# Contents

## Full Papers

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Natural Bipeds, Birds and Humans: An Inspiration for Bipedal Robots</td>
<td>3</td>
</tr>
<tr>
<td><em>Anick Abourachid and Vincent Hugel</em></td>
<td></td>
</tr>
<tr>
<td>Retina Color-Opponency Based Pursuit Implemented Through Spiking Neural Networks in the Neurorobotics Platform</td>
<td>16</td>
</tr>
<tr>
<td><em>Alessandro Ambrosano, Lorenzo Vannucci, Ugo Albanese, Murat Kirtay, Egidio Falotico, Pablo Martínez-Cañada, Georg Hinkel, Jacques Kaiser, Stefan Ulbrich, Paul Levi, Christian Morillas, Alois Knoll, Marc-Oliver Gewaltig, and Cecilia Laschi</em></td>
<td></td>
</tr>
<tr>
<td>A Two-Fingered Anthropomorphic Robotic Hand with Contact-Aided Cross Four-Bar Mechanisms as Finger Joints</td>
<td>28</td>
</tr>
<tr>
<td><em>Guochao Bai, Jieyu Wang, and Xianwen Kong</em></td>
<td></td>
</tr>
<tr>
<td>Living Designs</td>
<td>40</td>
</tr>
<tr>
<td><em>Rina Bernabei and Jacqueline Power</em></td>
<td></td>
</tr>
<tr>
<td>iCub Visual Memory Inspector: Visualising the iCub’s Thoughts</td>
<td>48</td>
</tr>
<tr>
<td><em>Daniel Camilleri, Andreas Damianou, Harry Jackson, Neil Lawrence, and Tony Prescott</em></td>
<td></td>
</tr>
<tr>
<td>A Preliminary Framework for a Social Robot “Sixth Sense”</td>
<td>58</td>
</tr>
<tr>
<td><em>Lorenzo Cominelli, Daniele Mazzei, Nicola Carbonaro, Roberto Garofalo, Abolfazl Zaraki, Alessandro Tognetti, and Danilo De Rossi</em></td>
<td></td>
</tr>
<tr>
<td>A Bio-Inspired Photopatterning Method to Deposit Silver Nanoparticles onto Non Conductive Surfaces Using Spinach Leaves Extract in Ethanol</td>
<td>71</td>
</tr>
<tr>
<td><em>Marc P.Y. Desmulliez, David E. Watson, Jose Marques-Hueso, and Jack Hoy-Gig Ng</em></td>
<td></td>
</tr>
<tr>
<td>Leg Stiffness Control Based on “TEGOTAE” for Quadruped Locomotion</td>
<td>79</td>
</tr>
<tr>
<td><em>Akira Fukuhara, Dai Owaki, Takeshi Kano, and Akio Ishiguro</em></td>
<td></td>
</tr>
<tr>
<td>Wall Following in a Semi-closed-loop Fly-Robotic Interface</td>
<td>85</td>
</tr>
<tr>
<td><em>Jiaqi V. Huang, Yilin Wang, and Holger G. Krapp</em></td>
<td></td>
</tr>
<tr>
<td>Sensing Contact Constraints in a Worm-like Robot by Detecting Load Anomalies</td>
<td>97</td>
</tr>
<tr>
<td><em>Akhil Kandhari, Andrew D. Horchler, George S. Zucker, Kathryn A. Daltorio, Hillel J. Chiel, and Roger D. Quinn</em></td>
<td></td>
</tr>
</tbody>
</table>
Head-Mounted Sensory Augmentation Device: Comparing Haptic and Audio Modality ................................................................. 107
   Hamideh Kerdegari, Yeongmi Kim, and Tony J. Prescott

Visual Target Sequence Prediction via Hierarchical Temporal Memory Implemented on the iCub Robot .................................................. 119
   Murat Kirtay, Egidio Falotico, Alessandro Ambrosano, Ugo Albanese, Lorenzo Vannucci, and Cecilia Laschi

Computer-Aided Biomimetics ............................................................. 131
   Ruben Kruiper, Jessica Chen-Burger, and Marc P.Y. Desmulliez

A Neural Network with Central Pattern Generators Entrained by Sensory Feedback Controls Walking of a Bipedal Model ......................... 144
   Wei Li, Nicholas S. Szczecinski, Alexander J. Hunt, and Roger D. Quinn

Towards Unsupervised Canine Posture Classification via Depth Shadow Detection and Infrared Reconstruction for Improved Image Segmentation Accuracy ............................................................ 155
   Sean Mealin, Steven Howell, and David L. Roberts

A Bio-Inspired Model for Visual Collision Avoidance on a Hexapod Walking Robot ............................................................. 167
   Hanno Gerd Meyer, Olivier J.N. Bertrand, Jan Paskarbeit, Jens Peter Lindemann, Axel Schneider, and Martin Egelhaaf

MIRO: A Robot “Mammal” with a Biomimetic Brain-Based Control System .................................................................................. 179
   Ben Mitchinson and Tony J. Prescott

