 107-0062  
JAPAN  
Tel: + 81 3 3408 3118  
Fax: + 81 3 3408 3553  
[tokyo.ofc@computer.org](mailto:tokyo.ofc@computer.org)

*Individual paper REPRINTS may be ordered at: <[reprints@computer.org](mailto:reprints@computer.org)>*

Editorial production by Randall Bilof  
Cover art production by Mark Bartosik



*IEEE Computer Society*  
**Conference Publishing Services (CPS)**  
<http://www.computer.org/cps>

# Preface

Computer graphics, imaging and visualization (CGiV) combined are used in some form or shape in most applications in this age. New applications show strong trends from graphics, imaging, and visualization. There are exciting explorations of theories and applications to a wide range of disciplines including social media, geo-sociology, health, business, security and more. Statistical analysis of literature illustrates that the chasm between academia and industries is being abridged as applications become more innovative and drive new research activities.

The collection in this volume has the latest contributions from scientists, artists, and users from a cross section of disciplines in the area of computer graphics, imaging, and visualization. Though the classification is somewhat difficult because of the overlapping nature of the subject, there are three themes of graphics, imaging and visualisation running through this book. Chapters contribute towards different new techniques, applications, and tools within the theme of the book. The book is designed to have the best possible utility for researchers, computer scientists, practicing engineers, and many others around the globe. It will also be equally and extremely useful for graduate students in the areas of computer science, engineering, and other computational science disciplines.

Each contributor does indeed add a fresh view and thoughts, challenges our beliefs, and encourages further exploration and innovation. We are grateful to all for providing the opportunity to share their valuable work with the research and scientific community. These contributions will definitely prove to be an asset for future awareness.

This book has come out of the efforts of the annual international forum of CGiV 2016. We are deeply indebted to all of the contributors to this book as well as the reviewers for their patience and cogent reviews of submitted manuscripts.

**Ebad Banissi, Muhammad Sarfraz, and Muhammad Fakir**  
*Editors*

## Acknowledgments

We are deeply indebted to all the authors and contributors to this collection, all the reviewers for their patience and cogent reviews of papers, who helped us and the CGiV community with their expertise and feedback to shape this content effectively.

Our very special thanks go to all programme, organizing and liaison committee members who go out of their way to help shape the CGiV Forum year after year.

We would like to extend sincere thanks to the local organising committee, especially Prof. M. Fakir of the Faculty of Sciences and Technics at Beni Mellal, Morocco.

Finally, we offer sincere thanks to the Graphicslink team for their continuous efforts in preparing, organising and handling the conference administration. Appreciation is also due to Randy Bilof, Proceedings Production Editor (Conference Publishing Services, IEEE Computer Society), for his high standards of editorial production of this Proceedings book.

### Organising Committee

#### **General Chair:**

Prof. M. Fakir, Faculty of Sciences and Technics, Beni Mellal, Morocco

#### **General Co-Chairs:**

Prof. Ebad Banissi, VGRU, LSBU, UK; Prof. M. Sarfraz, Kuwait University, Kuwait; and Dr. Weidong (Tony) Huang, CSIRO, Australia

#### **Local Organizing Committee:**

Professors Rachid El Ayachi, Najlae Idrissi, Mourad Nachaoui, Belaid Bouikhalene, Mohamed Baslam, Cherki Daoui, Mohamed Erritali, B. Minaoui, Abdellatif Hair, Mostapha Jourhmane, Ahmed Boumezzough, Mohamed Sabri, Abdelkarim Bencharke, Mohamed Gouskir, Mohamed Boutalline, M. Outanoute and Mohamed Biniz from Faculty of Sciences and Technics, Beni Mellal, Morocco

**Arrangement Co-Chairs:** Anita D'Pour, GraphicsLink, UK

### CGiV 2016 – Symposium Organizing & Liaison Committee

#### **Computer Graphics**

##### **Computer Animation**

Mark W. McK. Bannatyne, Purdue University, USA  
Jian J Zhang, Bournemouth University, UK

