

Commenced Publication in 1973

Founding and Former Series Editors:

Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

Editorial Board

David Hutchison

Lancaster University, Lancaster, UK

Takeo Kanade

Carnegie Mellon University, Pittsburgh, PA, USA

Josef Kittler

University of Surrey, Guildford, UK

Jon M. Kleinberg

Cornell University, Ithaca, NY, USA

Friedemann Mattern

ETH Zurich, Zurich, Switzerland

John C. Mitchell

Stanford University, Stanford, CA, USA

Moni Naor

Weizmann Institute of Science, Rehovot, Israel

C. Pandu Rangan

Indian Institute of Technology Madras, Chennai, India

Bernhard Steffen

TU Dortmund University, Dortmund, Germany

Demetri Terzopoulos

University of California, Los Angeles, CA, USA

Doug Tygar

University of California, Berkeley, CA, USA

Gerhard Weikum

Max Planck Institute for Informatics, Saarbrücken, Germany

More information about this series at <http://www.springer.com/series/7409>

Domenico Prattichizzo · Hiroyuki Shinoda
Hong Z. Tan · Emanuele Ruffaldi
Antonio Frisoli (Eds.)

Haptics: Science, Technology, and Applications

11th International Conference, EuroHaptics 2018
Pisa, Italy, June 13–16, 2018
Proceedings, Part I

Editors

Domenico Prattichizzo
University of Siena
Siena
Italy

Hiroyuki Shinoda
University of Tokyo
Tokyo
Japan

Hong Z. Tan
Purdue University
West Lafayette, IN
USA

Emanuele Ruffaldi
Scuola Superiore Sant'Anna
Pisa
Italy

and

MMI s.p.a.
Pisa
Italy

Antonio Frisoli
Scuola Superiore Sant'Anna
Pisa
Italy

ISSN 0302-9743 ISSN 1611-3349 (electronic)
Lecture Notes in Computer Science
ISBN 978-3-319-93444-0 ISBN 978-3-319-93445-7 (eBook)
<https://doi.org/10.1007/978-3-319-93445-7>

Library of Congress Control Number: 2018946626

LNCS Sublibrary: SL3 – Information Systems and Applications, incl. Internet/Web, and HCI

© Springer International Publishing AG, part of Springer Nature 2018

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors, and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Printed on acid-free paper

This Springer imprint is published by the registered company Springer International Publishing AG
part of Springer Nature
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

This volume contains the proceedings of the EuroHaptics 2018 conference, which was held in Pisa, Italy, during June 13–16, 2018. EuroHaptics is a major international conference on haptics and touch-enabled computer applications and is the primary European meeting for researchers in this field.

Eurohaptics 2018 covered all aspects of haptics, including neuroscience, psychophysics, perception, engineering, computing, interactions, virtual reality, and the arts. The papers address the recent advancements in haptics organized by three topic areas: haptics science, technology, and applications. We received a total of 138 submissions for the full-paper category. The contributions were from 24 countries: 41% from Europe, 45% from Asia, 12% from the Americas, and 2% from Oceania. The review process led to 95 of these being accepted for publication thanks to the great effort of the 43 members of the Program Committee and 270 external reviewers. These papers were presented at the conference either as oral presentations (40) or as poster presentations (55). In the proceedings, the two types of presentations are both published as regular papers with no distinction between them in terms of paper length. Furthermore, 48 hands-on demos were exhibited and 61 work-in-progress papers were presented.

The proceedings are organized in two volumes: the first covering “Haptic Science,” and the second covering the other two topics of “Haptic Technology and Applications.”

We thank the four distinguished keynote speakers from academia and leading industries who provided their insights and vision on current and future directions of haptic research: Mel Slater (University of Barcelona and University College of London), Hiroyasu Iwata (Waseda University), Freddy Abnoui (Facebook), and Shumin Zhai (Google).

We are thankful to the organizations that supported and sponsored the event: academia (Scuola Superiore Sant’Anna), industrial gold sponsors (Lofelt, BHCT and Moog), silver sponsors (Boreas, Bps Polytec Haption, Ultrahaptics, ForceDimension, Immersion, 3Dsystem, Hapt2U and EPCOS AG), and the industrial bronze sponsors (Tactile Labs, Disney Research, Facebook Reality Lab and Tanvas). We thank also Springer for sponsoring the Best Paper Award.

Finally, we thank all the speakers and paper contributors, associate editors, members of the Organizing Committee, and reviewers without whom the event could not have taken place. This scientific gathering has proven again the vibrant and multidisciplinary community of haptics.