A Hydraulic Hybrid Neuroprosthesis for Gait Restoration in People with Spinal Cord Injuries ...................................................... 192
   Mark J. Nandor, Sarah R. Chang, Rudi Kobetic, Ronald J. Triolo, and Roger Quinn

Principal Component Analysis of Two-Dimensional Flow Vector Fields on Human Facial Skin for Efficient Robot Face Design ..................... 203
   Nobuyuki Ota, Hisashi Ishihara, and Minoru Asada

Learning to Balance While Reaching: A Cerebellar-Based Control Architecture for a Self-balancing Robot ............................................. 214
   Maximilian Ruck, Ivan Herreros, Giovanni Maffei, Marti Sánchez-Fibla, and Paul Verschure

Optimizing Morphology and Locomotion on a Corpus of Parametric Legged Robots ............................................................... 227
   Grégoire Passault, Quentin Rouxel, Remi Fabre, Steve N’Guyen, and Olivier Ly
Stick(y) Insects — Evaluation of Static Stability for Bio-inspired Leg Coordination in Robotics .......................... 239
Jan Paskarbeit, Marc Otto, Malte Schilling, and Axel Schneider

Navigate the Unknown: Implications of Grid-Cells “Mental Travel” in Vicarious Trial and Error .................. 251
Diogo Santos-Pata, Riccardo Zucca, and Paul F.M.J. Verschure

Insect-Inspired Visual Navigation for Flying Robots ........... 263
Andrew Philippides, Nathan Steadman, Alex Dewar, Christopher Walker, and Paul Graham

Perceptive Invariance and Associative Memory Between Perception and Semantic Representation USER a Universal SEMantic RepresentationImplemented in a System on Chip (SoC) ...................... 275
Patrick Pirim

Thrust-Assisted Perching and Climbing for a Bioinspired UAV .... 288
Morgan T. Pope and Mark R. Cutkosky

The EASEL Project: Towards Educational Human-Robot Symbiotic Interaction ..................................... 297
Dennis Reidsma, Vicky Charisi, Daniel Davison, Frances Wijnen,
Jan van der Meij, Vanessa Evers, David Cameron, Samuel Fernando,
Roger Moore, Tony Prescott, Daniele Mazzei, Michael Pieroni,
Lorenzo Cominelli, Roberto Garofalo, Danilo De Rossi,
Vasiliki Vouloutsi, Riccardo Zucca, Klaudia Grechuta, Maria Blancas,
and Paul Verschure

Wasp-Inspired Needle Insertion with Low Net Push Force .......... 307
Tim Sprang, Paul Breedveld, and Dimitra Dodou

Use of Bifocal Objective Lens and Scanning Motion in Robotic Imaging Systems for Simultaneous Peripheral and High Resolution Observation of Objects ........................................... 319
Gašper Škulj and Drago Bračun

MantisBot Uses Minimal Descending Commands to Pursue Prey as Observed in Tenodera Sinensis ...................... 329
Nicholas S. Szczecinski, Andrew P. Getsy, Jacob W. Bosse,
Joshua P. Martin, Roy E. Ritzmann, and Roger D. Quinn

Eye-Head Stabilization Mechanism for a Humanoid Robot Tested on Human Inertial Data .................. 341
Lorenzo Vannucci, Egidio Falotico, Silvia Tolu, Paolo Dario,
Henrik Hautop Lund, and Cecilia Laschi
Towards a Synthetic Tutor Assistant: The EASEL Project and its Architecture

Vasiliki Vouloutsi, Maria Blancas, Riccardo Zucca, Pedro Omedas, Dennis Reidsma, Daniel Davison, Vicky Charisi, Frances Wijnen, Jan van der Meij, Vanessa Evers, David Cameron, Samuel Fernando, Roger Moore, Tony Prescott, Daniele Mazzei, Michael Pieroni, Lorenzo Cominelli, Roberto Garofalo, Danilo De Rossi, and Paul F.M.J. Verschure

Aplysia Californica as a Novel Source of Material for Biohybrid Robots and Organic Machines

Victoria A. Webster, Katherine J. Chapin, Emma L. Hawley, Jill M. Patel, Ozan Akkus, Hillel J. Chiel, and Roger D. Quinn

A Soft Pneumatic Maggot Robot

Tianqi Wei, Adam Stokes, and Barbara Webb

Short Papers

On Three Categories of Conscious Machines

Xerxes D. Arsiwalla, Ivan Herreros, and Paul Verschure

Gaussian Process Regression for a Biomimetic Tactile Sensor

Kirsty Aquilina, David A.W. Barton, and Nathan F. Lepora

Modulating Learning Through Expectation in a Simulated Robotic Setup

Maria Blancas, Riccardo Zucca, Vasiliki Vouloutsi, and Paul F.M.J. Verschure

Don’t Worry, We’ll Get There: Developing Robot Personalities to Maintain User Interaction After Robot Error

David Cameron, Emily Collins, Hugo Cheung, Adriel Chua, Jonathan M. Aitken, and James Law