##### **Computer Visualisation & Graphics Rendering**

Jian J Zhang, Bournemouth University, UK  
Priti Sehgal, University of Delhi, India

##### **Real-Time Computer Graphics**

Natasha Dejrumong, King Mongkut's University of Technology Thonburi, Thailand  
Wong Ya Ping, Multimedia University, Malaysia

##### **3D Visual Environments**

John Counsell, University of Wales Institute, UK  
Weidong (Tony) Huang, CSIRO ICT Centre, Australia

## **Imaging**

### **International Symposium on Image/Video Analysis**

Prof. Zulfiqar Habib, COMSATS Institute of Information Technology, Lahore, Pakistan  
Dr. Wong Chow Jeng, Universiti Sains Malaysia, Malaysia  
Prof. Leonardo Traversoni, UAM - Universidad Autonoma Metropolitana, Mexico  
Prof. Najlae Idrissi, Faculty of Sciences and Technics, Beni Mellal, Morocco

### **Forensic Digital Imaging**

Prof. Ebad Banissi, LSBU, UK  
Prof. Mourad Nachaoui, Faculty of Sciences and Technics, Beni Mellal, Morocco

### **Computer Vision Techniques for Computer Graphics**

Natasha Dejdumrong, King Mongkut's University of Technology Thonburi, Thailand  
Wong Ya Ping, Multimedia University, Malaysia

## **Visualisation**

### **Visualisation**

Haim Levkowitz, University of Massachusetts Lowell, USA

### **Spatial/Geographic Data Visualization**

Lim Hwee San, Universiti Sains Malaysia, Malaysia

### **Visualisation – Scientific & Information**

Jiawan Zhang, IBM Center, Tianjin University, China  
Mao Lin Huang, University of Technology, Sydney, Australia

### **Visual Analytics**

Quang Vinh Nguyen, University of Western Sydney, Australia

#### **Visual Reviewing Committee:**

Anton Bogdanovych, University of Western Sydney, Australia  
Wu Quan, University of Sydney, Australia  
Robert Shen, University of Melbourne, Australia  
Tony Huang, CSIRO, Australia

## **CGiV Application**

### **Symposium and Gallery of Digital Art**

Anna Ursyn, University of Northern Colorado, USA

#### **D-Art 2016 Symposium and Online Gallery of Digital Art Advisory, Programme and Reviewing Committee:**

Dena Eber, Bowling Green State University, OH  
Ernest Edmonds, University of Technology, Sydney, AU  
Marla Schweppe, Rochester Institute of Technology, NY  
Daniela Sirbu, University of Lethbridge, Canada  
LiQuin Tan, Rutgers University, NJ  
Anna Ursyn, University of Northern Colorado  
James Faure Walker, CCW Graduate School, University of the Arts, London

### **Computer Animation & Especial Effects Show**

Mark W. McK. Bannatyne, Dept. of Design and Communication Technology, Purdue University, UK