June 2018

Domenico Prattichizzo
Hiroyuki Shinoda
Hong Z. Tan
Emanuele Ruffaldi
Antonio Frisoli

Organization

General Chair

Antonio Frisoli	Scuola Superiore Sant'Anna, Italy
-----------------	-----------------------------------

Program Co-chairs

Domenico Prattichizzo	University of Siena, Italy
Hiroyuki Shinoda	University of Tokyo, Japan
Hong Z. Tan	Purdue University, USA

Publication Chair

Emanuele Ruffaldi	Scuola Superiore Sant'Anna & MMI s.p.a., Italy
-------------------	--

Finance Chair

Claudio Loconsole	Polytechnic University of Bari, Italy
-------------------	---------------------------------------

Industry and Sponsorship Co-chairs

Carlo Alberto Avizzano	Scuola Superiore Sant'Anna, Italy
Manuel Ferre	Universidad Politécnica de Madrid, Spain

Publicity and Media Co-chairs

Claudio Loconsole	Polytechnic University of Bari, Italy
Ildar Farkhatdinov	Imperial College London, UK

Workshops and Tutorial Co-chairs

Vincent Hayward	Pierre et Marie Curie University, France
Jee-Hwan Ryu	Korea University of Technology and Education, South Korea

Poster Co-chairs

Hirouyuki Kajimoto	University of Electro-Communications Tokyo, Japan
Marc Ernst	Ulm University, Germany

Demo Chair

Massimiliano Solazzi Scuola Superiore Sant'Anna, Italy

Awards Committee Co-chairs

Massimo Bergamasco Scuola Superiore Sant'Anna, Italy
Antonio Bicchi University of Pisa, Italy

Student Volunteers Co-chairs

Daniele Leonardis Scuola Superiore Sant'Anna, Italy
Matteo Bianchi University of Pisa, Italy

Local Arrangements Co-chairs

Daniele Leonardis Scuola Superiore Sant'Anna, Italy
Michele Barsotti Scuola Superiore Sant'Anna, Italy
Claudio Loconsole Polytechnic University of Bari, Italy
Massimiliano Solazzi Scuola Superiore Sant'Anna, Italy

Advisory Committee

Ed Colgate Northwestern University, USA
Jan Van Erp University of Twente, The Netherlands
Yasuyoshi Yokokohji Kobe University, Japan
Seungmoon Choi Pohang University of Science and Technology,
South Korea
Hong Z. Tan Purdue University, USA

Program Committee

Haptic Science

Andrea Bianchi KAIST, South Korea
Matteo Bianchi University of Pisa, Italy
Heather Culbertson University of Southern California, USA
Massimiliano Di Luca University of Birmingham, UK
Marc Ernst Ulm University, Germany
Jessica Hartcher TU Delft, The Netherlands
Astrid Kappers VU University, The Netherlands
Scinob Kuroki NTT Communication Science Laboratories, Japan
Masashi Nakatani Keio University, Japan
Shogo Okamoto The Nagoya University, Japan
Kyle B. Reed University of South Florida, USA
Oliver Schneider Hasso Plattner Institute, Germany
Jan van Erp University of Twente, The Netherlands

Qi Wang
Junji Watanabe

Columbia University, USA
NTT Communication Science Laboratories, Japan

Haptic Technology

Kaspar Althoefer
Seungmoon Choi
Brent Gillespie
Hiroyuki Kajimoto
Vincent Lévesque
Claudio Loconsole
Monica Malvezzi
Leonardo Meli
Kouta Minamizawa
Marcia K. O'Malley
Claudio Pacchierotti
Evren Samur
Massimiliano Solazzi
Michael Wiertlewski

King's College London, UK
POSTECH, South Korea
University of Michigan, USA
University of Electro-Communications, Japan
École de technologie supérieure, Canada
Polytechnic University of Bari, Italy
University of Siena, Italy
University of Siena, Italy
Keio University, Japan
Rice University, USA
CNRS, France
Boğaziçi University, Turkey
Scuola Superiore Sant'Anna, Italy
CNRS, France

Haptic Applications

David Abbink
Cagatay Basdogan
Manuel Cruz
Ildar Farkhatdinov
Francesco Ferrise
Rafael Morales González
Matthias Harders
Yang Jiao
Ayse Kucukyilmaz
Yoshihiro Kuroda
Yasutoshi Makino
Sabrina Panëels
Angelika Peer
Yoshihiro Tanaka

Delft University of Technology, The Netherlands
Koc University, Turkey
Immersion Corporation, Canada
Queen Mary University of London, UK
Polytechnic of Milan, Italy
Université Paris-Sud, France
ETH, Switzerland
Purdue University, USA
University of Lincoln, UK
Osaka University, Japan
University of Tokyo, Japan
CEA, France
Free University of Bolzano, Italy
Nagoya Institute of Technology, Japan