Designing Robot Personalities for Human-Robot Symbiotic Interaction in an Educational Context

David Cameron, Samuel Fernando, Abigail Millings, Michael Szollosy, Emily Collins, Roger Moore, Amanda Sharkey, and Tony Prescott

A Biomimetic Fingerprint Improves Spatial Tactile Perception

Luke Cramphorn, Benjamin Ward-Cherrier, and Nathan F. Lepora

Anticipating Synchronisation for Robot Control

Henry Eberle, Slawomir Nasuto, and Yoshikatsu Hayashi

MantisBot: The Implementation of a Photonic Vision System

Andrew P. Getsy, Nicholas S. Szczecinski, and Roger D. Quinn
Force Sensing with a Biomimetic Fingertip .................................................. 436
  Maria Elena Giannaccini, Stuart Whyle, and Nathan F. Lepora

Understanding Interlimb Coordination Mechanism of Hexapod Locomotion via “TEGOTAE”-Based Control .................................................. 441
  Masashi Goda, Sakiko Miyazawa, Susumu Itayama, Dai Owaki,
  Takeshi Kano, and Akio Ishiguro

Decentralized Control Scheme for Myriapod Locomotion That Exploits Local Force Feedback .................................................. 449
  Takeshi Kano, Kotaro Yasui, Dai Owaki, and Akio Ishiguro

TEGOTAE-Based Control Scheme for Snake-Like Robots That Enables Scaffold-Based Locomotion .................................................. 454
  Takeshi Kano, Ryo Yoshizawa, and Akio Ishiguro

Modelling the Effect of Cognitive Load on Eye Saccades and Reportability: The Validation Gate .................................................. 459
  Sock C. Low, Joeri B.G. van Wijngaarden, and Paul F.M.J. Verschure

Mutual Entrainment of Cardiac-Oscillators Through Mechanical Interaction . . . 467
  Koki Maekawa, Naoki Inoue, Masahiro Shimizu, Yoshihiro Isobe,
  Taro Saku, and Koh Hosoda

“TEGOTAE”-Based Control of Bipedal Walking .................................................. 472
  Dai Owaki, Shun-ya Horikiri, Jun Nishi, and Akio Ishiguro

Tactile Vision – Merging of Senses .................................................. 480
  Nedyalka Panova, Alexander C. Thompson,
  Francisco Tenopala-Carmona, and Ifor D.W. Samuel

Tactile Exploration by Contour Following Using a Biomimetic Fingertip . . . 485
  Nicholas Pestell, Benjamin Ward-Cherrier, Luke Cramphorn,
  and Nathan F. Lepora

Towards Self-controlled Robots Through Distributed Adaptive Control . . . 490
  Jordi-Ysard Puigbò, Clément Moulin-Frier, and Paul F.M.J. Verschure

Discrimination-Based Perception for Robot Touch .................................................. 498
  Emma Roscow, Christopher Kent, Ute Leonards, and Nathan F. Lepora

On Rock-and-Roll Effect of Quadruped Locomotion: From Mechanical and Control-Theoretical Viewpoints .................................................. 503
  Ryoichi Kuratani, Masato Ishikawa, and Yasuhiro Sugimoto

Hydromast: A Bioinspired Flow Sensor with Accelerometers .................................................. 510
  Asko Ristolainen, Jeffrey Andrew Tuhtan, Alar Kuusik,
  and Maarja Kruusmaa
Developing an Ecosystem for Interactive Electronic Implants . . . . . . . . . . . . 518
  Paul Strohmeier, Cedric Honnet, and Samppa von Cyborg

Gait Analysis of 6-Legged Robot with Actuator-Equipped Trunk and Insect
Inspired Body Structure . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 526
  Yasuhiro Sugimoto, Yuji Kito, Yuichiro Sueoka, and Koichi Osuka

Quadruped Gait Transition from Walk to Pace to Rotary Gallop
by Exploiting Head Movement . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 532
  Shura Suzuki, Dai Oyaki, Akira Fukuhara, and Akio Ishiguro

Exploiting Symmetry to Generalize Biomimetic Touch . . . . . . . . . . . . . . . . 540
  Benjamin Ward-Cherrier, Luke Cramphorn, and Nathan F. Lepora

Decentralized Control Scheme for Centipede Locomotion Based on Local
Reflexes. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 545
  Kotaro Yasui, Takeshi Kano, Dai Owaki, and Akio Ishiguro

Realization of Snakes’ Concertina Locomotion
by Using “TEGOTAE-Based Control” . . . . . . . . . . . . . . . . . . . . . . . . . . . . 548
  Ryo Yoshizawa, Takeshi Kano, and Akio Ishiguro

Author Index . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 553
Biomimetic and Biohybrid Systems
5th International Conference, Living Machines 2016,
Lepora, N.F.; Mura, A.; Mangan, M.; Verschure, P.F.M.J.;
Desmulliez, M.; Prescott, T.J. (Eds.)
2016, XVI, 555 p. 302 illus., Softcover
ISBN: 978-3-319-42416-3