**Computer-Aided Geometric Design**

M. Sarfraz, Department of Information Science, Kuwait University, Kuwait

**Intelligent Recognition Techniques, Applications, Systems & Tools**

M. Sarfraz, Department of Information Science, Kuwait University, Kuwait

**Multimedia**

Mohammad Dastbaz, Dean of CITE, University of East London, UK

**Digital Entertainment**

Ron Balsys, Central Queensland University, QLD, Australia

Jian J Zhang, Bournemouth University, UK

**Serious Games**

Prof. Cherki Daoui, Faculty of Sciences and Technics, Beni Mellal, Morocco

## Programme/Review Committee

Abd. Rahni Mt. Piah (MY)  
Adel Ahmed (SA)  
Ahmad Aljamali (KW)  
Ahmad Nasri (LB)  
Akash Singh (IN)  
Alper Yilmaz (USA)  
Amer Salman (UK)  
Andres Iglesias Prieto (ES)  
Anna Ursyn (USA)  
Anthony Maeder (AU)  
Anton Bogdanovych (AU)  
Chao-Hung Lin (TW)  
Chien-Liang Chen (TW)  
Chun-Cheng Lin (TW)  
Cowell, Andrew J (USA)  
Deryn Graham (UK)  
Dhanesh Ramachandram (MY)  
Dinesh Kant Kumar (AU)  
Donghai Liu (CN)  
Ebad Banissi (UK)  
Eric W Tatham (UK)  
Eugene Ch'ng (UK)  
Farzad Khosrowshahi (UK)  
Fuhua (Frank) Cheng (US)  
Gui Yun Tian (UK)  
Guy Melancon (FR)  
Haim Levkowitz (US)  
I-Chen Lin (TW)  
Jamaludin Ali (MY)  
Jian J Zhang (UK)  
Jiangjian Xiao (US)  
Jiangtao Xi (AU)  
Jihad Mohamad Jaam (QA)  
Jinan A. W. Faidhi (CA)  
Jingyi Yu (US)  
Jinhui Tang (SG)  
Jinhui Yu (CN)  
Jizhou Sun (CN)  
John Counsell (UK)  
Juan Manuel Pena (ES)  
Jung Hong Chuang (TW)  
Keith Unsworth (NZ)  
Kenneth Lam (HK)  
Kevin Suffern (AU)  
Khiruddin Abdullah (MY)  
Kin Chuen Hui (HK)  
Lee Seng Luan (SG)  
Leman Figen Gul (BA)  
Leonardo Traversoni (MX)  
Liangpei Zhang (CN)  
Lihua You (UK)  
Lim Hwee San (MY)  
Li-Qun Xu (UK)

Li-Yi Wei (CN)  
Maggie Parker (UK)  
Mao Lin Huang (AU)  
Marina Gavrilova (CA)  
Mark W. McK. Bannatyne (US)  
Meng Wang (CN)  
Mohammad Dastbaz (UK)  
Mohammed Azlan Bin Mohamed Iqbal (MY)  
Mohd Zubir Mat Jafri (MY)  
Muhammad Sarfraz (KU)  
Murtaza Khan (SA)  
Naofumi Yoshida (JP)  
Nasirun Mohd. Saleh (MY)  
Natasha Dejdumrong (TH)  
Nickolas S. Sapidis (GR)  
Nickolas Sapidis (GR)  
Noritaka Osawa (JP)  
Priti Sehgal (IN)  
Quang Vinh Nguyen (AU)  
Richang Hong (CN)  
Richard Laing (UK)  
Robin Bying-Yu Chen (TW)  
Ronald J. Balsys (AU)  
Sai-Keung Wong (TW)  
Sebti Foufou (FR)  
Sheung-Hung Poon (TW)  
Simeon Simoff (AU)  
Stuart Charters (NZ)  
Tan-Chi Ho (TW)  
Tan Tiow Seng (SG)  
Tang Jie (CN)  
Weidong (Tony) Huang (AU)  
Tony Jan (AU)  
Uğur Gudukbay (TR)  
Ugo Erra (IT)  
Varol Akman (TR)  
W. Schuhr (GE)  
Wai Lok Woo (UK)  
Wan-Yu Liu (TW)  
Weicheng Lin (TW)  
Wen-Chieh Lin (TW)  
Wong Chow Jeng (MY)  
Wong Ya Ping (MY)  
Wu Quan (AU)  
Xiaogang Jin (CN)  
Yangsheng Wang (CN)  
Yifan Hu (US)  
YingLi Tian (US)  
Yu-Shuen Wang (TW)  
Zheng-Jun Zha (CN)  
Zhigeng Pan (CN)  
Zhijie Xu (UK)  
Zulfiqar Habib (PK)



## D-Art Gallery 2016

The Symposium and Gallery of Digital Art D-Art accompanies two annual international conferences: the Information Visualization Conference and the Computer Graphics, Imaging & Visualization Conference.