Additional Reviewers

Miguel A. Otaduy
Anthony Aakre
Arsen Abdulali
Muhammad Abdullah
Victor Adriel de Jesus Oliveira
Marco Aggravi
Ioannis Agriomallos
Baris Akgun

Kerem Altun
Tomohiro Amemiya
Hideyuki Ando
Ferran Argelaguet Sanz
Gabriel Arnold
Yusuf Aydin
Mehmet Ayyildiz
Stephanie Badde

Priscilla Balestrucci
 Yuki Ban
 Giacinto Barresi Barresi
 Michele Barsotti
 Edoardo Battaglia
 Gabriel Baud-bovy
 Lynne Bernstein
 Amir Berrezag
 Joao Bimbo
 Serena Bochereau
 Henri Boessenkool
 R. Brent Gillespie Gillespie
 Jack Brooks
 Paul Bucci
 Domenico Buongiorno
 Felan Carlo Garcia
 Selem Charfi
 Aashish Chaudhary Chaudhary
 Francesco Chinello
 Youngjun Cho
 Vivian Chu
 Simone Ciotti
 Gabriel Cirio
 Roberto Conti
 Jeremy Cooperstock
 Sabine Coquillart
 Steven Cutlip
 Benoît Delhayé
 Yoshinori Dobashi
 Yanick Douven
 Knut Drewing
 Lucile Dupin
 Basil Duvernoy
 Brygida Dzidek
 Ulrich Eck
 J. Edward Colgate
 Mohamad Eid
 Khaled Elgeneidy
 Ildar Farkhatdinov
 Feng Feng
 Manuel Ferre
 Davide Filingeri
 Sean Follmer
 Camille Fradet
 Rebecca Friesen
 Qiushi Fu

Shogo Fukushima
 Masahiro Furukawa
 Massimiliano Gabardi
 Simone Gallo
 Gowrishankar Ganesh
 Igor Gaponov
 Paolo Gasparello
 Michele Gattullo
 Chiara Gaudeni
 Nirit Gavish
 Theodoros Georgiou
 Anne Giersch
 Marcello Giordano
 Frederic Giraud
 Florian Gosselin
 Danny Grant
 Burak Guclu
 David Gueorguiev
 Kaiwen Guo
 Abhishek Gupta
 Taku Hachisu
 Abdelwahab Hamam
 Jaehyun Han
 Ping-Hsuan Han
 Nobuhisa Hanamitsu
 M. Harders
 Vanessa Harrar
 Keisuke Hasegawa
 Shoichi Hasegawa
 Yuki Hashimoto
 Christian Hatzfeld
 Hirohiko Hayakawa
 Lauren Hayes
 Vincent Hayward
 Niels Henze
 Kosuke Higashi
 Hsin-Ni Ho
 Van Ho
 Sang Ho Yoon
 Elif Hocaoglu
 Mehdi Hojatmadani
 Raymond Holt
 Charles Hudin
 Thomas Hulin
 Ke Huo
 Irfan Hussain

Inwook Hwang
Chung Hyuk Park
Dong Hyun Jeong
Gholamreza Ilkhani
Yasuyuki Inoue
Hiroki Ishizuka
Ali Israr
William Jantscher
Seungwoo Je
Seokhee Jeon
Lynette Jones
Hernisa Kacorri
Jari Kangas
Fumihiko Kato
Takahiro Kawabe
Oguz Kayhan
Arvid Keemink
Gerard Kim
Hwan Kim
Sang-Youn Kim
Seokyeol Kim
Seung-Chan Kim
Yeongmi Kim
Ryo Kitada
Masashi Konyo
Rossitza Kotelova
Yuichi Kurita
Kiuk Kyung
Roshan L. Peiris
Roberta L. Klatzky
Hojin Lee
Philippe Lefevre
Arnaud Lelevé
Fabrizio Leo
Daniele Leonardi
Teng Li
Minas Liarokapis
Justin Lieber
Tommaso Lisini Baldi
Daniel Lobo
Pedro Lopes
Céphise Louison
JH Low
Granit Luzhnica
Juan M. Gandarias
Tonja-Katrin Machulla

Charlotte Magnusson
Maud Marchal
Kazumichi Matsumiya
Craig McDonald
Jared Medina
Martin Meier
Claudio Melchiorri
Mariacarla Memeo
Anna Metzger
David Meyer
Ekrem Misimi
Alessandro Moscatelli
Christos Mousas
Joe Mullenbach
Hikaru Nagano
Dhanya Nair
Kei Nakatsuma
Takuji Narumi
Ilana Nisky
Yohan Noh
Ian Oakley
Matjaz Ogrinc
Masahiro Ohka
Ata Otaran
Nizar Ouarti
Gunhyuk Park
Jaeyoung Park
Volkan Patoğlu
Ugo Pattacini
Sean Perkins
Michael Peshkin
Myrthe Plaisier
Jonathan Platkiewicz
Henning Pohl
Maria Pozzi
Roope Raisamo
Anuradha Ranasinghe
Jussi Rantala
Mohammad Reza Haji Samadi
Alessandro Ridolfi
Charles Rodenkirch
Emanuele Ruffaldi
Shah Rukh Humayoun
Alex Russomanno
Jin Ryong Kim
Jee-Hwan Ryu

Hannes Saal
Jamal Saboune
Satoshi Saga
Masamichi Sakaguchi
Gionata Salvietti
Katsunari Sato
Yann Savoye
Masataka Sawayama
Lorenzo Scalera
Brian Schriver
Hasti Seifi
Théo Senat
Irene Senna Senna
Jongman Seo
Zhuanghua Shi
Mai Shibahara
Hiroyuki Shinoda
Camila Shiota
Peter Shull
Dominik Sieber
Stephen Sinclair
Edoardo Sotgiu
Florent Souvestre
Giovanni Spagnoletti
Adam Spiers
Eckehard Steinbach
Evan Strasnick
Fabio Stroppa
Sriram Subramanian
Jordan Suchow
Atsushi Takagi
Masaya Takasaki
Hong Z. Tan
Fabio Tatti
Mahdi Tavakoli

Ozan Tokatli
Michael Tolley
Emma Treadway
Andrés Trujillo-León
Luca Turchet
Tatsuya Umeda
Eduardo Veas
Filipe Veiga
Yon Visell
Julie Walker
Jeroen Wildenbeest
Elisabeth Wilhelm
Christian Willemse
Graham Wilson
Bing Wu
Evagoras Xydas
Akio Yamamoto
MHD Yamen Saraiji
Nesra Yannier
Vibol Yem
Takumi Yokosaka
Yongjae Yoo
Masahiro Yoshikawa
Shunsuke Yoshimoto
Wenzhen Yuan
Jacopo Zenzeri
Kai Zhang
Siyan Zhao
Igor Zubrycki
Gholamreza Ilkhani
Femke van Beek
Jeroen van Oosterhout
Linda van der Spaa
Robrecht vanderWel
Yasemin Vardar

Contents – Part I

Haptic Science

Effect of Dual Tasking on Vibrotactile Feedback Guided Reaching – A Pilot Study	3
<i>Valay A. Shah, Nicoletta Risi, Giulia Ballardini, Leigh Ann Mrotek, Maura Casadio, and Robert A. Scheidt</i>	
Is Cross-Modal Matching Necessary? A Bayesian Analysis of Individual Reference Cues	15
<i>Tobias Michael Benz and Verena Nitsch</i>	
Differences in Beta Oscillation of the Middle Frontal Cortex with or Without Tactile Stimulation in Active Touch Task	27
<i>Wanjoo Park and Mohamad Eid</i>	
Optimization of the Hanger Reflex (I): Examining the Correlation Between Skin Deformation and Illusion Intensity	36
<i>Masahiro Miyakami, Yuki Kon, Takuto Nakamura, and Hiroyuki Kajimoto</i>	
A Case of Perceptual Completion in Spatio-Temporal Tactile Space	49
<i>Seitaro Kaneko, Hiroyuki Kajimoto, and Vincent Hayward</i>	
How Visual Images and Tactile Durations Affect the Emotional Ratings of the Cutaneous-Rabbit Illusion	58
<i>Mounia Ziat, Kimberly Snell, Chatrine Johannessen, and Roope Raisamo</i>	
Simon Effect for the Design of Tactile Stimulation	69
<i>Alix Pérusseau-Lambert, Margarita Anastassova, Mehdi Boukallel, Mohamed Chetouani, and Ouriel Grynszpan</i>	
Parameters that Affect Subjective Hardness in the Acceleration Response of a Stylus when Hitting an Object	80
<i>Yasuyuki Saito and Kotaro Tadano</i>	
Correlation Between Electro vibration Perception Magnitude and the Normal Force Applied by Finger.	91
<i>Xingwei Guo, Yuru Zhang, Dangxiao Wang, Lei Lu, Jian Jiao, and Weiliang Xu</i>	