This year the setup is as follows: Information Visualization Conference (IVS), 19th International Conference on Information Visualization ([www.graphicslink.co.uk/IV2015](http://www.graphicslink.co.uk/IV2015)), 21–24 July 2015 • University of Barcelona • Barcelona, Spain

13th International Conference on Computer Graphics, Imaging & Visualization  
29 March–1 April, 2016 • Sultan Moulay Sliman University • Morocco  
<http://www.graphicslink.co.uk/cgiv2016>

Artists, scientists, mathematicians, and anyone using digital imagery and data, involved in visual storytelling, art, and graphics are invited to contribute.

Topics might relate to:

- Preparing artists to learn programming, preparing programmers to learn aesthetics
- Interrelationship between disciplines. How computer graphics can influence computer science and software engineering
- Issues in digital art: technical challenge and artistic quality, criticism, perception in the field
- Art and visualization of spatial, tonal, and temporal domains: industry, academia, media
- New media arts approaches within medical science and technology, nano art
- Games and interactive multimedia
- Information technology in visual arts and culture, visual art for IT visualization
- Cognitive science issues, digital art and visual learning: critical and abstract thinking, problem finding
- The role of digital art and graphics in production of web video for marketing
- Digital fabrication methods. Process (including collaborative efforts)
- History of computer graphics and art
- Copyright (representation through a detail, watermark, resolution, etc.)

Interested parties are invited to submit a paper presentation proposal for a conference of their choice, and/or for the D-Art Gallery. The artwork media range from 2-D, 3-D, time-based animations and movies, games, or any form of interactive work, which bring about the connections between art, science, data visualization, simulation, or any form of interactivity.

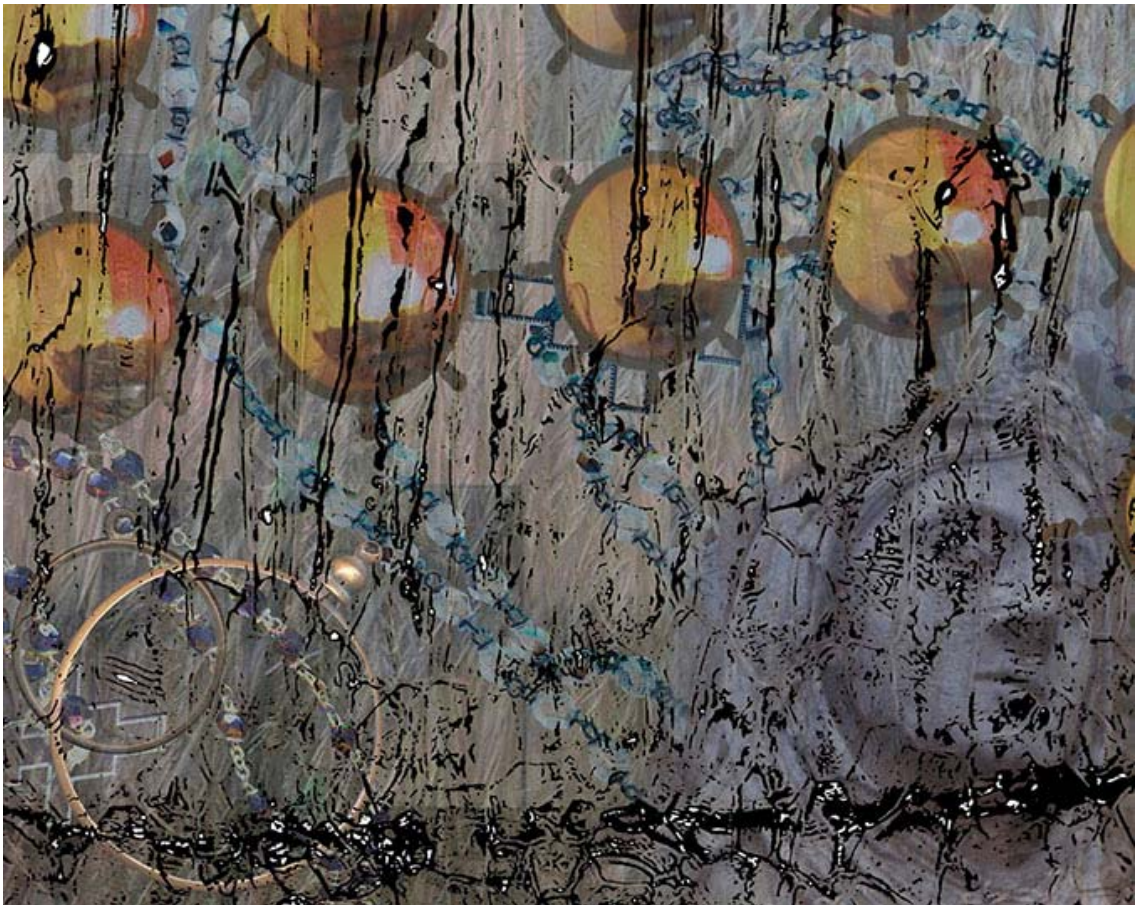
The gallery is located on the London office's server, for a year from the beginning of each conference until the beginning of the new one. Moreover, artists have the opportunity to present their work during the conference. The office in London is requesting work coordinated by people from different continents and distributed worldwide.