Haptic Texture Perception on 3D-Printed Surfaces Transcribed from Visual Natural Textures	102
<i>Scinob Kuroki, Masataka Sawayama, and Shin'ya Nishida</i>	
Identification and Evaluation of Perceptual Attributes for Periodic Whole-Body and Hand-Arm Vibration.	113
<i>Robert Rosenkranz, Sebastian Gruschwitz, Martin Wilberg, M. Ercan Altinsoy, and Sebastian Merchel</i>	
Influence of Shape Elements on Performance During Haptic Rotation	125
<i>Kathrin Krieger, Alexandra Moringen, Astrid M. L. Kappers, and Helge Ritter</i>	
Effects of Chai3D Texture Rendering Parameters on Texture Perception	138
<i>Nicolo Balzarotti and Gabriel Baud-Bovy</i>	
Effect of Control Movement Scale on Visual Haptic Interactions	150
<i>Joseph H. R. Isaac, Arun Krishnadas, Natesan Damodaran, and Manivannan Muniyandi</i>	
Tactile Apparent Motion Through Human-Human Physical Touch	163
<i>Taku Hachisu and Kenji Suzuki</i>	
Preliminary Stiffness Perception Assessment for a Tele-palpaton Haptic Interface	175
<i>Juan Manuel Jacinto, Alessandro Filippeschi, Carlo Alberto Avizzano, and Emanuele Ruffaldi</i>	
Passive Probing Perception: Effect of Latency in Visual-Haptic Feedback . . .	186
<i>Ravali Gourishetti, Joseph Hosanna Raj Isaac, and M. Manivannan</i>	
Perceived Frequency of Aperiodic Vibrotactile Stimuli Depends on Temporal Encoding	199
<i>Kevin K. W. Ng, Ingvars Birznieks, Ian T. H. Tse, Josefin Andersen, Sara Nilsson, and Richard M. Vickery</i>	
Haptic Tracing of Midair Linear Trajectories Presented by Ultrasound Bessel Beams	209
<i>Shun Suzuki, Keisuke Hasegawa, Yasutoshi Makino, and Hiroyuki Shinoda</i>	
Asymmetric Cooling and Heating Perception	221
<i>Mehdi Hojatmadani and Kyle Reed</i>	
Haptic Scene Analysis: Mechanical Property Separation Despite Parasitic Dynamics	234
<i>Emma Treadway, Steven Cutlip, and R. Brent Gillespie</i>	

Influence of Scanning Velocity on Skin Vibration for Coarse Texture	246
<i>Kohei Kimura, Makiko Natsume, and Yoshihiro Tanaka</i>	
Judged Roughness as a Function of Groove Frequency and Groove Width in 3D-Printed Gratings	258
<i>Knut Drawing</i>	
Using Spatiotemporal Modulation to Draw Tactile Patterns in Mid-Air	270
<i>William Frier, Damien Ablart, Jamie Chilles, Benjamin Long, Marcello Giordano, Marianna Obrist, and Sriram Subramanian</i>	
Discovering Articulations by Touch: A Human Study for Robotics Applications.	282
<i>Roxana Leontie and Evan Drumwright</i>	
A Multimodal Illusion of Force Improves Control Perception in Above-Surface Gesture: Elastic Zed-Zoom	295
<i>Dilan Ustek, Kevin Chow, Haihua Zhang, and Karon MacLean</i>	
Pseudohaptic Feedback for Teleoperated Gripping Interactions	309
<i>Sarah Anna Wojcik, Carsten Neupert, Johannes Bilz, Roland Werthschützky, Mario Kupnik, and Christian Hatzfeld</i>	
A Pilot Study: Introduction of Time-Domain Segment to Intensity-Based Perception Model of High-Frequency Vibration	321
<i>Nan Cao, Hikaru Nagano, Masashi Konyo, Shogo Okamoto, and Satoshi Tadokoro</i>	
Haptic Human-Human Interaction Through a Compliant Connection Does Not Improve Motor Learning in a Force Field	333
<i>Niek Beckers, Arvid Keemink, Edwin van Asseldonk, and Herman van der Kooij</i>	
Relative Sensation of Wetness of Different Materials.	345
<i>Mai Shibahara, Katsunari Sato, and Astrid M. L. Kappers</i>	
Exploring Fingers' Limitation of Texture Density Perception on Ultrasonic Haptic Displays.	354
<i>Farzan Kalantari, David Gueorguiev, Edward Lank, Nicolas Bremard, and Laurent Grisoni</i>	
Hardness Perception Through Tapping: Peak and Impulse of the Reaction Force Reflect the Subjective Hardness	366
<i>Kosuke Higashi, Shogo Okamoto, Yoji Yamada, Hikaru Nagano, and Masashi Konyo</i>	

Analysis of Ultrasound Radiation and Proposal of Design Criteria
in Ultrasonic Haptic Display for Practical Applications 376
*Kiyoshi Taninaka, Akinori Miyamoto, Yuichi Kamata, Yasuhiro Endo,
and Yoshihiro Mizuno*

Haptic Saliency Model for Rigid Textured Surfaces. 389
Anna Metzger, Matteo Toscani, Matteo Valsecchi, and Knut Drewing

Vibrotactile Pattern Identification in a Multisensory Display 401
Lynette A. Jones and Anshul Singhal

Influence of Different Types of Prior Knowledge on Haptic Exploration
of Soft Objects 413
*Aaron Cedric Zöller, Alexandra Lezkan, Vivian C. Paulun,
Roland W. Fleming, and Knut Drewing*

Author Index 425

Contents – Part II

Haptic Technology

Weight Estimation of Lifted Object from Body Motions Using Neural Network	3
<i>Tomoki Oji, Yasutoshi Makino, and Hiroyuki Shinoda</i>	
Electromagnetic Actuator for Tactile Communication.	14
<i>Basil Duvernoy, Ildar Farkhatdinov, Sven Topp, and Vincent Hayward</i>	
Vibrotactile Signal Generation from Texture Images or Attributes Using Generative Adversarial Network	25
<i>Yusuke Ujitoko and Yuki Ban</i>	
Haptic Material: A Holistic Approach for Haptic Texture Mapping	37
<i>Antoine Costes, Fabien Danieau, Ferran Argelaguet, Anatole Lécuyer, and Philippe Guillotel</i>	
Estimation of the Pressing Force from Finger Image by Using Neural Network	46
<i>Yoshinori Inoue, Yasutoshi Makino, and Hiroyuki Shinoda</i>	
Multi-point Pressure Sensation Display Using Pneumatic Actuators	58
<i>Takaaki Taniguchi, Sho Sakurai, Takuya Nojima, and Koichi Hirota</i>	
A Simple Minimum Cable-Tension Algorithm for a 2-DOF Planar Cable-Driven Robot Driven by 4 Cables	68
<i>Gabriel Baud-Bovy and Kamil Cetin</i>	
Autonomous Reconfigurable Dynamic Investigation Test-rig on hAptics (ARDITA).	82
<i>Maria Laura D'Angelo and Ferdinando Cannella</i>	
Modelling the Air-Gap Field Strength of Electric Machines to Improve Performance of Haptic Mechanisms.	94
<i>William S. Harwin</i>	
Assessment of Perceived Intensity and Thermal Comfort Associated with Area of Warm Stimulation to the Waist	106
<i>Katsunari Sato and Manami Usui</i>	

Vibrotactile Feedback to Combine with Swing Presentation for Virtual Reality Applications	114
<i>Hirotaka Shionoiri, Rei Sakuragi, Ryo Kodama, and Hiroyuki Kajimoto</i>	
The Rice Haptic Rocker: Comparing Longitudinal and Lateral Upper-Limb Skin Stretch Perception	125
<i>Janelle P. Clark, Sung Y. Kim, and Marcia K. O'Malley</i>	
Buttock Skin Stretch: Inducing Shear Force Perception and Acceleration Illusion on Self-motion Perception	135
<i>Arata Horie, Hikaru Nagano, Masashi Konyo, and Satoshi Tadokoro</i>	
A Soft Vibrotactile Actuator with Knitted PVC Gel Fabric.	148
<i>Won-Hyeong Park, Yongjae Yoo, Gobong Choi, Seungmoon Choi, and Sang-Youn Kim</i>	
A Tangible Surface for Digital Sculpting in Virtual Environments.	157
<i>Edouard Callens, Fabien Danieau, Antoine Costes, and Philippe Guillotel</i>	
A Tactile Feedback Glove for Reproducing Realistic Surface Roughness and Continual Lateral Stroking Perception	169
<i>Ping-Hua Lin and Shana Smith</i>	
3D Printed Haptics: Creating Pneumatic Haptic Display Based on 3D Printed Airbags.	180
<i>Yuan-Ling Feng, Roshan Lalintha Peiris, Charith Lasantha Fernando, and Kouta Minamizawa</i>	
HaptI/O: Physical I/O Node over the Internet	193
<i>Satoshi Matsuzono, Haruki Nakamura, Daiya Kato, Roshan Peiris, and Kouta Minamizawa</i>	
Synergy-Based Multi-fingers Forces Reconstruction and Discrimination from Forearm EMG.	204
<i>Luis Pelaez Murciego, Michele Barsotti, and Antonio Frisoli</i>	
Basic Design on Blocking Part of Skin-Propagated Vibration for Artificial Hand.	214
<i>Yuki Kito, Yoshihiro Tanaka, Noritaka Kawashima, and Masahiro Yoshikawa</i>	
Estimating the Direction of Force Applied to the Grasped Object Using the Surface EMG	226
<i>Yuki Ban</i>	