Many definitions have changed; aesthetics goes together with usability, criticism with

standards, objectives with assessment, etc. Art goes with science, math with music, data with information, shapes with meaning, colors and textures with coding, and combination of lines with a message.

As technology progresses, the gap between art, science, technology, and information diminishes, and gains its visual power. This allows more space for interaction, the integrative, often collaborative nature of the work, and the range of aesthetical choices. We could witness nano art and photographic images, dynamic real-time data display, the beauty of glyphs, data mining, semantic web, metaphorical display of information, to say nothing about fractal geometry, or various types of data representation.

The idea of the container of the story finds many supporting works. We have a need to consider almost everything as a story, but each story needs to be retold differently to fit each purpose and medium, such as a poem, a novel, theatrical performance within a limited space of the stage, an animation, a video (often merged with animation).



"A Time of Beliefs" © Margie Labadie

*"These works address the visual nature of religion and that we garner information about religion and even identify with religion based on its visible cues. Religious beliefs are based in*

*the history of the religion. A religious community will constantly, albeit imperfectly, bring ancient ideas into the present through visualization, i.e., through art and performance vis-a-vis sculpture, jewellery, costume and ritual."*

**The D-ART 2015/16 Gallery Exhibiting Artists**

LiQin Tan  
Anna Chupa  
Joohyun Pyune  
Santiago Echeverry  
Harvey Goldman  
Daniela Sirbu  
John Corbett  
Gabriele Peters  
Nancy Wood  
Heather Freeman  
Bogdan Soban  
Galt Tomasino  
Gina Gibson  
Margie Labadie  
Dena Elisabeth Eber  
Corinne Whitaker

Gloria DeFilipps Brush  
Chris Kitchener  
Matjuska Teja Krasek  
Olivia Koval  
Mike Kingan  
Jean Constant  
John Antoine Labadie  
Alan Singer  
Anna Ursyn  
Neil Howe  
Andras Szalai  
Chiara Passa  
Richard Merritt  
Mohammad Majid al-Rifaie

## Title Page Image Credits

### **“Genetic Landscapes Series I” – Daniela Sirbu**

“This is part of an algorithmic art series generated through interactions between the artist and a multi-agent computational system. The artificial system creates a medium for visual content development populated by intelligent agents, which draw new shapes in the process of adapting their behavior to input from the artist. The panel includes several frames sampled from 56 generations of system evolution. Programming language: Processing.”