Substitution of Hand-Object Pressure Cues with the Sole of the Foot for Haptic Presentation Using a Tactile Pin Array	239
<i>Keigo Hiki, Tetsuhiro Okano, Sho Sakurai, Takuya Nojima, Michiteru Kitazaki, Yasushi Ikei, and Koichi Hirota</i>	
Motor Shaft Vibrations May Have a Negative Effect on Ability to Implement a Stiff Haptic Wall	252
<i>Louis Swaidani, Luke Steele, and William Harwin</i>	
Virtual Reality: Impact of Vibro-Kinetic Technology on Immersion and Psychophysiological State in Passive Seated Vehicular Movement.	264
<i>Alexandre Gardé, Pierre-Majorique Léger, Sylvain Sénécal, Marc Fredette, Shang-Lin Chen, Élise Labonté-Lemoyne, and Jean-François Ménard</i>	
Lateral Modulation of Midair Ultrasound Focus for Intensified Vibrotactile Stimuli	276
<i>Ryoko Takahashi, Keisuke Hasegawa, and Hiroyuki Shinoda</i>	
Improving Perception Accuracy with Multi-sensory Haptic Cue Delivery	289
<i>Nathan Dunkelberger, Joshua Bradley, Jennifer L. Sullivan, Ali Israr, Frances Lau, Keith Klumb, Freddy Abnoui, and Marcia K. O'Malley</i>	
Travelling Ultrasonic Wave Enhances Keyclick Sensation	302
<i>David Gueorguiev, Anis Kaci, Michel Amberg, Frédéric Giraud, and Betty Lemaire-Semail</i>	
A High Performance Thermal Control for Simulation of Different Materials in a Fingertip Haptic Device.	313
<i>Massimiliano Gabardi, Domenico Chiaradia, Daniele Leonardi, Massimiliano Solazzi, and Antonio Frisoli</i>	
Overcoming the Variability of Fingertip Friction with Surface-Haptic Force-Feedback.	326
<i>Nicolas Huloux, Jocelyn Monnoyer, Marc Boyron, and Michaël Wiertelwski</i>	
Localisation of Vibrotactile Stimuli with Spatio-Temporal Inverse Filtering	338
<i>Charles Hudin and Sabrina Paněls</i>	

Haptic Applications

Reaching and Grasping of Objects by Humanoid Robots Through Visual Servoing	353
<i>Paola Ardón, Mauro Dragone, and Mustafa Suphi Erden</i>	

LiquidReality: Wetness Sensations on the Face for Virtual Reality	366
<i>Roshan Lalintha Peiris, Liwei Chan, and Kouta Minamizawa</i>	
A Classroom Deployment of a Haptic System for Learning Cell Biology	379
<i>Ozan Tokatli, Megan Tracey, Faustina Hwang, Natasha Barrett, Chris Jones, Ros Johnson, Mary Webb, and William Harwin</i>	
Haptic Rendering of Solid Object Submerged in Flowing Fluid with Environment Dependent Texture	390
<i>Avirup Mandal, Dwaipayan Sardar, and Subhasis Chaudhuri</i>	
Haptic Guidance with a Soft Exoskeleton Reduces Error in Drone Teleoperation	404
<i>Carine Rognon, Amy R. Wu, Stefano Mintchev, Auke Ijspeert, and Dario Floreano</i>	
Human Guidance: Suggesting Walking Pace Under Workload	416
<i>Tommaso Lisini Baldi, Gianluca Paolucci, and Domenico Prattichizzo</i>	
Haptics of Screwing and Unscrewing for Its Application in Smart Factories for Disassembly	428
<i>Dima Mironov, Miguel Altamirano, Hasan Zabihifar, Alina Liviniuk, Viktor Liviniuk, and Dmitry Tsetserukou</i>	
Towards a Test Battery to Benchmark Dexterous Performance in Teleoperated Systems.	440
<i>Milène Catoire, Bouke N. Krom, and Jan B. F. van Erp</i>	
Evaluation of Sensory Feedback from a Robotic Hand: A Preliminary Study	452
<i>İpek Karakuş, Hasan Şahin, Ahmet Atasoy, Erkan Kaplanoğlu, Mehmed Özkan, and Burak Güçlü</i>	
Suitability of a Tool-Speed-Dependent Force Model for VR-Based Soft-Tissue Dissection	464
<i>Fernando Trejo and Yaoping Hu</i>	
Making a Socially Assistive Robot Companion Touch Sensitive	476
<i>Steffen Müller and Horst-Michael Gross</i>	
Design and Evaluation of Mid-Air Haptic Interactions in an Augmented Reality Environment	489
<i>Brygida Dzidek, William Frier, Adam Harwood, and Richard Hayden</i>	
Anti-Veering Vibrotactile HMD for Assistance of Blind Pedestrians	500
<i>Victor Adriel de Jesus Oliveira, Luciana Nedel, Anderson Maciel, and Luca Brayda</i>	

An Improved Adaptive Robotic Assistance Methodology for Upper-Limb Rehabilitation	513
<i>Fabio Stroppa, Claudio Loconsole, Simone Marcheschi, Nicola Mastronicola, and Antonio Frisoli</i>	
Assessing Articulatory Modalities for Intercommunication Using Vibrotactile HMDs	526
<i>Victor Adriel de Jesus Oliveira, Luciana Nedel, and Anderson Maciel</i>	
Operation Guidance Method for Touch Devices by Direction Presentation Using Anisotropic Roughness	539
<i>Masato Kobayashi, Takahiro Shitara, Seitaro Kaneko, and Hiroyuki Kajimoto</i>	
Effect of Pseudo-Haptic Feedback on Touchscreens on Visual Memory During Image Browsing	551
<i>Takeru Hashimoto, Takuji Narumi, Ryohei Nagao, Tomohiro Tanikawa, and Michitaka Hirose</i>	
HANDSON-COMPUTING: Promoting Algorithmic Thinking Through Haptic Educational Robots	564
<i>Ata Otaran, Ozan Tokatli, and Volkan Patoglu</i>	
Experimental Evaluation of Vibrotactile Training Mappings for Dual- Joystick Directional Guidance	575
<i>Lorenzo Scalera, Stefano Seriani, Paolo Gallina, Massimiliano Di Luca, and Alessandro Gasparetto</i>	
A Novel Pneumatic Force Sensor for Robot-Assisted Surgery	587
<i>Chiara Gaudeni, Leonardo Meli, and Domenico Prattichizzo</i>	
Efficient Evaluation of Coding Strategies for Transcutaneous Language Communication	600
<i>Robert Turcott, Jennifer Chen, Pablo Castillo, Brian Knott, Wahyudinata Setiawan, Forrest Briggs, Keith Klumb, Freddy Abnoui, Prasad Chakka, Frances Lau, and Ali Israr</i>	
A Novel Haptic Glove (ExoTen-Glove) Based on Twisted String Actuation (TSA) System for Virtual Reality	612
<i>Mohssen Hosseini, Yudha Pane, Ali Sengül, Joris De Schutter, and Herman Bruyninckx</i>	
A Comparative Study of Phoneme- and Word-Based Learning of English Words Presented to the Skin	623
<i>Yang Jiao, Frederico M. Severgnini, Juan Sebastian Martinez, Jaehong Jung, Hong Z. Tan, Charlotte M. Reed, E. Courtenay Wilson, Frances Lau, Ali Israr, Robert Turcott, Keith Klumb, and Freddy Abnoui</i>	

Vibrotactile Feedback Improves Collision Detection in Fast Playback of First-Person View Videos	636
<i>Daniel Gongora, Hikaru Nagano, Masashi Konyo, and Satoshi Tadokoro</i>	
Preliminary Study on Real-Time Interactive Virtual Fixture Generation Method for Shared Teleoperation in Unstructured Environments	648
<i>Vitalii Pruks, Ildar Farkhatdinov, and Jee-Hwan Ryu</i>	
Network-Aware Adaptive Sampling for Low Bitrate Telehaptic Communication	660
<i>Vineet Gokhale, Jayakrishnan Nair, Subhasis Chaudhuri, and Suhas Kakade</i>	
Congruent Visuo-Tactile Feedback Facilitates the Extension of Peripersonal Space	673
<i>Ali Sengül, Michiel van Elk, Olaf Blanke, and Hannes Bleuler</i>	
Harmonious Textures: The Perceptual Dimensions of Synthetic Sinusoidal Gratings	685
<i>Corentin Bernard, Jocelyn Monnoyer, and Michaël Wiertelowski</i>	
Haptic Logos: Insight into the Feasibility of Digital Haptic Branding.	696
<i>Muhammad Abdullah, Waseem Hassan, Ahsan Raza, and Seokhee Jeon</i>	
Author Index	709